10.10 Air Quality

An air quality impact assessment has been undertaken by SLR for the proposed Mandalong Southern Extension Project in order to:

- Assess the potential air quality impacts on surrounding sensitive receivers (see **Figure 5**) associated with the construction and operational phases of the Project; and
- Identify appropriate mitigation measures to minimise air emissions, along with appropriate monitoring and management strategies.

The assessment focussed on the Project's two surface infrastructure sites, being the existing Mandalong Mine Access Site and proposed Mandalong South Surface Site. The Project will not result in any changes to the ventilation system or emissions from the ventilation fan at the Cooranbong Entry Site. A quantitative assessment of the emissions generating activities at the Cooranbong Entry Site, including the mine ventilation fan, will be undertaken as part of the development application for the Northern Coal Logistics Project.

SLR's assessment has been completed in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC 2005) (the Approved Methods) and addresses the key issues raised within the DGRs (see **Section 1.7.2**).

A copy of SLR's *Air Quality Impact Assessment* (2013a) is contained within **Appendix C**, with significant findings and recommendations summarised below.

10.10.1 Sensitive Receptors

As evident on **Figure 5**, there are a number of privately-owned residences in the area surrounding the existing Mandalong Mine Access Site and proposed Mandalong South Surface Site. The nearest residences to the Mandalong Mine Access Site are identified to the east of the site on Gimberts Road, which is on the eastern side of the Sydney-Newcastle F3 Freeway, and to the south and west of the site on Mandalong Road. The nearest residences to the proposed Mandalong South Surface Site are identified at over 950 metres to the south and west along Mandalong Road and Wyee Farms Road.

10.10.2 Existing Environment

The air quality in the region surrounding Mandalong Mine is influenced by emissions generated by a range of sources, originating from both within and outside of the local area. Specifically, air quality is influenced by the following existing features in the area:

- Eraring, Munmorah and Vales Point power stations;
- Traffic-generated emissions, particularly the Sydney-Newcastle F3 Freeway; and
- Mining operations, including Mandalong Mine and Mannering Colliery.

The existing Mandalong Mine Access Site is located immediately adjacent to the Sydney-Newcastle F3 Freeway (to the east) and Mandalong Road (to the south). There are several privately-owned residences located on the edge of the Freeway (see **Figure 5**), with the nearest located approximately 85 metres (R7) to the east.

The close proximity of these roads may have implications in terms of elevated background concentrations of combustion-related pollutants, including PM_{10} (particulate matter with an aerodynamic diameter of 10 microns (µm) or less), $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 µm or less), sulfur dioxide (SO_2), oxides of nitrogen (NO_X), carbon monoxide (CO) and volatile organic compounds (VOCs).

Centennial Mandalong operates seven dust deposition (insoluble solids) gauges in the vicinity of the Mandalong Mine Access Site. The location of these gauges is shown on **Figure 5,** and **Table 39** summarises the latest monitoring results from gauges, as reported in the 2012 AEMR for Mandalong Mine.

Table 39 – Dust Deposition Monitoring Program Results

Gauge	Insoluble Solids (Combustible Matter + Ash) g/m^2/month		
	Pre-Construction of Mandalong Mine Access Site	Average 2012	Long-Term Average[2]
DG5	0.7	0.7	0.9
DG6	0.8	1.2	1.3
DG7	3.2	1.1	1.4
DG8	0.9	0.8	0.9
DG9	0.9	0.8	1.2
DG10	N/A[1]	1.9	1.3
DG11	N/A[1]	0.9	1.2

1 - not available. Dust gauges installed after commencing construction.
2 – long-term averaging period is from September 1999 to December 2012

The dust deposition rates in **Table 39** include the contribution of Mandalong Mine Access Site and other background dust levels. The 2012 and long-term average results are well below the EPA's air quality goal of 4 g/m^2/month (grams per square metre per month).

SLR (2013a) utilised regional background air quality data from monitoring sites operated by the EPA at Newcastle, Beresfield and Wallsend, supplemented with emissions to atmosphere from Vales Point, Munmorah and Eraring power stations. A dispersion modelling exercise was undertaken by SLR (2013a) using publicly available information, specifically stack sources associated with Eraring, Vales Point and Munmorah power stations, to determine the contribution from power station emissions. In addition to emissions from stack sources, emissions from coal stockpiles and ash dams were also considered by SLR (2013a) using the National Pollutant Inventory (NPI) default values. Limited research has been undertaken to assess the fraction of PM_{10} from the wide range of sources, which would be emitted as $PM_{2.5}$, and, as such, publicly available emission rates for $PM_{2.5}$ are not available. On this basis, the $PM_{2.5}$ / PM_{10} ratios presented in *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors* (MRI 2006, cited in SLR 2013a) were used by SLR (2013a) to calculate the emission rates for $PM_{2.5}$.

The site-specific ambient air quality levels adopted by SLR (2013a) are summarised in **Table 40**.

Table 40 – Ambient Air Quality Environment

Parameter	Averaging Period	Assumed Background Ambient Level	Notes
TSP	Annual	29.4 µg/m^3 Includes power station contribution	Maximum Power Station Increment is 0.4 µg/m^3 at Receptor R5
PM_{10}	24-hour	Varying	Maximum Power Station Increment is 2.3 µg/m^3 at Receptor R4
	Annual	14.7 µg/m^3 Includes power station contribution	
$PM_{2.5}$	24-hour	Varying	Maximum Power Station Increment is 0.6 µg/m^3 at Receptor R4
	Annual	4.6 µg/m^3 Includes power station contribution	
Deposited Dust	Annual	2 g/m^2/month	Assumed
Odour	1-hour	0 odour units (OU)	Assumed
NO_2	1-hour	71.5 µg/m^3	Newcastle monitoring station
	Annual	31.3 µg/m^3	Newcastle monitoring station
CO	8-hour	1,604 µg/m^3	Newcastle monitoring station
	1-hour	No data	Newcastle monitoring station
SO_2	1-hour	70.7 µg/m^3	Newcastle monitoring station
	24-hour	13.1 µg/m^3	Newcastle monitoring station
	Annual	2.6 µg/m^3	Newcastle monitoring station

TSP (total suspended particulate) - particulate matter which is less than 50 microns in diameter.
PM_{10} - particulate matter with an aerodynamic diameter of 10 microns (µm) or less.
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 µm or less.
NO_2 – nitrogen dioxide.
CO – carbon monoxide.
SO_2 – sulfur dioxide.

10.10.3 Air Quality Criteria

Air quality impact assessment criteria adopted by the EPA are contained in the Approved Methods (DEC 2005). The criteria listed in the Approved Methods are derived from a range of sources and are the defining ambient air quality criteria for NSW. They have been developed in consultation with a number of organisations, including the National Health and Medical Research Council (NHMRC), National Environment Protection Council (NEPC), World Health Organisation (WHO) and Australian and New Zealand Environment Conservation Council (ANZECC).

The air quality criteria adopted by SLR (2013a), which conform to current EPA (NSW) and NEPC (Commonwealth) air quality criteria, are summarised in **Table 41**.

Table 41 – Project Air Quality Goals

Pollutant	Averaging Period	Goal
TSP	Annual	90 µg/m^3 (Approved Methods, DEC 2005)
PM_{10}	24-Hour	50 µg/m^3 (Approved Methods, DEC 2005)
	Annual	30 µg/m^3 (Approved Methods, DEC 2005)
$PM_{2.5}$	24-Hour	25 µg/m^3 (Interim Advisory Reporting Standard, NEPC 2003)
	Annual	8 µg/m^3 (Interim Advisory Reporting Standard, NEPC 2003)
Deposited Dust	Annual Maximum Increase	2 g/m^2/month (Approved Methods, DEC 2005)
	Annual Maximum Total	4 g/m^2/month (Approved Methods, DEC 2005)
Odour	1-hour	4 OU (99th percentile) (Technical Framework, DEC 2006)
NO_2	1-hour	246 µg/m^3 (Approved Methods, DEC 2005)
	Annual	62 µg/m^3 (Approved Methods, DEC 2005)
CO	15-minutes	100 mg/m^3 (Approved Methods, DEC 2005)
	1-hour	30 mg/m^3 (Approved Methods, DEC 2005)
	8-hours	10 mg/m^3 (Approved Methods, DEC 2005)
SO_2	10-minutes	712 µg/m^3 (Approved Methods, DEC 2005)
	1-hour	570 µg/m^3 (Approved Methods, DEC 2005)
	24-hours	228 µg/m^3 (Approved Methods, DEC 2005)
	Annual	60 µg/m^3 (Approved Methods, DEC 2005)

10.10.4 Emission Sources and Controls

Existing Mandalong Mine Access Site

The potential emission sources for the existing Mandalong Mine Access Site are:

- Existing methane gas drainage system and the operation of gas flares (currently under construction) or gas engines (approved but not yet constructed); and
- Existing mine ventilation system, comprising two ventilation fans (horizontally emitting fans), which exhausts air from the underground mine workings (including underground diesel vehicles).

The locations of these items are shown on **Figure 22**.

Atmospheric pollutants likely to be generated include fugitive emissions of particulates (TSP, PM_{10}, $PM_{2.5}$), along with those generated through the combustion of fuel (PM_{10}, $PM_{2.5}$, CO, SO_2, NO_X and VOCs).

In order to estimate emissions from the ventilation fans, an on-site monitoring program was conducted by SLR in June 2012 and August 2012 measuring TSP, PM_{10}, $PM_{2.5}$ and odour. The monitoring of particulate and odour emissions was undertaken during a period of normal underground mining operations. It must be noted that the air drawn into the mine via the decline portal, which is approximately 180 metres from the Sydney-Newcastle F3 Freeway, will include pollutants the Freeway itself and from nearby power stations. While the air measurements from the mine ventilation fans could not determine the proportion of pollutants attributable to background sources, the air quality assessment undertaken by SLR (2013a) conservatively assumes all pollutants in the ventilation air are from the mine operation.

Emissions from the gas flares have been estimated by SLR (2013a) using emission factors from the National Pollutant Inventory (NPI) Emission Estimation Technique (EET) manual *Oil and Gas Exploration and Production* (DEWHA 2010). Emissions from the gas engines have been based on monitoring data from similar gas engines.

Proposed Mandalong South Surface Site

The potential emission sources for the proposed Mandalong South Surface Site are:

- Proposed construction related activities; and
- Proposed mine ventilation system, comprising two horizontally emitting ventilation fans.

The locations of these items are shown on **Figure 24**. The results of the monitoring conducted by SLR at the existing Mandalong Mine Access Site (see above) have been adopted to assess the potential impacts from the proposed new ventilation fans at the Mandalong South Surface Site, which will be operating under similar conditions, including:

- Proposed mining in the Southern Extension Area will be carried out in similar geological conditions and using similar underground mining equipment to the existing Mandalong Mine;
- The coal production rates achieved in the Southern Extension Area will be similar to those achieved in the existing Mandalong Mine; and
- The proposed ventilation fans will be of a similar volumetric capacity and design (i.e. horizontal evasee) to the existing fans at the Mandalong Mine Access Site.

The proposed ventilation fans at the Mandalong South Surface Site will operate concurrently with the existing fans at the Mandalong Mine Access Site. Based on distribution of coal production, it is anticipated that the ventilation throughput at the Mandalong South Surface Site will gradually increase as the throughput at the Mandalong Mine Access Site concurrently decreases. However, to assess the worst case impacts, SLR (2013a) has assessed the ventilation fans at both sites operating concurrently.

Summary of Project Emission Sources

A summary of the emissions sources and the associated pollutants evaluated by SLR (2013a) is presented in **Table 42**.

Table 42 – Summary of Air Emission Sources

Emission Source	Emission Type	Pollutants
Existing Mandalong Mine Access Site		
Ventilation fans	Underground mine exhaust	TSP, PM_{10}, $PM_{2.5}$, odour
Gas flares	Flare	CO, NO_X
Gas engines	Stack	CO, NO_X, SO_2
Proposed Mandalong South Surface Site		
Ventilation fans	Underground mine exhaust	TSP, PM_{10}, $PM_{2.5}$, odour
Construction activities	Material handling, wind erosion, wheel generated dust	TSP, PM_{10} and $PM_{2.5}$

Existing and proposed mitigation measures to minimise particulate matter emissions from the Project include:

- Best management practice control measures for all construction activities;
- The underground dust suppression system, including water sprays on coal cutting machinery and rubber conveyor belts;
- Maintaining plant and equipment to ensure optimal operating conditions;
- Use of water sprays/carts to dampen exposed surfaces and trafficable areas;

- Use of low sulfur diesel and diesel engines that conform to the United States EPA Tier 3 standards for exhaust emissions; and
- Use of particulate filter assembly units on mobile machinery.

In addition, the fan evasee at the Mandalong South Surface Site will be designed and installed to be directed away from the closest sensitive receptors to minimise potential air quality impacts.

10.10.5 Modelled Scenarios

Dispersion modelling was conducted by SLR (2013a) for three separate scenarios:

Scenario 1 - Construction

This scenario assesses the emissions due to construction activities at the proposed Mandalong South Surface Site, along with the operation of the existing mine ventilation fans at the Mandalong Mine Access Site. As outlined in **Section 4.13.2**, the construction activities are proposed to be conducted in phases. In order to assess the worst case air quality impacts, SLR (2013a) has assumed that the longest running construction phase of dust generating activities (excavation phase) will be running for a full year in conjunction with the construction of the access road. In other words, the particulate emissions generated during the excavation phase (14 weeks) and access road phase (8 weeks), which will occur concurrently, have been modelled over a full year (52 weeks) to investigate the potential impact of seasonal variability on resulting concentrations. This is considered to be a conservative approach.

The sinking of the new ventilation shaft at the Mandalong South Surface Site has not been included in the construction scenario. It will be done independently of the other construction activities and will include water flushing in the drilling process to reduce dust and is therefore unlikely to make a significant contribution to dust emissions (SLR 2013a).

Scenario 2a – Gas Flaring

This scenario assesses the emissions associated with operation of the gas flares (currently under construction) at the Mandalong Mine Access Site, along with the operation of the ventilation fans at both the Mandalong Mine Access Site and proposed Mandalong South Surface Site. As a worst case scenario, the modelling has been undertaken assuming that 100 percent of the methane from the gas drainage plant will be flared.

Scenario 2b – Gas Engines

This scenario assesses the emissions associated with operation of the gas engines (approved but not yet constructed) at the Mandalong Mine Access Site, along with the operation of the ventilation fans at both the Mandalong Mine Access Site and proposed Mandalong South Surface Site. Upon operation of the gas engines, the gas flare units will remain as back-up or for peak gas flows. As a worst case scenario for the operation of the gas engines, the modelling has been undertaken assuming that 100 percent of the methane is combusted in the gas engines and that no methane will be flared.

Summary of Scenarios

The emission sources for the three construction and operation scenarios are summarised in **Table 43**.

Table 43 – Air Quality Assessment Scenarios

Scenario	Emission Sources	Pollutants
Scenario 1 – Construction	Material handling, wheel generated dust, wind erosion	TSP, PM_{10}, $PM_{2.5}$, deposited dust
	Existing ventilation fans at Mandalong Mine Access Site	TSP, PM_{10}, $PM_{2.5}$, deposited dust, odour
Scenario 2a – Gas Flaring	Gas flares at Mandalong Mine Access Site	CO, NO_X
	Existing ventilation fans at Mandalong Mine Access Site	TSP, PM_{10}, $PM_{2.5}$, deposited dust, odour
	Proposed ventilation fans at Mandalong South Surface Site	TSP, PM_{10}, $PM_{2.5}$, deposited dust, odour
Scenario 2b – Gas Engines	Gas engines at Mandalong Mine Access Site	CO, NO_X, SO_2
	Existing ventilation fans at Mandalong Mine Access Site	TSP, PM_{10}, $PM_{2.5}$, deposited dust, odour
	Proposed ventilation fans at Mandalong South Surface Site	TSP, PM_{10}, $PM_{2.5}$, deposited dust, odour

10.10.6 Impact Assessment

Emissions associated with the three construction and operation scenarios for the Project were modelled by SLR (2013a) using the US EPA's CALPUFF (version 6.267) modelling system, which is a multi-layer, multi-species, non-steady state puff dispersion modelling system that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. The advantages of using CALPUFF (rather than using a steady state Gaussian dispersion model such as AUSPLUME) is its ability to handle calm wind speeds (i.e. less than 0.5 metres per second) and the effects of complicated terrain on plume dispersion (SLR 2013a). Detailed information regarding the adopted dispersion meteorology is presented in SLR's report in **Appendix C**.

A detailed assessment of the background concentrations in the area surrounding the Project Application Area was performed. SLR (2013a) determined a regional background concentration and added a contribution from local power stations (see **Table 40**). A further contribution from Project activities to the background dataset was added in order to provide information on the cumulative impact of Project activities on the air quality within the local area. A summary of SLR's (2013a) dispersion modelling predictions for the three assessment scenarios (see **Section 10.10.5**) at the residences/properties identified on **Figure 5** are summarised below. The full datasets and pollutant isopleth plots are provided in SLR's (2013a) report in **Appendix C**.

Dust Deposition

The modelling results indicate that incremental and cumulative annual average dust deposition rates at all nominated residences/properties surrounding the existing Mandalong Mine Access Site and proposed Mandalong South Surface Site are predicted to be well below the incremental increase in dust deposition criterion of 2 g/m^2/month and below the cumulative dust deposition criterion of 4 g/m^2/month for all three scenarios. Given that the nominated residences/properties were chosen as being indicative of all surrounding residences/properties, SLR (2013a) concludes that cumulative dust deposition levels at residences/properties surrounding those modelled would also be below the relevant criterion of 4 g/m^2/month.

Total Suspended Particulates – Annual Average

The annual average TSP concentrations are predicted to be well below the criterion of 90 µg/m^3 at all identified sensitive receptor locations for Scenarios 1, 2a and 2b. As the nominated residences/properties were chosen as being indicative sensitive locations typifying the local surrounding communities, SLR (2013a) concludes it is unlikely that annual average TSP concentrations at other residences and properties surrounding these modelled residences would exceed the EPA criterion of 90 µg/m^3.

Particulates as PM_{10} – Maximum 24-Hour Average

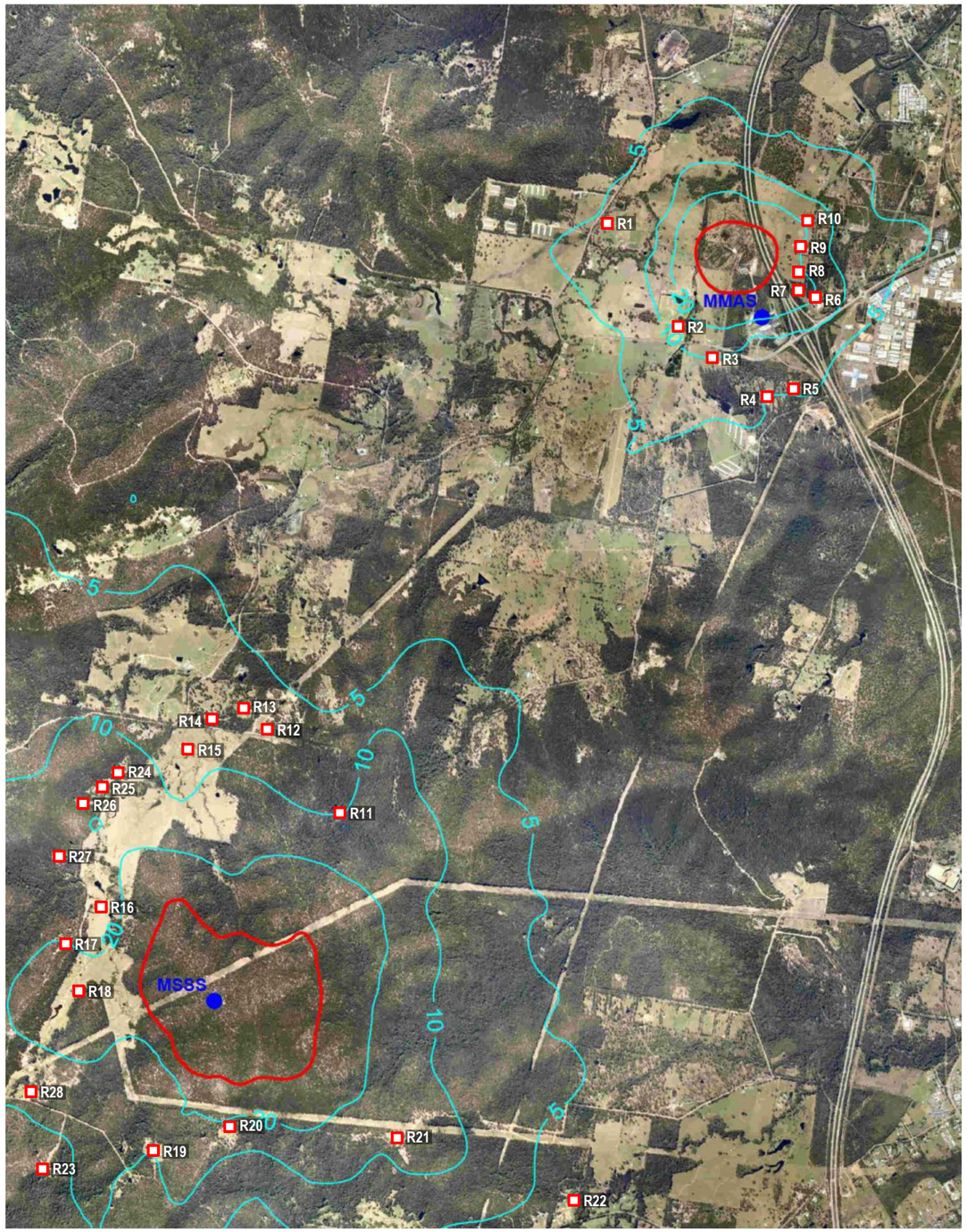
The maximum 24-hour average PM_{10} increment from the Project is predicted to be 29 µg/m^3 at receptor R7. The predicted maximum cumulative concentrations, which represent the maximum of the sum of concurrent increments of regional background, power stations and the Project, are predicted to be below the criterion of 50 µg/m^3 at all identified sensitive receptor locations for Scenarios 1, 2a and 2b. Further investigation by SLR (2013a) revealed that the cumulative maximum 24-hour average concentrations are dominated by the background concentrations, which contribute up to 85 percent for Scenario 1 and up to 96 percent for Scenarios 2a and 2b.

Contour plots of the predicted maximum 24-hour average PM_{10} concentrations for Scenarios 1, 2a and 2b are presented on **Figure 47**.

Particulates as PM_{10} – Annual Average

Annual average PM_{10} concentrations are predicted to be below the criterion of 30 µg/m^3 at all identified sensitive receptor locations for Scenarios 1, 2a and 2b. As the nominated residences/properties were chosen as being indicative sensitive locations typifying the local surrounding communities, SLR (2013a) concludes it is unlikely that annual average PM_{10} concentrations at other residences and properties surrounding these modelled residences would exceed the EPA criterion of 30 µg/m^3.

Contour plots of the predicted annual average PM_{10} concentrations for Scenarios 1, 2a and 2b are presented on **Figure 48**.



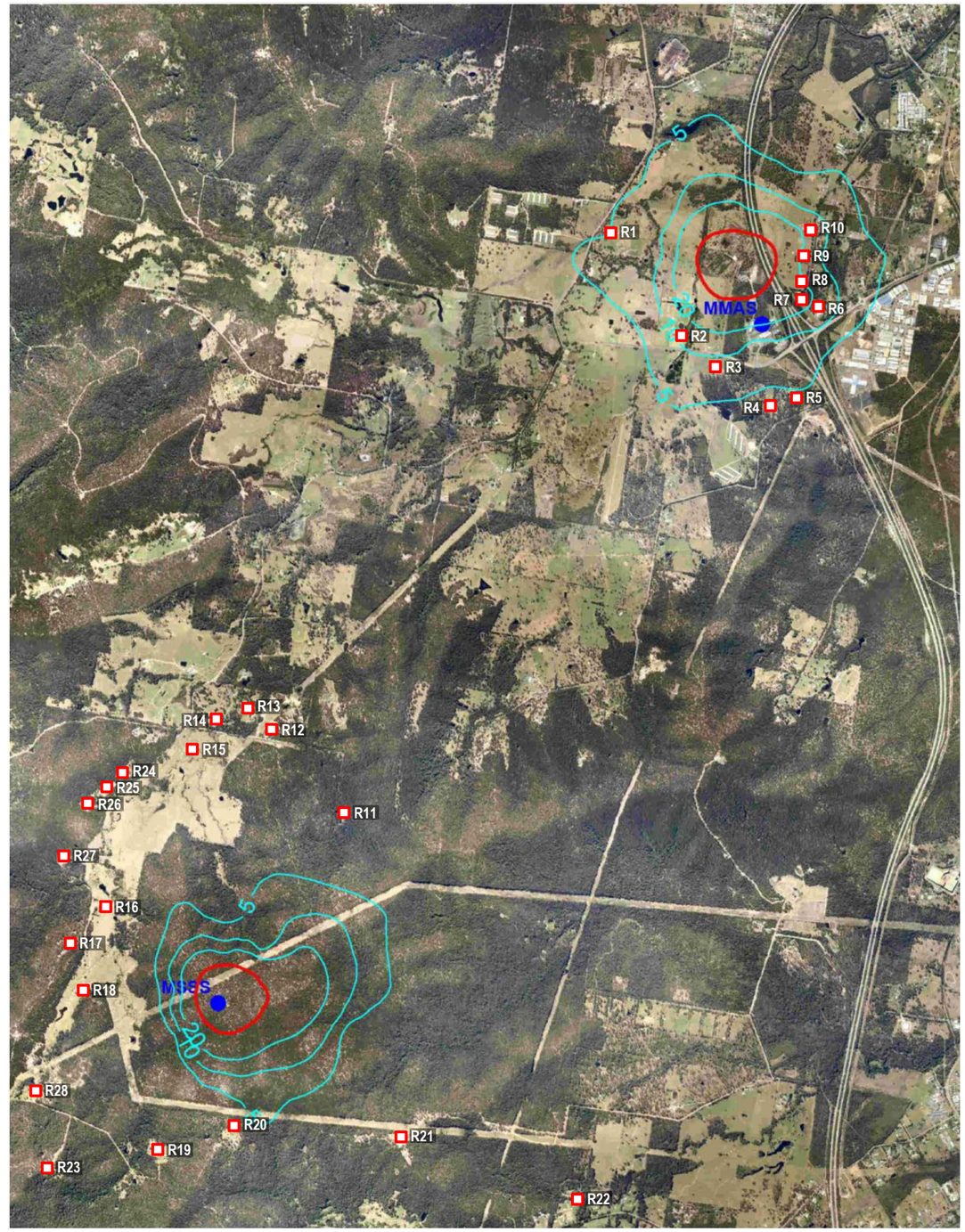
LEGEND:

- Residences (in close proximity to Surface Sites)
- R20 Receiver identification number

NOTE:
Guideline: 50 µg/m³ (red contour)

Scenario 1
PM_{10} Maximum 24hr Average (µg/m³) Increment

Data Source: SLR - Air Quality Impact Assessment Report



LEGEND:

- Residences (in close proximity to Surface Sites)
- R20 Receiver identification number

NOTE:
Guideline: 50 µg/m³ (red contour)

Scenario 2a & 2b
PM_{10} Maximum 24hr Average (µg/m³) Increment

Data Source: SLR - Air Quality Impact Assessment Report

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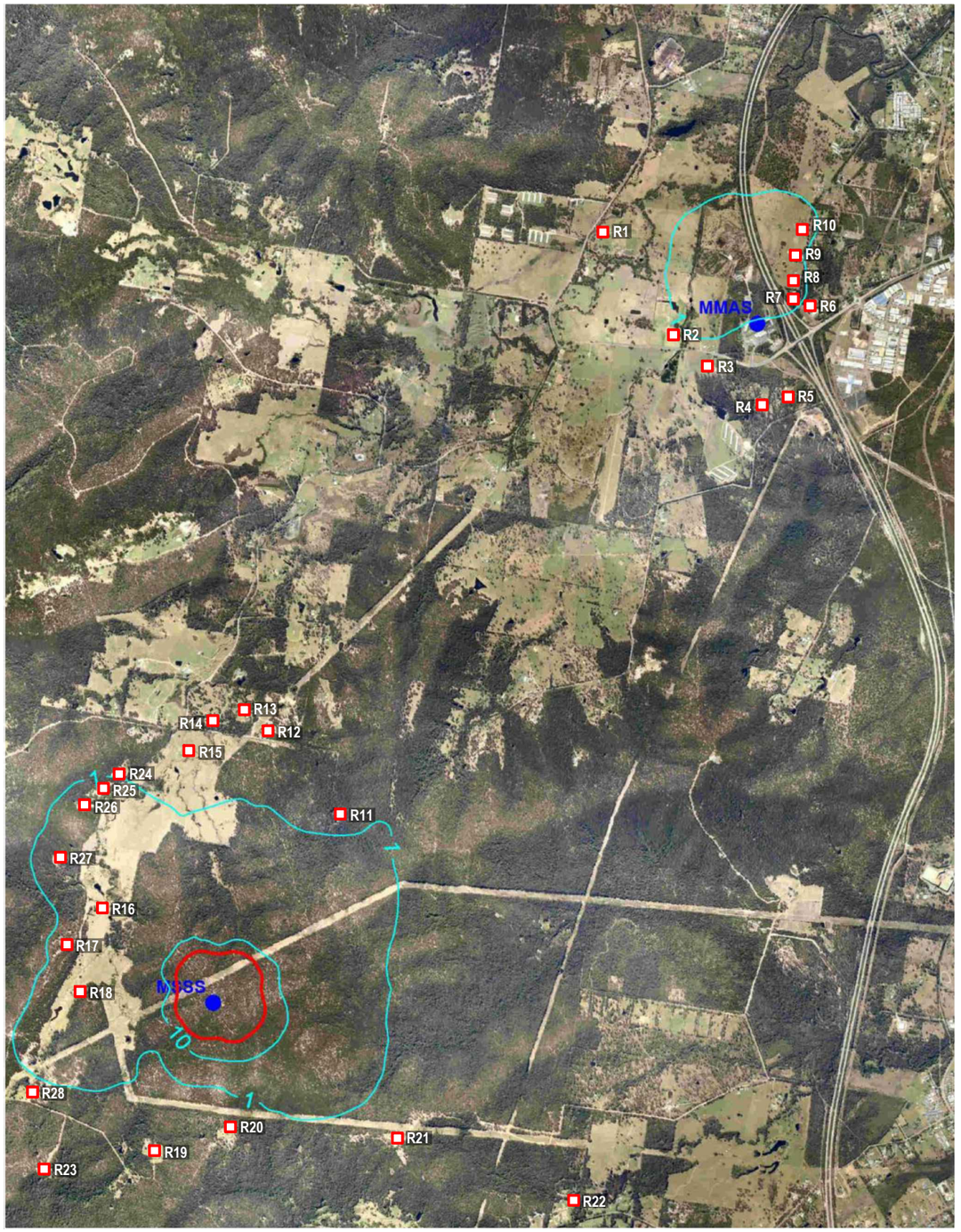
Maximum 24-Hour Average PM_{10} Concentrations

FIGURE 47



LEGEND:

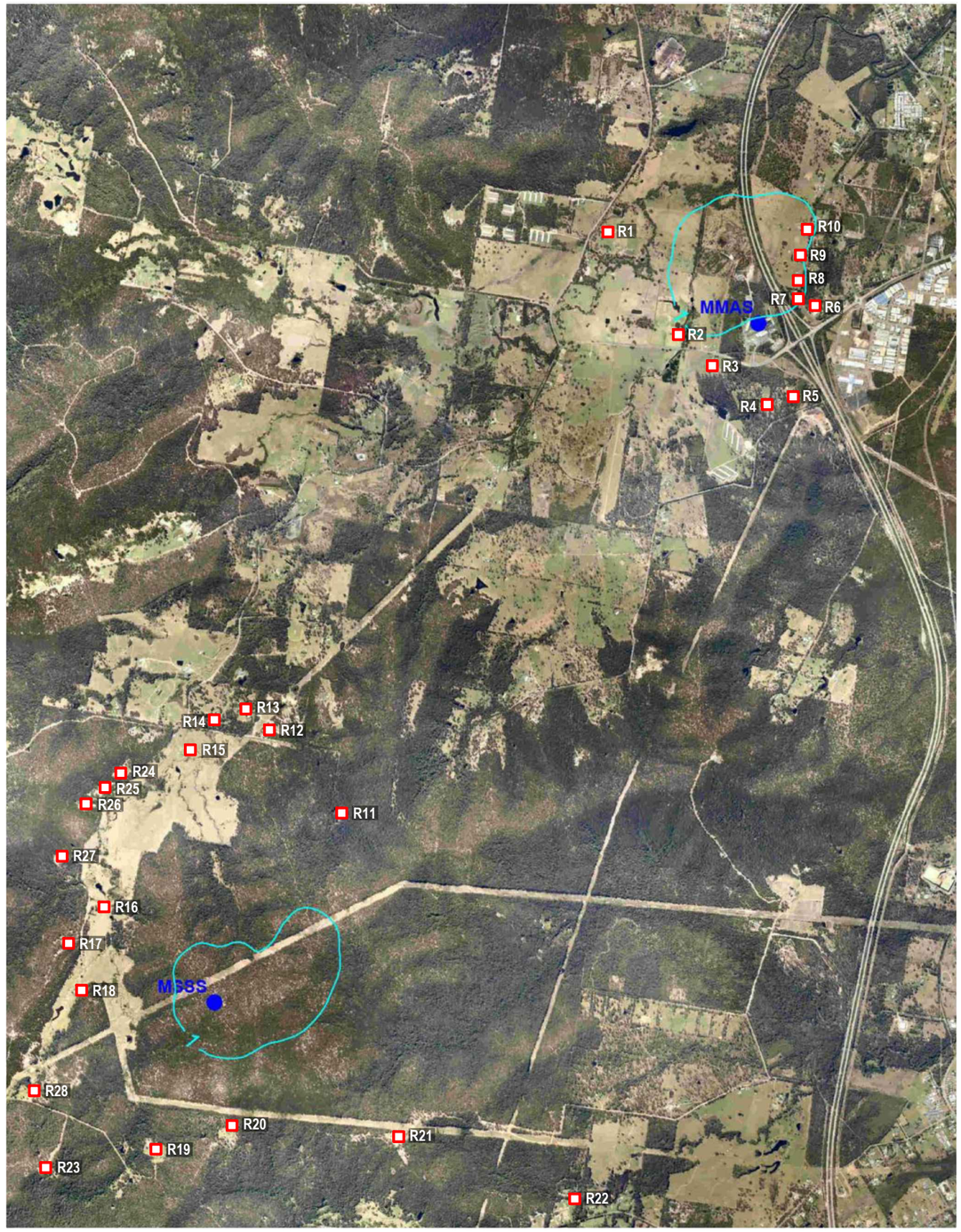
Residences (in close proximity to Surface Sites)

R20 Receiver identification number

NOTE:
Guideline: 30 µg/m³ (red contour)

Scenario 1
PM_{10} Annual Average (µg/m³) Increment

Data Source: SLR - Air Quality Impact Assessment Report



LEGEND:

Residences (in close proximity to Surface Sites)

R20 Receiver identification number

NOTE:
Guideline: 30 µg/m³ (red contour)

Scenario 2a & 2b
PM_{10} Annual Average (µg/m³) Increment

Data Source: SLR - Air Quality Impact Assessment Report

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Annual Average PM_{10} Concentrations

FIGURE 48

Particulates as $PM_{2.5}$ – Maximum 24-Hour Average

The predicted maximum 24-hour average $PM_{2.5}$ cumulative concentrations for Scenario 1, which represent the maximum of the sum of concurrent increments of regional background, power stations and the Project, are predicted to exceed the advisory reporting standard of 25 µg/m^3 at three nominated receptors (R6, R7 and R8) surrounding the existing Mandalong Mine Access Site by up to 25 µg/m^3. SLR (2013a) predicts that the source of related $PM_{2.5}$ emissions from the Project is the existing ventilation fans at the Mandalong Mine Access Site. The majority of the ventilation air for the mine is drawn in through the men and materials drift located at the Mandalong Mine Access Site adjacent to the Sydney-Newcastle F3 Freeway, which is likely to already contain elevated levels of $PM_{2.5}$ from traffic along the Freeway. The particulate sampling undertaken from the ventilation fans at the Mandalong Mine Access Site was unable to differentiate between the particulate emissions drawn into the mine from the Freeway and those generated by the underground operations alone.

To ensure the workforce operating underground are not exposed to elevated $PM_{2.5}$ levels, Centennial Mandalong:

- Utilises a low sulfur diesel, which is a premium grade diesel that results in lower emissions of particulate matter and sulfur dioxide;
- Ensures diesel engines conform to the United States EPA Tier 3 standards for exhaust emissions; and
- Ensures all machines are fitted with particulate filter assembly units.

These measures are current best practice standards for the underground coal mining industry in Australia for reducing $PM_{2.5}$ emissions

The predictive model for Scenario 1 shows that the background concentrations contribute up to 88 percent (at R22) of the total cumulative concentrations. The exceedance of the $PM_{2.5}$ advisory reporting standard at receptor R7 is shown to be marginally dominated by the Project, with the Project contributing 51 percent to the total predicted concentration.

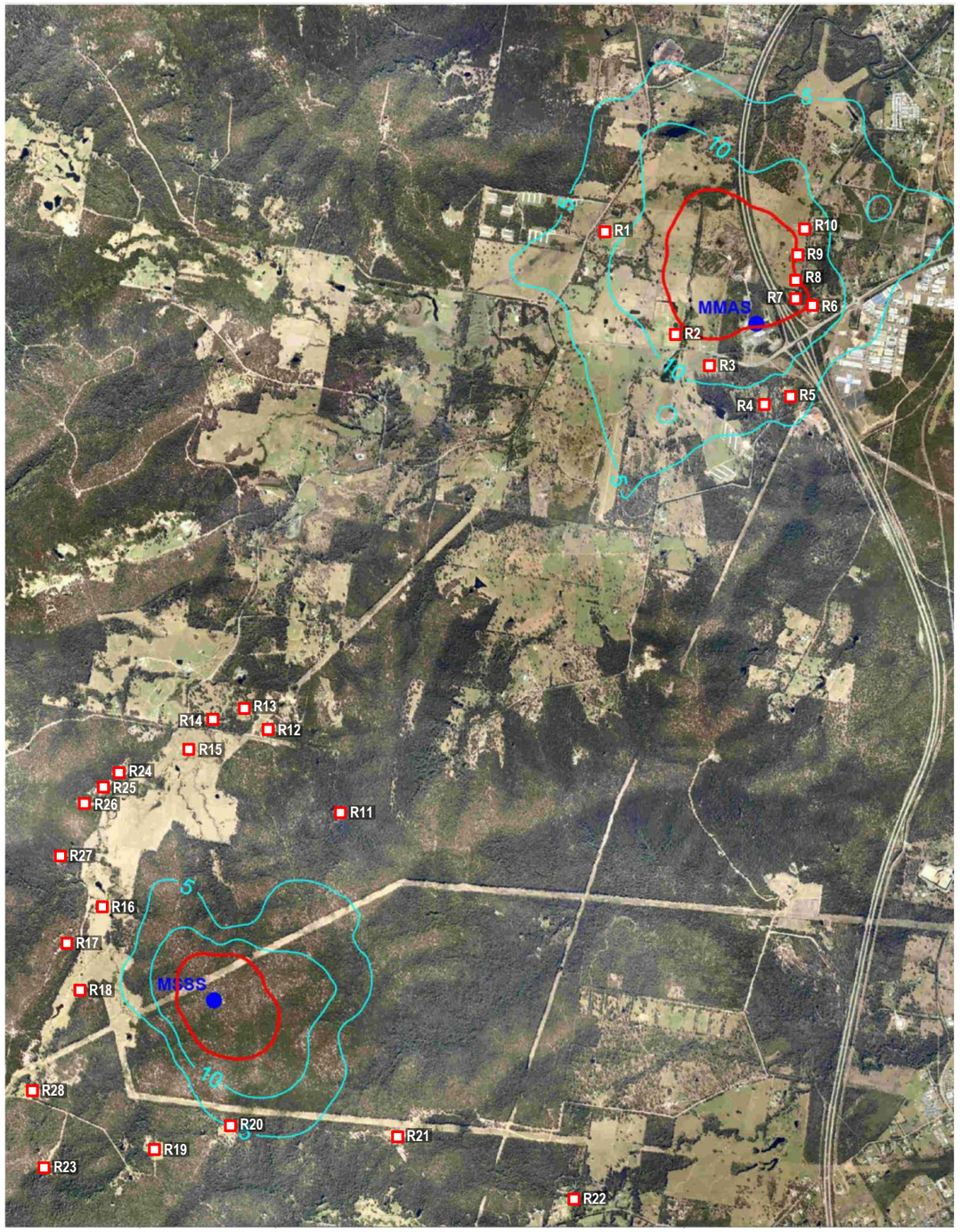
The predicted maximum 24-hour average $PM_{2.5}$ cumulative concentrations for Scenarios 2a and 2b are also predicted to exceed the advisory reporting standard of 25 µg/m^3 at the same three receptors (R6, R7 and R8) near the existing Mandalong Mine Access Site. The source of related $PM_{2.5}$ emissions from the Project is again the existing ventilation fans (SLR 2013a). For Scenarios 2a and 2b, the predictive model shows that the background concentrations contribute up to 83 percent (at R11) of the total cumulative concentrations.

Contour plots of the predicted maximum 24-hour $PM_{2.5}$ concentrations for Scenarios 1, 2a and 2b are presented on **Figure 49**.

Particulates as $PM_{2.5}$ – Annual Average

Annual average $PM_{2.5}$ concentrations are predicted to be below the advisory reporting standard of 8 µg/m^3 at all identified sensitive receptor locations for Scenarios 1, 2a and 2b. As the nominated residences/properties were chosen as being indicative sensitive locations typifying the local surrounding communities, it is unlikely that annual average $PM_{2.5}$ concentrations at other residences and properties surrounding these modelled residences would exceed the 8 µg/m^3 standard.

Contour plots of the predicted annual average $PM_{2.5}$ concentrations for Scenarios 1, 2a and 2b are presented on **Figure 50**.



N
W E
S

0 0.75 1.5km

LEGEND:

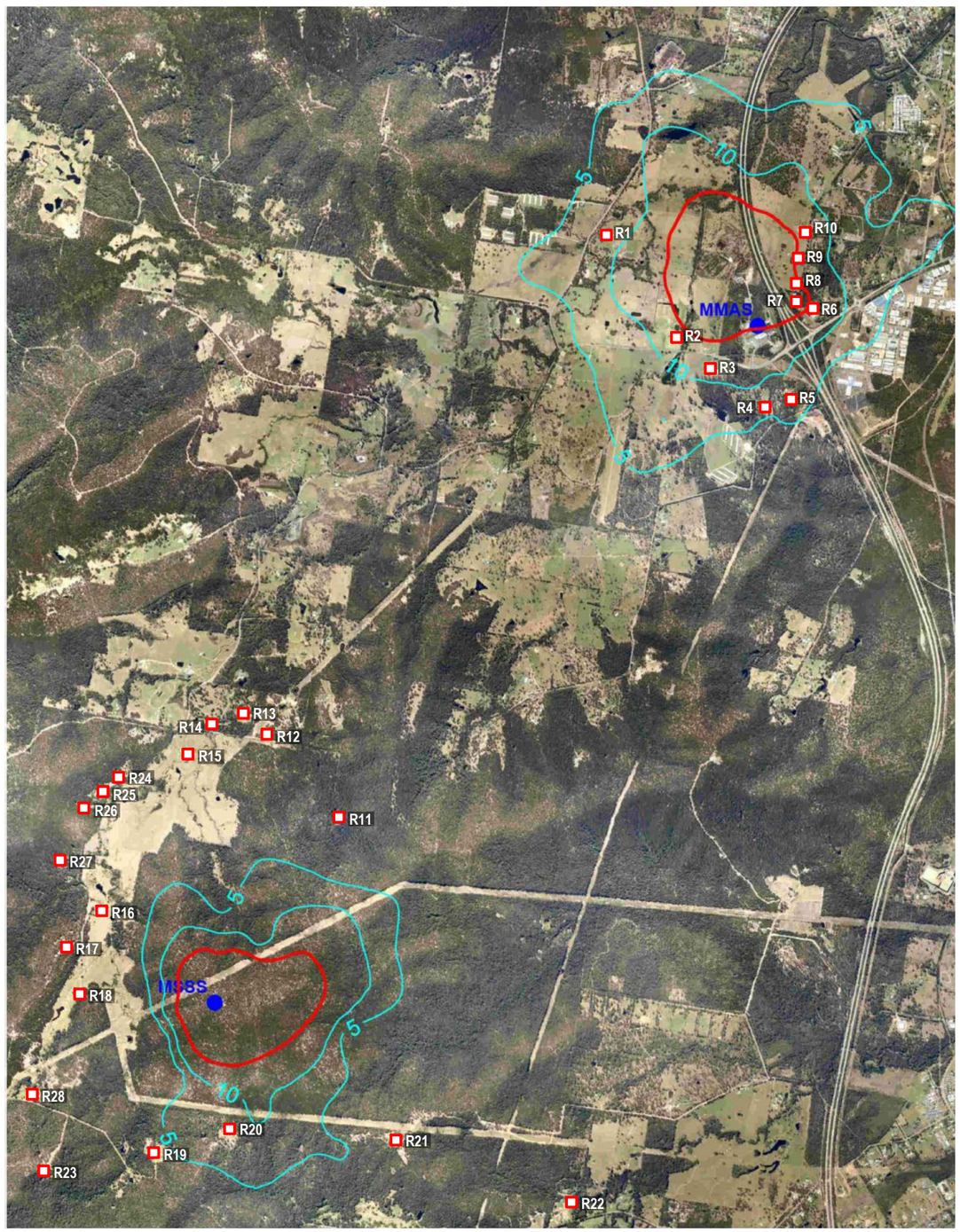
Residences (in close proximity to Surface Sites)

R20 Receiver identification number

NOTE:
Guideline: 25 µg/m³ (red contour)

Scenario 1
$PM_{2.5}$ Maximum 24-Hour Average (µg/m³) Increment

Data Source: SLR - Air Quality Impact Assessment Report



N
W E
S

0 0.75 1.5km

LEGEND:

Residences (in close proximity to Surface Sites)

R20 Receiver identification number

NOTE:
Guideline: 25 µg/m³ (red contour)

Scenario 2a & 2b
$PM_{2.5}$ Maximum 24-Hour Average (µg/m³) Increment

Data Source: SLR - Air Quality Impact Assessment Report

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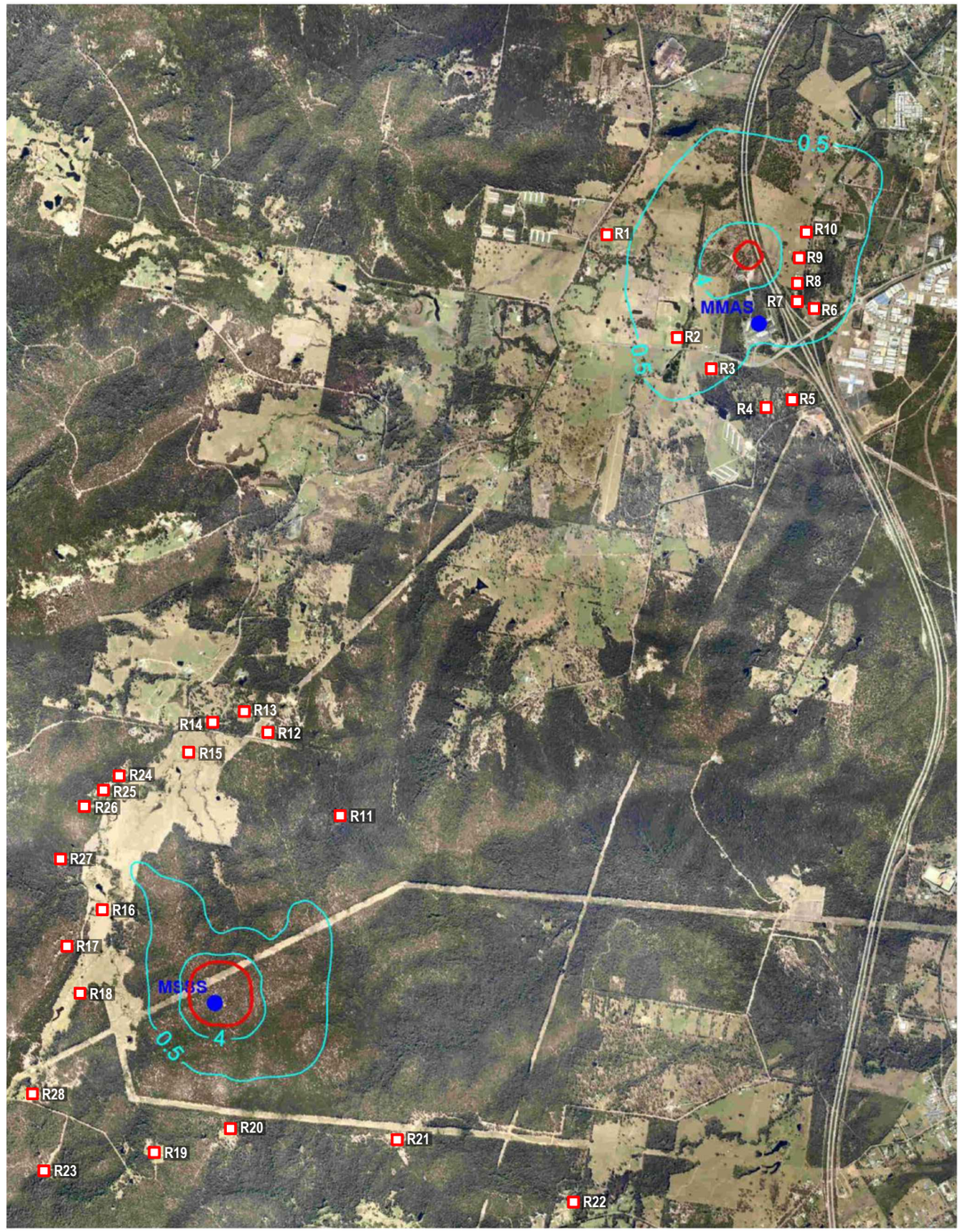
Maximum 24-Hour Average $PM_{2.5}$ Concentrations

FIGURE 49



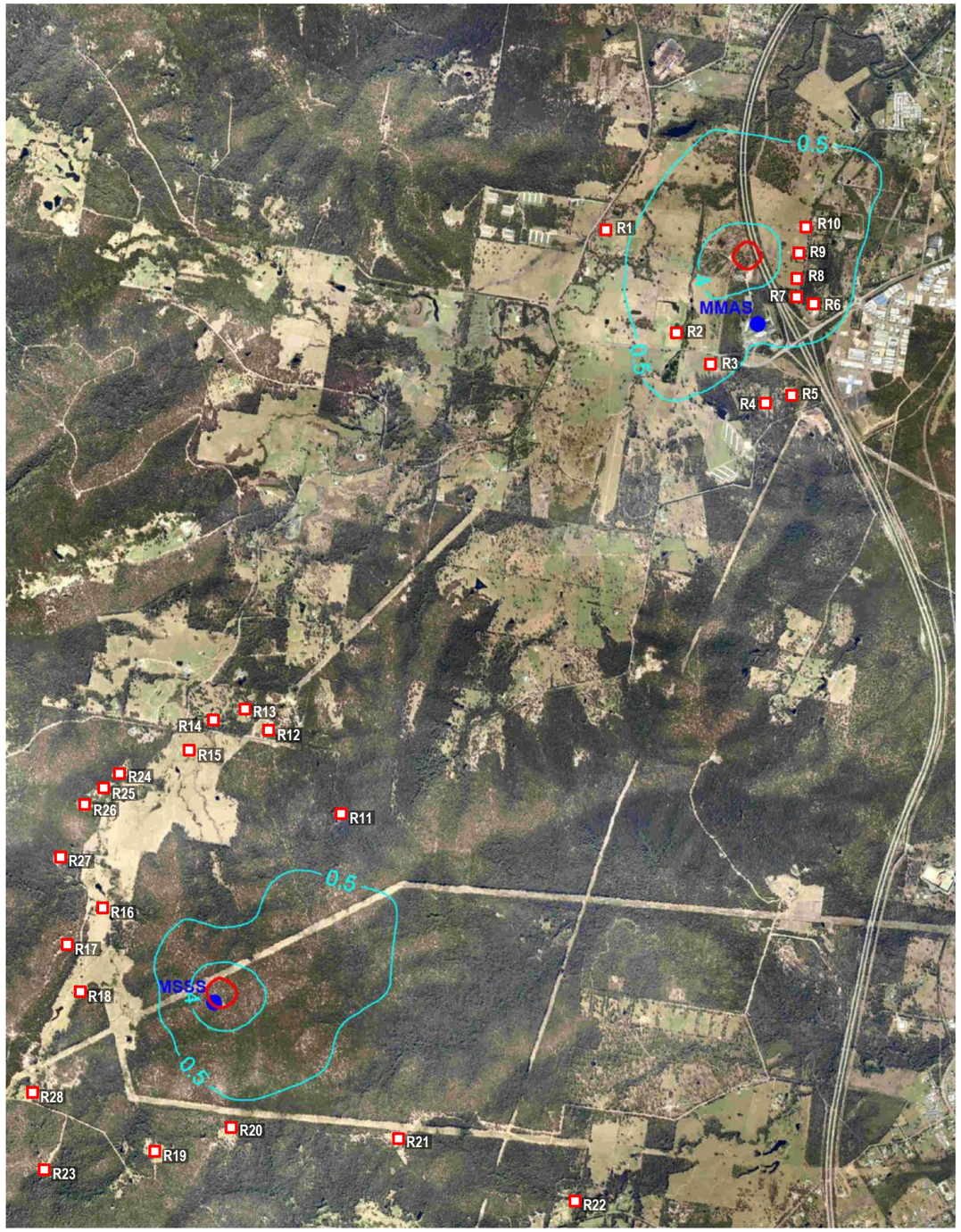
LEGEND:

Residences (in close proximity to Surface Sites)

NOTE:
Guideline: 8 µg/m³ (red contour)

Scenario 1
$PM_{2.5}$ Annual Average (µg/m³) Increment

Data Source: SLR - Air Quality Impact Assessment Report



LEGEND:

Residences (in close proximity to Surface Sites)

NOTE:
Guideline: 8 µg/m³ (red contour)

Scenario 2a & 2b
$PM_{2.5}$ Annual Average (µg/m³) Increment

Data Source: SLR - Air Quality Impact Assessment Report

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Annual Average $PM_{2.5}$ Concentrations

FIGURE 50

Odour

The adopted 99th percentile 1-hour average odour criterion of 4 OU is predicted to be exceeded at eight sensitive receptors during Scenarios 1, 2a and 2b. These eight receptors are identified as R1 to R3 and R6 to R10, which are all located in the vicinity of the existing Mandalong Mine Access Site. The exceedances are due to the operation of the existing ventilation fans at the Mandalong Mine Access Site, which represents an existing impact rather than a change in impact as a result of the Project.

While the odour concentrations are predicted to exceed the adopted criterion, SLR (2013a) advises that attention should be given to the characteristics of the odour. From the odour monitoring undertaken in August 2012, it is noted that the characteristics of odour experienced from the existing ventilation fans were mostly yeast, exhaust and metallic in character (SLR 2012a, cited in SLR 2013a). In addition, a "Community Odour Diary" has been issued to the community through the Mandalong CCC in order to monitor and record any odour issues in the community surrounding the Mandalong Mine Access Site. The odour diaries provided to Centennial Mandalong indicate that the odours experienced in the area are chicken manure, "Weetbix" and bush fire in character. Since commencement of operations of the ventilation fans at the Mandalong Mine Access Site, there have been no complaints associated with odour. Based on the odour monitoring and Community Odour Diary, SLR (2013a) concludes that the odour from ventilation fans is likely to be non-offensive to the community.

No exceedances of the odour criteria are predicted at the sensitive receptors surrounding the proposed Mandalong South Surface Site.

Contour plots of the predicted 99th percentile 1-hour average odour concentrations for Scenarios 1, 2a and 2b are presented on **Figure 51**.

Nitrogen Dioxide (NO_2)

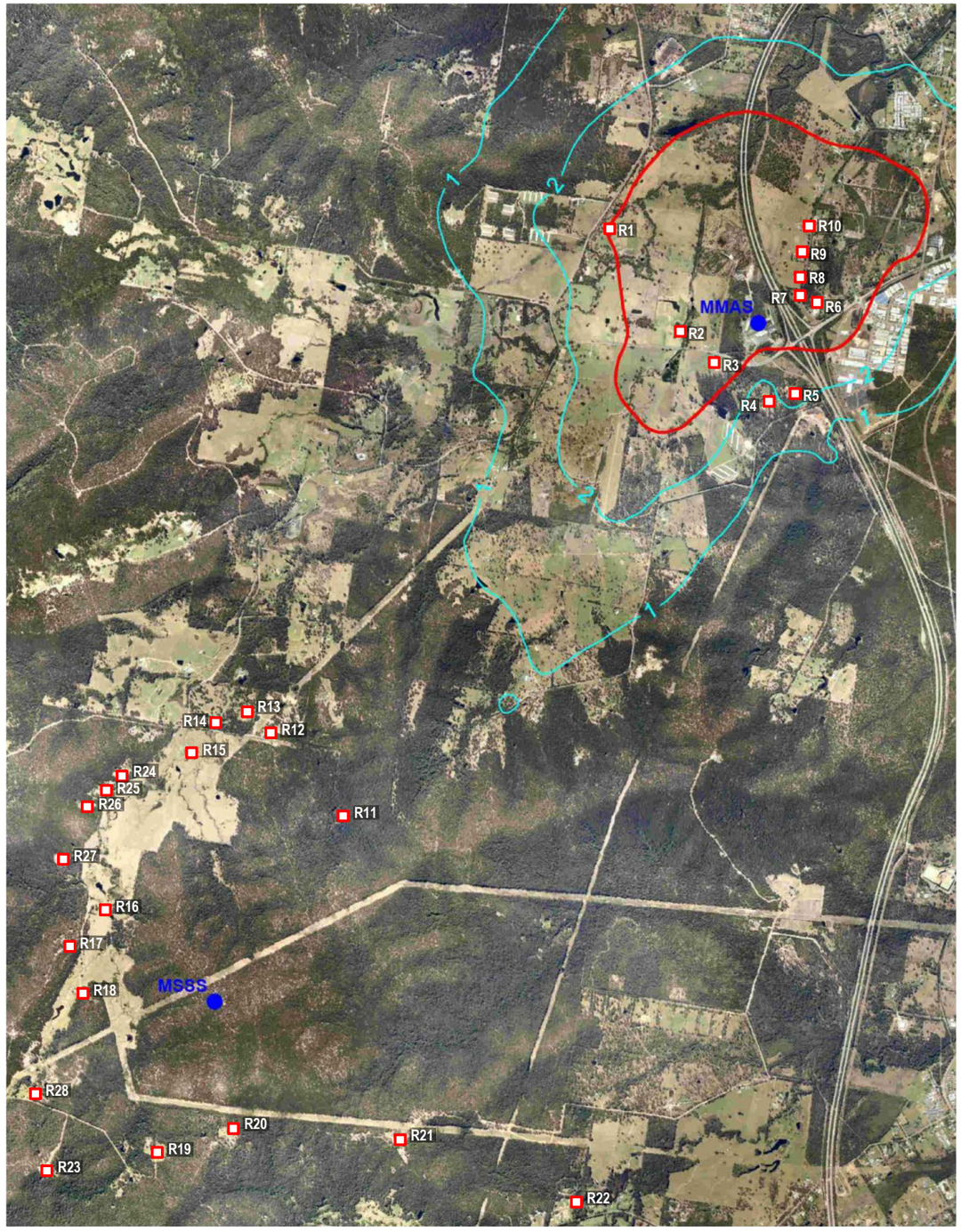
The maximum 1-hour average and annual average nitrogen dioxide concentrations are predicted to be below the project criteria of 246 µg/m^3 and 62 µg/m^3, respectively, at all the sensitive receptors during Scenarios 2a and 2b. There are no nitrogen dioxide emissions associated with Scenario 1.

Carbon Monoxide (CO)

The maximum 1-hour average and 8-hour average carbon monoxide concentrations are predicted to be below the project criteria of 30 mg/m^3 and 10 mg/m^3, respectively, at all the sensitive receptors during Scenarios 2a and 2b. There are no carbon monoxide emissions associated with Scenario 1.

Sulfur Dioxide (SO_2)

The maximum 1-hour average, 24-hour average and annual average sulfur dioxide concentrations are predicted to be below the project criteria of 570 µg/m^3, 228 µg/m^3 and 60 µg/m^3, respectively, at all of the sensitive receptors during Scenario 2b. There are no sulfur dioxide emissions associated with Scenario 1 or Scenario 2a.



N
W E
S

0 0.75 1.5km

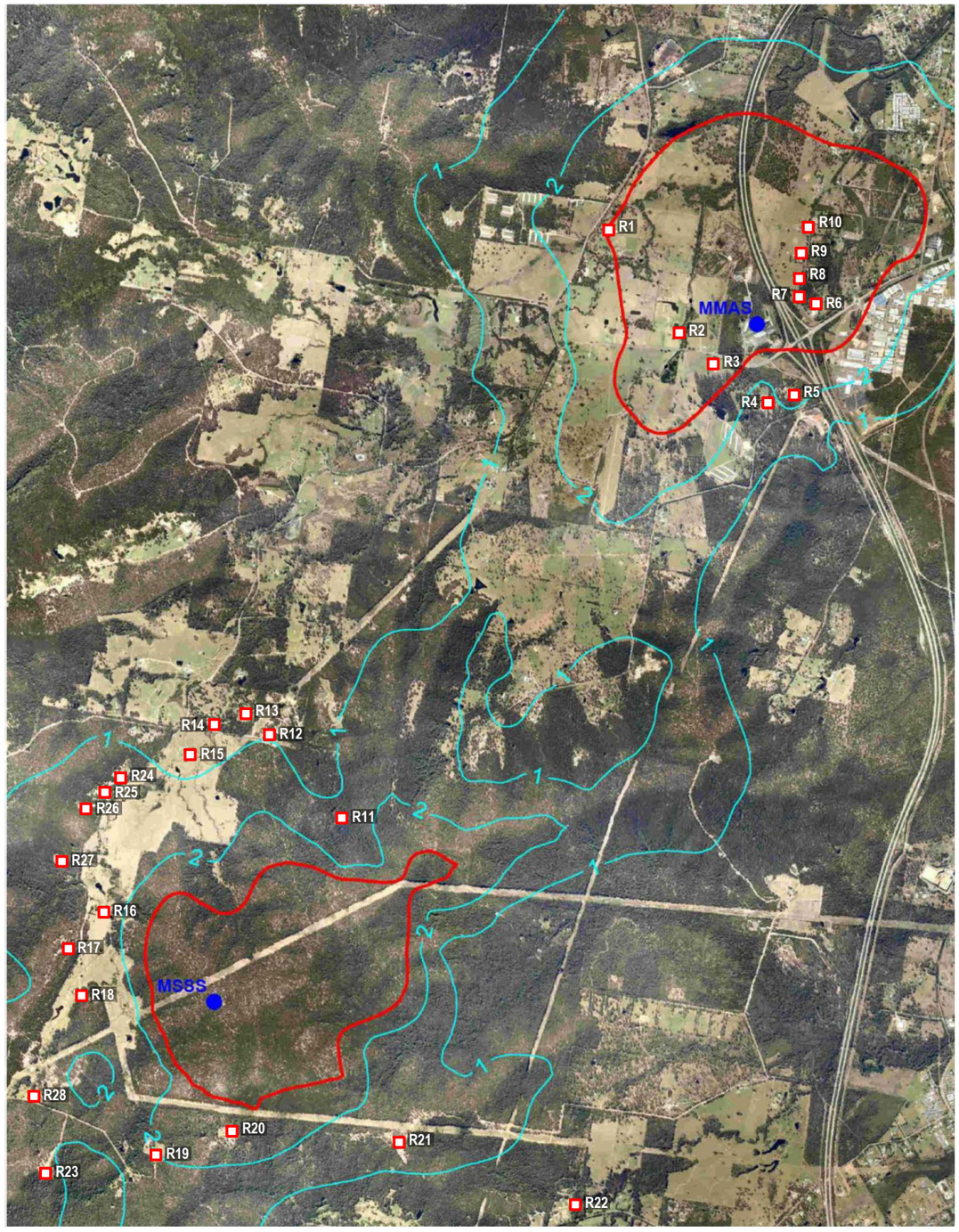
LEGEND:

Residences (in close proximity to Surface Sites)

NOTE:
Guideline: 4 OU (red contour)

Scenario 1
Odour 1-Hour Average
(OU, 99th Percentile)

Data Source: SLR - Air Quality Impact Assessment Report



N
W E
S

0 0.75 1.5km

LEGEND:

Residences (in close proximity to Surface Sites)

NOTE:
Guideline: 4 OU (red contour)

Scenario 2a and 2b
Odour 1-Hour Average
(OU, 99th Percentile)

Data Source: SLR - Air Quality Impact Assessment Report

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99th Percentile 1-Hour Average Odour Concentrations

FIGURE 51

Summary

Table 44 summarises the predictions and conclusions of SLR's (2013a) dispersion modelling exercise.

Table 44 – Air Quality Assessment Predictions

Pollutant	Compliance with Project Criteria			Notes
	Scenario 1	Scenario 2a	Scenario 2b	
Dust Deposition – Incremental Increase	✓	✓	✓	
Dust Deposition - Cumulative	✓	✓	✓	
TSP – Annual Average	✓	✓	✓	
PM_{10} – Maximum 24-Hour	✓	✓	✓	
PM_{10} – Annual Average	✓	✓	✓	
$PM_{2.5}$ – Maximum 24-Hour	✗	✗	✗	The predicted exceedances are at R6, R7 and R8 surrounding the Mandalong Mine Access Site.
$PM_{2.5}$ – Annual Average	✓	✓	✓	
Odour	✗	✗	✗	The predicted exceedances are at R1 to R3 and R6 to R10 surrounding the Mandalong Mine Access Site. Based on the odour monitoring undertaken in August 2012 and the Community Odour Diary, it is concluded that odour from ventilation fans is likely to be non-offensive to the community.
Nitrogen Dioxide (NO_2)	N/A	✓	✓	
Carbon Monoxide (CO)	N/A	✓	✓	
Sulfur Dioxide (SO_2)	N/A	N/A	✓	

10.10.7 Mitigation and Management

Centennial Mandalong will continue to employ the mitigation measures and management strategies currently adopted at the Mandalong Mine, as relevant to the Project, to minimise emissions of dust and particulate matter. These are standard work procedures to minimise emissions of particulate matter, maintaining plant and equipment to ensure optimal operating conditions, the use of water sprays/carts to dampen exposed surfaces and trafficable areas to minimise windblown and traffic-generate dust emissions, use of low sulfur diesel, use of diesel engines that conform to the United States EPA Tier 3 standards for exhaust emissions and an underground dust suppression system (water sprays on coal cutting machinery and rubber conveyor belts). Additionally, all mobile machines are fitted with particulate filter assembly units. This is current best practice standards for the underground coal mining industry.

The fan evasee at the Mandalong South Surface Site will be designed and installed to be directed away from the closest sensitive receptors to minimise potential air quality impacts.

The following additional key commitments are also made:

Particulate Matter Characterisation

Additional studies will be commissioned to establish the source of the particulate matter entering the mine and the contribution of this to the total emissions from the ventilation fans at the Mandalong Mine Access Site. These studies will inform the need for and scope of mitigation measures and management strategies considered necessary to address particulate matter emission from the ventilation fans.

Air Quality Management Plan

Mandalong Mine's currently approved and implemented EMS, including the *Air Quality Management Plan,* will be reviewed and updated for the Mandalong Southern Extension Project. The review will take into consideration the findings and conclusions of the air quality impact assessment (SLR 2013a), the commitments made in this EIS and all relevant consent conditions. Specifically the *Air Quality Management Plan* will include:

- A review of existing air quality conditions;
- An overview of air quality criteria;
- A summary of potential emission sources;
- Strategies to mitigate and manage air quality impacts which will include maintaining trafficable surfaces to minimise windblown dust and utilisation of low sulfur diesel and the use of underground mining equipment that conforms to the United States Tier 3 standards for exhaust emissions;
- Consultation processes to be implemented with potentially impacted landholders; and
- Monitoring and reporting requirements.

Construction Management Plan

As recommended by SLR (2013a), a Construction Management Plan will be developed for the construction phase of the Mandalong South Surface Site. The following basic procedures will be incorporated into the Construction Management Plan for air quality management:

- When conditions are dry, dusty and/or windy, water sprays, sprinklers and/or water carts will be used to dampen exposed surfaces and stockpiles, work areas and trafficable areas during working hours to minimise windblown and traffic-generated dust emissions;
- If necessary, dust suppression equipment will be fitted to on-site material batching plant;
- Where possible, construction activities will be modified during high or unfavourable wind conditions;
- Vegetation clearing and surface disturbance will be limited to the designated disturbance footprint required for construction;
- Working areas, disturbance areas and access roads will be revegetated and/or stabilised as soon as practicable to prevent or minimise windblown dust;
- Stockpiles and handling areas will be maintained in a condition that minimises windblown and traffic-generated dust;
- Silt will be removed from behind sediment fences and other erosion control structures on a regular basis, so that collected silt does not become a source of dust;
- Any dust, soil or mud that has been tracked on to public roads by construction activities and vehicle movements will be removed as soon as practicable;
- Where possible, vehicles on site will be confined to designated roadways;
- Loaded trucks leaving the construction site will be covered to minimise the transport of dust off site; and

- Centennial Mandalong will work to ensure trucks entering and leaving the surface sites during both the construction and operational phases are well maintained in accordance with the manufacturer's specification to comply with relevant regulations and ensure optimal operation.

Air Quality Monitoring

Centennial Mandalong will expand the existing air quality monitoring program, which currently comprises dust deposition monitoring around the Mandalong Mine Access Site (see **Section 10.10.2**), to include the following:

- Additional deposited dust gauges around the proposed Mandalong South Surface Site for both the construction and operational phases; and
- A PM_{10} and $PM_{2.5}$ monitoring system, which will be used for model verification purposes and to inform particulate management at the Mandalong Mine Access Site.

The optimal location for these additional monitoring activities, along with the method and frequency of the monitoring activities, will be determined in consultation with a suitably qualified consultant.

Considering the predicted short-term fine particulate (PM_{10} and $PM_{2.5}$) concentrations and number of exceedances predicted, SLR (2013a) advises that real time monitoring is not considered necessary. Real time monitoring is useful in circumstances where activities can be modified to immediately reduce particulate concentrations (for example, overburden dumping and blasting). For this Project, the majority of particulate sources are located underground, with ventilation fans being the major emission source at the surface. If particulate concentrations are shown to be elevated, limited measures can be taken to reduce these emissions and thus concentrations. SLR (2013a) further advises that their assessment has adopted a number of conservative assumptions in the estimation and modelling of particulates and considers that any exceedances will likely be due to elevations in background concentrations over which Centennial Mandalong has no control.

Centennial Mandalong implements a number of particulate controls on underground operations to minimise emissions at the surface facilities that are considered current best practice standards for the underground coal mining industry. These include the use of low sulfur diesel, use of diesel engines that conform to the United States EPA Tier 3 standards for exhaust emissions, use of filter assembly units on underground mobile equipment and an underground dust suppression system (water sprays on coal cutting machinery and runner conveyor belts). It is considered that these mitigation measures will be sufficient to control emissions.

Centennial Mandalong will continue to report air quality monitoring results on a monthly basis on Centennial's website and on an annual basis in the Annual Review.