# Appendix H

## Addendum
## Air quality impact assessment

# Question today
*Imagine tomorrow*
Create for the future

## EnergyConnect (NSW – Western Section)
## Amendment Report – Air Quality Impact Assessment

TransGrid

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| REV | DATE | DETAILS |
|---|---|---|
| B | 6/04/2021 | Final |

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# GLOSSARY

| TERM/ACRONYM | DESCRIPTION |
|---|---|
| AAQMS | Ambient Air Quality Monitoring Station |
| Approved Methods | Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2016 |
| AWS | Automatic Weather Station |
| BoM | Bureau of Meteorology |
| EIS | Environmental Impact Statement |
| EnergyConnect | EnergyConnect is a proposed new electricity interconnector between Wagga Wagga in New South Wales and Robertstown in South Australia, with an added connection into north-west Victoria. EnergyConnect is a joint project between TransGrid and ElectraNet, who operate the transmission networks in New South Wales (NSW) and South Australia (SA), respectively. |
| EPA | Environment Protection Authority |
| EPL | Environmental Protection Licence |
| HV | High Voltage |
| MH1 | Emission source: Loading trucks at site 1 |
| MH2 | Emission source: Loading trucks at site 2 |
| MH3 | Emission source: Loading trucks at the stockpile |
| MH4 | Emission source: Trucks dumping onto the stockpile |
| MH5 | Emission source: Trucks dumping at the substation pad |
| NPI | National Pollutant Inventory |
| NSW | New South Wales |
| $PM_{2.5}$ | Particles with an aerodynamic diameter of 2.5 micrometres or less |
| $PM_{10}$ | Particles with an aerodynamic diameter of 10 micrometres or less |
| POEO Act | (NSW) *Protection of the Environment Operations Act 1997* |
| SA | South Australia |
| Site 1 | Earthworks material site 1 |
| Site 2 | Earthworks material site 2 |
| TSP | Total Suspended Particulates |
| TAPM | The Air Pollution Model |
| WSP | WSP Australia Proprietary Limited |

| TERM/ACRONYM | DESCRIPTION |
| --- | --- |
| (the) Site | The Site area include:<br>— Buronga substation pad<br>— earthworks material site 1 (site 1)<br>— earthworks material site 2 (site 2)<br>— crushing and screening site<br>— stockpile area<br>— Buronga main construction compound and accommodation camp site. |
| Units | |
| ºC | Degree Celsius |
| km | kilometre |
| km/h | kilometre per hour |
| kg/VKT | kilogram per vehicle kilometres travelled |
| kg/t | kilogram per tonne |
| kV | kilovolts |
| g/s | gram per second |
| m | Metre |
| mm | Millimetres |
| MW | Megawatt |
| t/a | tonne per annum |
| $\mu g/m^3$ | Microgram per cubic meter |

# EXECUTIVE SUMMARY

The Environmental Impact Statement (EIS) for EnergyConnect (NSW – Western section) was publicly exhibited in 2020. TransGrid proposes to make a series of amendments to the proposal which have been developed since the public exhibition of the EIS, including a series of clarifications and refinements as a result of ongoing design of the proposal and comments received during exhibition of the EIS which have been described in the Amendment Report. This includes the inclusion of additional earthwork activities to potentially obtain fill material for the substation upgrade and expansion from two earthworks material sites adjacent to the substation rather than importing all materials from surrounding quarries. To ensure excavated material is suitable for use in the substation pad, a mobile crushing and screening plant may be required. It is estimated that up to 100,000 cubic metres of material would be crushed and screened in total which triggers the requirement for an Environmental Protection Licence (EPL) according to the *Environmental Operation Act 1997* (POEO Act).

An air quality impact assessment including dispersion modelling for particulate matters generated from crushing, screening and all other contemporaneous operations was requested by the NSW Environment Protection Authority (EPA). This report was completed to support the Amendment Report.

Rainfall and wind conditions at the Mildura Airport for the past six years were reviewed, and the year 2018 was selected for dispersion modelling as representative of long term meteorological conditions and slightly conservative for dust dispersion modelling.

Site-specific meteorological files for 2018 was generated using CALMET with prognostic data generated by The Air Pollution Model (TAPM) and observational data collected at Mildura Airport Automatic Weather Station (AWS).

Background data collected at the Buronga ambient air quality monitoring station for 2018 were processed and adopted as background for this assessment. The adopted background data are characterised as:

- Annual average TSP and $PM_{10}$ concentrations were below criteria, while the annual average $PM_{2.5}$ exceeded its criterion due primarily to elevated concentrations derived from the TSP concentrations.
- 24-hour average $PM_{10}$ concentrations exceeded its criterion on seven days and 24-hour average $PM_{2.5}$ concentrations exceeded its criterion on 16 days.

An emission inventory was developed for the following sources:

- machinery operation (i.e. excavators, scrapers, dozers and graders)
- materials handling (loading and unloading trucks)
- wheel generated dust from unpaved roads
- crushing, screening and associated activities
- wind erosion from stockpiles and other exposed areas.

Dispersion modelling was conducted using CALPUFF, and the modelling results indicate that:

- TSP: the total annual average TSP concentrations are predicted to be below the impact assessment criterion of 90 µg/m$^3$ and the highest incremental annual average at receptors is predicted to be 0.09 per cent of the criterion.
- $PM_{10}$: The highest predicted incremental 24-hour average at all receptors is 17.5 per cent of the criterion and the highest incremental annual average $PM_{10}$ is 1.8 per cent of the criterion. One day of additional exceedance is predicted to occur at R1 and R3 over modelled 365 days (up to 0.2 µg/m$^3$ above the criterion), with background accounting for 96.1 per cent of criterion and maximum contribution from the Site accounting for 4.1 per cent of the criterion.

- $PM_{2.5}$: The highest predicted incremental 24-hour average at all receptors is 5.2 per cent of the criterion and the highest incremental annual average $PM_{2.5}$ is 0.9 per cent of the criterion. No additional exceedances would occur as a result of the Site activities. Cumulative concentration exceedances are all caused by existing background exceedances.
- Deposited dust: Maximum incremental monthly dust deposition concentrations at all receptors are below the assessment criterion, with the maximum of 0.06 $g/m^2$/month accounting for three per cent of the criterion.

As summarised above, all incremental concentrations for TSP, $PM_{10}$, $PM_{2.5}$ and deposited dust at all sensitive receptors are predicted to account for a small portion of the corresponding criteria. There is only one day of additional exceedance over 365 days are predicted for $PM_{10}$ due to elevated background (background accounts for 96.1 per cent of the criterion), and the exceedances are only up to 0.2 $\mu g/m^3$ above the criterion.

There are a number of unknowns regarding the construction methodology at the time of assessment. Therefore, a conservative approach was taken to many of the assumptions which will lead to a conservative assessment outcome. The actual impacts are likely to be less than those predicted for this assessment.".

Due to the limited availability of background data, a conservative methodology was used to develop a whole year time-varying background data (i.e. assuming 100 per cent of TSP is $PM_{10}$ and $PM_{2.5}$ for 1 January to 10 May). Moreover, the monitoring at Buronga AQMS was not conducted using Australian standard methods. Therefore, the background data can only provide a indicative level of local ambient air quality.

What's more, due to the nature of construction activities, air quality impacts associated with the Site earthworks activities would be transient given the contribution would be for the duration of this particular activity and would not be an ongoing emission source.

In summary, predicted particulate matters impacts at the modelled sensitive receptors associated with crushing, screening and all other contemporaneous operations were predicted to be low.

# 1 INTRODUCTION

## 1.1 BACKGROUND

TransGrid (electricity transmission operator in New South Wales (NSW)) and ElectraNet (electricity transmission operator in South Australia (SA)) are seeking regulatory and environmental planning approval for the construction and operation of a new High Voltage (HV) interconnector between NSW and SA, with an added connection to north-west Victoria. Collectively, the proposed interconnector is known as EnergyConnect.

The Environmental Impact Statement (EIS) for EnergyConnect (NSW – Western section) was publicly exhibited in 2020. TransGrid proposes to make a series of amendments to the proposal which have been developed since the public exhibition of the EIS, including a series of clarifications and refinements as a result of ongoing design of the proposal and comments received during exhibition of the EIS which have been described in the Amendment Report. This includes the inclusion of additional earthwork activities to potentially obtain fill material for the substation upgrade and expansion from two earthworks material sites adjacent to the substation rather than importing all materials from surrounding quarries. To ensure excavated material is suitable for use in the substation upgrade and expansion pad, a mobile crushing and screening plant may be required. It is estimated that up to 100,000 cubic metres of material would be crushed and screened in total which triggers the requirement for an Environmental Protection Licence (EPL) according to the *Environmental Operation Act 1997* (POEO Act).

An air quality impact assessment including dispersion modelling for particulate matters generated from crushing, screening and all other contemporaneous operations was required by the NSW Environment Protection Authority (EPA). This report was completed in support the Amendment Report.

## 1.2 ASSESSMENT SCOPE

All dust generating activities that would occur for the period crushing would be required are included in this assessment. The assessment areas (the Site) include:

- Buronga substation upgrade and expansion pad (substation pad)
- earthworks material site 1 (site 1)
- earthworks material site 2 (site 2)
- crushing and screening site
- stockpile area
- Buronga main construction compound and accommodation camp site (construction compound and camp site).

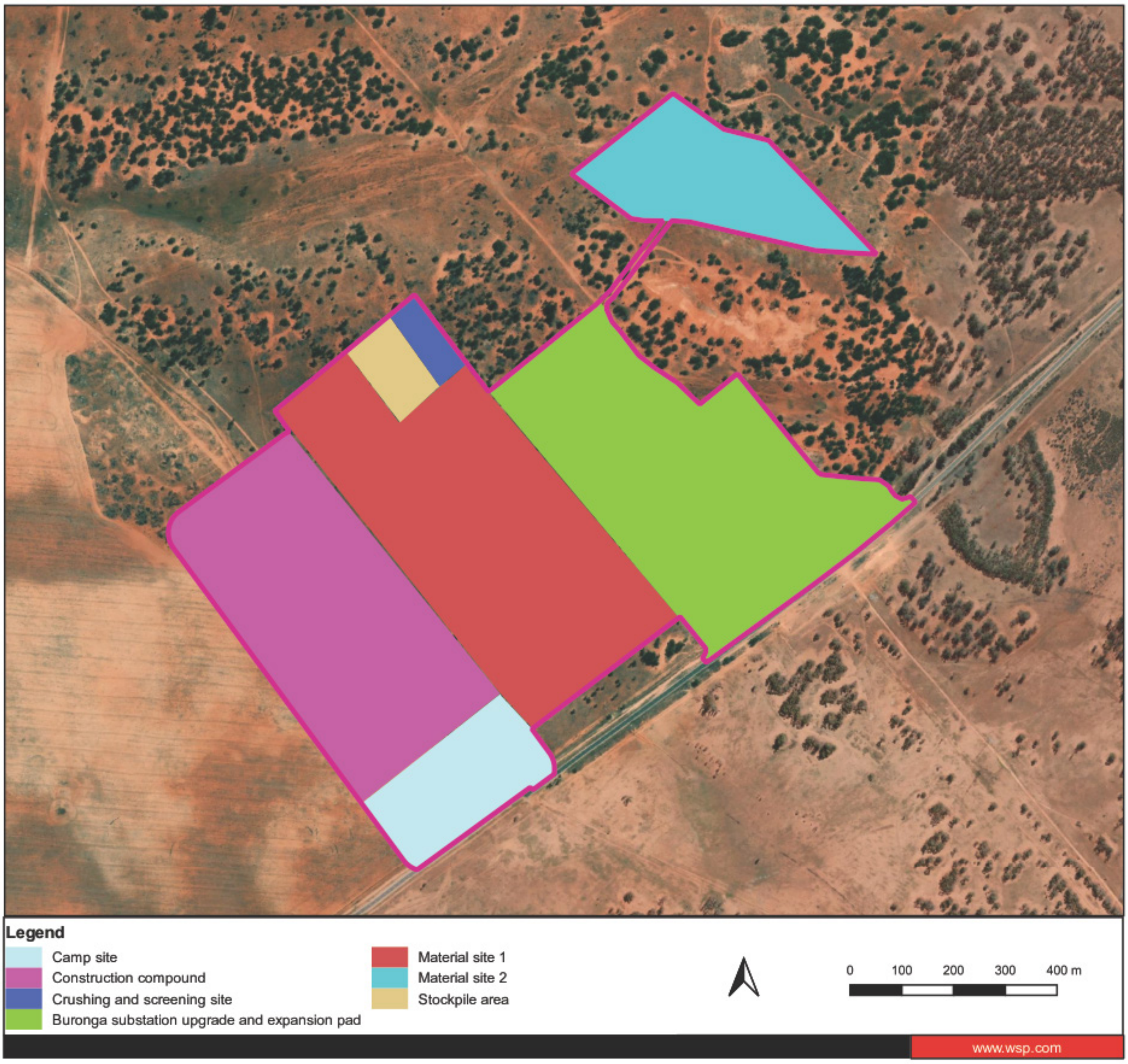



Figure 1.1 The Site layout

## 1.3 SCOPE OF WORKS

The scope of works includes:

- develop appropriate ambient air quality data to be used as background for the assessment
- generate an emission inventory for all sources. This includes proposed earthworks material sites, Buronga substation upgrade and expansion works, crushing and screening site, stockpile area and construction compound
- generate site specific meteorological files for one year using CALMET with prognostic data generated by The Air Pollution Model (TAPM) and observational data collected at the nearest Bureau of Meteorology (BoM) Automatic Weather Station (AWS) to Buronga substation
- predict incremental and cumulative ground level concentrations for TSP, $PM_{10}$, $PM_{2.5}$ and deposited dust using CALPUFF in accordance with the EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2016)
- prepare contour plots illustrating the extent of air quality impact
- prepare an air quality impact assessment report to support the Amendment Report.

## 1.4 POLLUTANTS OF INTEREST

The modelled pollutants in this assessment include:

- total suspended particulates (TSP)
- particulate matters equal to or less than 10 micrometres in aerodynamic diameter ($PM_{10}$)
- particulate matters equal to or less than 2.5 micrometres in aerodynamic diameter ($PM_{2.5}$)
- deposited dust.

# 2 ASSESSMENT CRITERIA

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2016* (Approved Methods) prescribes the statutory methods for modelling and assessing emissions of air pollutants from stationary sources.

The Approved Methods lists impact assessment criteria for a number of pollutants and the relevant criteria of this proposal are presented in Table 2.1. As stated in the Approved Methods, these criteria should be applied at the nearest existing or likely future off-site sensitive receptors.

Table 2.1 Air quality impact assessment criteria for relevant pollutants

| POLLUTANT | AVERAGING PERIOD | CRITERIA |
|---|---|---|
| TSP | Annual | 90 µg/$m^3$ |
| $PM_{10}$ | 24 hours | 50 µg/$m^3$ |
| | Annual | 25 µg/$m^3$ |
| $PM_{2.5}$ | 24 hours | 25 µg/$m^3$ |
| | Annual | 8 µg/$m^3$ |
| Deposited dust | Annual | 2 g/$m^2$/month (increase)<br>4 g/$m^2$/month (cumulative) |

Two levels of impact assessment are outlined by the Approved Methods as follows:

- Level 1: screening-level dispersion modelling technique using worst-case input data
- Level 2: refined dispersion modelling technique using site-specific input data.

Due to the elevated background data, a level 2 assessment was conducted directly to assess potential impacts from the proposal.

For a level 2 assessment, the Approved Methods require at least one year of continuous measurements which is contemporaneous with the meteorological data should be included. At each sensitive receptor, each individual dispersion model prediction is added to the corresponding measured background concentration (e.g. the predicted 24-hour ground level concentration of $PM_{10}$ for 1 January 2018 is added to the background concentration on the same day to obtain the 24-hour predicted cumulative impact).

The occurrence of additional exceedances of the impact assessment criteria need to be assessed. If additional exceedances are predicted to occur by the addition of the proposed sources, additional management practices or emission controls should be applied.

# 3 METEOROLOGICAL MODELLING

## 3.1 MODELLING YEAR SELECTION

There is no site-specific meteorological data collected for the Site. The closest Bureau of Meteorology (BoM) automatic weather station (AWS) is Mildura Airport, approximately 21 kilometres southwest of the Buronga substation. Wind direction, wind speed and rainfall data collected at this station for the period 2015 to 2020 were analysed to select a representative year for CALPUFF meteorological dataset compilation.

Annual rainfall data are listed in Table 3.1, and seasonal and annual wind roses are presented in Figure 3.1. The data indicates that:

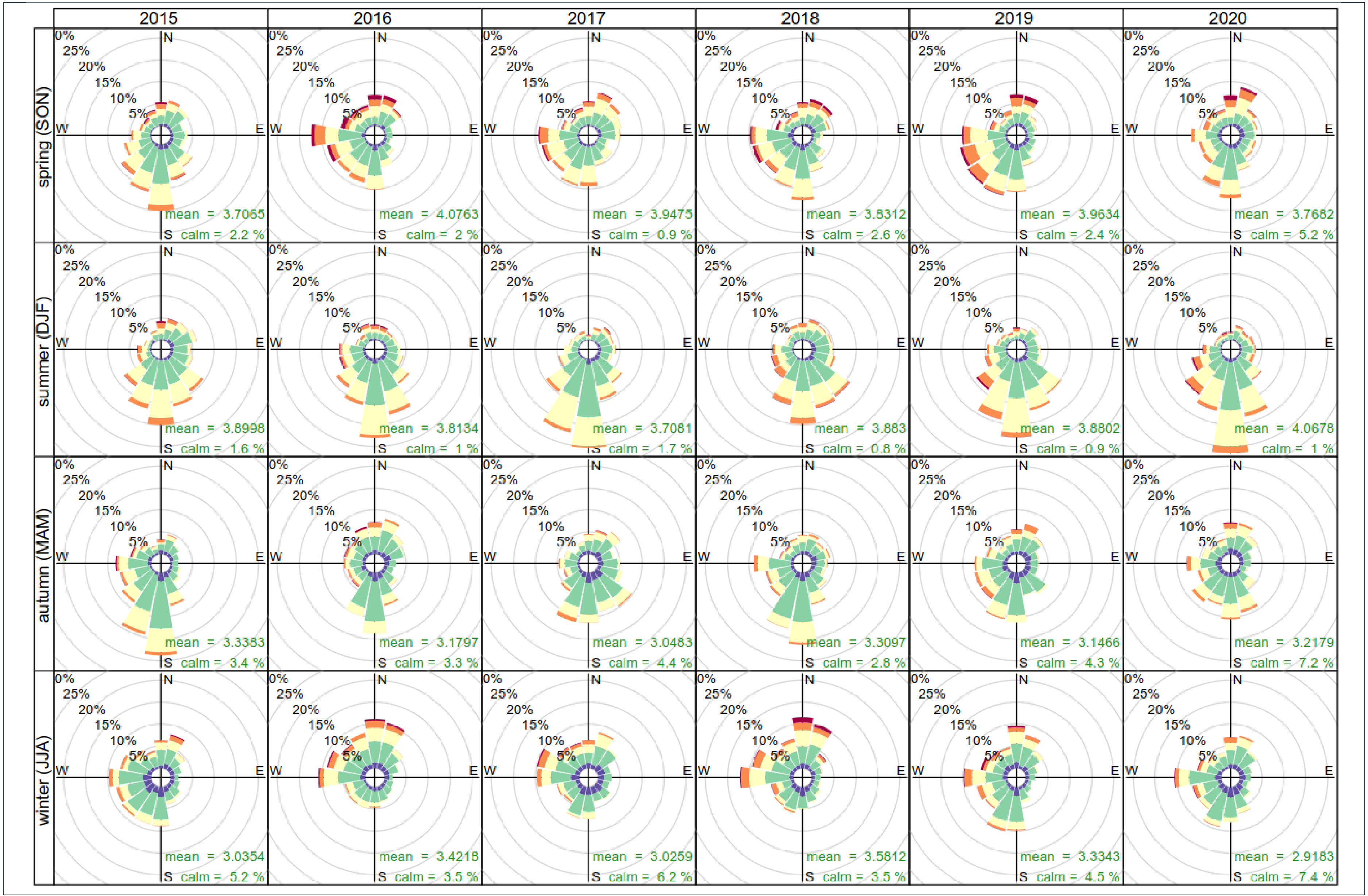
- 5.2 per cent of calm winds in 2020 was much higher than all other years (maximum of 3.3 per cent)
- calm winds and average wind speed in 2018 were generally consistent with other years, and within the upper range of average wind speed and lower range of calm winds proportion which are favourable for dust generating
- annual rainfall of 111.6 millimetres in 2019 was the lowest in all six years
- although rainfall in 2015 to 2017 were higher than that in 2018 and 2019, the national rainfall history on the BoM website (http://www.bom.gov.au/climate/history/rainfall/) indicates that rainfall in 2016 and 2017 were the highest in the last nine years.

In summary, the year 2018 was selected for dispersion modelling as representative of the long-term meteorological conditions at the Site. The meteorological data is also considered slightly conservative for dust dispersion modelling as particulate matters are more likely to be generated and travel far under windy and no-rain conditions.

Table 3.1 Total annual rainfall at the Mildura Airport AWS from 2015 to 2020

| YEAR | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| Annual rainfall (mm) | 221.8 | 358.2 | 251 | 130.2 | 111.6 | 265.4 |

A Level 2 assessment was conducted for this proposal. One year of continuous meteorological data used in the dispersion modelling should be contemporaneous with one year of continuous ambient air quality monitoring data for TSP, $PM_{10}$ and $PM_{2.5}$. The year 2018 was used for both the generation of the meteorological modelling files and the adopted background concentrations.


2015
2016
2017
2018
2019
2020
spring (SON)
summer (DJF)
autumn (MAM)
winter (JJA)
N
E
S
W
0%
25%
20%
15%
10%
5%
mean = 3.7065
calm = 2.2 %
mean = 4.0763
calm = 2 %
mean = 3.9475
calm = 0.9 %
mean = 3.8312
calm = 2.6 %
mean = 3.9634
calm = 2.4 %
mean = 3.7682
calm = 5.2 %
mean = 3.8998
calm = 1.6 %
mean = 3.8134
calm = 1 %
mean = 3.7081
calm = 1.7 %
mean = 3.883
calm = 0.8 %
mean = 3.8802
calm = 0.9 %
mean = 4.0678
calm = 1 %
mean = 3.3383
calm = 3.4 %
mean = 3.1797
calm = 3.3 %
mean = 3.0483
calm = 4.4 %
mean = 3.3097
calm = 2.8 %
mean = 3.1466
calm = 4.3 %
mean = 3.2179
calm = 7.2 %
mean = 3.0354
calm = 5.2 %
mean = 3.4218
calm = 3.5 %
mean = 3.0259
calm = 6.2 %
mean = 3.5812
calm = 3.5 %
mean = 3.3343
calm = 4.5 %
mean = 2.9183
calm = 7.4 %

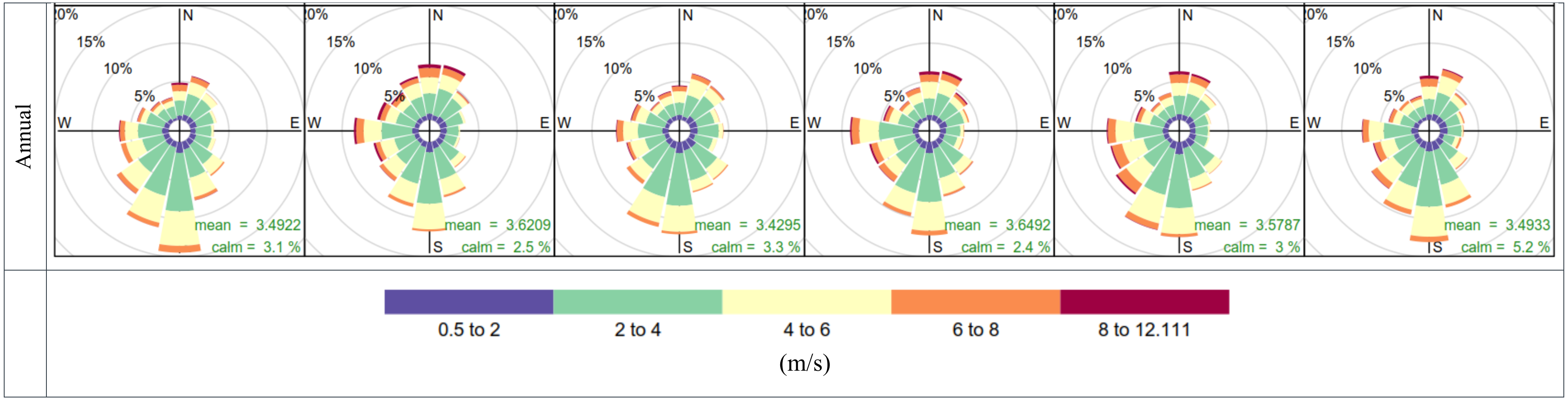



Figure 3.1 Seasonal and annual wind roses at Mildura Airport AWS for 2015-2020

## 3.2 TAPM

In the absence of a full suite of meteorological data required as input for dispersion modelling purposes, the Approved Methods specifies that The Air Pollution Model can be used to generate meteorological files.

The meteorological component of TAPM is an incompressible, optionally non-hydrostatic, primitive equation model with a terrain-following vertical co-ordinate for three dimensional simulations. The model is connected to '*databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature and synoptic –scale meteorological analysis for various regions around the world*'. These inputs were used together with observations from the Mildura Airport automatic weather station (AWS) [site number: 076031], located 21 kilometres to the southwest of Buronga substation, to generate synthetic meteorological files for the period 1 January to 31 December 2018:

TAPM (Version 4.0.5) was run adopting the setup in compliance with the requirements from the Approved Methods and using the following parameters:

- Four nesting grids of 30 kilometres, 10 kilometres, three kilometres and one kilometre
- 25 by 25 horizontal grid points
- grid centre of 34º6' S, 142º15' E (MGA Zone 54H 615728 m E, 6225749 m S)
- observation file for wind speed and wind direction from Mildura Airport AWS with areas of influence of 10,000 metres and four layers of the atmosphere influenced by the readings.
- 25 vertical levels (10 metres, 25 metres, 50 metres, 100 metres, 150 metres 200 metres, 250 metres, 300 metres 400 metres, 500 metres, 600 metres, 750 metres, 1000 metres, 1250 metres, 1500 metres, 1750 metres, 2000 metres, 2500 metres, 3000 metres, 3500 metres, 4000 metres 5000 metres, 6000 metres, 7000 metres and 8000 metres)
- GEODATA 9-Second terrain height database
- TAPM default database for land use, synoptic analysis and sea surface temperature.

TAPM's output was exported as an upper air station at MGA Zone 54H 615728 m E, 6225749 m S and used as upper air data in the meteorological modelling.

## 3.3 CALMET

The meteorology was modelled using CALMET (V6.5.0). CALMET is a meteorological model which includes a diagnostic wind field generator. It accounts for the treatment of slope flows, terrain effects, such as blocking, and a micrometeorological model for overland and overwater boundary layers. This model produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are utilised in the CALPUFF dispersion model.

A one year meteorological dataset was compiled for CALPUFF for the calendar year 2018. Observed data from the Mildura Airport AWS were used to create surface data and precipitation data files for CALMET.

Upper air data were generated using TAPM as detailed in section 3.2.

Two grid domains were modelled to account for the meteorological station:

- the outer domain with a coarse resolution of 500 metres and a 40 kilometres x 40 kilometres extent as an initial guess
- the inner domain with a finer resolution of 200 metres and 20 kilometres x 20 kilometres extent.

Output from the inner domain was then used in the CALPUFF dispersion modelling. Site-specific meteorological data were extracted from the inner domain output at the Buronga substation (i.e. MGA Zone 54H 615740 m E, 6225840 m S). Wind direction, wind speed data were then analysed and presented in section 4.1.

Table 3.2 provides a summary of the CALMET configuration.

Table 3.2 CALMET configuration summary

| PARAMETERS | CONFIGURATION |
|---|---|
| Outer domain | Southwest corner (MGA Zone 54H): 595710 m E, 6205827 m S.<br>Resolution: 500 m<br>Extent: 40 km x 40 km |
| Inner domain | Southwest corner (MGA Zone 54H): 605550 m E, 6215716 m S.<br>Resolution: 200 m<br>Extent: 20 km x 20 km |
| Cell faces heights (m) | 0, 20, 30, 40, 50, 70, 90, 100, 250, 500, 1000, 1500, 2000. |
| Biases | -1, -1, -0.75, -0.5, -0.25, 0, 0.5, 1, 1, 1, 1, 1 |
| TERRAD | 2 km |
| Terrain data | 1 Second DEM from ELVIS: https://elevation.fsdf.org.au/ |
| Land use | Catchment Scale Land Use Data for Australia (CLUM): https://www.agriculture.gov.au/abares/aclump/land-use/catchment-scale-land-use-of-australia-update-december-2018 |

# 4 EXISTING ENVIRONMENT

## 4.1 SITE-SPECIFIC METEOROLOGICAL CONDITION

### *4.1.1 WIND CONDITIONS*

Site-specific wind conditions were extracted from CALMET at the Buronga substation. Seasonal and annual wind roses for 2018 at this location are presented in Figure 3.1. The wind roses indicate that wind conditions at the Site were generally consistent with that at the Mildura Airport AWS.

The wind roses indicate that the winds at the Site in 2018 were:

- most frequently ranging from the south to west and rarely from the east during spring with an average wind speed of 3.8 m/s
- most frequently from the south east to south southwest during summer with an average wind speed of 3.9 m/s
- most frequently from the south and south-southwest during autumn with an average wind speed of 3.3 m/s
- most frequently form the north, north-northeast and the west during winter with an average wind speed of 3.6 m/s
- overall most frequently from the south and south-southwest and the west directions with an average wind speed of 3.7m/s and calm winds of 2.5 per cent over the year.

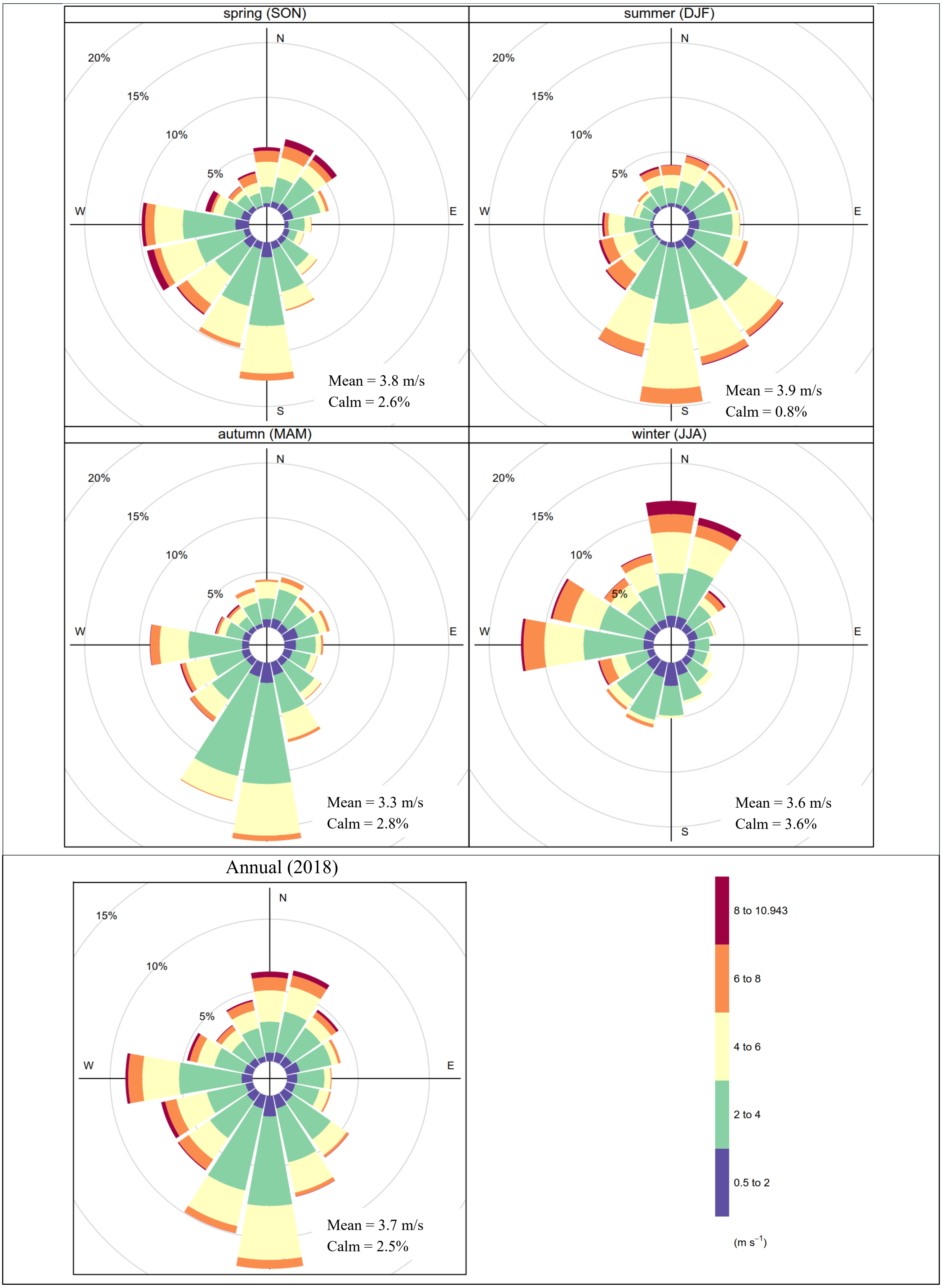



Figure 4.1 Seasonal and annual wind roses at the Site (2018)

### 4.1.2 STABILITY CLASS

Stability categories are used as indicators of atmospheric turbulence and the dispersive properties of the atmosphere by Gaussian plume dispersion models. Higher stability of the atmosphere typically results in poor dispersion conditions and higher ground level concentrations, whilst unstable atmospheres typically have the opposite impact.

Stability classes described by Pasquill-Gifford are presented Table 4.1. Usually, Class F and G are combined into one class, F.

Table 4.1 Atmospheric stability classes

| STABILITY CLASS | CATEGORY | DESCRIPTION |
|---|---|---|
| A | Very stable | Low winds, clear skies, hot daytime conditions |
| B | Unstable | Moderate winds, clear skies, daytime conditions |
| C | Slightly unstable | Moderate winds, slightly overcast daytime conditions |
| D | Neutral | High winds or cloudy days and nights |
| E | Slightly stable | Moderate winds, slightly overcast night-time conditions |
| F | Stable | Low winds, clear skies, cold night-time conditions |
| G | Very stable | |

Figure 4.2 shows the predicted frequency of stability classes at the Site. Stability classes have been predicted using the methodology outlined in section 3.3. The distribution of stability classes indicates that there are:

— very rare low wind days with high solar insolation (Class A)
— a low amount of sunny days with moderate winds (Class B)
— a relatively low amount of slightly overcast days with moderate winds (Class C) and slightly overcast nights with moderate winds (Class E)
— a high amount of overcast days and nights (Class D)
— a moderate amount of calm and cold night time conditions (Class F).

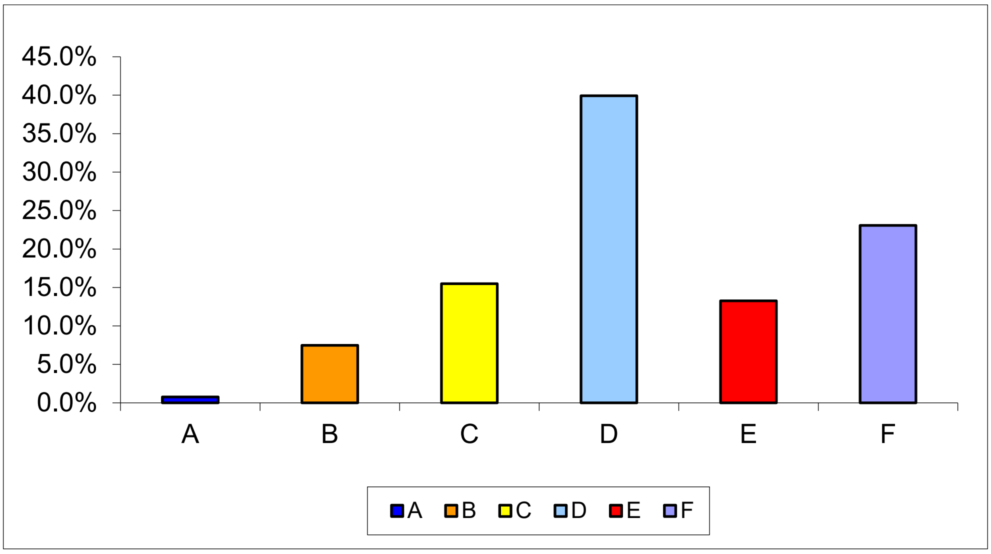



Figure 4.2 Frequency of atmospheric stability classes predicted for the Site

## 4.2 AMBIENT BACKGROUND DATA

The nearest ambient air quality monitoring station (AAQMS) is the Buronga AAQMS, located approximately 8.7 kilometres to the southwest of the Site. There are no other AAQMS within 70 kilometres of the Site.

TSP, $PM_{10}$ and $PM_{2.5}$ were monitored at this station using DustTracks which is not a reference or reference equivalent monitoring method. Theoretically, the data collected at this station should not be used for compliance assessment but provides an indicative level of particulate matter concentrations in the rural area. Due to the limitation of background data availability, the monitoring data collected at Buronga AAQMS in 2018 (the selected meteorological year) was adopted as background.

An email notification from NSW EPA was received in February 2021 indicating the $PM_{10}$ and $PM_{2.5}$ data provided previously and presented in the *EnergyConnect (NSW – Western Section): Technical paper 7 – Air Quality* (October 2020, WSP) report for the period 1 January to 10 May 2018 were incorrect and should not be used as background data for air quality impact assessments. Only valid TSP data is available for this period. Consequently, for 1 January to 10 May 2018, 24 hour $PM_{10}$ and $PM_{2.5}$ concentrations were derived based on $PM_{10}$ to TSP and $PM_{2.5}$ to TSP to ratios using valid TSP, $PM_{10}$ and $PM_{2.5}$ data collected for the period 10 May to 31 December 2018.

Given the ratio of $PM_{10}$ to TSP ranged from 0.96 to 1 and the ratio of $PM_{2.5}$ to TSP ranged from 0.49 to1 for the rest of the year (10 May to 31 December 2018), both the $PM_{10}$ and $PM_{2.5}$ 24-hour concentrations were conservatively assumed to be 100 per cent of TSP for the period 1 January 2018 to 10 May 2018. Where background data for all three pollutants (i.e. TSP, $PM_{10}$ and $PM_{2.5}$) were missing, the $70^{th}$ percentile of 24-hour average concentrations for each pollutant was adopted for that day in order to develop a continuous full year background. By including derived 24 hour $PM_{10}$ and $PM_{2.5}$ concentrations in the 2018 dataset, this allowed a contemporaneous assessment (i.e. adding the predicted 24 hour $PM_{10}$ and $PM_{2.5}$ ground level concentration with the same 24-hour background concentration) to be conducted as required by the Approved Methods.

Time-varying background concentrations for the year 2018 were adopted as the background dataset for this assessment. Table 4.2 presents 24-hour average data availability and Table 4.3 presents a summary of background concentrations. Figure 4.3 to Figure 4.5 illustrate daily concentrations for TSP, $PM_{10}$ and $PM_{2.5}$ for the year 2018.

It is noted that no monitoring data for deposited dust is available while preparing this report.

The adopted background data are characterised as:

- annual average TSP and $PM_{10}$ concentrations were below their relevant criteria, while annual average $PM_{2.5}$ exceeded its criterion primarily due to the elevated concentrations derived from the $PM_{2.5}$ to TSP ratio
- 24-hour average $PM_{10}$ concentrations exceeded its criterion on seven days and the 24-hour average $PM_{2.5}$ concentrations exceeded its criterion on 16 days.

Table 4.2 Data availability

| ITEM | TYPE | TSP | $PM_{10}$ | $PM_{2.5}$ |
|---|---|---|---|---|
| 24-hour average data availability | Raw data | 87% | 52% | 52% |
| | After applying $PM_{10}$/TSP and $PM_{2.5}$/TSP Ratio | 87% | 87% | 87% |
| | After filling missing data using $70^{th}$ percentile | 100% | 100% | 100% |

Table 4.3 Summary of background concentrations

| SPECIES | ANNUAL (µG/M³) | | 24-HOUR AVERAGE (µG/M³) | | | |
|---|---|---|---|---|---|---|
| | Criteria | Background | Criteria | Maximum | 70th percentile | Number of exceedances |
| TSP | 90 | 13.7 | None | 634.6 | 9.6 | N/A |
| $PM_{10}$ | 25 | 13.7 | 50 | **634.6** | 9.6 | 7 days |
| $PM_{2.5}$ | 8 | **12.5** | 25 | **634.6** | 8.6 | 16 days |

*Note: Exceedances of criteria are highlighted in bold*

*N/A: Not applicable*

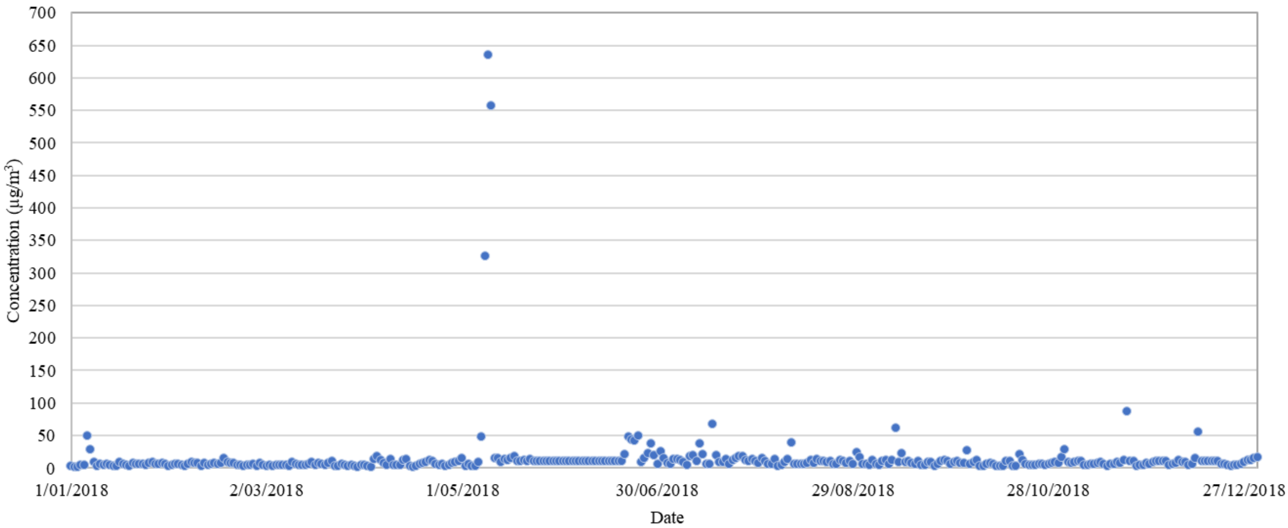
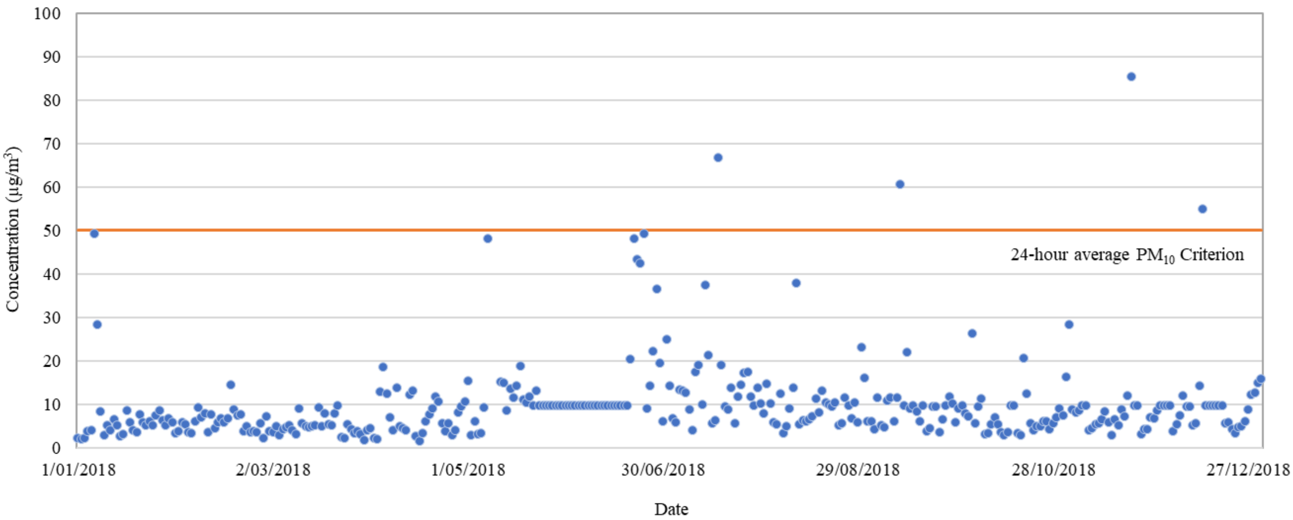
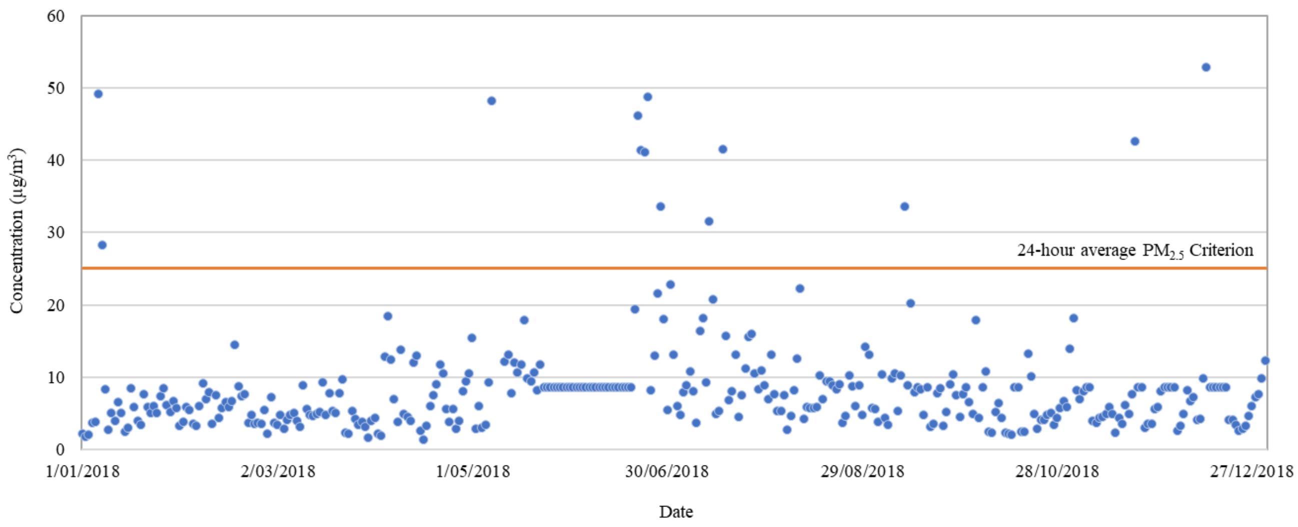



Figure 4.3 24-hour average TSP concentrations




*Note: The three exceedances above 300µg/m³shown in Figure 4.3 have been removed from the figure to aid visual representation pf the data*

Figure 4.4 24-hour average $PM_{10}$ concentrations




*Note: The three exceedances above 300 μg/m³ shown in Figure 4.3 are removed from the figure to aid visual representation.*

Figure 4.5 24-hour average $PM_{2.5}$ concentrations

## 4.3 SENSITIVE RECEPTORS

The Approved Methods (EPA, 2016) describes a sensitive receptor as:

> A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area. An air quality impact assessment should also consider the location of any known or likely future sensitive receptor.

Both confirmed and potential sensitive receptors within five kilometres of the Site were identified and presented in Table 4.4 and Figure 4.6.

Table 4.4 Identified sensitive receptors

| RECEPTORS | TYPE | DISTANCE TO THE SITE (M) |
|---|---|---|
| R1 | Residential (shed) | 1500 |
| R2 | Residential | 1780 |
| R3 | Potential dwelling | 3870 |
| R4 | Workplace (industry facility) | 4050 |
| R5 | Potential dwelling | 4065 |
| R6 | Workplace (industry facility) | 5011 |

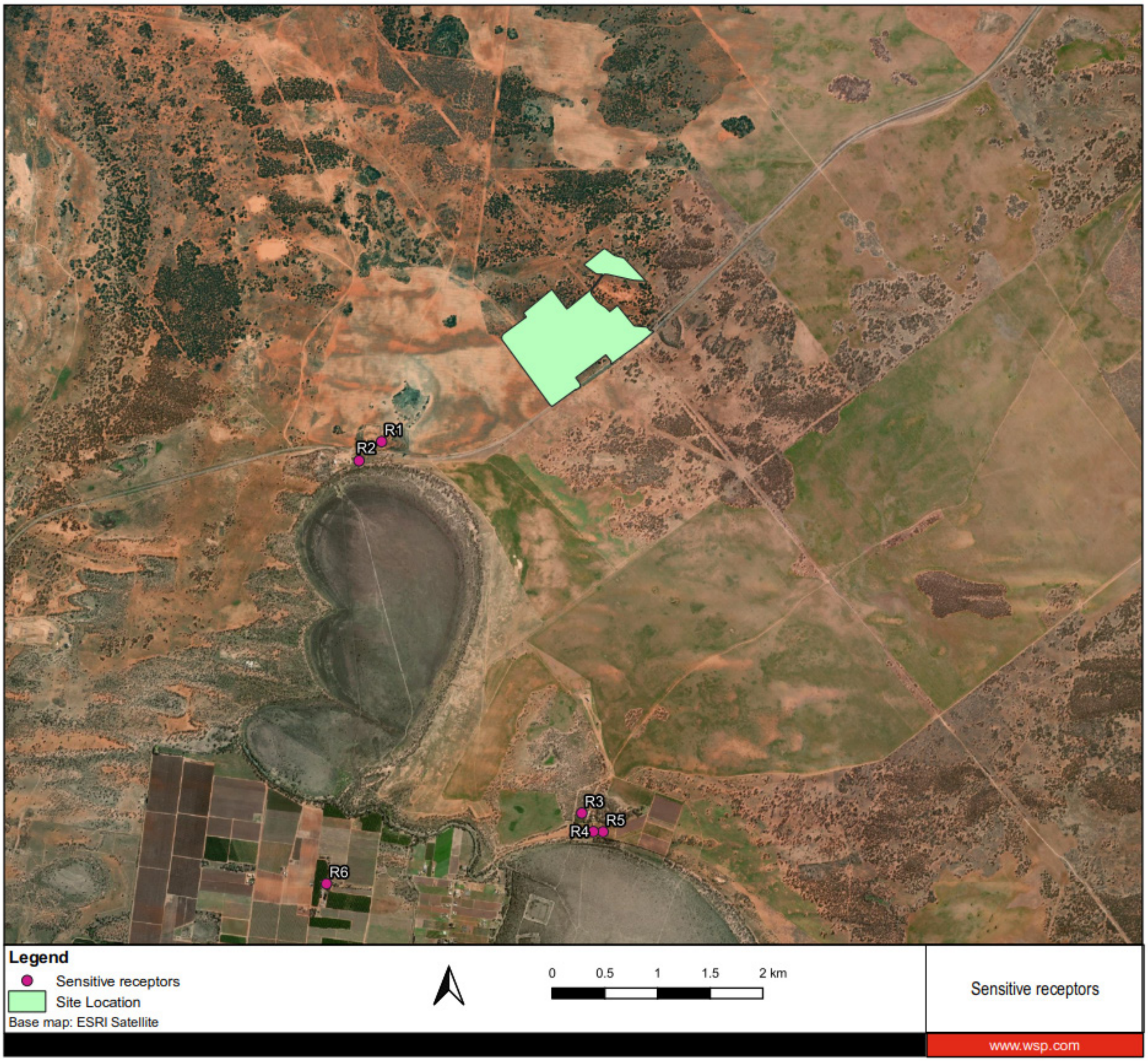



Figure 4.6 Modelled sensitive receptors

# 5 DISPERSION MODELLING

## 5.1 AIR DISPERSION MODEL

CALPUFF is a multi-layer, multi-species, non-steady-state Gaussian puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport.

CALPUFF is one of the most commonly used models for regulatory dispersion modelling applications in NSW and it provides a distinct advantage in the treatment of calm conditions over steady-state models (such as AERMOD).

Air dispersion modelling was undertaken using the latest version of CALPUFF (V.7.2.1) in accordance with the requirements of the Approved Methods.

## 5.2 EMISSION ESTIMATION

### *5.2.1 METHODOLOGY*

Emission rates for activities at Buronga substation were determined using National Pollutant Inventory (NPI) emission factors and the United States Environmental Protection Agency (USEPA) AP-42. An emission factor is a value representing the relationship between an activity and the rate of emissions of a specified pollutant. Emission factors are developed based on test data, material mass balance studies and engineering estimates.

Emission estimates for the Site were based on the following NPI and USEPA AP-42 references:

- NPI Emission Estimation Technique Manual for Mining Version 3.1 (NPI Mining)
- AP-42 Section 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing
- AP-42 Section 13.2.2: Unpaved Roads
- AP-42 Section 13.2.3: Heavy Construction Operation.

The emission calculations and resultant emission rates are discussed in the following sections using the equation presented below and information provided by TransGrid.

Emission factors are expressed as a function of the weight, volume, distance or duration of the activity emitting the pollutant. The general equation used for the estimation of emissions is:

$$E = A \times EF \times \left(1 - \frac{ER}{100}\right)$$

Where:

E = emission rate
A = activity rate
EF = emission factor
ER = overall emission reduction efficiency (%)

### *5.2.2 EMISSION SOURCES*

Fugitive emissions at the Site have the potential to arise from the following sources:

- machinery operation (i.e. Excavators, scrapers, dozers and graders)
- materials handling (loading and unloading trucks)
- wheel generated dust from unpaved roads
- crushing, screening and associated activities
- wind erosion from stockpiles and other exposed areas.

### 5.2.3 EMISSION INVENTORY

Standard working hours for construction works would be from 7:00 am to 7:00 pm with one hour break. All emissions are expected be generated during this period except for wind erosion which were modelled for all hours.

As site-specific silt content and moisture content were not available while preparing this report, default emission factors from the NPI Mining manual were used to estimate emission rates.

It is noted that where an emission factor for $PM_{2.5}$ is not available, a $PM_{2.5}$ to $PM_{10}$ ratio of 0.15 was used as recommended by USEPA AP-42.

The final extent of the material sites 1 and 2 would be confirmed by further geotechnical investigations during detailed design. Material sites 1 and 2 may not both be required, or the final extent may be smaller than the area presented in Figure 5.1.

#### 5.2.3.1 MACHINERY OPERATION

For assessment purposes, it is estimated that three excavators, three scrapers, one dozer and one grader would be used on the Site at various locations. In practice, the machinery would be used on material site 1, site 2, the substation pad or construction compound and camp site. However, for the purpose of this assessment, where the machinery would be used both on site 1 and site 2, the machinery was conservatively modelled at site 1 which is closer to sensitive receptors.

The dozer and grader were modelled at different sites based on the estimated amount of time they would operate at each site. It is noted that the exact months are only indicative and should not be interpreted as working schedules.

Scrapers may be used both for topsoil removal and materials transportation. The emission rates for scrapers were estimated assuming topsoil removal. Dust generated from materials transportation are outlined in section 5.2.3.3.

Emission factors adopted for all machinery are obtained from Table 2 in the NPI Mining manual and the emission inventory for machinery operation is presented in Table 5.1 to Table 5.3.

Table 5.1 Emission inventory for excavators and scrapers

| MACHINERY | MODELLED LOCATION | OPERATION PERIOD | EMISSION FACTORS (KG/T) | | | THROUGHPUT(T/H) | CONTROL MEASURES AND REDUCTION RATE | MODELLED EMISSION RATES (G/S) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TSP | $PM_{10}$ | $PM_{2.5}$ | | | TSP | $PM_{10}$ | $PM_{2.5}$ |
| Excavator_1 | Site 1 | Whole year, Working hours | 0.029 | 0.014 | 0.0021 | 96 | No control | 0.77 | 0.372 | 0.056 |
| Excavator_2 | Site 1 | | 0.029 | 0.014 | 0.0021 | 96 | No control | 0.77 | 0.372 | 0.056 |
| Excavator_3 | Site 1 | | 0.029 | 0.014 | 0.0021 | 64 | No control | 0.514 | 0.248 | 0.037 |
| Scraper_1 | Site 1 | | 0.029 | 0.0073 | 0.0011 | 85 | Water sprays (50%) | 0.342 | 0.086 | 0.013 |
| Scraper_2 | Site 1 | | 0.029 | 0.0073 | 0.0011 | 85 | Water sprays (50%) | 0.342 | 0.086 | 0.013 |
| Scraper_3 | Substation pad | | 0.029 | 0.0073 | 0.0011 | 85 | Water sprays (50%) | 0.342 | 0.086 | 0.013 |

Table 5.2 Emission inventory for the dozer

| MACHINERY | MODELLED LOCATION | OPERATION PERIOD | EMISSION FACTORS (KG/H/VEHICLE) | | | CONTROL MEASURES AND REDUCTION RATE | MODELLED EMISSION RATES (G/S) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | TSP | $PM_{10}$ | $PM_{2.5}$ | | TSP | $PM_{10}$ | $PM_{2.5}$ |
| Dozer | Construction compound | Sep-Oct, working hours | 17 | 4.1 | 0.615 | Water sprays (50%) | 2.361 | 0.569 | 0.085 |
| | Site 1 | Jan-Aug, Nov-Dec, working hours | 17 | 4.1 | 0.615 | Water sprays (50%) | 2.361 | 0.569 | 0.085 |

Table 5.3 Emission inventory for grader

| MACHINERY | MODELLED LOCATION | OPERATION PERIOD | EMISSION FACTORS (KG/H/VKT) | | | VEHICLE SPEED (KM/H) | CONTROL MEASURES AND REDUCTION RATE | MODELLED EMISSION RATES (G/S) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | TSP | $PM_{10}$ | $PM_{2.5}$ | | | TSP | $PM_{10}$ | $PM_{2.5}$ |
| Grader | Site 1 | Aug-Sep, working hours | 1.08 | 0.340 | 0.051 | 10 | Water sprays (50%) | 1.493 | 0.472 | 0.071 |
| | Construction Compound | Oct-Dec, working hours | 1.08 | 0.340 | 0.051 | 10 | Water sprays (50%) | 1.493 | 0.472 | 0.071 |
| | Substation pad | Jan-July, working hours | 1.08 | 0.340 | 0.051 | 10 | Water sprays (50%) | 1.493 | 0.472 | 0.071 |

#### 5.2.3.2 MATERIALS HANDLING

Materials handling operations at the Site include the transfer of materials by means of loading and unloading trucks. Potential emission sources are identified to be:

- loading trucks at site 1 (MH1)
- loading trucks at site 2 (MH2)
- loading trucks at the stockpile (MH3)
- trucks dumping onto the stockpile (MH4)
- trucks dumping at the substation pad (MH5).

Emission factors for materials handling are obtained from Table 2 in the NPI Mining manual and the emission inventory is presented in Table 5.4.

Table 5.4 Emission inventory for materials handling

| ACTIVITIES | OPERATION PERIOD | EMISSION FACTORS (KG/T) | | | THROUGHPUT(T/H) | CONTROL MEASURES AND REDUCTION RATE | MODELLED EMISSION RATES (G/S) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TSP | $PM_{10}$ | $PM_{2.5}$ | | | TSP | $PM_{10}$ | $PM_{2.5}$ |
| MH1 | Whole year, working hours | 0.029 | 0.014 | 2.1E-03 | 390 | Water sprays (50%) | 1.57 | 0.76 | 0.11 |
| MH2 | Dec-May, working hours | 0.029 | 0.014 | 2.1E-03 | 180 | Water sprays (50%) | 0.73 | 0.35 | 0.05 |
| MH3 | Whole year, working hours | 0.029 | 0.014 | 2.1E-03 | 120 | Water sprays (50%) | 0.48 | 0.23 | 0.04 |
| MH4 | Whole year, working hours | 0.01 | 0.0042 | 6.3E-04 | 210 | Water sprays (70%) | 0.18 | 0.07 | 0.01 |
| MH5 | Whole year, working hours | 0.01 | 0.0042 | 6.3E-04 | 405 | Water sprays (70%) | 0.34 | 0.14 | 0.02 |

#### 5.2.3.3 WHEEL GENERATED DUST FROM UNPAVED ROADS

Vehicles travelling on unpaved haulage roads would generate dust by the force of the wheels on the road surface. For assessment purposes, approximately 65 per cent of excavated soil from site 1 and site 2 has been assumed would be transferred to the substation upgrade and expansion pad directly for use, while 35 per cent of excavated materials would be transferred to the stockpile for crushing and screening. The product from crushing and screening would then be transferred to the substation upgrade and expansion pad or stockpiled if not suitable for use.

Both trucks and scrapers may be used to transport materials among different sites (i.e. site 1, site 2, the stockpile area and substation pad). This assessment conservatively assumed all materials would be transported using trucks. Specific haul roads have not been developed at this stage. Haulage routes modelled in this assessment represents a simplified and averaged indication of the future haul roads.

Five possible haul roads have been identified as follows:

- site 2 to intersection (S2-Inter)
- intersection to substation pad (Inter-Pad)
- intersection to the stockpile (Inter-Stk)
- site 1 to the stockpile (S1-Stk)
- site 1 to substation pad (S1-pad).

The unpaved road emission factor equations obtained from the NPI Mining are:

$$E_{TSP} = \frac{0.4536}{1.6093} \times 4.9 \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45} \quad kg/VKT$$

$$E_{PM10} = \frac{0.4536}{1.6093} \times 1.5 \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45} \quad kg/VKT$$

Where:

s = silt content (%).
W = vehicle gross mass (t).

Silt content of 8.5 per cent was used in the modelling based on the mean silt content for construction sites obtained from *AP-42, Section 13.2.2 Unpaved Roads*. The emission inventory for wheel generated dust from unpaved roads is presented in Table 5.5.

Table 5.5 Emission inventory for wheel generated dust from unpaved roads

| ROADS | STATUS | OPERATION PERIOD | VEHICLE WEIGHT(T) | EMISSION FACTORS (KG/VKT) | | | TRIPS/HOUR | ROAD LENGTH (M) | CONTROL MEASURES AND REDUCTION RATE | MODELLED EMISSION RATES (G/S) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | TSP | $PM_{10}$ | $PM_{2.5}$ | | | | TSP | $PM_{10}$ | $PM_{2.5}$ |
| S2-Inter | Loaded | Dec-May, working hours | 70 | 4.68 | 1.37 | 0.21 | 6.0 | 379 | Level 2 watering (75%) | 3.46E-03 | 1.01E-03 | 1.52E-04 |
| | Unloaded | Dec-May, working hours | 40 | 3.64 | 1.07 | 0.16 | 6.0 | | | | | |
| Inter-Pad | Loaded | Dec-May, working hours | 70 | 4.68 | 1.37 | 0.21 | 4.5 | 416 | Level 2 watering (75%) | 2.60E-03 | 7.61E-04 | 1.14E-04 |
| | Unloaded | Dec-May, working hours | 40 | 3.64 | 1.07 | 0.16 | 4.5 | | | | | |
| | Loaded | Other months, working hours | 70 | 4.68 | 1.37 | 0.21 | 1.5 | | | 8.66E-04 | 2.54E-04 | 3.81E-05 |
| | Unloaded | Other months, working hours | 40 | 3.64 | 1.07 | 0.16 | 1.5 | | | | | |
| Inter-Stk | Loaded | Dec-May, working hours | 70 | 4.68 | 1.37 | 0.21 | 4.5 | 484 | Level 2 watering (75%) | 2.60E-03 | 7.61E-04 | 1.14E-04 |
| | Unloaded | Dec-May, working hours | 40 | 3.64 | 1.07 | 0.16 | 4.5 | | | | | |
| | Loaded | Other months, working hours | 70 | 4.68 | 1.37 | 0.21 | 1.5 | | | 8.66E-04 | 2.54E-04 | 3.81E-05 |
| | Unloaded | Other months, working hours | 40 | 3.64 | 1.07 | 0.16 | 1.5 | | | | | |
| S1-Stk | Loaded | Whole year, working hours | 70 | 4.68 | 1.37 | 0.21 | 4.0 | 547 | Level 2 watering (75%) | 2.31E-03 | 6.77E-04 | 1.01E-04 |
| | Unloaded | Whole year, working hours | 40 | 3.64 | 1.07 | 0.16 | 4.0 | | | | | |
| S1-pad | Loaded | Whole year, working hours | 70 | 4.68 | 1.37 | 0.21 | 9.0 | 448 | | 5.20E-03 | 1.52E-03 | 2.28E-04 |
| | Unloaded | Whole year, working hours | 40 | 3.64 | 1.07 | 0.16 | 9.0 | | | | | |

### 5.2.3.4 CRUSHING AND SCREENING

Mobile crushing and screening plant is proposed to reduce the size of excavated material from sites 1 and 2 and meet the engineering requirements for use as the substation base. Excavated material is expected to be crushed and screened at a rate of approximately 600 to 700 cubic metres per day. The final quantity of material requiring crushing and screening would be further developed during detailed design.

The crushing and screening plant would be operating for approximately five hours per day during 7:00 am to 7:00 pm. As the exact operation hours is not known at this stage, the emission estimation was conducted using an average total daily throughput over a 12-hour period. Material density of 1.8 tonnes per cubic metre was assumed in the assessment.

The exact crushing and screening methodology would be developed during detailed design. This assessment assumed primary crushing, secondary crushing and screening would be required. Emission factors for crushing and screening activities were obtained from *AP-42 Section 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing* as recommended by *AP-42 Section 13.2.3: Heavy Construction Operation*. Other activities associated with crushing and screening include:

- loading to hopper
- conveyor transfer points
- conveyor dropping points
- unloading from surge piles.

Materials would be transferred between the crushing and screening plant, transferred out of the plant using conveyors. Emission factors for the associated activities were adopted from the NPI Mining manual. Given the small footprint of the crushing and screening plant and multiple emission sources contained within the plant, all sources associated with crushing and screening were combined and modelled as one volume source.

The emission inventory for crushing, screening and associated activities is presented in Table 5.6.

Table 5.6 Emission inventory for crushing, screening and associated activities

| SOURCES | NUMBER OF SOURCES | EMISSION FACTORS (KG/T) | | | THROUGHPUT (T/H) | CONTROL MEASURES AND REDUCTION RATE | MODELLED EMISSION RATES (G/S) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TSP | $PM_{10}$ | $PM_{2.5}$ | | | TSP | $PM_{10}$ | $PM_{2.5}$ |
| Loading to hopper | 1 | 0.029 | 0.014 | 0.0021 | 105 | Water sprays (50%) | 0.423 | 0.204 | 0.031 |
| Primary crushing (controlled) | 1 | 0.0006 | 0.00027 | 0.00005 | 105 | Water sprays | 1.75E-02 | 7.88E-03 | 1.46E-03 |
| Secondary crushing (controlled) | 1 | 0.0006 | 0.00027 | 0.00005 | 105 | Water sprays | 1.75E-02 | 7.88E-03 | 1.46E-03 |
| Screening (controlled) | 1 | 0.0011 | 0.00037 | 0.000025 | 105 | Water sprays | 3.21E-02 | 1.08E-02 | 7.29E-04 |
| Conveyor transfer points | 3 | 0.00032 | 0.00015 | 0.0000225 | 105 | Covering and water sprays (70%) | 0.0084 | 0.0039 | 0.0006 |
| Conveyor dropping points | 1 | 0.004 | 0.0017 | 0.000255 | 105 | Water sprays (50%) | 0.058 | 0.025 | 0.004 |
| Unloading from surge piles | 1 | 0.03 | 0.013 | 0.00195 | 105 | Water sprays (50%) | 0.438 | 0.190 | 0.028 |
| Total | | | | | | | 0.994 | 0.449 | 0.067 |

#### 5.2.3.5 WIND EROSION

Dust emissions are expected to occur due to the wind erosion of stockpiles and exposed areas. The following sources potentially subject to wind erosion were identified:

- material site 1
- material site 2
- material stockpiles
- substation pad.

The Buronga construction compound and accommodation camp would be covered by hardstand materials, and a laydown area would be used to mainly store plant, machinery and other non-dust-generating materials. Therefore, wind erosion at this area was not considered.

As discussed in Section 5.2.3, the final extent of the material sites 1 and 2 would be confirmed by further geotechnical investigations during detailed design. For assessment purposes, it is conservatively assumed that material from both sites would be required and potential impact from the full extent was assessed. Excavation of the material sites would be conducted progressively and up to 50 per cent of the area presented in Figure 5.1 would be exposed at any given time with other exposed areas being thoroughly compacted and no loose surface remaining. Water spray and re-compaction would be used if any loose surface was observed. Dust generated from 50 per cent of the non-active area due to wind erosion would be negligible and therefore not included as an emission source in the assessment.

As the works are subject to more detailed construction planning, a conservative approach to this assessment was adopted. The whole extent of the extraction area presented in Figure 5.1 was modelled as an exposed area, with a factor of 50 per cent used to adjust the area afterwards. This method is expected to slightly overestimate the impacts on sensitive receptors rather than modelling actual extent of extraction over a smaller area.

Water sprays would be used for all exposed areas and stockpiles. In addition, both site 1 and site 2 would be compacted using rollers or compactors at the end of each working day which would stabilise the surface and reduce dust emissions at night. As such, dust emission reduction is considered to be 50 per cent during working hours and 75 per cent at night time. The exact operation duration of the material sites is unknown at the time of this assessment, so the model has conservatively assessed emissions from wind erosion over the entire potential exposure period. Material sites would be rehabilitated and revegetated once earthworks are finished.

Multiple stockpiles would likely be required at the stockpile area with a height of up to 2.5 metres. As the exact position of the stockpiles within the stockpile area is not known at this stage, the stockpiles were combined and modelled as one in this assessment with a total volume of 5,500 cubic metres. Exported materials would be delivered to the substation upgrade and expansion pad directly.

Existing topsoil would be removed from the substation pad at the start of earthworks. This assessment conservatively assumed topsoil removal would occur in the first two months and the whole substation upgrade and expansion pad would be subjected to wind erosion.

All materials imported or from the material sites 1 and 2 to the substation upgrade and expansion pad would be compacted once placed and dampened with water sprays. Dust generated from wind erosion at the substation upgrade and expansion pad during base construction is considered to be negligible and not modelled in this assessment. Dust generated during trucks unloading or other machinery operation are included in the model, the details of which are presented in section 5.2.3.1 to 5.2.3.3.

Default emission factors for wind erosion from the NPI Mining was adopted in this assessment and the emission inventory is presented in Table 5.7. It is noted that emission rates presented in this table are the total emissions. Each wind erosion source was broken down to multiple volume sources to optimise model run time. Figure 5.1 presents the volume sources included in the model.

Table 5.7 Emission inventory for wind erosion

| SOURCES | PERIOD | EMISSION FACTORS (KG/T) | | | AREA ($M^2$) | CONTROL MEASURES AND REDUCTION RATE | MODELLED EMISSION RATES (G/S) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TSP | $PM_{10}$ | $PM_{2.5}$ | | | TSP | $PM_{10}$ | $PM_{2.5}$ |
| Site 1 | 7am-7pm, whole year | 1.11E-05 | 5.56E-06 | 8.33E-07 | 253,000 | Water sprays (50%) | 1.406 | 0.703 | 0.105 |
| | Other hours, whole year | 1.11E-05 | 5.56E-06 | 8.33E-07 | | Water sprays + compaction (75%) | 0.703 | 0.351 | 0.053 |
| Site 2 | 7am-7pm, Dec-may | 1.11E-05 | 5.56E-06 | 8.33E-07 | 80,000 | Water sprays (50%) | 0.444 | 0.222 | 0.033 |
| | Other hours, Dec-May | 1.11E-05 | 5.56E-06 | 8.33E-07 | | Water sprays + compaction (75%) | 0.222 | 0.111 | 0.017 |
| | Jun-Nov | 1.11E-05 | 5.56E-06 | 8.33E-07 | | Revegetation (90%) | 0.089 | 0.044 | 0.007 |
| Material stockpile | Whole year | 1.11E-05 | 5.56E-06 | 8.33E-07 | 2,200 | Water sprays (50%) | 0.012 | 0.006 | 0.001 |
| Substation pad | Jan-Feb | 1.11E-05 | 5.56E-06 | 8.33E-07 | 110,000 | Water sprays (50%) | 0.611 | 0.306 | 0.046 |

#### 5.2.3.6 SOURCE CHARACTERISTICS

Emission sources are modelled as follows:

— machinery: 11 volume sources
— material handling: five volume sources
— unpaved roads: five road sources
— crushing and screening: one volume source
— wind erosion: 177 volume sources.

Source modelled locations are presented in Figure 5.1 and Figure 5.2. Model inputs for each source parameter are presented in Appendix A.

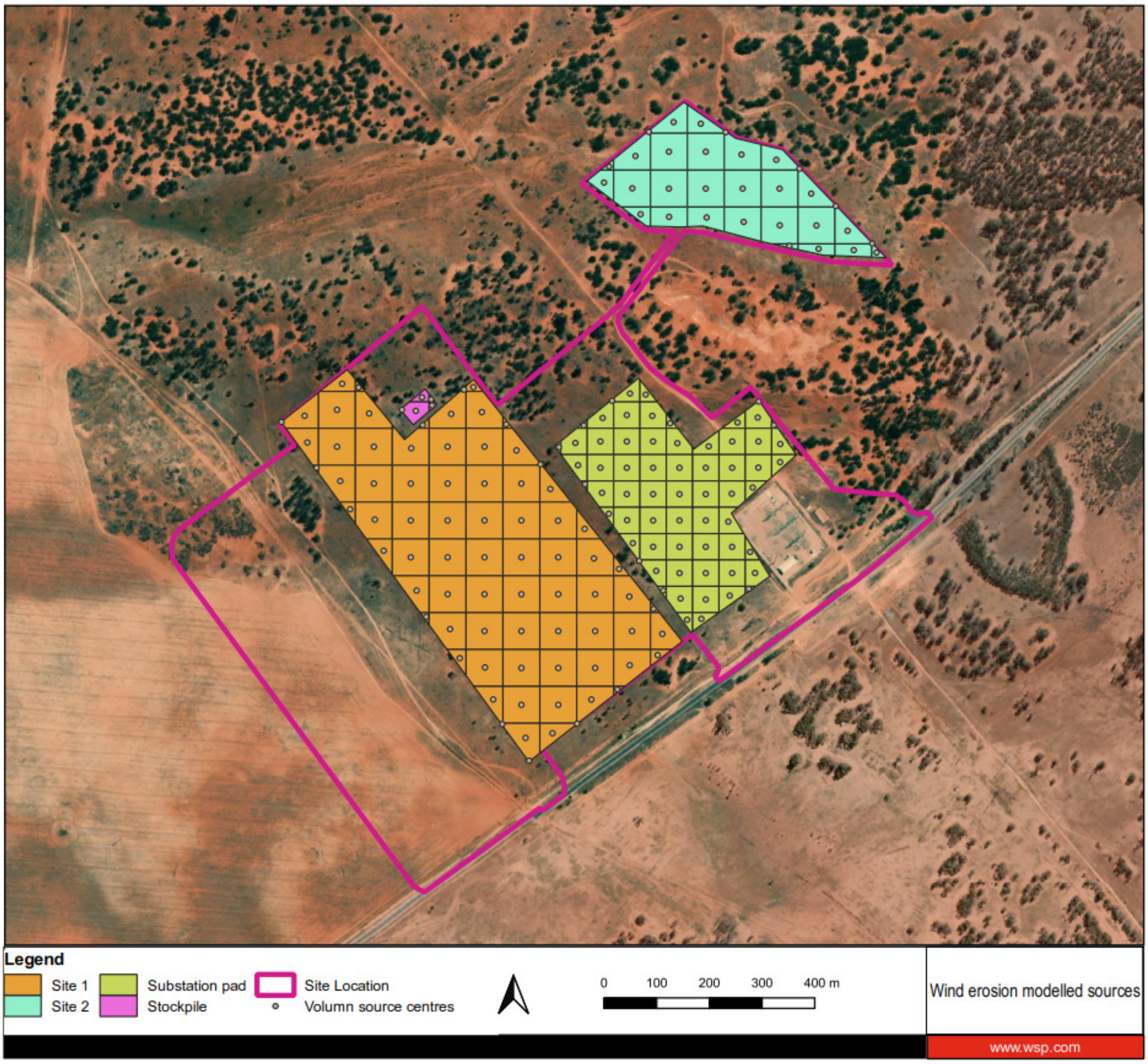



Figure 5.1 Wind erosion modelled sources

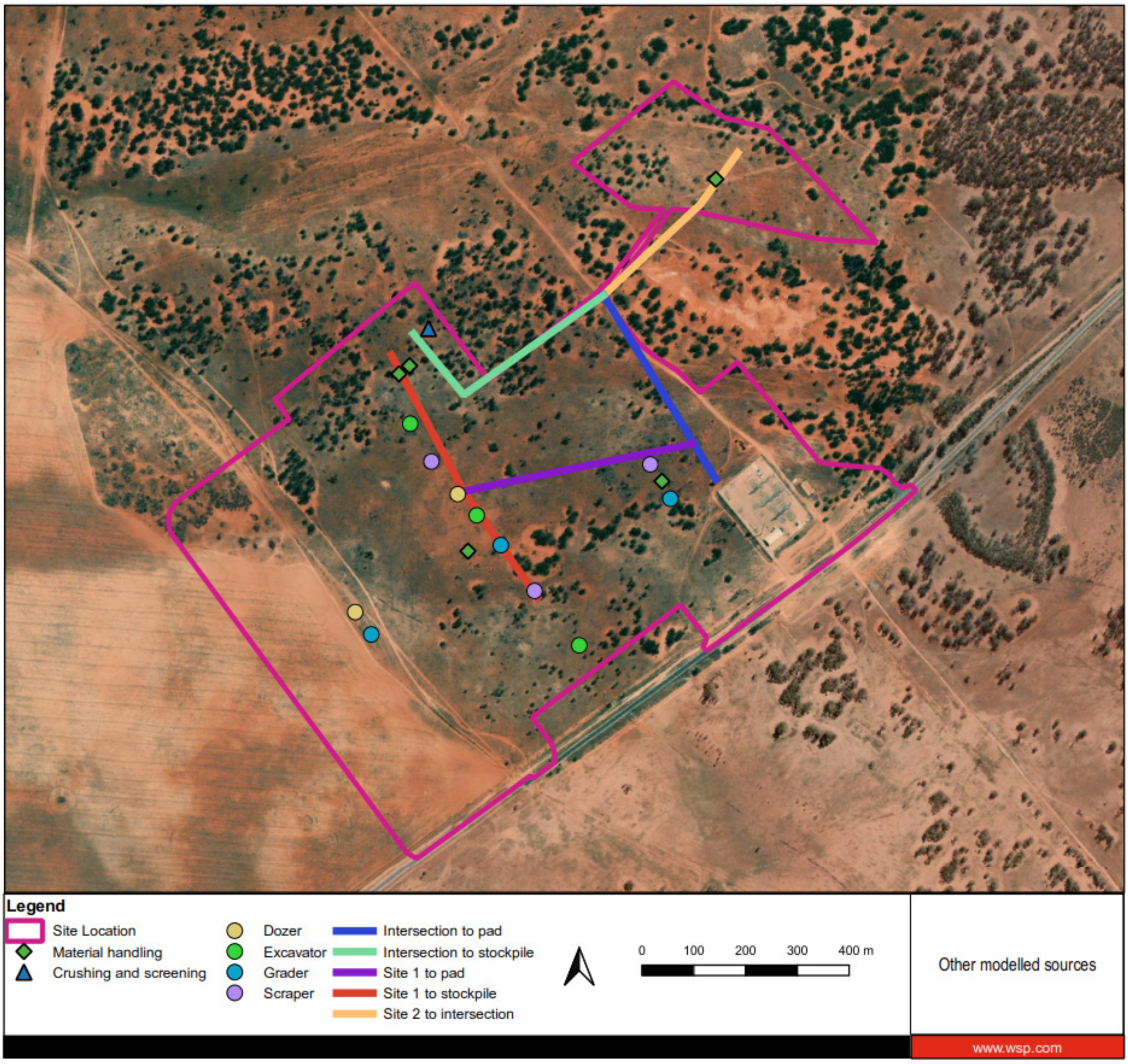



Figure 5.2 Other modelled sources

## 5.3 MODELLED RECEPTORS

Both gridded and sensitive receptors identified in section 4.3 were included in the modelling. The south-west corner of the uniform grid domain was located at 605550 m E, 6215716 m S (MGA Zone 54H) with a resolution of 200 metres. A total extent of 20 kilometres by 20 kilometres was covered in the modelling.

## 5.4 PARTICLE SIZE DISTRIBUTION

TSP was modelled as particles to output dust deposition, while $PM_{10}$ and $PM_{2.5}$ were modelled as a gas. As site-specific particle size distribution was not available at the time of modelling, general particle size for material handling and processing of aggregate and unprocessed ore was obtained from the USEPA *AP-42, Appendix B.2 Generalized Particle Size Distributions* was adopted in this assessment. The configuration of relevant parameters input to CALPUFF are as follows:

- geometric mean diameter (µm): 9.7
- geometric standard deviation (µm): 3.75.

## 5.5 MODELLING RESULTS

The maximum predicted incremental concentrations for TSP, $PM_{10}$, $PM_{2.5}$ and deposited dust for averaging periods consistent with the assessment criteria were extracted at modelled sensitive receptors. Background data were added to incremental concentrations to assess compliance of cumulative concentrations with relevant impact assessment criteria.

### *5.5.1 TSP*

Table 5.8 lists predicted annual average incremental and cumulative TSP concentrations. The contour plot for annual average incremental concentrations is presented in Appendix B.

The modelling results indicate that:

- the cumulative annual average ground level concentrations of TSP are predicted to be below the assessment criterion of 90 µg/m$^3$ at all sensitive receptors
- the predicted highest incremental annual average TSP concentration of 0.08 µg/m$^3$ occurred at receptor R1 and accounts for 0.09 per cent of the assessment criterion.

Table 5.8 Predicted annual average TSP ground level concentrations

| RECEPTORS | INCREMENTAL (µG/M$^3$) | CUMULATIVE (µG/M$^3$) |
|---|---|---|
| R1 | 0.08 | 13.8 |
| R2 | 0.06 | 13.8 |
| R3 | 0.03 | 13.7 |
| R4 | 0.02 | 13.7 |
| R5 | 0.02 | 13.7 |
| R6 | 0.02 | 13.7 |
| Criterion | 90 | |

### 5.5.2 $PM_{10}$

24-hour average $PM_{10}$ time-series concentrations were extracted from modelling results and added to contemporaneous background to assess compliance of the 24-hour average concentrations. Predicted results are summarised in Table 5.9. Contour plots for 24-hour average and annual average $PM_{10}$ incremental concentrations are presented in Appendix B.

The modelling results indicate that:

- maximum incremental 24-hour average $PM_{10}$ concentration at all receptors is 8.74 µg/m$^3$ accounting for 17.5 per cent of the assessment criterion, and maximum incremental annual average $PM_{10}$ concentration at all receptors is 0.46 µg/m$^3$ accounting for 1.8 per cent of corresponding criterion
- one day of additional exceedance is predicted to occur at R1 and R3 over the modelled 365 days, with background accounting for 96.1 per cent of criterion and maximum contribution from the Site accounting for 4.1 per cent of the criterion (refer to Chapter 6 for further discussion of the exceedances).

Table 5.9 Predicted 24-hour average and annual average $PM_{10}$ concentrations

| RECEPTORS | 24-HOUR AVERAGE | | | | | | ANNUAL AVERAGE (µG/M$^3$) | |
|---|---|---|---|---|---|---|---|---|
| | Maximum Increment (µg/m$^3$) | | | Additional Exceedances (µg/m$^3$) | | | | |
| | Date | Incremental | Cumulative | Date | Incremental | Cumulative | Incremental | Cumulative |
| R1 | 26/05/2018 | 8.74 | 18.4 | 21/06/2018 | 2.1 | **50.2** | 0.46 | 14.2 |
| R2 | 26/05/2018 | 7.32 | 16.9 | None | | | 0.38 | 14.1 |
| R3 | 8/06/2018 | 2.49 | 12.1 | 7/05/2018 | 2.08 | **50.2** | 0.17 | 13.9 |
| R4 | 8/06/2018 | 2.02 | 11.6 | 7/05/2018 | 1.92 | 50.0 | 0.15 | 13.9 |
| R5 | 7/05/2018 | 1.92 | 50.0 | 7/05/2018 | 1.92 | 50.0 | 0.15 | 13.9 |
| R6 | 2/07/2018 | 2.52 | 16.7 | None | | | 0.12 | 13.8 |
| Criteria | 50 | | | 50 | | | 25 | |

*Note: Additional exceedances are highlighted in bold.*

### 5.5.3 $PM_{2.5}$

24-hour average $PM_{2.5}$ time-series concentrations were extracted from modelling results and added to contemporaneous background to assess compliance of 24-hour average concentrations. Predicted results are summarised in Table 5.10. Contour plots for 24-hour average and annual average $PM_{2.5}$ incremental concentrations are presented in Appendix B.

The modelling results indicate that:

- maximum incremental 24-hour average $PM_{2.5}$ concentration at all receptors is 1.31 $\mu g/m^3$ accounting for 5.2 per cent of the assessment criterion, and maximum incremental annual average $PM_{2.5}$ concentration at all receptors is 0.07 $\mu g/m^3$ accounting for 0.9 per cent of corresponding criterion
- no additional exceedances would occur as a result of the Site activities. Cumulative concentration exceedances are all caused by existing background exceedances.

Table 5.10 Predicted 24-hour average and annual average $PM_{2.5}$ concentrations

| RECEPTORS | 24-HOUR AVERAGE | | | | | | ANNUAL AVERAGE ($\mu G/M^3$) | |
|---|---|---|---|---|---|---|---|---|
| | MAXIMUM INCREMENT ($\mu g/M^3$) | | | ADDITIONAL EXCEEDANCES ($\mu g/M^3$) | | | | |
| | Date | Incremental | Cumulative | Date | Incremental | Cumulative | Incremental | Cumulative |
| R1 | 26/05/2018 | 1.31 | 9.9 | None | | | 0.07 | **12.6**[2] |
| R2 | 26/05/2018 | 1.10 | 9.6 | None | | | 0.057 | **12.6**[2] |
| R3 | 8/06/2018 | 0.37 | 8.9 | None | | | 0.025 | **12.5**[2] |
| R4 | 8/06/2018 | 0.30 | 8.9 | None | | | 0.023 | **12.5**[2] |
| R5 | 7/05/2018 | 0.29 | **48.4**[1] | None | | | 0.023 | **12.5**[2] |
| R6 | 2/07/2018 | 0.38 | 13.4 | None | | | 0.018 | **12.5**[2] |
| Criteria | 25 | | | 25 | | | 8 | |

*Note 1: Adopted background $PM_{2.5}$ 24-hour concentration of 48.1 $\mu g/m^3$ on 7 May 2018*

*2: Adopted background $PM_{2.5}$ annual concentration of 12.5 $\mu g/m^3$ which exceeds the criterion of 8 $\mu g/m^3$*

### 5.5.4 DEPOSITED DUST

Predicted maximum monthly incremental dust deposition levels are presented in Table 5.11. There is no background monitoring data for dust deposition at Buronga AAQMS and incremental results only are assessed. The contour plot for the predicted monthly dust deposition levels is presented in Appendix B.

The modelling results indicate that maximum increase in dust deposition levels at all receptors are below the assessment criterion. The highest level of 0.06 $g/m^2$/month was predicted at sensitive receptor R1, accounting for three per cent of the criterion.

Table 5.11 Predicted maximum monthly deposited dust levels

| RECEPTORS | INCREMENTAL ($G/M^2$/MONTH) |
|---|---|
| R1 | 0.06 |
| R2 | 0.04 |
| R3 | 0.02 |
| R4 | 0.02 |
| R5 | 0.02 |
| R6 | 0.01 |
| Maximum increase criterion | 2 |

# 6 DISCUSSION AND CONCLUSION

The modelling results indicate that:

- TSP: the total annual average TSP concentrations are predicted to be below the impact assessment criterion of 90 µg/$m^3$ and the highest incremental annual average at receptors is predicted to be 0.09 per cent of the criterion.
- $PM_{10}$: The highest predicted incremental 24-hour average at all receptors is 17.5 per cent of the criterion and the highest incremental annual average $PM_{10}$ is 1.8 per cent of the criterion. One day of additional exceedance is predicted to occur at R1 and R3 over modelled 365 days (up to 0.2 µg/$m^3$ above the criterion), with background accounting for 96.1 per cent of criterion and maximum contribution from the Site accounting for 4.1 per cent of the criterion.
- $PM_{2.5}$: The highest predicted incremental 24-hour average at all receptors is 5.2 per cent of the criterion and the highest incremental annual average $PM_{2.5}$ is 0.9 per cent of the criterion. No additional exceedances would occur as a result of the Site activities. Cumulative concentration exceedances are all caused by existing background exceedances.
- Deposited dust: Maximum incremental monthly dust deposition concentrations at all receptors are below the assessment criterion, with the maximum of 0.06 g/$m^2$/month accounting for three per cent of the criterion.

As summarised above, all incremental concentrations for TSP, $PM_{10}$, $PM_{2.5}$ and deposited dust at all sensitive receptors are predicted to account for a small portion of the corresponding criteria. There is only one day of additional exceedance over 365 days are predicted for $PM_{10}$ due to elevated background (background accounts for 96.1 per cent of the criterion), and the exceedances are only up to 0.2 µg/$m^3$ above the criterion.

At this early stage of the proposal, there are many uncertainties in the construction methodology and would be further developed in the detailed design. This assessment was finished in a conservative way and the real impact is likely to be smaller than prediction.

Due to the limited availability of background data, a conservative methodology was used to develop a whole year time-varying background data (i.e. assuming 100 per cent of TSP is $PM_{10}$ and $PM_{2.5}$ for 1 January to 10 May). Moreover, the monitoring at Buronga AQMS was not conducted using Australian standard methods. Therefore, the background data can only provide a indicative level of local ambient air quality.

What's more, due to the nature of construction activities, air quality impacts associated with the Site earthworks activities would be transient given the contribution would be for the duration of this particular activity and would not be an ongoing emission source.

In summary, predicted particulate matters impacts at the modelled sensitive receptors associated with crushing, screening and all other contemporaneous operations were predicted to be low.

# 7 LIMITATIONS

This Report is provided by WSP Australia Pty Limited (WSP) for TransGrid (Client) in response to specific instructions from the Client and in accordance with WSP's proposal dated September 2019 and agreement with the Client dated 31 October 2020 (Agreement) and as agreed under variations up to March 2021.

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# REFERENCES


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- Environmental Operation Act 1997 (POEO Act).
- NPI Emission Estimation Technique Manual for Mining Version 3.1.
- US EPA, AP-42 Section 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing.
- US EPA, AP-42 Section 13.2.2: Unpaved Roads.
- US EPA, AP-42 Section 13.2.3: Heavy Construction Operation.
- US EPA AP-42 Appendix B.2: Generalized Particle Size Distributions.

# APPENDIX A

## MODEL INPUTS

| SOURCE | | X (M) | Y (M) | BASE ELEVATION (M) | EFFECTIVE HEIGHT ABOVE GROUND (M) | SIGMA Y | SIGMA Z |
|---|---|---|---|---|---|---|---|
| Machinery | Excavator_1 | 615488 | 6225875 | 51 | 1.5 | 1.43 | 1.40 |
| | Excavator_2 | 615617 | 6225698 | 52 | 1.5 | 1.43 | 1.40 |
| | Excavator_3 | 615815 | 6225447 | 47 | 1.5 | 1.43 | 1.40 |
| | Scraper_1 | 615529 | 6225802 | 53 | 2.1 | 0.91 | 1.94 |
| | Scraper_2 | 615728 | 6225552 | 50 | 2.1 | 0.91 | 1.94 |
| | Scraper_3 | 615952 | 6225796 | 52 | 2.1 | 0.91 | 1.94 |
| | Dozer | 615382 | 6225511 | 46 | 0.9 | 0.61 | 0.79 |
| | | 615580 | 6225739 | 53 | 0.9 | 0.61 | 0.79 |
| | Grader | 615413 | 6225468 | 46 | 0.6 | 0.65 | 0.58 |
| | | 615663 | 6225640 | 51 | 0.6 | 0.65 | 0.58 |
| | | 615990 | 6225730 | 52 | 0.6 | 0.65 | 0.58 |
| Material handling | MH1 | 615600 | 6225629 | 52 | 3.7 | 1.16 | 0.12 |
| | MH2 | 616078 | 6226347 | 52 | 3.7 | 1.16 | 0.12 |
| | MH3 | 615466 | 6225971 | 50 | 3.7 | 1.16 | 0.12 |
| | MH4 | 615487 | 6225987 | 51 | 1.75 | 1.16 | 1.63 |
| | MH5 | 615974 | 6225764 | 52 | 1.75 | 1.16 | 1.63 |
| Haul roads | S2-Inter | 616121 | 6226398 | 53 | 2.55 | 4.19 | 2.37 |
| | | 616048 | 6226299 | 52 | | | |
| | | 615955 | 6226211 | 53 | | | |
| | | 615862 | 6226123 | 55 | | | |
| | Inter-Pad | 615861 | 6226123 | 55 | 2.55 | 4.19 | 2.37 |
| | | 616078 | 6225768 | 51 | | | |
| | Inter-Stk | 615861 | 6226122 | 55 | 2.55 | 4.19 | 2.37 |
| | | 615591 | 6225930 | 53 | | | |
| | | 615494 | 6226048 | 51 | | | |
| | S1-Stk | 615733 | 6225540 | 50 | 2.55 | 4.19 | 2.37 |
| | | 615591 | 6225745 | 53 | | | |
| | | 615452 | 6226008 | 50 | | | |
| | S1-pad | 616033 | 6225836 | 53 | 2.55 | 4.19 | 2.37 |
| | | 615595 | 6225745 | 53 | | | |
| Crushing and screening | Crus_Scr | 615524 | 6226059 | 51 | 3 | 5.8 | 0.3 |

| SOURCE | | X (M) | Y (M) | BASE ELEVATION (M) | EFFECTIVE HEIGHT ABOVE GROUND (M) | SIGMA Y | SIGMA Z |
|---|---|---|---|---|---|---|---|
| Wind erosion at site 1 | S1_1 | 615230 | 6225927 | 48 | 0.1 | 0.47 | 0.05 |
| | S1_2 | 615274 | 6225939 | 48 | 0.1 | 24.60 | 0.05 |
| | S1_3 | 615279 | 6225889 | 49 | 0.1 | 23.55 | 0.05 |
| | S1_4 | 615297 | 6225840 | 49 | 0.1 | 4.29 | 0.05 |
| | S1_5 | 615345 | 6226000 | 49 | 0.1 | 18.46 | 0.05 |
| | S1_6 | 615335 | 6225950 | 49 | 0.1 | 32.56 | 0.05 |
| | S1_7 | 615335 | 6225880 | 49 | 0.1 | 32.56 | 0.05 |
| | S1_8 | 615342 | 6225815 | 50 | 0.1 | 28.71 | 0.05 |
| | S1_9 | 615360 | 6225762 | 51 | 0.1 | 11.60 | 0.05 |
| | S1_10 | 615377 | 6225993 | 49 | 0.1 | 6.68 | 0.05 |
| | S1_11 | 615397 | 6225943 | 50 | 0.1 | 26.59 | 0.05 |
| | S1_12 | 615405 | 6225880 | 50 | 0.1 | 32.56 | 0.05 |
| | S1_13 | 615405 | 6225810 | 51 | 0.1 | 32.56 | 0.05 |
| | S1_14 | 615407 | 6225742 | 51 | 0.1 | 31.55 | 0.05 |
| | S1_15 | 615424 | 6225683 | 52 | 0.1 | 18.92 | 0.05 |
| | S1_16 | 615498 | 6225921 | 52 | 0.1 | 7.07 | 0.05 |
| | S1_17 | 615476 | 6225878 | 51 | 0.1 | 31.01 | 0.05 |
| | S1_18 | 615475 | 6225810 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_19 | 615475 | 6225740 | 53 | 0.1 | 32.56 | 0.05 |
| | S1_20 | 615475 | 6225670 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_21 | 615487 | 6225607 | 51 | 0.1 | 25.40 | 0.05 |
| | S1_22 | 615505 | 6225558 | 50 | 0.1 | 6.59 | 0.05 |
| | S1_23 | 615577 | 6225989 | 53 | 0.1 | 3.60 | 0.05 |
| | S1_24 | 615552 | 6225943 | 53 | 0.1 | 27.21 | 0.05 |
| | S1_25 | 615545 | 6225880 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_26 | 615545 | 6225810 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_27 | 615545 | 6225740 | 53 | 0.1 | 32.56 | 0.05 |
| | S1_28 | 615545 | 6225670 | 53 | 0.1 | 32.56 | 0.05 |
| | S1_29 | 615545 | 6225600 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_30 | 615550 | 6225534 | 51 | 0.1 | 29.83 | 0.05 |
| | S1_31 | 615568 | 6225479 | 49 | 0.1 | 13.91 | 0.05 |
| | S1_32 | 615594 | 6225994 | 53 | 0.1 | 9.75 | 0.05 |
| | S1_33 | 615610 | 6225946 | 54 | 0.1 | 29.45 | 0.05 |
| | S1_34 | 615615 | 6225880 | 53 | 0.1 | 32.56 | 0.05 |

| SOURCE | | X (M) | Y (M) | BASE ELEVATION (M) | EFFECTIVE HEIGHT ABOVE GROUND (M) | SIGMA Y | SIGMA Z |
|---|---|---|---|---|---|---|---|
| | S1_35 | 615615 | 6225810 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_36 | 615615 | 6225740 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_37 | 615615 | 6225670 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_38 | 615615 | 6225600 | 51 | 0.1 | 32.56 | 0.05 |
| | S1_39 | 615615 | 6225530 | 51 | 0.1 | 32.56 | 0.05 |
| | S1_40 | 615616 | 6225461 | 50 | 0.1 | 32.06 | 0.05 |
| | S1_41 | 615632 | 6225400 | 48 | 0.1 | 21.18 | 0.05 |
| | S1_42 | 615649 | 6225354 | 46 | 0.1 | 1.61 | 0.05 |
| | S1_43 | 615656 | 6225923 | 53 | 0.1 | 6.66 | 0.05 |
| | S1_44 | 615676 | 6225873 | 52 | 0.1 | 26.35 | 0.05 |
| | S1_45 | 615685 | 6225810 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_46 | 615685 | 6225740 | 51 | 0.1 | 32.56 | 0.05 |
| | S1_47 | 615685 | 6225670 | 51 | 0.1 | 32.56 | 0.05 |
| | S1_48 | 615685 | 6225600 | 51 | 0.1 | 32.56 | 0.05 |
| | S1_49 | 615685 | 6225530 | 49 | 0.1 | 32.56 | 0.05 |
| | S1_50 | 615685 | 6225460 | 48 | 0.1 | 32.56 | 0.05 |
| | S1_51 | 615685 | 6225390 | 47 | 0.1 | 32.56 | 0.05 |
| | S1_52 | 615693 | 6225328 | 45 | 0.1 | 26.63 | 0.05 |
| | S1_53 | 615700 | 6225284 | 45 | 0.1 | 1.40 | 0.05 |
| | S1_54 | 615722 | 6225847 | 52 | 0.1 | 1.40 | 0.05 |
| | S1_55 | 615740 | 6225800 | 51 | 0.1 | 21.92 | 0.05 |
| | S1_56 | 615755 | 6225740 | 51 | 0.1 | 32.34 | 0.05 |
| | S1_57 | 615755 | 6225670 | 52 | 0.1 | 32.56 | 0.05 |
| | S1_58 | 615755 | 6225600 | 51 | 0.1 | 32.56 | 0.05 |
| | S1_59 | 615755 | 6225530 | 50 | 0.1 | 32.56 | 0.05 |
| | S1_60 | 615755 | 6225460 | 48 | 0.1 | 32.56 | 0.05 |
| | S1_61 | 615755 | 6225390 | 46 | 0.1 | 32.56 | 0.05 |
| | S1_62 | 615744 | 6225336 | 45 | 0.1 | 21.05 | 0.05 |
| | S1_63 | 615806 | 6225724 | 51 | 0.1 | 16.72 | 0.05 |
| | S1_64 | 615823 | 6225668 | 51 | 0.1 | 31.27 | 0.05 |
| | S1_65 | 615825 | 6225600 | 50 | 0.1 | 32.56 | 0.05 |
| | S1_66 | 615825 | 6225530 | 50 | 0.1 | 32.56 | 0.05 |
| | S1_67 | 615825 | 6225460 | 47 | 0.1 | 32.56 | 0.05 |
| | S1_68 | 615818 | 6225400 | 46 | 0.1 | 25.91 | 0.05 |

| SOURCE | | X (M) | Y (M) | BASE ELEVATION (M) | EFFECTIVE HEIGHT ABOVE GROUND (M) | SIGMA Y | SIGMA Z |
|---|---|---|---|---|---|---|---|
| | S1_69 | 615791 | 6225355 | 46 | 0.1 | 0.66 | 0.05 |
| | S1_70 | 615871 | 6225648 | 51 | 0.1 | 11.47 | 0.05 |
| | S1_71 | 615890 | 6225596 | 50 | 0.1 | 29.24 | 0.05 |
| | S1_72 | 615895 | 6225530 | 49 | 0.1 | 32.56 | 0.05 |
| | S1_73 | 615891 | 6225466 | 47 | 0.1 | 29.34 | 0.05 |
| | S1_74 | 615868 | 6225420 | 46 | 0.1 | 6.27 | 0.05 |
| | S1_75 | 615936 | 6225572 | 50 | 0.1 | 6.22 | 0.05 |
| | S1_76 | 615953 | 6225525 | 48 | 0.1 | 25.00 | 0.05 |
| | S1_77 | 615944 | 6225485 | 48 | 0.1 | 11.87 | 0.05 |
| Wind erosion at site 2 | S2_1 | 615852 | 6226412 | 52 | 0.1 | 7.53 | 0.05 |
| | S2_2 | 615842 | 6226382 | 52 | 0.1 | 19.43 | 0.05 |
| | S2_3 | 615927 | 6226478 | 52 | 0.1 | 2.75 | 0.05 |
| | S2_4 | 615902 | 6226432 | 52 | 0.1 | 27.13 | 0.05 |
| | S2_5 | 615896 | 6226371 | 52 | 0.1 | 32.29 | 0.05 |
| | S2_6 | 615912 | 6226322 | 52 | 0.1 | 15.74 | 0.05 |
| | S2_7 | 615974 | 6226497 | 53 | 0.1 | 23.19 | 0.05 |
| | S2_8 | 615965 | 6226440 | 53 | 0.1 | 32.56 | 0.05 |
| | S2_9 | 615965 | 6226370 | 52 | 0.1 | 32.56 | 0.05 |
| | S2_10 | 615966 | 6226317 | 52 | 0.1 | 23.76 | 0.05 |
| | S2_11 | 616026 | 6226494 | 53 | 0.1 | 21.26 | 0.05 |
| | S2_12 | 616035 | 6226440 | 53 | 0.1 | 32.56 | 0.05 |
| | S2_13 | 616035 | 6226370 | 53 | 0.1 | 32.56 | 0.05 |
| | S2_14 | 616037 | 6226316 | 52 | 0.1 | 24.45 | 0.05 |
| | S2_15 | 616073 | 6226477 | 53 | 0.1 | 2.18 | 0.05 |
| | S2_16 | 616103 | 6226435 | 53 | 0.1 | 29.76 | 0.05 |
| | S2_17 | 616105 | 6226370 | 52 | 0.1 | 32.56 | 0.05 |
| | S2_18 | 616107 | 6226307 | 52 | 0.1 | 29.14 | 0.05 |
| | S2_19 | 616169 | 6226425 | 54 | 0.1 | 23.14 | 0.05 |
| | S2_20 | 616175 | 6226370 | 53 | 0.1 | 32.56 | 0.05 |
| | S2_21 | 616176 | 6226301 | 51 | 0.1 | 32.40 | 0.05 |
| | S2_22 | 616194 | 6226262 | 51 | 0.1 | 7.59 | 0.05 |
| | S2_23 | 616213 | 6226408 | 55 | 0.1 | 2.63 | 0.05 |
| | S2_24 | 616235 | 6226361 | 53 | 0.1 | 25.00 | 0.05 |
| | S2_25 | 616245 | 6226300 | 51 | 0.1 | 32.56 | 0.05 |

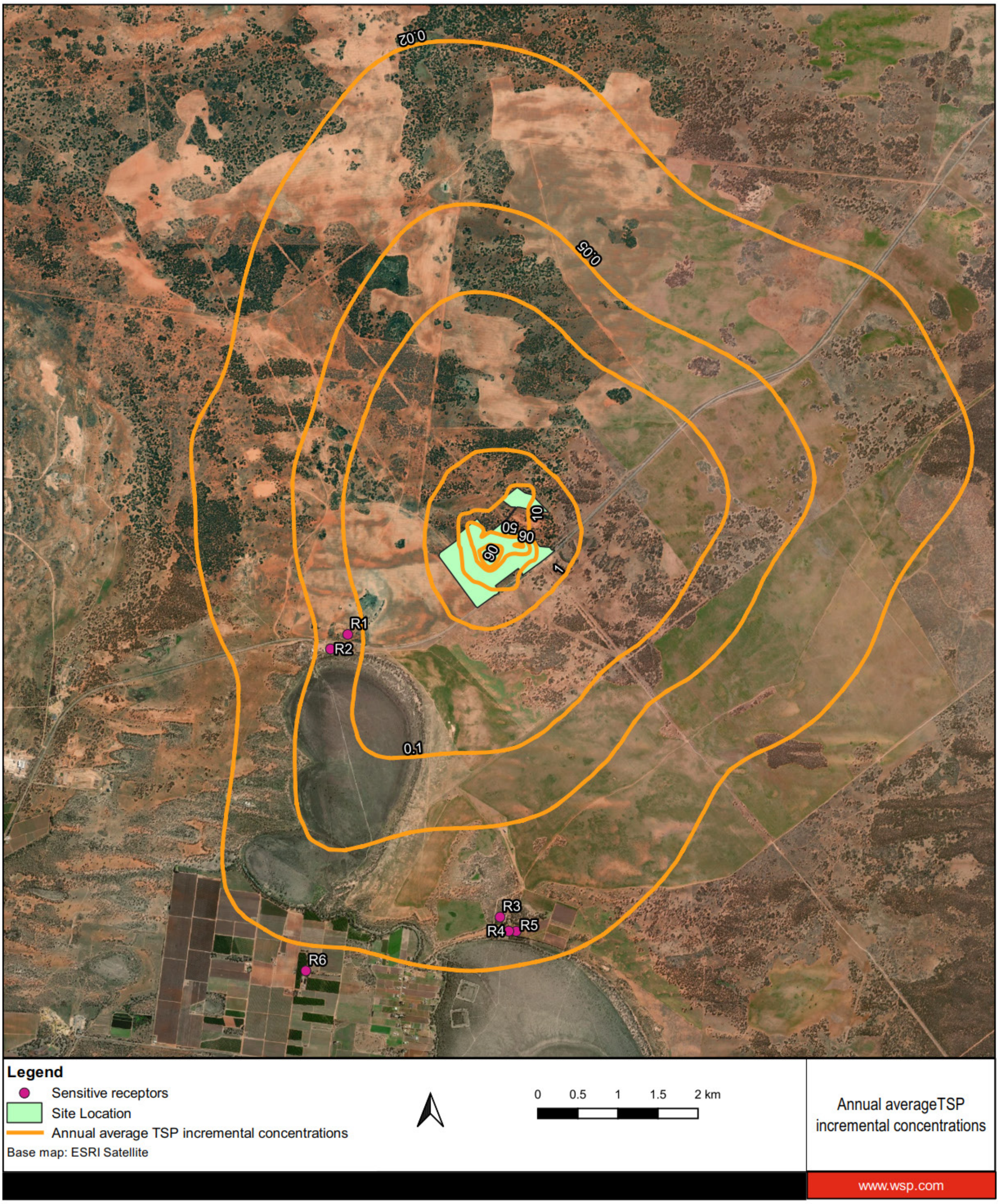
| SOURCE | | X (M) | Y (M) | BASE ELEVATION (M) | EFFECTIVE HEIGHT ABOVE GROUND (M) | SIGMA Y | SIGMA Z |
|---|---|---|---|---|---|---|---|
| | S2_26 | 616250 | 6226256 | 51 | 0.1 | 16.45 | 0.05 |
| | S2_27 | 616282 | 6226337 | 53 | 0.1 | 1.68 | 0.05 |
| | S2_28 | 616305 | 6226290 | 52 | 0.1 | 24.16 | 0.05 |
| | S2_29 | 616316 | 6226254 | 51 | 0.1 | 18.91 | 0.05 |
| | S2_30 | 616351 | 6226266 | 52 | 0.1 | 0.66 | 0.05 |
| | S2_31 | 616360 | 6226249 | 51 | 0.1 | 8.91 | 0.05 |
| Wind erosion at substation pad | Pad_1 | 615757 | 6225879 | 52 | 0.1 | 5.68 | 0.05 |
| | Pad_2 | 615804 | 6225921 | 52 | 0.1 | 5.96 | 0.05 |
| | Pad_3 | 615788 | 6225888 | 52 | 0.1 | 21.51 | 0.05 |
| | Pad_4 | 615793 | 6225845 | 52 | 0.1 | 18.49 | 0.05 |
| | Pad_5 | 615806 | 6225809 | 51 | 0.1 | 5.14 | 0.05 |
| | Pad_6 | 615858 | 6225968 | 52 | 0.1 | 2.50 | 0.05 |
| | Pad_7 | 615840 | 6225935 | 51 | 0.1 | 19.74 | 0.05 |
| | Pad_8 | 615835 | 6225890 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_9 | 615835 | 6225840 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_10 | 615838 | 6225793 | 51 | 0.1 | 21.48 | 0.05 |
| | Pad_11 | 615852 | 6225753 | 51 | 0.1 | 10.33 | 0.05 |
| | Pad_12 | 615892 | 6225981 | 52 | 0.1 | 17.11 | 0.05 |
| | Pad_13 | 615885 | 6225940 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_14 | 615885 | 6225890 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_15 | 615885 | 6225840 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_16 | 615885 | 6225790 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_17 | 615886 | 6225741 | 51 | 0.1 | 22.96 | 0.05 |
| | Pad_18 | 615897 | 6225697 | 51 | 0.1 | 15.45 | 0.05 |
| | Pad_19 | 615909 | 6225664 | 51 | 0.1 | 1.47 | 0.05 |
| | Pad_20 | 615921 | 6225979 | 52 | 0.1 | 12.25 | 0.05 |
| | Pad_21 | 615934 | 6225939 | 52 | 0.1 | 22.36 | 0.05 |
| | Pad_22 | 615935 | 6225890 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_23 | 615935 | 6225840 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_24 | 615935 | 6225790 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_25 | 615935 | 6225740 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_26 | 615935 | 6225690 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_27 | 615941 | 6225645 | 50 | 0.1 | 19.56 | 0.05 |
| | Pad_28 | 615955 | 6225608 | 50 | 0.1 | 6.66 | 0.05 |

| SOURCE | | X (M) | Y (M) | BASE ELEVATION (M) | EFFECTIVE HEIGHT ABOVE GROUND (M) | SIGMA Y | SIGMA Z |
|---|---|---|---|---|---|---|---|
| | Pad_29 | 615968 | 6225925 | 52 | 0.1 | 8.11 | 0.05 |
| | Pad_30 | 615981 | 6225887 | 52 | 0.1 | 20.74 | 0.05 |
| | Pad_31 | 615985 | 6225840 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_32 | 615985 | 6225790 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_33 | 615985 | 6225740 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_34 | 615985 | 6225690 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_35 | 615985 | 6225640 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_36 | 615988 | 6225592 | 51 | 0.1 | 22.05 | 0.05 |
| | Pad_37 | 616000 | 6225552 | 50 | 0.1 | 11.76 | 0.05 |
| | Pad_38 | 616041 | 6225881 | 52 | 0.1 | 17.26 | 0.05 |
| | Pad_39 | 616035 | 6225840 | 53 | 0.1 | 23.26 | 0.05 |
| | Pad_40 | 616035 | 6225790 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_41 | 616035 | 6225740 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_42 | 616035 | 6225690 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_43 | 616035 | 6225640 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_44 | 616035 | 6225590 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_45 | 616027 | 6225554 | 51 | 0.1 | 13.81 | 0.05 |
| | Pad_46 | 616096 | 6225926 | 51 | 0.1 | 12.64 | 0.05 |
| | Pad_47 | 616086 | 6225890 | 52 | 0.1 | 23.21 | 0.05 |
| | Pad_48 | 616085 | 6225840 | 52 | 0.1 | 23.26 | 0.05 |
| | Pad_49 | 616085 | 6225791 | 52 | 0.1 | 22.85 | 0.05 |
| | Pad_50 | 616078 | 6225738 | 51 | 0.1 | 19.22 | 0.05 |
| | Pad_51 | 616085 | 6225690 | 51 | 0.1 | 23.23 | 0.05 |
| | Pad_52 | 616085 | 6225640 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_53 | 616081 | 6225598 | 51 | 0.1 | 18.60 | 0.05 |
| | Pad_54 | 616136 | 6225966 | 52 | 0.1 | 1.14 | 0.05 |
| | Pad_55 | 616134 | 6225936 | 51 | 0.1 | 20.52 | 0.05 |
| | Pad_56 | 616135 | 6225890 | 51 | 0.1 | 23.26 | 0.05 |
| | Pad_57 | 616135 | 6225841 | 51 | 0.1 | 23.13 | 0.05 |
| | Pad_58 | 616124 | 6225803 | 51 | 0.1 | 13.04 | 0.05 |
| | Pad_59 | 616120 | 6225681 | 52 | 0.1 | 11.67 | 0.05 |
| | Pad_60 | 616129 | 6225641 | 52 | 0.1 | 19.65 | 0.05 |
| | Pad_61 | 616117 | 6225611 | 52 | 0.1 | 5.52 | 0.05 |
| | Pad_62 | 616165 | 6225921 | 51 | 0.1 | 4.81 | 0.05 |

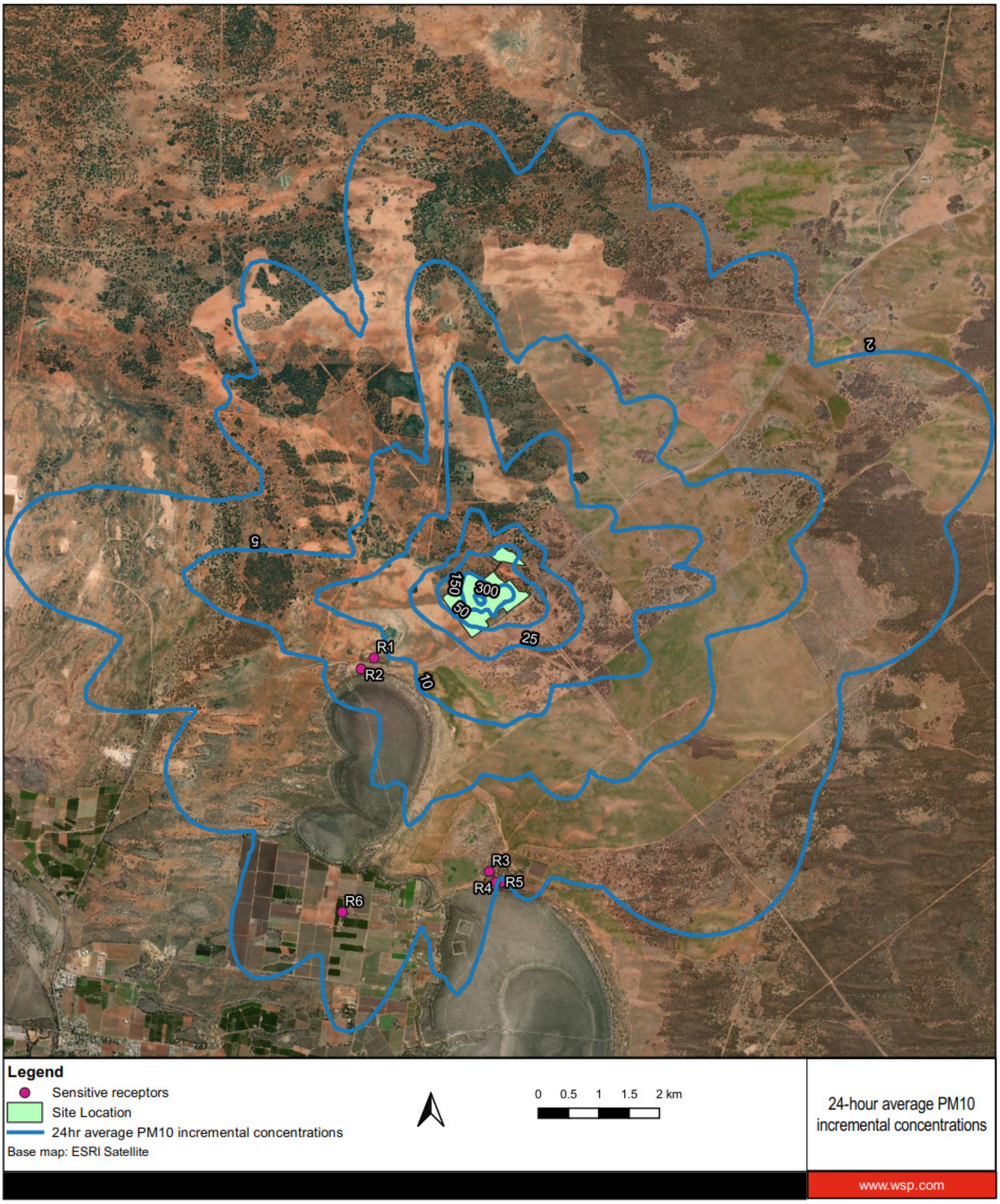
| SOURCE | | X (M) | Y (M) | BASE ELEVATION (M) | EFFECTIVE HEIGHT ABOVE GROUND (M) | SIGMA Y | SIGMA Z |
|---|---|---|---|---|---|---|---|
| | Pad_63 | 616177 | 6225886 | 51 | 0.1 | 17.85 | 0.05 |
| | Pad_64 | 616176 | 6225851 | 51 | 0.1 | 14.88 | 0.05 |
| Wind erosion at the stockpile | Stp_1 | 615459 | 6225951 | 51 | 2.5 | 2.28 | 1.16 |
| | Stp_2 | 615497 | 6225974 | 52 | 2.5 | 10.62 | 1.16 |
| | Stp_3 | 615485 | 6225949 | 51 | 2.5 | 17.95 | 1.16 |
| | Stp_4 | 615514 | 6225970 | 52 | 2.5 | 4.13 | 1.16 |
| | Stp_5 | 615516 | 6225959 | 52 | 2.5 | 5.81 | 1.16 |

# APPENDIX B

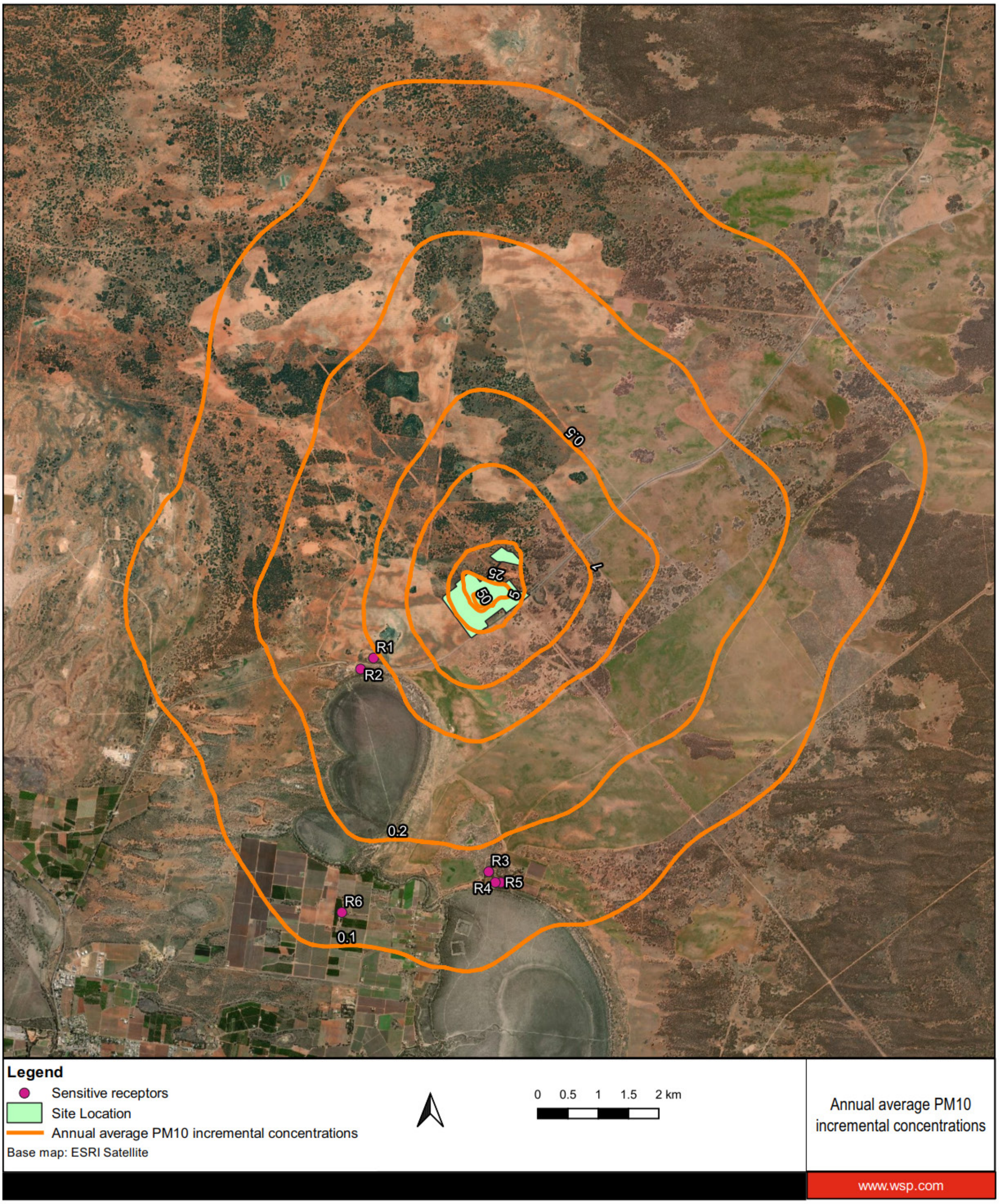
CONTOUR PLOTS



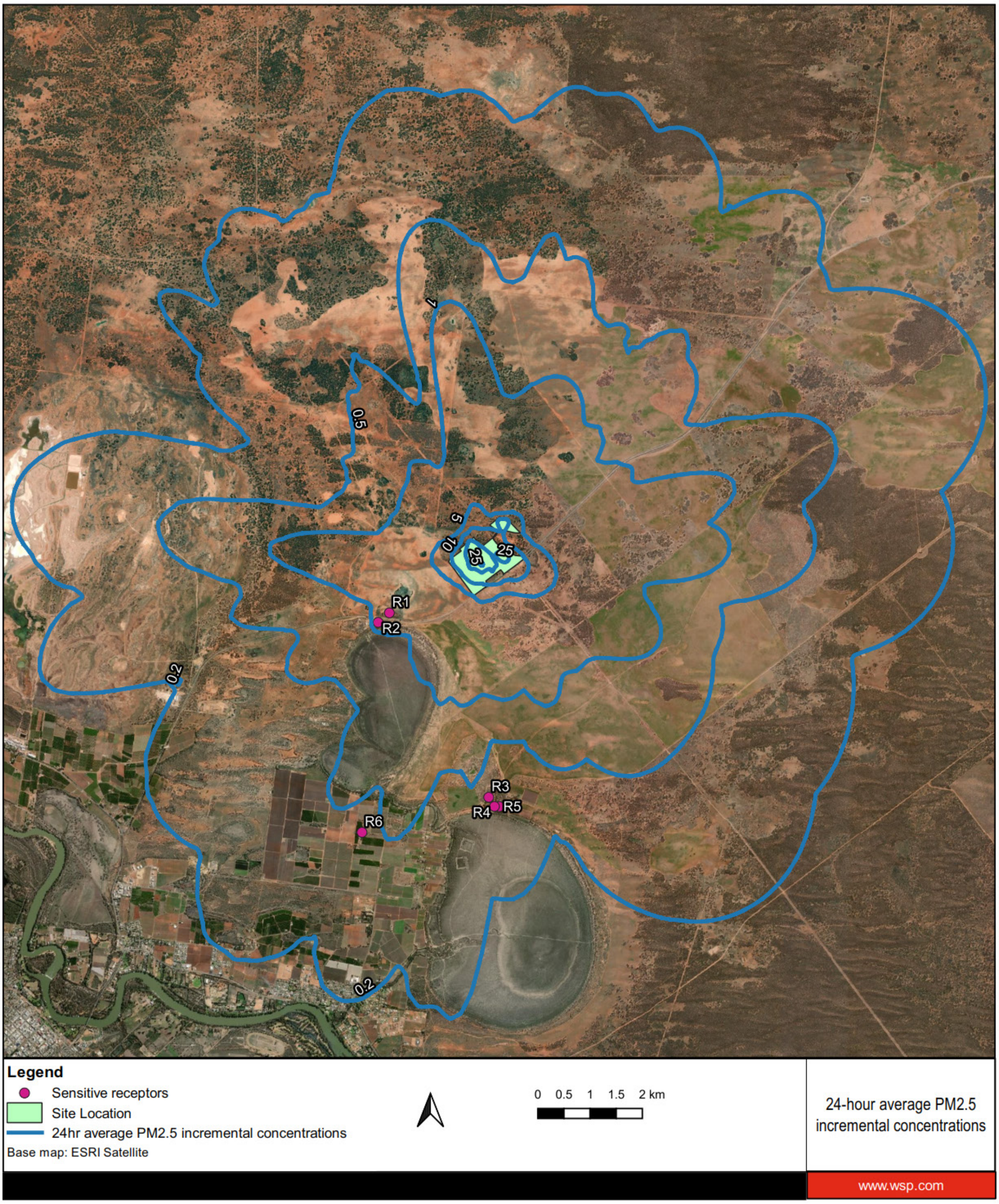
0.02
0.05
0.1
1
10
50
90
90
R1
R2
R3
R4
R5
R6
Legend
Sensitive receptors
Site Location
Annual average TSP incremental concentrations
Base map: ESRI Satellite
0 0.5 1 1.5 2 km
Annual averageTSP incremental concentrations
www.wsp.com



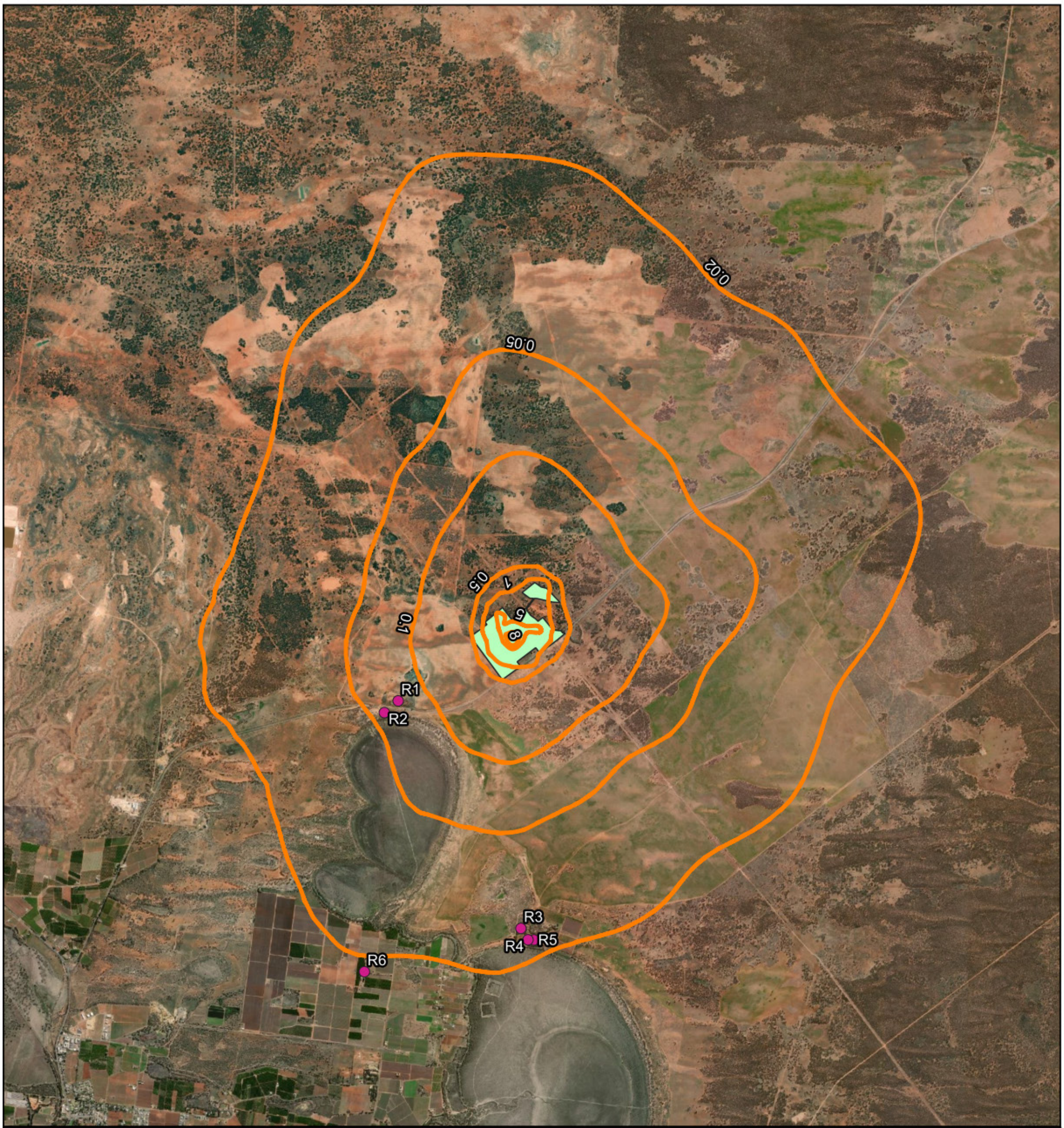
2
5
150
300
50
25
10
R1
R2
R3
R4
R5
R6
Legend
Sensitive receptors
Site Location
24hr average PM10 incremental concentrations
Base map: ESRI Satellite
0 0.5 1 1.5 2 km
24-hour average PM10 incremental concentrations
www.wsp.com



0.5
1
25
5
50
R1
R2
0.2
R3
R4
R5
R6
0.1
Legend
Sensitive receptors
Site Location
Annual average PM10 incremental concentrations
Base map: ESRI Satellite
0 0.5 1 1.5 2 km
Annual average PM10 incremental concentrations
www.wsp.com



0.5
1
5
10
25
25
0.2
0.2
R1
R2
R3
R4
R5
R6
Legend
Sensitive receptors
Site Location
24hr average PM2.5 incremental concentrations
Base map: ESRI Satellite
0 0.5 1 1.5 2 km
24-hour average PM2.5 incremental concentrations
www.wsp.com




**Legend**

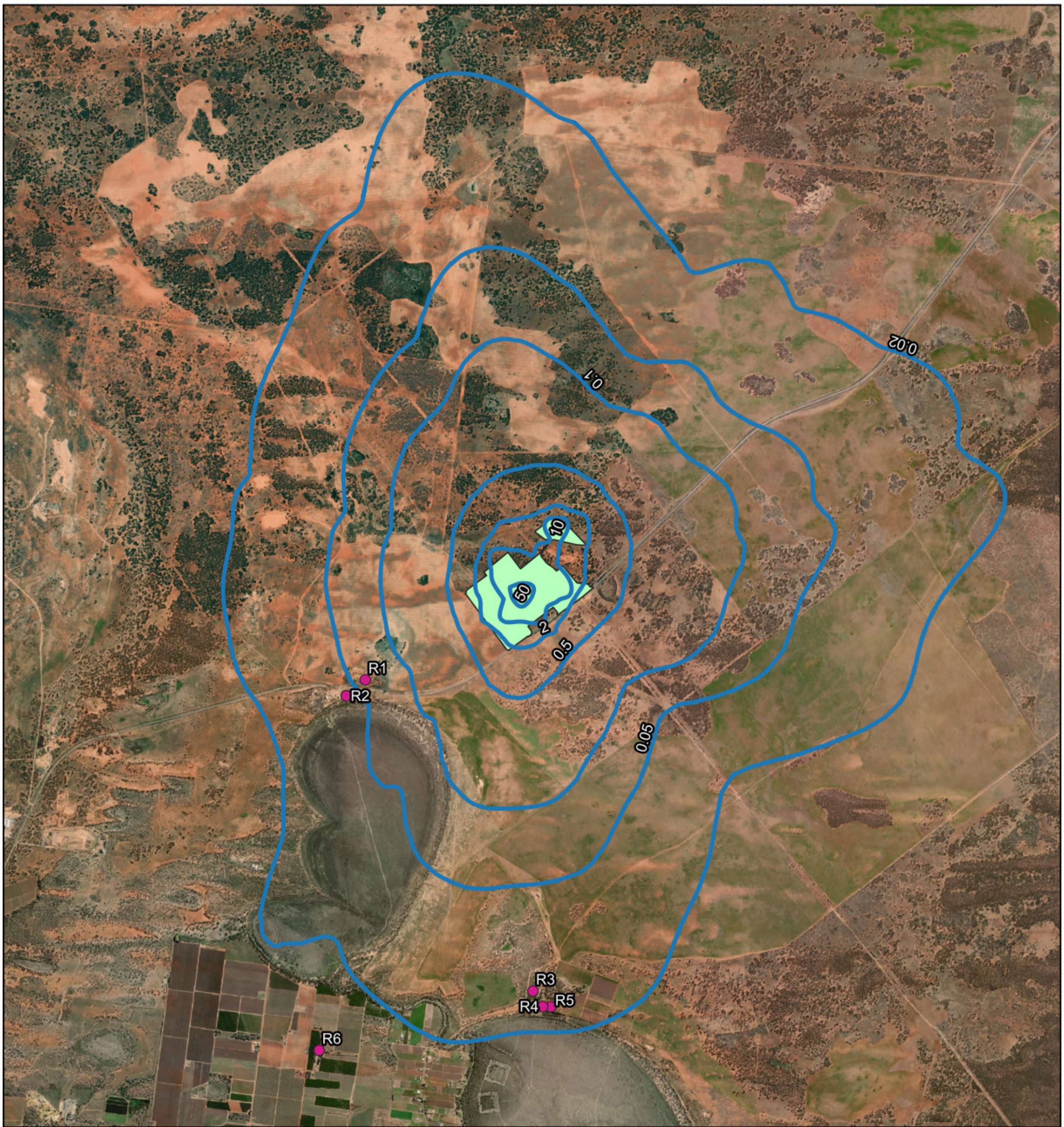
- Sensitive receptors
- Site Location
- Annual average PM2.5 incremental concentrations

Base map: ESRI Satellite

0 0.5 1 1.5 2 km

Annual average PM2.5 incremental concentrations

www.wsp.com




**Legend**

- Sensitive receptors
- Site Location
- Monthly deposited dust incremental concentrations

Base map: ESRI Satellite

0 0.5 1 1.5 2 km

Monthly deposited dust incremental concentrations

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## ABOUT US

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project delivery and strategic consulting services. With approximately 50,000 talented people globally, we engineer projects that will help societies grow for lifetimes to come.