ST MARYS RESOURCE RECOVERY FACILITY

Appendix P: Air Quality Impact Assessment

Incorporating

Hyder

Intended for
Arcadis

Document type
Report

Date
June 2017

Project No.
AS122079

AIR QUALITY IMPACT ASSESSMENT
ST MARYS RESOURCE RECOVERY FACILTY

RAMBOLL ENVIRON

AIR QUALITY IMPACT ASSESSMENT
ST MARYS RESOURCE RECOVERY FACILTY

Revision	Date	Made by	Checked by	Approved by	Signed
Final	6/06/2017	R.Kellaghan	S. Fishwick	R. Kellaghan	Ronan Kellaghan

Rambol Environ Australia Pty Ltd
Level 3, 100 Pacific Highway
PO Box 560
North Sydney
NSW 2060
Australia
T +61 2 9954 8100
F +61 2 9954 8150
www.ramboll-environ.com

Project No. 1832

EXECUTIVE SUMMARY

Introduction

An air quality impact assessment has been prepared for the proposed redevelopment of the St Marys Resource Recovery Facility. The key operational components of the Proposal would include:

- Increasing operational (including processing and waste delivery and collection) hours to 24 hours per day, Monday to Saturday (no works on Sundays or public holidays would be undertaken)
- Processing of up to 350,000 tpa of non-putrescible waste
- Waste storage of up to 20,000 tonnes of non-putrescible waste at any given time

Study approach

Local air quality impacts are assessed using a Level 2 assessment approach in general accordance with the Approved Methods (refined dispersion modelling technique using site-representative input data). The assessment approach for the Proposal is as follows:

- Emissions are estimated for Proposal related activities.
- Dispersion modelling is undertaken using a regulatory dispersion model to predict ground level concentrations for key pollutants at nearby sensitive receptors.
- Cumulative impacts are assessed by taking into account the combined effect of the Proposal with existing baseline air quality and/or other local sources of emissions.

The assessment focuses on the operational phase of the development. Although the construction phase would contribute to dust emissions, the emissions intensity would be significantly less than for the operation of the Proposal and is therefore not considered further.

The key emissions to air during the operation of the Proposal are fugitive dust / particulate matter (PM) generated from waste receipt, handling, processing and dispatch.

Existing environment

Baseline air quality and meteorology is described with reference to the St Marys monitoring site operated by the Office of Environment and Heritage (OEH). A representative meteorological dataset for 2016 is used for modelling, using data from St Mary's and supplemented with Bureau of Meteorology (BoM) data from Penrith and Richmond.

The annual mean PM_{10} concentration for 2016 (16 µg/m³) is 64% of the impact assessment criteria, while the annual mean $PM_{2.5}$ concentration (7.7 µg/m³) is 96% of the impact assessment criteria. Exceedances of the 24-hour average impact assessment criteria for PM_{10} and $PM_{2.5}$ occurred on a number of occasions during 2016.

Emissions

Emission estimates are presented for each dust generating activity (wheel generated dust, waste handling, storage, processing and wind erosion). Emissions are estimated for a 'normal' operational scenario, based on an annual production rate of 350,000 tonnes per annum. An additional 'peak day' scenario is also presented, to assess maximum daily average PM_{10} and $PM_{2.5}$ concentrations based on a worst case daily production rate of 2,400 tonnes per day. The Proposal includes a number of design features for dust control which are incorporated into the emissions inventory.

Results and conclusion

The predicted Proposal-only incremental PM_{10}, $PM_{2.5}$, TSP and dust deposition are minor at all sensitive receptors, both in the context of the existing background levels and when compared against the impact assessment criteria. When background is added, the cumulative annual average ground level concentrations comply with all relevant impact assessment criteria at all sensitive receptors.

CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

APPENDICES

1. INTRODUCTION

Ramboll Environ has conducted an air quality impact assessment for the St Marys Resource Recovery Facility. This report forms part of the Environmental Impact Statement (EIS) for approval of the Proposal.

1.1 Proposal overview

St Mary's Recycling Pty Ltd, a subsidiary of Bingo Industries Limited (Bingo Industries), operates an existing Resource Recovery Facility (RRF) at 25 Dunheved Circuit, St Marys. The RRF operates under development consent (DA01/1034), which was issued by Penrith City Council (Council) in June 2001, development consent (DA15/1042), which was issued by Council in June 2016, and an Environmental Protection Licence (EPL) from the New South Wales (NSW) Environmental Protection Authority (EPA), EPL No. 20621. Bingo Recycling Pty Ltd (the Applicant), also a subsidiary of Bingo Industries, is seeking approval to extend the RRF onto the neighbouring lot; 21 Dunheved Circuit (the Proposal). The proposed RRF would extend across 21 Dunheved Circuit and 25 Dunheved Circuit (the Proposal site) in order to optimise operations and facilitate a throughput of 350,000 tonnes per annum (tpa) of general solid waste (non-putrescible).

The EIS is seeking approval, under Part 4, Division 4.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act), for the construction and operation of the Proposal. The key components of the Proposal would include:

- Demolition of all structures, except for electrical substations, at 21 Dunheved Circuit
- Demolition of a section of the eastern wall of the approved processing shed at 25 Dunheved Circuit to provide access between the existing processing shed and the proposed extension to the processing shed
- Extension of the processing shed and external hardstand onto 21 Dunheved Circuit
- Relocation of existing, and provision of additional, on-site car parking spaces
- Extension of the existing site office on 25 Dunheved Circuit
- Widening the existing driveway access to 25 Dunheved to separate vehicle access and egress
- Provision of a second vehicle egress point along Dunheved Circuit
- Installation of a new 20 m long in-ground weighbridge at the second vehicle egress point
- Installation of two in-ground wheel wash bays at the exit weighbridges
- Relocation of four onsite stormwater detention (OSD) tanks and installation of a new rainwater reuse tank
- Relocation of the 30,000 L self-bunded fuel tank
- Extension of a dust suppression and sprinkler system
- Upgrade of two intersections comprising minor widening at the intersections of Dunheved Circuit loop to Dunheved Circuit (both the northern and southern legs)

The key operational components of the Proposal would include:

- Increasing operational (including processing and waste delivery and collection) hours to 24 hours per day, Monday to Saturday (no processing on Sundays or public holidays would be undertaken)
- Processing of up to 350,000 tpa of non-putrescible waste
- Waste storage of up to 20,000 tonnes of non-putrescible waste at any given time

Waste streams to be received, and processed waste streams, include a range of non-putrescible waste types. **Appendix 1** provides a list types that would be processed. The key components of the Proposal are shown in **Figure 1-1**.

1.2 Background to the Proposal

Number 25 Dunheved Circuit has operated as a RRF since 2001. Initially the operations consisted of a temporary above-ground weighbridge, small modular cabin and a workshop / storage shed at the rear of the site. The approval allowed for the processing, however waste materials were not permitted to be stored outside buildings (unless within waste bins). Waste was sorted into light and heavy fractions. The light fraction was sent for further recycling at other facilities, with a portion ending up in landfill. The heavy stream was sent to other Bingo recycling facilities for processing

A development application (DA 15/1042) was lodged in August 2015 with PCC for the redevelopment of 25 Dunheved Circuit, to construct and operate an enclosed RRF which would substantially improve the resource recovery rate and the environmental performance of the site. Construction of the RRF at 25 Dunheved Circuit commenced in November 2016 and was completed in April 2017. The RRF at 25 Dunheved Circuit (the existing RRF) has been operational since this time.

1.3 Study objectives and requirements

This report supports the EIS for the Proposal and has been prepared as part of a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the EP&A Act. This report has been prepared to address:

- The Secretary's Environmental Assessment Requirements (SEARs) (SSD 8200) for the Proposal, issued by NSW Department of Planning and Environment (DP&E) on 6 February 2017.
- Comments provided by the NSW EPA and PCC in preparation of the SEARs.

Table 1-1 and **Table 1-2** provide a summary of the SEARs and agency comments relevant to this study and where the requirement has been addressed in this report.

Table 1-1: Summary of SEARs for air quality

Requirement	How requirement is addressed
Air Quality and Odour - including: • a quantitative assessment of the potential air quality, dust and odour impacts of the development in accordance with relevant Environment Protection Authority guidelines;	Report prepared in accordance with the Approved Methods (refer **Section 2**).
• the details of buildings and air handling systems and strong justification for any material handling, processing or stockpiling external to the building;	No handling, processing or stockpiling proposed external to the building. Refer **Section 4**
• a greenhouse gas assessment; and	Addressed in a separate report
• details of the proposed mitigation, management and monitoring measures	Refer **Section 6**
Sensitive Receivers – including consideration of potential impacts, particularly noise and air quality, to future residents of the St Marys ADI Site – Central Precinct.	Refer **Section 2.6**

Table 1-2: Summary of Agency comments relevant to air quality

Requirement	How comment is addressed
NSW EPA	
The EPA is concerned that the large proposed volume throughput at the Premises may generate a large volume of pollutants discharged to air. The Proponent must demonstrate effective control of dust, odour and other potential pollutants from the Premises.	Refer **Section 4** and **5**
The EPA would expect that all haulage routes on the Premises are sealed and that all external surfaces be either sealed or vegetated.	All travel routes will be sealed, a road sweeper used to clean paved surfaces, and a wheel wash installed at exit to the building. Refer **Section 4**
The EPA would have expected that all waste storage and processing be undertaken inside the building	No handling, processing or stockpiling proposed external to the building. Refer **Section 4**
Penrith City Council	
The future residences in the St Marys ADI Site – Central Precinct (SREP 30) should also be considered in any assessment relating to environmental impacts, such as potential noise and air quality impacts.	Refer **Section 2.6**

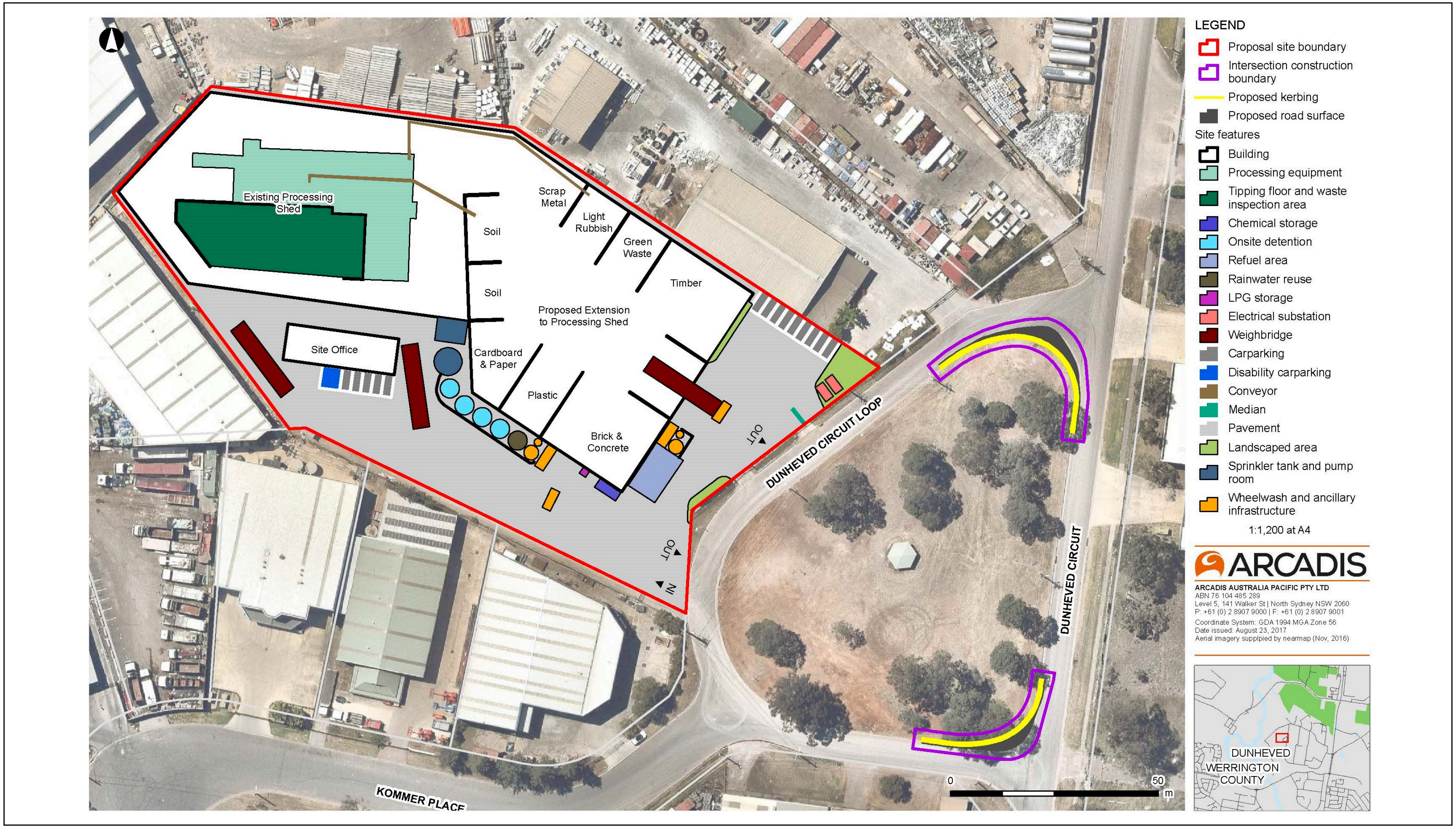


Figure 1-1: The Proposal site

2. STUDY APPROACH

2.1 Assessment approach

The approach to the assessment follows guidelines recommended in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ("the Approved Methods") (NSW EPA, 2016). Local air quality impacts are assessed using a Level 2 assessment approach in general accordance with the Approved Methods (refined dispersion modelling technique using site-representative input data).

The assessment approach for the Proposal is as follows:

- Emissions are estimated for Proposal related activities.
- Dispersion modelling is undertaken using a regulatory dispersion model to predict ground level concentrations (GLCs) for key pollutants at nearby sensitive receptors.
- Cumulative impacts are assessed by taking into account the combined effect of the Proposal with existing baseline air quality and/or other local sources of emissions.

2.2 Assessment scenarios

In accordance with the SEARs, the quantitative air quality assessment focuses on the operational phase of the development. Although the construction phase of the Proposal would also contribute to dust emissions, the emissions intensity would be significantly less than for the operation of the Proposal. Consequently, construction phase emissions are not inventoried or modelled. The construction phase impacts would be short in duration (approximately four months) and relatively easy to manage through commonly applied dust control measures, such as watering. Procedures for controlling dust impacts during construction are outlined in **Section 6**.

2.3 Pollutant indicators

The key emissions to air during the operation of the Proposal are fugitive dust / particulate matter (PM), generated from waste receipt, handling, processing and dispatch.

The combustion of diesel in trucks and other equipment would result in combustion-related emissions including Particulate Matter (PM), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), carbon dioxide (CO_2), carbon monoxide (CO) and volatile organic compounds (VOCs).

The air quality indicators that have been considered in this report are summarised in **Table 2-1**.

Table 2-1: Air quality indicators for assessment

Emission source	Air quality indicator
Waste handling and processing	Particulate matter (TSP[1], PM_{10}[2] and $PM_{2.5}$[3])
	Nuisance dust (dust deposition)
Diesel fuel combustion	Primarily $PM_{2.5}$

Note:
[1] Total Suspended Particulate matter
[2] Particulate matter less than 10 microns in aerodynamic diameter
[3] Particulate matter less than 2.5 microns in aerodynamic diameter

With the exception of PM, combustion derived emissions have not been quantitatively assessed, as they would not result in significant off-site concentrations. For completeness, combustion derived PM has been included as part of the overall site emissions, as for $PM_{2.5}$ in particular, it can be a relatively significant component of total site emissions.

2.4 Assessment criteria

When first regulated, airborne PM was assessed based on concentrations of "total suspended particulate matter" (TSP). In practice, this typically referred to PM smaller than about 30-50 micrometres (µm) in diameter. As air sampling technology improved and the importance of particle size and chemical composition become more apparent, ambient air quality standards have been revised to focus on the smaller particle sizes, thought to be most dangerous to human health. Contemporary air quality assessment typically focuses on "fine" and "coarse" inhalable PM, based on health-based ambient air quality standards set for PM_{10} and $PM_{2.5}$.

Air quality criteria for PM in Australia are given for particle size metrics including TSP, PM_{10} and $PM_{2.5}$. The 2016 update to the 'Approved Methods', gazetted on 20 January 2017, includes particle assessment criteria that are consistent with revised National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) national reporting standards (National Environment Protection Council [NEPC], 1998; NEPC, 2015).

For the purpose of this report, predicted ground level concentrations (GLCs) are assessed against the NSW EPA's impact assessment criteria presented in **Table 2-2**.

Table 2-2: Impact assessment criteria for PM

PM metric	Averaging period	Concentration (µg/m^3)
TSP	Annual	90
PM_{10}	24 hour	50
	Annual	25
$PM_{2.5}$	24 hour	25
	Annual	8

Note: µg/m^3 = micrograms per cubic metre.

The Approved Methods specifies that the impact assessment criteria for 'criteria pollutants[1]' are applied at the nearest existing or likely future off-site sensitive receptor and compared against the 100th percentile (i.e. the highest) dispersion modelling prediction. Both the incremental and cumulative impacts need to be considered (consideration of existing ambient background concentration is required).

The Approved Methods also prescribes nuisance based goals for dust deposition, which relate to amenity type impacts such as soiling of exposed surfaces. The NSW EPA impact assessment criteria for dust deposition are summarised in **Table 2-3**, illustrating the maximum increase and total dust deposition rates which would be acceptable so that dust nuisance can be avoided.

Table 2-3: Dust deposition criteria

Pollutant	Maximum Increase in Dust Deposition	Maximum Total Dust Deposition Level
Deposited dust (assessed as insoluble solids)	2 g/m^2/month	4 g/m^2/month

Note: g/m^2 = grams per square metre.

2.5 Dispersion model selection

Local air quality impacts are modelled using AERMOD, the United States Environmental Protection Agency's (US EPA) recommended steady-state plume dispersion model for regulatory purposes.

[1] 'Criteria pollutants' is used to describe air pollutants that are commonly regulated and typically used as indicators for air quality. In the Approved Methods, the criteria pollutants are TSP, PM_{10}, nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), deposited dust, hydrogen fluoride and lead.

AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006. Ausplume, a steady state Gaussian plume dispersion model developed by the Victorian EPA and recommended in the Approved Methods for simple near-field applications, is largely based on the ISC model. AERMOD has replaced Ausplume as the regulatory model in Victoria (EPA Victoria, 2013) and is likely to be included as an approved regulatory model in the next update to the Approved Methods.

Compared to ISC and Ausplume, AERMOD represents an advanced new-generation model, which requires additional meteorological and land use inputs to provide more refined predictions. The most important feature of AERMOD, compared to ISC and Ausplume, is its modification of the basic dispersion model to account more effectively for a variety of meteorological factors and surface characteristics. In particular, it uses the Monin-Obukhov length scale rather than Pasquill-Gifford stability categories to account for the effects of atmospheric stratification. Whereas Ausplume and ISC parameterise dispersion based on semi-empirical fits to field observations and meteorological extrapolations, AERMOD uses surface-layer and boundary layer theory for improved characterisation of the planetary boundary layer turbulence structure.

2.6 Assessment locations

A number of residential suburbs are located in proximity to the Proposal site, including:

- Werrington and Werrington County, located 1,375 m southwest of the Proposal site.
- North St Marys, located 1,375 m southeast of the Proposal site.
- Ropes Crossing, located 1,245 m northeast of the Proposal site.

In addition, a future residential area, known as the St Marys ADI Site – Central Precinct is located approximately 825 m to the west-northwest and is included in this assessment. The closest non-residential sensitive receptor, the Dunheved Golf Club, is located approximately 300 m southwest of the Proposal site.

Locations representative of these residential areas and sensitive receptors have also been identified and selected as discrete sensitive receptors. The sensitive assessment locations are shown in **Figure 2-1**.

The Proposal site is immediately adjacent to other industrial / commercial facilities. Although the Approved Methods defines sensitive receptors as a location where people are likely to work or reside, the examples given are "*dwelling, school, hospital, office, recreational area*".

Therefore, adjacent commercial/industrial facilities are not considered sensitive receptors for the purpose of this assessment, although predicted ground level concentrations impacts at these locations are presented in **Appendix 5**.

2.7 Cumulative impacts

Cumulative impacts are assessed by combining the contribution from the Proposal with the existing ambient air quality environment. The baseline monitoring data (described in **Section 3.2**) is assumed to account for all existing local sources of air pollution for consideration of cumulative impacts.

Cumulative impact assessment should also consider reasonably foreseeable future development. It is noted that the Western Sydney inland container terminal facility is proposing the construction and operation of a road and rail link from St Marys to Port Botany that would have a throughput of up to 301,000 twenty-foot equivalent units (TEU) per annum. This facility is proposed to be located approximately 1.6 km south-southeast of the Proposal site and is currently in planning phase, with SEARs issued for the proposed container terminal facility in October 2015. As the proposed container terminal facility is in a planning phase at the time of assessment, no detailed assessment data is available for the proposed container terminal facility. However, based on our experience in assessing air quality impacts from similar intermodal facilities (i.e. ENVIRON, 2015), the additional cumulative impacts from the operational phase are expected to be minor and would not change the conclusions of this assessment.

Figure 2-1: Sensitive receptor locations

3. EXISTING ENVIRONMENT

3.1 Meteorology

Meteorological mechanisms govern the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. To adequately characterise the dispersion meteorology of a region, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability.

Reference is made to the St Marys monitoring site, operated by the Office of Environment and Heritage (OEH). The monitoring site is located approximately 6 km south of the Proposal site on Mamre Road and is considered the most representative dataset to describe local meteorology and generate input files for modelling

An analysis of the most recent 5 years of wind data from the St Marys shows that there was relatively little inter-annual variability in wind speed and direction between 2012 and 2016 (refer **Appendix 3**) and therefore the most recent year, 2016, is selected for modelling.

3.1.1 Prevailing winds

An annual wind rose of recorded wind speed and direction data from the OEH's St Marys site for 2016 is presented in **Figure 3-1**. The annual recorded wind pattern is dominated by north-northwest and south-southwest flow.

The average recorded wind speed for 2016 was low (approximately 1.2 m/s) with calm conditions (wind speeds less than 0.5 m/s) occurring for a relatively significant amount of the year (30%).

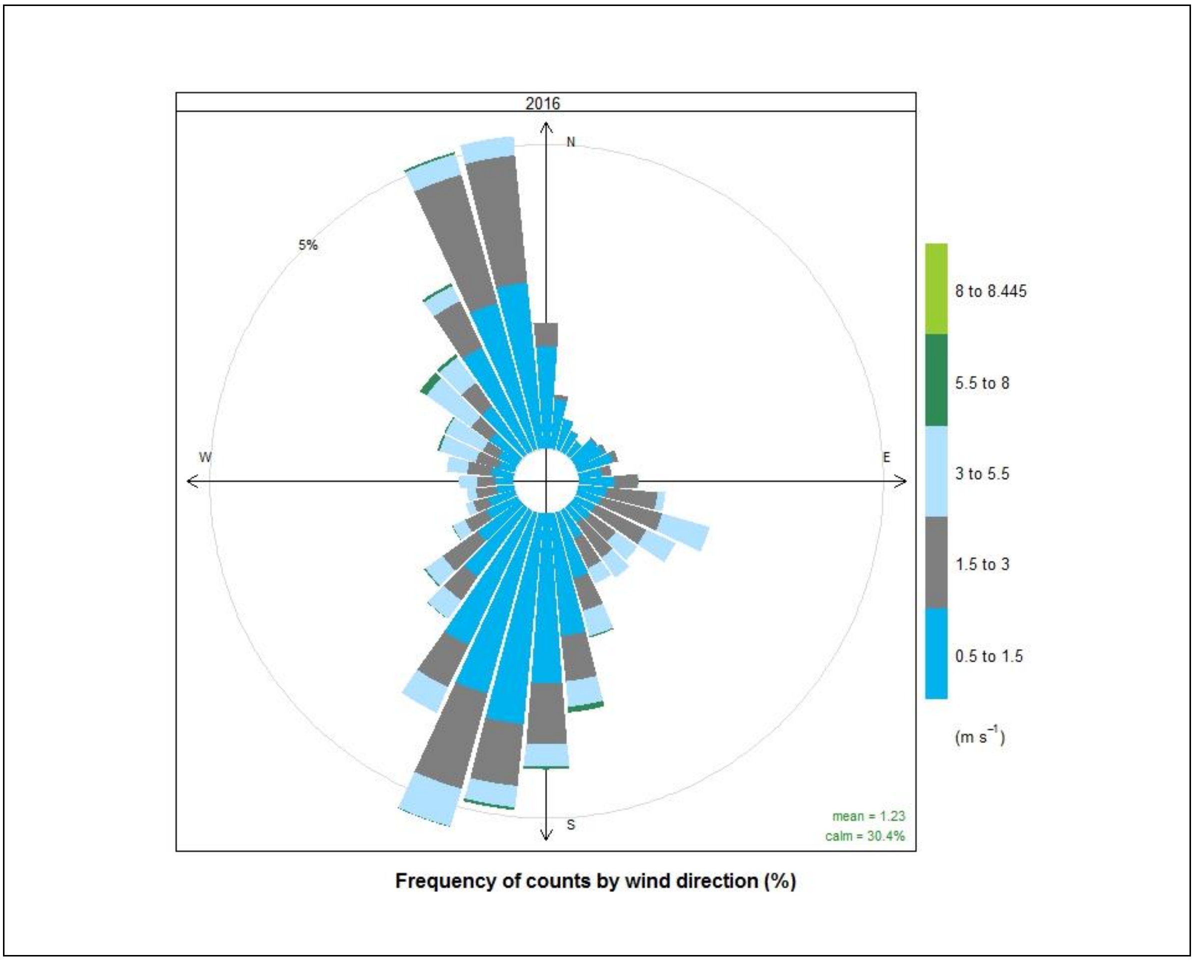


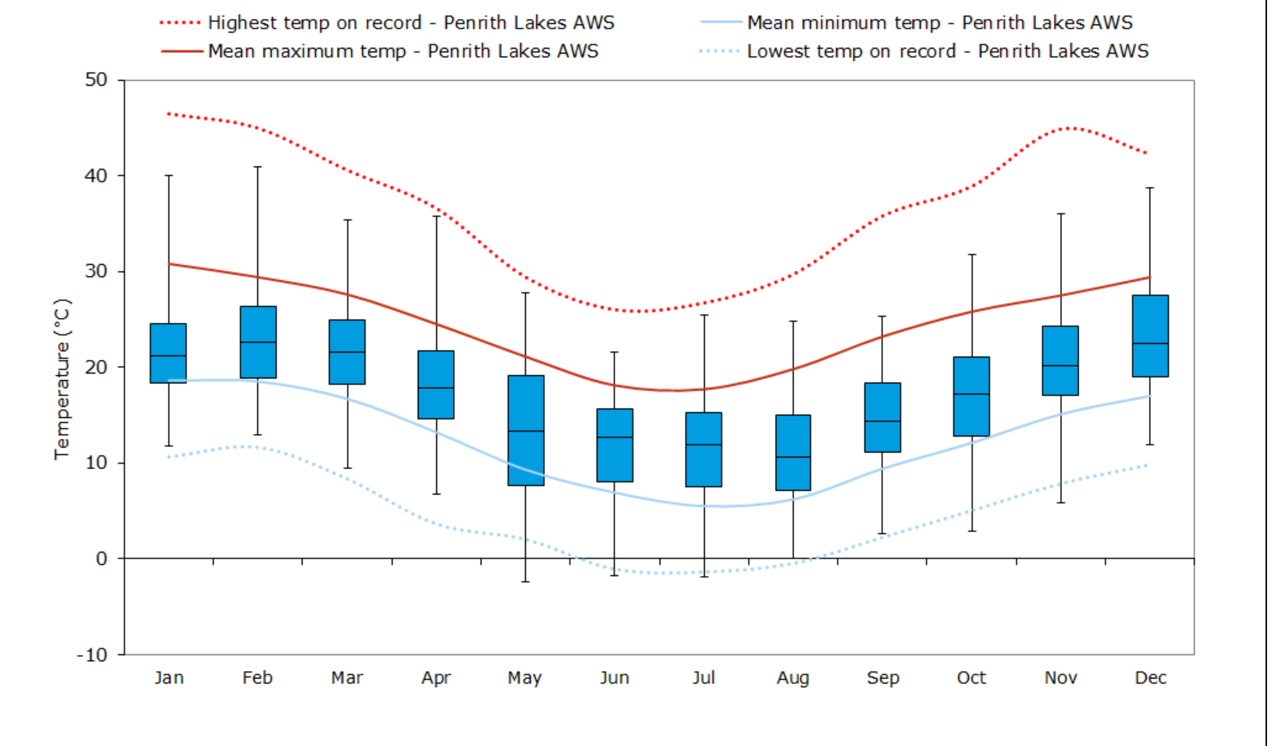
Figure 3-1: Annual wind rose for 2016 – OEH site at St Marys

Seasonal and diurnal wind roses are presented in **Appendix 3**. The dominant north-northwest flow is most defined during the day and the dominant south-southwest flow most evident at night. The dominant wind directions are relatively consistent across all seasons. Mean wind speeds are higher during day time hours and the occurrence of calm wind conditions are more frequent at night.

3.1.2 Ambient temperature

The minimum, maximum, mean and upper and lower quartile temperatures for each month of the modelling dataset are presented as a box and whisker plot shown in **Figure 3-2**. The maximum temperature occurs in February (40.9 ºC), while the highest mean monthly temperature occurs in December (23.5 ºC). The lowest recorded minimum temperature occurs in May (-2.4 ºC), while the lowest monthly mean occurs in August (10.9 ºC).

The modelling dataset is compared with long-term records at the Bureau of Meteorology (BoM) Penrith Lakes Automatic Weather Station (AWS), and shown to correlate well with the long-term historical trends. The upper and lower quartile and mean temperatures for 2016 at St Marys fall within the long term mean monthly maximum and minimum temperatures. At St Marys, the highest temperatures occur during January, February and December and the lowest temperatures occur during May, June, July and August. The maximum temperatures for 2016 are less than the maximum temperatures on record, while some of the lowest temperatures for 2016 at St Marys fall below the long term minimum temperatures on record.



2016 St Marys data are illustrated by the 'box and whisker' plot. Boxes indicate 25th, median and 75th percentile temperature values while upper and lower whiskers indicate maximum and minimum values.

Figure 3-2: Comparison of long-term temperature records with modelling period

3.1.3 Rainfall

Precipitation is important to air pollution since it impacts on dust generation potential and represents a removal mechanism for atmospheric pollutants. Fugitive emissions may be harder to control during low rainfall periods while drier periods may also result in more frequent dust storms and bushfire activity, resulting in higher regional background dust levels. Rainfall also acts as a removal mechanism for dust, lowering pollutant concentrations by removing them more efficiently than during dry periods.

Rainfall is not measured at the St Marys OEH site, however long term rainfall records for the BoM Penrith Lakes AWS are presented in **Figure 3-3**. Higher monthly rainfall occurs during summer months, however the months with the greatest number of rain days are June, July and November.

To provide a conservative (upper bound) estimate of the pollutant concentrations, wet deposition (removal of particles from the air by rainfall) was excluded from the dispersion modelling simulations undertaken in this report.

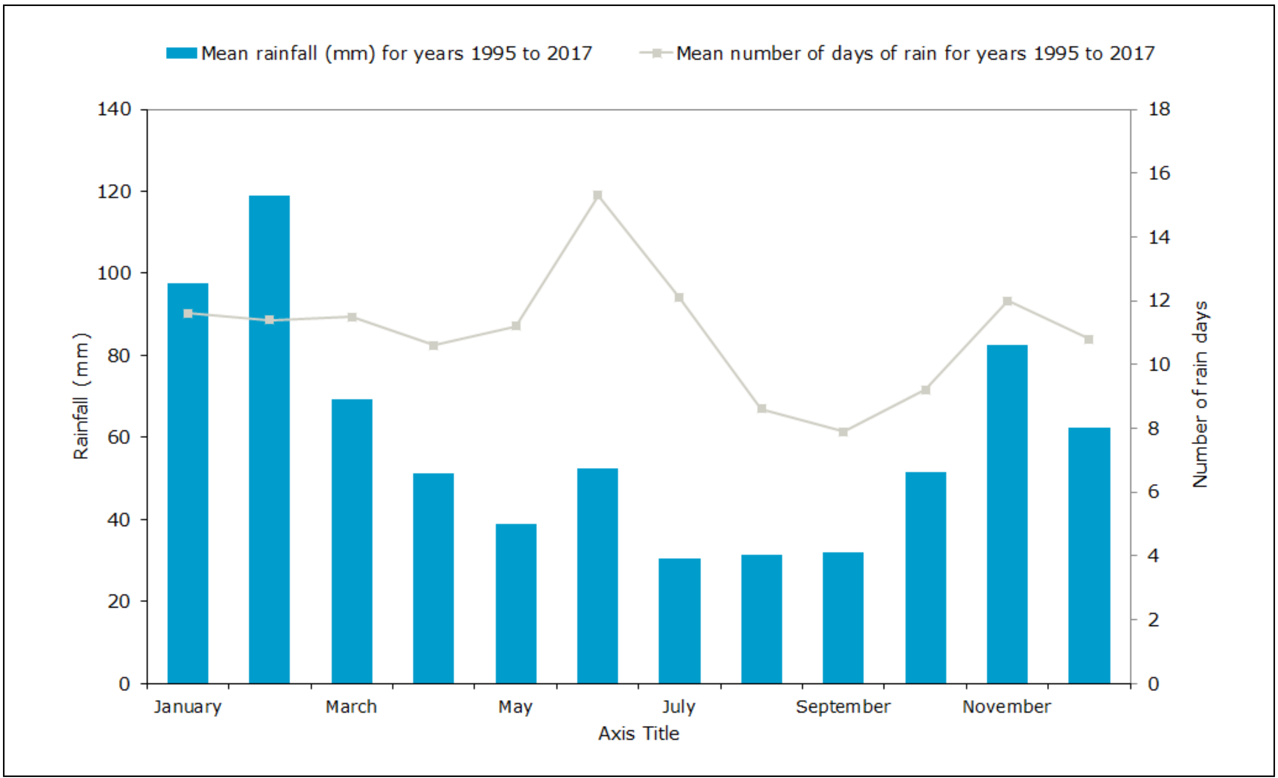


Figure 3-3: Long-term rainfall records for Penrith Lakes AWS

3.1.4 Boundary layer heights

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. This layer is directly affected by the earth's surface, either through the retardation of air flow due to the frictional drag of the earth's surface (mechanical mechanisms), or as result of the heat and moisture exchanges that take place at the surface (convective mixing) (Stull, 1997; Oke, 2003).

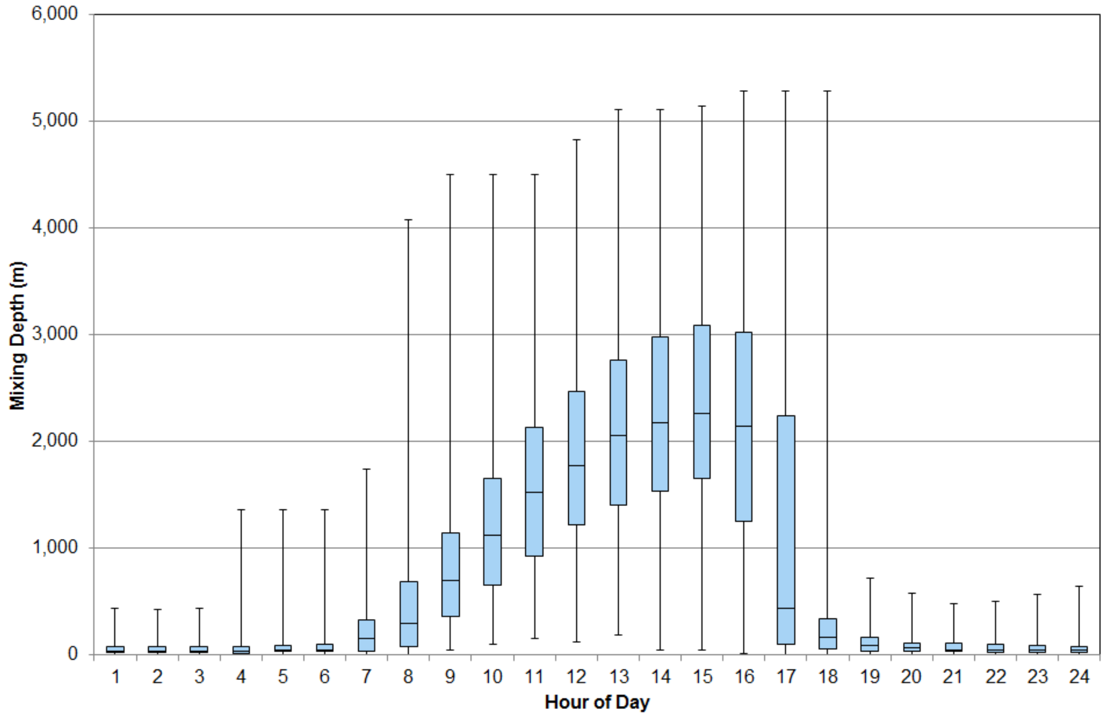
During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the extension of the mixing layer to the lowest elevated subsidence inversion. Elevated inversions may occur for a variety of reasons including anticyclonic subsidence and the passage of frontal systems. Due to radiative flux divergence, nights are typically characterised by weak to no vertical mixing and the predominance of stable conditions. These conditions are normally associated with low wind speeds and hence lower dilution potentials.

Hourly-varying atmospheric boundary layer heights were generated for modelling by AERMET, the meteorological processor for the AERMOD dispersion model, using a combination of surface observations from the St Marys weather station, sunrise and sunset times and adjusted TAPM[2]-predicted upper air temperature profile (further discussion provided in **Appendix 2**).

The variation in average boundary layer heights by hour of the day is illustrated in **Figure 3-4**. The figure shows that greater boundary layer heights are experienced during the day time hours, peaking in the mid to late afternoon. Higher day-time wind velocities and the onset of incoming

[2] The Air Pollution Model, developed by CSIRO

solar radiation increases the amount of mechanical and convective turbulence in the atmosphere. As turbulence increases so too does the depth of the boundary layer, generally contributing to higher mixing depths and greater potential for atmospheric dispersion of pollutants.



Lower, middle and upper box markers indicate 25th percentile, median and 75th percentile of AERMET-generated mixing height data respectively, while upper and lower whiskers indicate maximum and minimum values.

Figure 3-4: AERMET-generated diurnal variations in average boundary layer depth

3.1.5 Atmospheric stability

Atmospheric stability refers to the degree of turbulence or mixing that occurs on the atmosphere and is a controlling factor in the rate of atmospheric dispersion of pollutants. The Monin-Obukhov length (L) provides a measure of the stability of the surface layer (i.e. the layer above the ground in which vertical variation of heat and momentum flux is negligible - typically about 10% of the mixing height). Negative L values correspond to unstable atmospheric conditions, while positive L values correspond to stable atmospheric conditions. Very large positive or negative L values correspond to neutral atmospheric conditions.

Figure 3-5 illustrates the diurnal variation of atmospheric stability derived from the Monin-Obukhov length calculated by AERMET for modelling. The diurnal profile presented illustrates that atmospheric instability increases during daylight hours as convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile indicates that the potential for atmospheric dispersion of emissions would be greatest during day time hours and lowest during evening through to early morning hours.

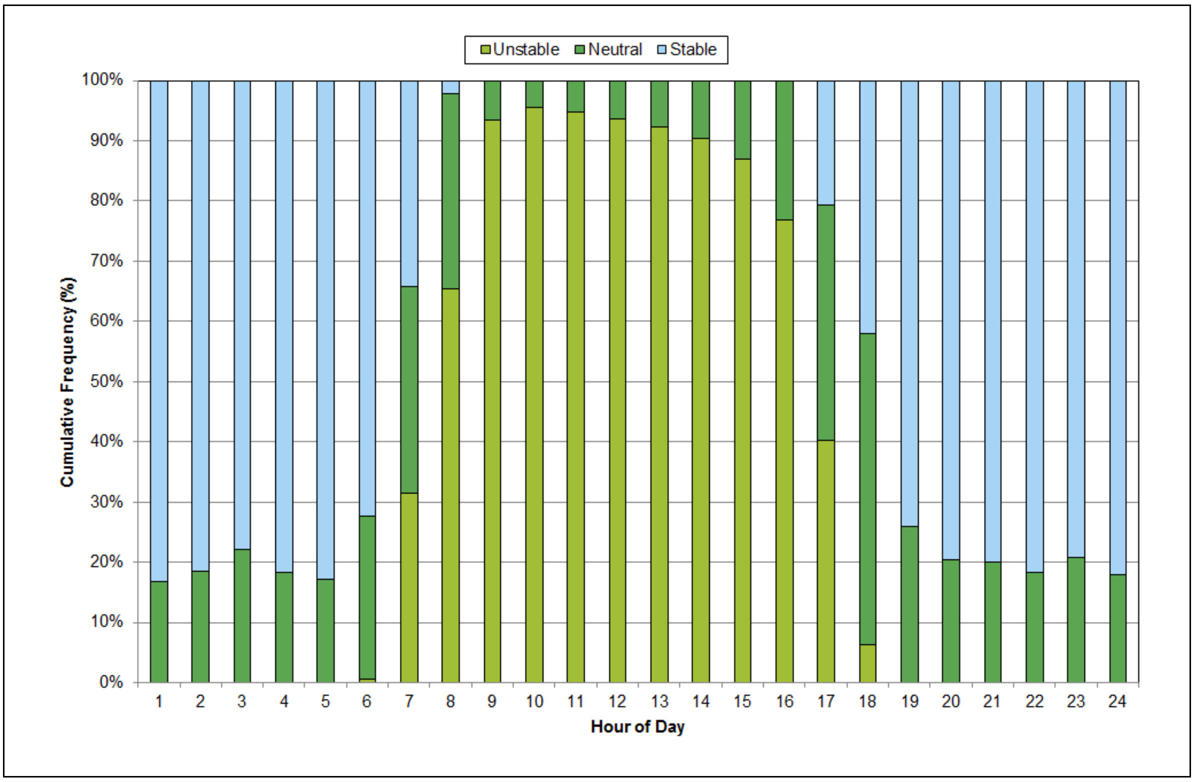


Figure 3-5: Diurnal variations in AERMET-generated atmospheric stability

3.2 Baseline ambient air quality

Background air quality is described with reference to St Marys OEH monitoring site, located on Mamre Road in a low density residential area. The monitoring station measures PM_{10}, NO_2, O_3 and fine particles by nephelometry. $PM_{2.5}$ was added as a parameter in March 2016.

3.2.1 Summary statistics

The summary statistics for key pollutants for the modelling year (2016) are presented in **Table 3-1**. The annual mean PM_{10} concentration for 2016 (16 µg/m³) is 64% of the impact assessment criteria. $PM_{2.5}$ was only added as a parameter in March 2016, therefore a full year of monitoring data are not available. However, measurements of fine particles by nephelometry are available for the complete year, and are used to fill in gaps in the $PM_{2.5}$ data record. The linear relationship between the two variables is derived and used to 'predict' the missing $PM_{2.5}$ concentrations based on the nephelometry data. Using this approach, the annual mean $PM_{2.5}$ concentrations is 7.7 µg/m³ which is 96% of the impact assessment criteria.

Exceedances of the 24-hour average impact assessment criteria for PM_{10} and $PM_{2.5}$ occurred on a number of occasions during 2016. A timeseries plot of the 24-hour average concentrations (**Figure 3-6**) shows four days when the 24-hour average PM_{10} concentration reaches or exceeds 50 µg/m³ and seven days when the 24-hour average $PM_{2.5}$ concentration reaches or exceeds 25 µg/m³.

Table 3-1: Summary statistics (µg/m³) for St Marys OEH monitoring site

Statistic	**PM_{10}**	**$PM_{2.5}$**
Annual mean	16.0	7.7
Daily max	99.4	92.6
99th percentile	43.3	34.9
95th percentile	29.6	13.2
Number of exceedances	4[3]	7

3.2.2 TSP concentration and nuisance dust deposition

TSP concentrations are not measured in the vicinity of the Proposal site, however historical measurements of TSP and PM_{10} in Sydney[4] indicate that PM_{10}/TSP ratios in urban areas typically range from 0.4 to 0.5. These ratios can be applied to the PM_{10} concentration data to derive an annual average TSP concentration.

Similarly, dust deposition is not measured in the vicinity of the Proposal site. Background dust deposition across much of NSW is typically measured in the range of 1 g/m^2/month to 2 g/m^2/month, expressed as an annual average. In the absence of data to quantify existing baseline, modelling has focussed on the incremental contribution from the Proposal and assessed against the NSW EPA incremental criterion of 2 g/m^2/month. This is effectively equivalent to assuming the existing baseline is less than or equal to 2 g/m^2/month.

3.2.3 Adopted background for cumulative assessment

To demonstrate compliance with the impact assessment criteria described in **Section 2.4**, consideration of cumulative air quality impacts is required, including how the Proposal will interact with existing and future sources of air emissions. For cumulative assessment in this report, baseline air quality is assumed to include the contribution from all existing emissions sources, summarised in Section 5, and the background values adopted for cumulative assessment are summarised in **Table 3-2**. For short term impacts, daily varying PM_{10} and $PM_{2.5}$ concentrations are paired with modelling predictions for assessment of cumulative impacts.

Table 3-2: Adopted background for cumulative assessment

Pollutant	**Averaging period**	**Adopted background value**
PM_{10}	24-hour average	Daily varying
	Annual average	16.0 µg/m³
$PM_{2.5}$	24-hour average	Daily varying
	Annual average	7.7 µg/m³
TSP	Annual average	40.0 µg/m³
Dust deposition	Annual average	<= 2 g/m^2/month

[3] Includes a 24-hour period when the concentration equals 50 µg/m³

[4] Reported in Quarterly Air Quality Monitoring Reports - http://www.environment.nsw.gov.au/aqms/datareports.htm#quarterlies

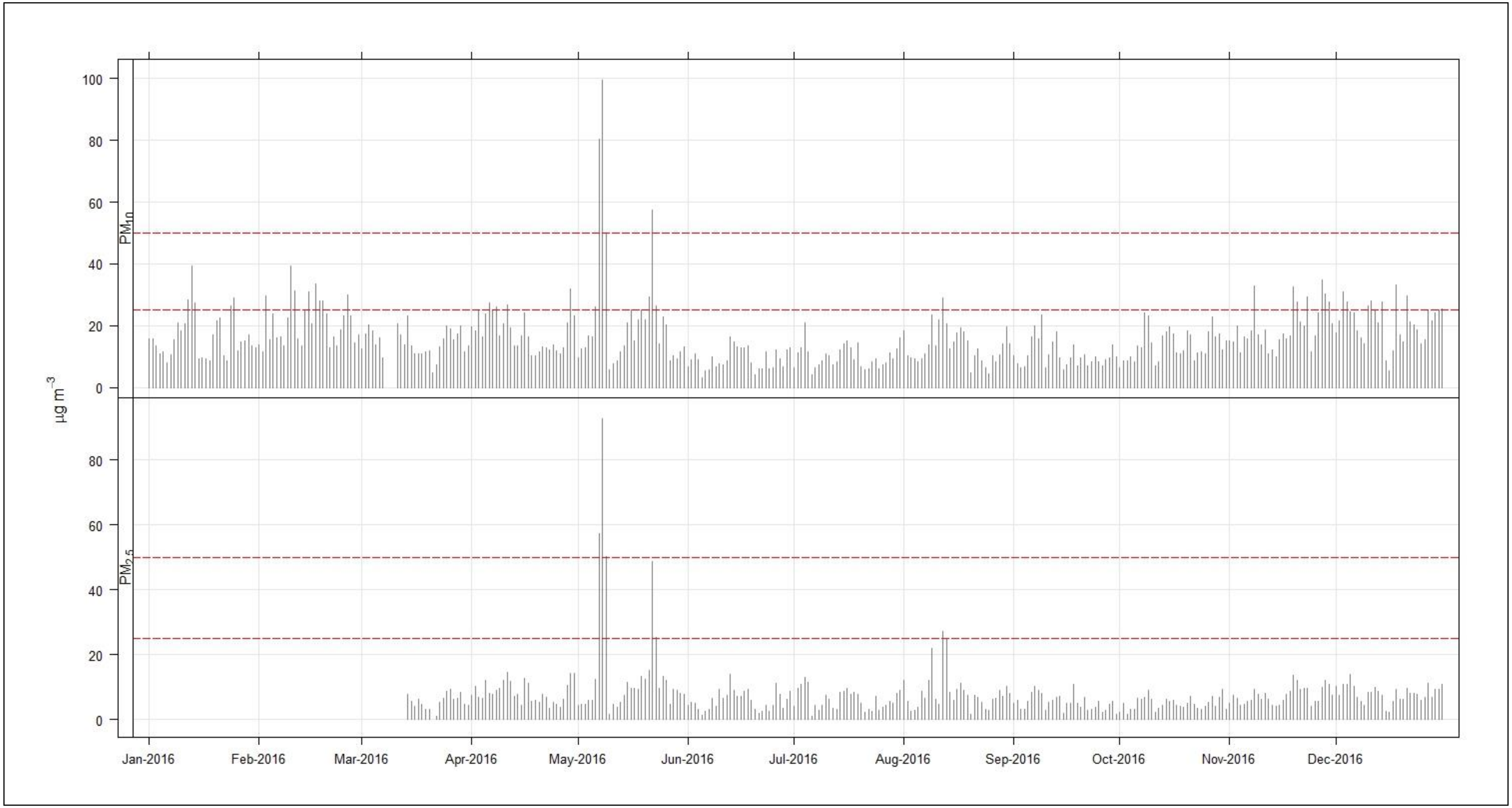


Figure 3-6: 24-hour average PM_{10} and $PM_{2.5}$ concentrations for 2016 at St Marys

4. EMISSION INVENTORY

4.1 Overview

Emission factors developed by the US EPA[5] have been applied to estimate the amount of dust produced by each activity (wheel generated dust, waste handling / processing and wind erosion).

Emissions estimates have been developed for TSP, PM_{10} and $PM_{2.5}$, with the emission estimates for TSP also used to estimate dust deposition rates. Further details on the emission inventory development, including the assumptions, input data and emission factors used, is provided in **Appendix 4**.

4.2 Emission controls

The Proposal includes a number of design features for dust control which are consistent with industry best practice (Sustainability Victoria, 2009; EPA SA, 2010), and outlined as follows:

- Enclosure of all material handling, processing and storage within a purpose built shed.
- Installation of a fixed sprinkler system for dust suppression within the storage shed.
- Sealing of all travel routes onsite and use of a road sweeper to clean paved surfaces of spillages and tracked material.
- Use of conveyors within the storage shed to reduce the need for material handling / transfer by front end loader or truck.
- Installation of a wheel wash at the shed exits to prevent material track out onto public road.

Dust controls are incorporated into the emissions inventory for each relevant dust source based on control efficiencies reported in the literature. All activities occurring within the shed are assigned a control efficiency of 70%. This is based on, for example, reported control efficiencies for enclosure of conveyors (70%), or a combination of wind shielding (40%) and watering (50%) which can be applied to stockpiles and material unloading. To account for the operation of the road sweeper on the access road a control efficiency of 50% is assumed while for travel routes within the shed a control efficiency of 70% is applied (i.e. for enclosure or a combination of wind shielding and watering).

A summary of the annual TSP, PM_{10} and $PM_{2.5}$ emissions is presented in **Table 4-1**, comparing uncontrolled emissions with the controlled emissions used for modelling. The measures described above result in an overall reduction in emissions of approximately 65% for TSP and PM_{10} and approximately 40% for $PM_{2.5}$. The overall reduction is lower for $PM_{2.5}$ because of the relatively higher contribution of diesel emissions for $PM_{2.5}$, which are not controlled (see **Section 4.4**).

4.3 Emission scenarios

Emissions are estimated for a 'normal' operational scenario, based on an annual production rate of 350,000 tonnes per annum. An additional 'peak day' scenario is also presented, to assess maximum daily average PM_{10} and $PM_{2.5}$ concentrations based on a worst case daily production rate of 2,400 tonnes per day (refer **Table 5-2**). The peak scenario is based on the maximum processing rate that the processing equipment can handle (100 tonnes per hour) operating continuously for 24 hours. This represents a doubling of the average daily production rate based for 350,000 tonnes per annum.

4.4 Diesel emissions

The emission factors for these activities do not separate PM emissions that results from mechanical processes and / or diesel exhaust. The extent to which the emissions factors account for the exhaust component varies according to the monitoring method which was used in deriving the emission factor. To be conservative for this assessment, we have assumed that the emissions factors do not include the exhaust component and emissions from diesel combustion

[5] US EPA AP-42 Compilation of Air Pollutant Emission Factors (US EPA, 1998b; US EPA, 2004; US EPA, 2006).

are explicitly included as a separate emissions source. The methodology for estimating diesel emissions is described in **Appendix 4**.

Table 4-1: Particulate matter emissions for normal operations (kg/annum) – uncontrolled and controlled

Activity	Uncontrolled emissions (kg/annum)			Controlled emissions (kg/annum)		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Wheel generated dust - trucks on access roadway	133.0	25.5	6.2	66.5	12.8	3.1
Wheel generated dust - trucks moving within the building	133.0	251.2	6.2	39.9	75.4	1.9
Trucks unloading	209.1	98.9	15.0	62.7	29.7	4.5
Ex/FEL sorting	209.1	98.9	15.0	62.7	29.7	4.5
Ex/FEL loading hopper	209.1	98.9	15.0	62.7	29.7	4.5
Screening	4,375.0	1,505	151	1,312.5	452	45.2
Transfer points	836.5	396	60	250.9	119	18.0
Unloading to storage bays	209.1	98.9	15.0	62.7	29.7	4.5
FEL loading trucks	209.1	98.9	15.0	62.7	29.7	4.5
Wind erosion	119.0	59.5	8.9	35.7	17.9	2.7
Diesel combustion - equipment operating in building	214.2	214	196	214.2	214	196
Diesel combustion - on-road trucks	6.0	6.0	5.5	6.0	6.0	5.5
Total (kg/yr)	**6,862**	**2,952**	**508**	**2,239**	**1,045**	**295**

Table 4-2: Particulate matter emissions for peak day scenario (kg/day) - controlled

Activity	kg/day		
	TSP	PM_{10}	$PM_{2.5}$
Wheel generated dust - trucks on access roadway	N/A[1]	0.05	0.01
Wheel generated dust - trucks moving within the building		0.29	0.01
Trucks unloading		0.20	0.10
Ex/FEL sorting		0.20	0.10
Ex/FEL loading hopper		0.20	0.10
Screening		3.10	0.31
Transfer points		0.81	0.03
Unloading to storage bays		0.20	0.10
FEL loading trucks		0.20	0.10
Wind erosion		0.002	0.0003
Diesel combustion - equipment operating in building		1.43	1.31
Diesel combustion - on-road trucks		0.02	0.02
Total (kg/yr)		**6.72**	**2.2**

Note: [1] TSP emissions for a peak day are not required because the impact assessment criteria are expressed as an annual average

5. DISPERSION MODELLING RESULTS

5.1 PM_{10} and $PM_{2.5}$

The predicted Proposal-only and cumulative ground level concentrations (GLCs) of PM_{10} and $PM_{2.5}$ at each sensitive receptor for normal operations are presented in **Table 5-1**. The Proposal-only incremental concentrations are minor, in the context of the existing background levels and when compared against the impact assessment criteria.

The highest annual average PM_{10} and $PM_{2.5}$ concentrations occur at AR1 (the golf course off Links road) at 0.7 µg/m³ and 0.2 µg/m³ respectively. When background is added, the cumulative annual average GLCs comply with the impact assessment criteria at all sensitive receptors.

Modelling results for 24-hour PM_{10} and $PM_{2.5}$ concentrations are presented for normal operations and a peak day scenario (**Table 5-2**). As described above, the peak scenario represents a doubling of the average daily production rate, which in turn results in approximately a two fold increase in emissions and predicted GLCs.

For normal operations, a maximum 24-hour average PM_{10} of 1.9 µg/m³ and maximum 24-hour average $PM_{2.5}$ concentration of 0.7 µg/m³ is predicted at AR1, increasing to 3.6 µg/m³ and 1.5 µg/m³ respectively for the peak day scenario. Cumulative predictions for 24-hour PM_{10} and $PM_{2.5}$ include a daily varying baseline and the analysis shows that the Proposal would result in no additional exceedances of the impacts assessment criteria, for either normal operations or the peak day scenario.

As described in **Section 3.2**, the background dataset contains existing exceedances of the impact assessment criteria and the cumulative 24-hour average PM_{10} is therefore calculated using the 5th highest background day (excluding the four days already at or over 50 µg/m³) and the cumulative 24-hour average $PM_{2.5}$ is calculated using the 8th highest background day (excluding the seven days already over 25 µg/m³).

Table 5-1: Normal operations – PM_{10} an $PM_{2.5}$ modelling predictions for sensitive receptors

Receptor	PM_{10} (µg/m³)				$PM_{2.5}$ (µg/m³)			
	24-Hour Max		Annual Ave		24-Hour Max		Annual Ave	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Criteria	50 µg/m³		25 µg/m³		25 µg/m³		8 µg/m³	
Receptor Max	**1.9**	**40.2**	**0.7**	**16.7**	**0.7**	**22.3**	**0.2**	**7.9**
R1	0.2	39.3	0.1	16.1	0.1	22.0	<0.1	7.7
R2	0.2	39.3	0.1	16.1	0.1	22.0	<0.1	7.7
R3	0.4	39.3	0.1	16.1	0.1	22.0	<0.1	7.7
R4	0.3	39.3	0.1	16.1	0.1	22.0	<0.1	7.7
R5	0.4	39.3	0.1	16.1	0.1	22.0	<0.1	7.7
R6	0.3	39.3	0.1	16.1	0.1	22.0	<0.1	7.7
R7	0.5	39.4	0.2	16.2	0.2	22.1	0.1	7.8
AR1	1.9	40.2	0.7	16.7	0.7	22.3	0.2	7.9

Table 5-2: Peak day – PM_{10} an $PM_{2.5}$ modelling predictions for sensitive receptors

Receptor	Worst case operations			
	PM_{10} (µg/m^3) 24-Hour Max		$PM_{2.5}$ (µg/m^3) 24-Hour Max	
	Increment	Cumulative	Increment	Cumulative
Goal	50 µg/m^3		25 µg/m^3	
Receptor Max	**3.6**	**41.2**	**1.5**	**22.7**
R1	0.4	39.4	0.2	22.1
R2	0.3	39.4	0.1	22.1
R3	0.8	39.4	0.3	22.1
R4	0.5	39.4	0.2	22.1
R5	0.8	39.4	0.3	22.1
R6	0.6	39.4	0.2	22.0
R7	0.9	39.6	0.4	22.1
AR1	3.6	41.2	1.5	22.7

5.2 TSP and Dust Deposition

The predicted Proposal-only and cumulative ground level concentration of TSP and dust deposition at each sensitive receptor for normal operations are presented in **Table 5-3**. The Proposal-only incremental TSP concentrations are minor, in the context of the existing background levels and when compared against the impact assessment criteria. The highest annual average TSP concentration of 1.0 µg/m^3 occurs at AR1 (the golf course off Links road). When background is added, the cumulative annual average GLCs comply with the impact assessment criteria at all sensitive receptors.

The predicted incremental dust deposition at all receptors is less than 0.05 g/m^2/month at all receptors.

Table 5-3: Normal operations – TSP and dust deposition modelling predictions for sensitive receptors

Receptor	TSP (µg/m^3)		Dust Deposition (g/m^2/month)	
	Annual Ave		Annual Ave	
	Increment	Cumulative	Increment	Cumulative
Goal	90 µg/m^3		2g/m^2/m	4g/m^2/m
Receptor Max	**1.0**	**41.0**	**<0.1**	**2.0**
R1	0.1	40.1	<0.1	2.0
R2	0.1	40.1	<0.1	2.0
R3	0.1	40.1	<0.1	2.0
R4	0.1	40.1	<0.1	2.0
R5	0.1	40.1	<0.1	2.0
R6	0.1	40.1	<0.1	2.0
R7	0.2	40.2	<0.1	2.0
AR1	1.0	41.0	<0.1	2.0

6. MANAGEMENT AND MONITORING

6.1 Construction phase

The principal emissions during the construction phase will be dust from activities including:

- Demolition of existing structures and handling of demolition material.
- Bulk earthworks and handling of fill material, including for intersection upgrades.
- Movement of heavy plant and machinery within the site on unsealed areas and for intersection upgrades.
- Wind erosion from exposed surfaces.

The following measures for controlling dust during construction should be considered.

6.1.1 Demolition

Where practicable, materials and structures should be dampened using water sprays prior to demolition. During adverse weather (hot, dry and windy conditions), consideration should be given to modify demolition activities when dust is seen leaving the site.

6.1.2 Bulk earthworks

6.1.3 Where practicable fill material should be dampened using water sprays prior to handling. Work practices should be modified during periods of adverse weather (hot, dry and windy conditions) or when dust is seen leaving the site (i.e. limiting material handling or increase watering). Haulage and heavy plant and equipment movements

Vehicles travelling over paved or unpaved surfaces produce wheel generated dust and can result in dirt track-out on paved surfaces surrounding the work areas. Mitigation measures include:

- Operation of a water cart on all unsealed internal roadways and travel routes.
- All vehicles on-site should be confined to a designated route with a speed limit of <10km/hr enforced.
- Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips.
- Dirt track-out should be managed using shaker grids and / or wheel cleaning. Dirt that has been tracked onto public roads should be cleaned as soon as practicable.
- All trucks delivering fill or leaving the site with spoil material will have their load covered.

6.1.4 Wind erosion

Wind erosion from exposed ground should be limited by avoiding unnecessary surface disturbance and limiting to the minimum footprint required.

6.2 Operational phase

The principal emission sources during the operation of the Proposal will be fugitive dust from activities including:

- Movement of vehicles on travel routes and re-entrainment of dust from paved surfaces.
- Material handling (trucks unloading, loading, screening, sorting).
- Diesel vehicle exhaust from the trucks, front end loaders, excavators etc.

As outlined in **Section 4.2**, a number of design features have been incorporated into the Proposal specifically for dust control, including:

- Enclosure of all material handling, processing and storage within a purpose build shed.
- Installation of a fixed sprinkler system within the storage shed and an external sprinkler system for external hardstand areas for dust suppression.
- Sealing of all travel routes onsite and use of a road sweeper to clean paved surfaces of spillages and tracked material.
- Use of conveyors within the storage shed to reduce the need for material handling / transfer by front end loader or truck.
- Installation of a wheel wash at the shed exits to prevent material track out onto public road.

Prior to commencement, the Proponent will develop and implement an Operational Environmental Management Plan (OEMP) which will outline the roles, responsibilities and the tasks to be performed to ensure environmental impacts are minimised.

- The OEMP will describe, as a minimum, the implementation of the design features described above plus the following air quality management measures: Ensure equipment is well maintained in accordance with the manufacturer's specifications.
- Equipment with smoky exhausts (more than 10 seconds) should be inspected for maintenance/repair.
- Waste receipt and dispatch (loading and unloading) coordinated to minimise truck movements.
- Un-necessary idling avoided through communication and information signs.
- Ensure all trucks have their loads covered.

6.3 Monitoring

Dust monitoring onsite will comprise visual checks throughout the day and completion of a daily checklist by the Site Supervisor. Daily visual checks of excessive dust generated at source (wheel generated dust, material handling) would be used to implement additional controls, such as increased watering or surface sweeping, and ensure no dust is leaving the site.

7. CONCLUSION

Local air quality impacts from the Proposal are assessed using a Level 2 assessment approach in accordance with the Approved Methods. Emissions are estimated for all Proposal related activities and dispersion modelling is used to predict ground level concentrations at surrounding sensitive receptors. Cumulative impacts are assessed by combining the contribution from the Proposal with the existing ambient air quality environment, described based on baseline monitoring data.

Emissions inventories have been developed for TSP, PM_{10} and $PM_{2.5}$ for a representative operational scenario, based on an annual production rate of 350,000 tpa. In addition, predictions of maximum daily average PM_{10} and $PM_{2.5}$ concentrations have been made based on a worst case daily production rate of 2,400 tonnes per day.

The predicted Proposal-only incremental ground level concentrations for PM_{10} and $PM_{2.5}$ are minor at all sensitive locations, when compared to existing background and the relevant impact assessment criteria. Cumulative predictions for all pollutants (TSP, PM_{10}, $PM_{2.5}$ and dust deposition) comply with the relevant impact assessment criteria for all relevant averaging periods and do not result in any additional exceedances.

8. GLOSSARY OF TERMS AND ACONYMNS

$\mu g/m^3$	micrograms per cubic metre
µm	micron
Approved Methods	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
AQIA	Air quality impact assessment
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CO	Carbon Monoxide
CO_2	Carbon dioxide
EPA	Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environmental Protection Licence
DP&E	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
GLC	Ground level concentrations
ISC	Industrial Source Complex
km	kilometre
m	metre
m/s	Metres per second
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
OSD	Onsite stormwater detention
PCC	Penrith City Council
PM	particulate matter
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 µm
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 µm
Proposal	The St Mary's Resource Recovery Facility
RRF	Resource Recovery Facility
SEARs	Secretary's Environmental Assessment Requirements
SO_2	Sulphur Dioxide
SSD	State Significant Development
TAPM	The Air Pollution Model
tpa	Tonnes per annum
TSP	Total suspended particulate matter
US EPA	United States Environment Protection Agency
VOCs	volatile organic compounds

9. REFERENCES

Australian Bureau of Statistics (2015). 9208.0 – Survey of Motor Vehicle Use, Australia, 12 months ended 31 October. Website: http://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0/.

ENVIRON (2015). SIMTA Moorebank Intermodal Facility - Air Quality Impact Assessment. Prepared for Hyder Consulting. Prepared by ENVIRON Australia Pty Ltd. 26/05/2015. Project Number AS121793.

EPA Victoria (2013). Guidance notes for using the regulatory air pollution model AERMOD in Victoria. Publication 1551. October 2013. Authorised and published by EPA Victoria, 200 Victoria St, Carlton.

NEPC (1998). National Environmental Protection Measure for Ambient Air Quality. National Environmental Protection Council.

NEPC (2003). National Environmental Protection Measure (Ambient Air Quality) Measure, as amended, made under the National Environment Protection Act 1994. National Environmental Protection Council, 7 July 2003.

NEPC (2015). Variation to the National Environment Protection (Ambient Air Quality) Measure. National Environment Protection Act 1994. National Environmental Protection Council, 15 December 2015.

NSW EPA (2005). Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, August 2015.

NSW EPA (2012). Technical Report No. 6. Air Emissions Inventory for the Greater Metropolitan Region in New South Wales. 2008 Calendar Year. Off Road Mobile Emissions: Results.

NSW EPA (2016). Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, minor revisions November 2016, published January 2017.

Oke T.T. (2003). Boundary Layer Climates, Second Edition, Routledge, London and New York, 435 pp.

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

Stull R. B. (1997). An Introduction to Boundary Layer Meteorology, Kluwer Academic Publishers, London.

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

US EPA (1998a). Emission Factor Documentation for AP-42. Section 13.2.2. Unpaved Roads. Final Report for U.S. United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Factor and Inventory Group. MRI Project No. 4864. September 1998.

US EPA (1998b). AP-42 Emission Factor Database, Chapter 11.9 Western Surface Coal Mining, United States Environmental Protection Agency, 1998.

US EPA (2004). User’s Guide for the AMS/EPA Regulatory Model - AERMOD.

US EPA (2006). AP-42 Emission Factor Database, Chapter 13.2.5 Industrial Wind Erosion, United States Environmental Protection Agency, November 2006.

APPENDIX 1
WASTE TYPES

Table A1-1: Waste types

Waste	Description	Other Limits	Estimated Volume (%)	Estimated Volume (tonnes)
				350,000
GSW (Non putrescible)	GSW (non putrescible) including but not limited to materials listed in this table			N/A
General solid waste (non- putrescible)	Foundry sand waste that meets all conditions of a resource recovery order under Clause 91 of the Protection of the Environment Operations (Waste) Regulation 2014	-	0.1	350.00
General solid waste (non- putrescible)	Virgin excavated natural material as defined in Schedule 1 of the POEO Act, in force from time to time	-	4	14,000.00
General solid waste (non- putrescible)	Building and demolition waste as defined in Schedule 1 of the POEO Act, in force from time to time	Any individual material or mixture of building and demolition materials	75	262,500.00
General solid waste (non- putrescible)	Soil that meet the CT1 thresholds for general solid waste in Table 1 of the Waste Classification Guidelines as in force from time to time with the exception of the maximum threshold values for contaminants specified in the 'Other Limits' column		10	35,000.00
General solid waste (non- putrescible)	Asphalt waste (including asphalt resulting from road construction and waterproofing works as defined in Schedule 1 of the POEO Act, in force from time to time	-	1	3,500.00
General solid waste (non- putrescible)	Office and packaging waste (including paper, plastics, glass, metal, timber) that is not contaminated or mixed with any other type of waste	-	2	7,000.00
General solid waste (non- putrescible)	Non -chemical waste generated from manufacturing and services (including metal, timber, paper, ceramics, plastics, thermosets and composites)	-	2	7,000.00
General solid waste (non- putrescible)	Household waste from municipal clean up that does not contain food as defined in Schedule 1 of the POEO Act, in force from time to time		2	7,000.00

Waste	Description	Other Limits	Estimated Volume (%)	Estimated Volume (tonnes)
				350,000
General solid waste (non- putrescible)	Garden waste as defined in Schedule 1 of the POEO Act, in force from time to time		0.2	700.00
General or Specific Exempted Waste	Waste that meets all conditions of a resource recovery order under Clause 91 of the Protection of the Environment Operations (Waste) Regulation 2014		0.2	700.00
General solid waste (non- putrescible)	Glass, plastic, rubber, plasterboard, ceramics, bricks, concrete or metal		0.4	1,400.00
General solid waste (non- putrescible)	Paper or cardboard		0.4	1,400.00
General solid waste (non- putrescible)	Wood waste		2	7,000.00
General solid waste (non- putrescible)	Any mixture of wastes referred to above		Mix	N/A
General Solid Waste (non- putrescible)	Bulky goods waste containing building de-fit fittings, fixtures and furniture that is not contaminated or mixed with any other type of waste		0.1	350.00
General solid waste (non- putrescible)	Waste collected by, or on behalf of local councils from street sweepings		0.1	350.00
General solid waste (non- putrescible)	Grit, sediment, litter, gross pollutants collected in and removed from stormwater treatment devices and or stormwater management systems that have been dewatered so that they do not contain free liquids		0.1	350.00
General solid waste (non- putrescible)	Grit and screenings from potable water and water reticulation plants that have been dewatered so that they do not contain free liquids		0.1	350.00
General solid waste (non- putrescible)	Non-putrescible vegetative waste from agriculture, silviculture or horticulture		0.1	350.00
General solid waste (non- putrescible)	Cured concrete waste from a batch plant		0.1	350.00

Waste	Description	Other Limits	Estimated Volume (%)	Estimated Volume (tonnes)
				350,000
Unexpected finds	materials such as asbestos, tyres, batteries, gas bottles, fire extinguishers and food.	Limited to waste identified during inspection and resource recovery operations being unexpected finds in tipped, unprocessed and processed material. Storage only for the purposes of safe and lawful handling, storage and transport to a lawful facility.	0.1	350.00
		TOTAL	100	

APPENDIX 2
OVERVIEW OF DISPERSION MODELLING

Overview of modelling approach

Local air quality modelling is presented using the AERMOD system, which is composed of two pre-processors that generate the input files required by the AERMOD dispersion model: AERMET (for the preparation of meteorological data) and AERMAP (for the preparation of terrain data).

AERMET is run using the 'onsite' processing option using hourly measurements from the St Marys monitoring station. For parameters not measured at St Marys (i.e. atmospheric pressure) data were obtained data from the nearest BoM site at Penrith and Richmond. TAPM was also used to derive a vertical temperature profile for modelling. The TAPM vertical temperature profile was adjusted by first substituting the predicted 10 m above ground temperature with the hourly measured temperature at 10 m. The difference between the TAPM predicted temperature and the measured 10 m temperature was applied to the entire predicted vertical temperature profile. This modified vertical profile was used in combination with the ambient air temperature throughout the day to calculate convective mixing heights between sunrise and sunset and included in the AERMET input data.

Values for surface roughness length, albedo, and Bowen ratio were selected using the AERSURFACE Utility by assigning appropriate land use types in the vicinity of the Project. Surface roughness length is the height at which the mean horizontal wind speed approaches zero and is related to the roughness characteristics of the surrounding area. For example, low flat landscapes are assigned a lower surface roughness length than urban or forest areas. Bowen ratio relates to the amount of moisture at the surface and plays an important role in deriving Monin-Obukhov length and therefore atmospheric stability. Albedo is defined as the fraction of incoming solar radiation reflected from the ground when the sun is overhead.

Terrain data for the wider modelling domain was sourced from NASA's Shuttle Radar Topography Mission data. This data set provided a high-resolution topography at 3 arc-second (~90 m) grid spacing.

Modelling was completed for three size fractions; TSP, PM_{10} and $PM_{2.5}$ based on a mean particle diameter of 15 microns for TSP, 5 microns for PM_{10} and 1 micron for $PM_{2.5.}$ All activities are represented by a series of volume sources located across the site corresponding to the access road and the building location.

For modelling volume sources, estimates of horizontal spread (initial sigma y [σy]) and vertical spread (initial sigma z [σz]) need to be assigned. For all sources, a value of 10 m is assigned for σy and 2 m for σz.

APPENDIX 3
WIND ROSES

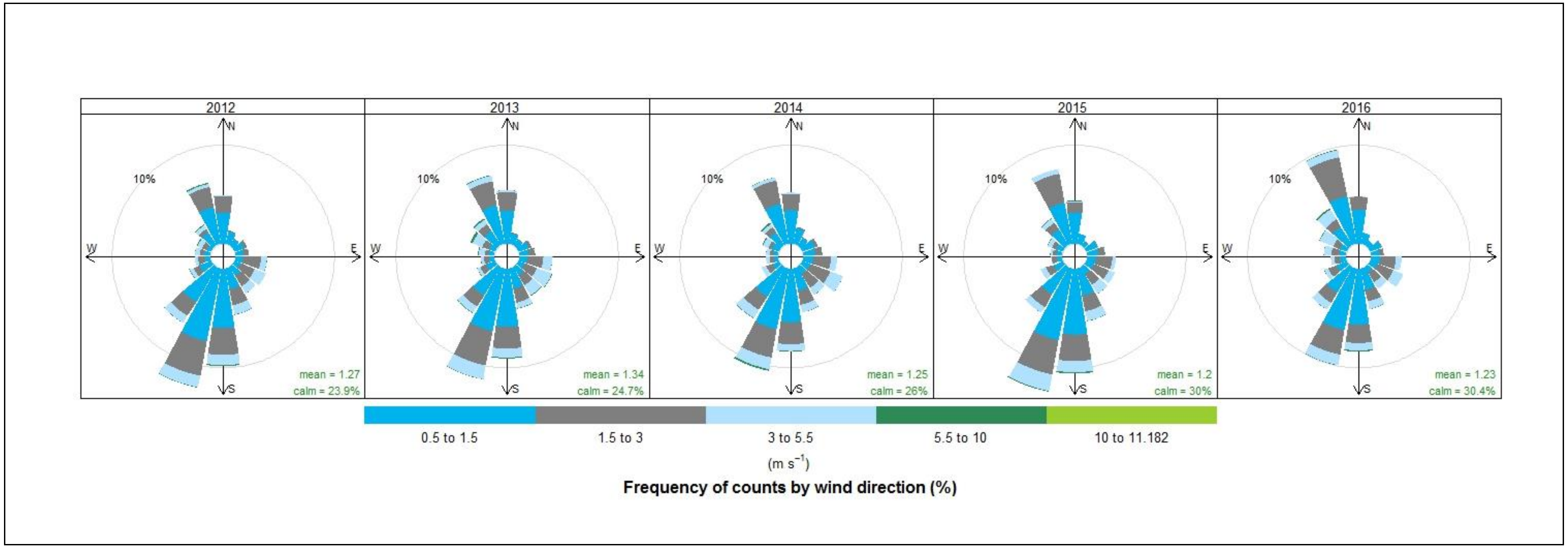


Figure A3-1: Annual wind roses for St Marys - 2012-2016

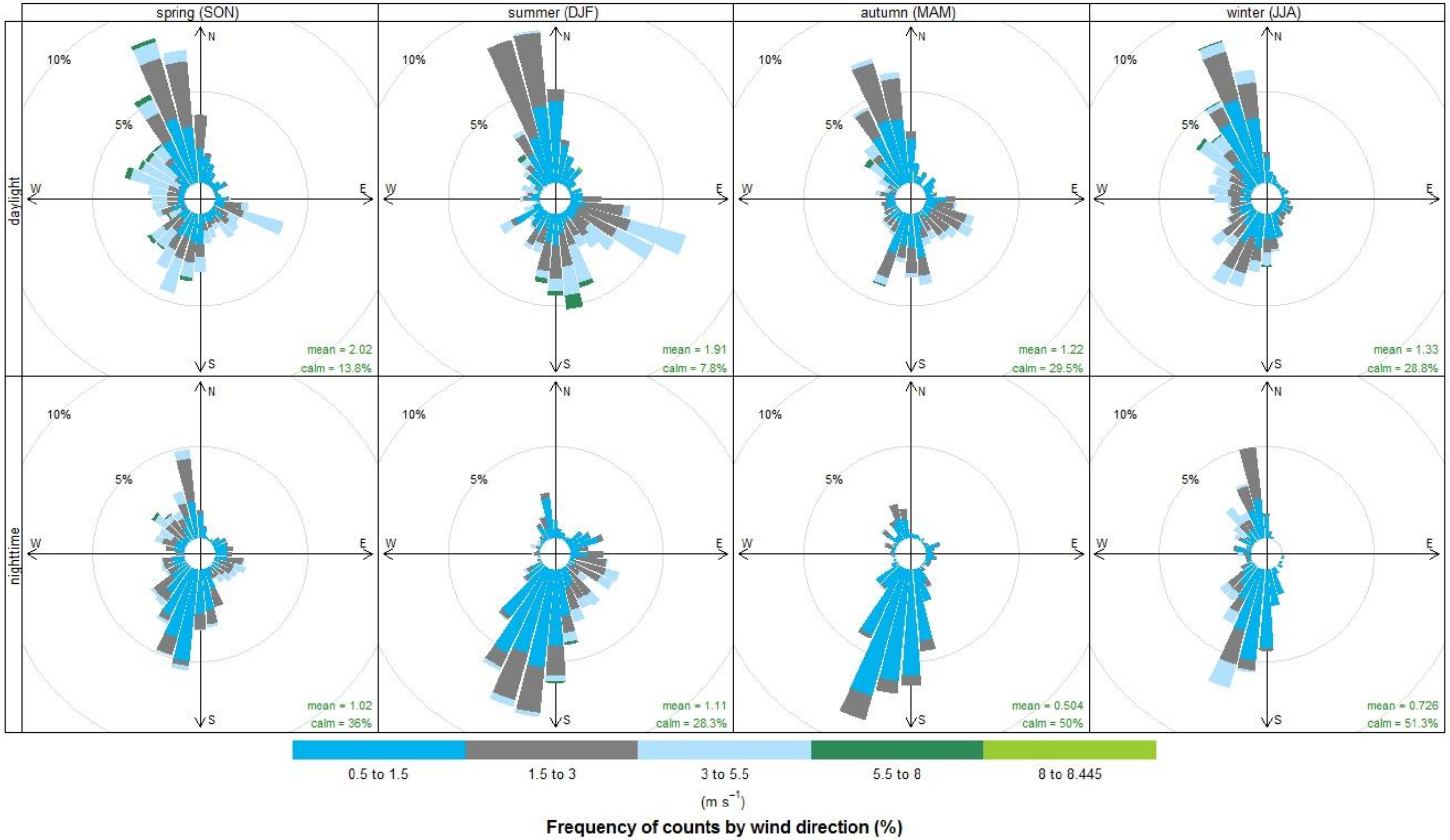


Figure A3-2: Seasonal wind roses for St Marys - 2016

APPENDIX 4
EMISSIONS INVENTORY DEVELOPMENT

Dust emissions were estimated using US EPA AP-42 emission factors and predictive equations taken from the following chapters:

- Chapter 11.9 Western Surface Coal Mining.
- Chapter 13.2.2 Unpaved Roads.
- Chapter 13.2.1 Paved Roads
- Chapter 13.2.4 Aggregate Handling and Storage Piles.
- Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing.
- Chapter 13.2.5 Industrial Wind Erosion.

The material properties listed in **Table A4-1** are used as input to the various emission factor equations listed in **Table A4-2** to derive site specific uncontrolled emission factors for each source.

Table A4-1: Material properties

Properties	Value	Source of Information
Silt loading of paved surface	0.6 g/m2 7.4 g/m2	AP42 13.2.1 Table 13.2.1-2 Access road – ubiquitous baseline for ADT volume <500 Inside the building – for municipal solid waste landfills
Return travel distance for paved surface	0.34	Estimated from aerial photography
Average truck load	30 t	Weighted average for all trucks
Truck weight	35 t	Average of loaded and unloaded vehicle mass
Moisture content of raw material and product	2%	AP42 13.2.4 Table 13.2.4-1 – value for stone quarrying and processing – various limestone products
Area for storage bays	0.1 ha	Estimated shed dimensions

Emissions were quantified for each particle size fraction, with the TSP size fraction also used to predict dust deposition rates. Fine particles (PM_{10} and $PM_{2.5}$) were estimated using the fraction specific equations or ratios for the different particle size fractions available within the literature (shown in **Table A4-2**).

Emissions from onsite diesel consumption are estimated as follows:

- For on-road trucks, we have assumed a truck fuel consumption of 56.9 litres per 100 km and emission factor of 1.2 kg/kl and 1.1 kg/kl for PM_{10} and $PM_{2.5}$.
- For onsite equipment, (3 excavators, 2 FEL) for the crusher and FEL, a combined daily diesel consumption of 85 litres per hour and 12 hours per day operation (50% utilisation) with US EPA Tier 3 emission factors (kg/kL).

Table A4-2: Equations and emission factors

Inventory activity	Units	TSP emission factor/equation	PM_{10} emission factor/equation	$PM_{2.5}$ emission factor/equation	EF source
Material handling (loading trucks unloading trucks, loading crusher)	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right)$	AP42 13.2.4
Wind erosion	kg/ha/yr	0.85×1000	0.5 * TSP	0.075 * TSP	AP42 11.9 & 13.2.5
Hauling on sealed surfaces	g/VKT	$3.23\ x\ sL^{0.91} \times W^{1.02}$	$0.62\ x\ sL^{0.91} \times W^{1.02}$	$0.15\ x\ sL^{0.91} \times W^{1.02}$	AP43 13.2.1
Screening	kg/t	0.0125	0.0043	0.00043	AP42 11.19.2

Note: VKT = vehicle kilometre travelled; U = wind speed (m/s); M = moisture content (%); s = silt content (%); W = vehicle weight (t); S = speed (km/hr); ha = hectares, sL = silt loading

APPENDIX 5
MODELLING PREDICTIONS AT ADJACENT INDUSTRIAL RECEPTORS

Adjacent industrial / commercial premises

Modelling predictions at the adjacent industrial / commercial premises are show in **Table A5-1**, **Table A5-2** and **Table A5-3**. The modelling predictions show that cumulative 24-hour average and annual average PM_{10} concentrations exceed the impact assessment criteria at one of the adjacent industrial premises. Cumulative 24-hour average $PM_{2.5}$ concentrations exceed the impact assessment criteria at one of the adjacent industrial premises and cumulative annual average $PM_{2.5}$ concentrations exceed the impact assessment criteria at all adjacent receptors.

Table A5-1: Normal operations – PM_{10} and $PM_{2.5}$ modelling predictions for adjacent industrial/commercial premises

Receptor	PM_{10} (µg/m³)				$PM_{2.5}$ (µg/m³)			
	24-Hour Max		Annual Ave		24-Hour Max		Annual Ave	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Goal	50 µg/m³		25 µg/m³		25 µg/m³		8 µg/m³	
Receptor Max	**30.7**	**52.7**	**11.5**	**27.5**	**8.8**	**26.2**	**3.3**	**11.0**
I1	11.6	45.9	5.0	21.0	3.5	24.0	1.5	9.2
I2	14.6	46.5	5.9	21.9	4.4	24.3	1.8	9.5
I3	30.7	52.7	11.5	27.5	8.8	26.2	3.3	11.0
I4	10.2	44.2	4.0	20.0	3.2	23.5	1.2	8.9

Table A5-2: Peak day – PM_{10} and $PM_{2.5}$ modelling predictions for adjacent industrial/commercial premises

Receptor	Worst case operations			
	PM_{10} (µg/m³) 24-Hour Max		$PM_{2.5}$ (µg/m³) 24-Hour Max	
	Increment	Cumulative	Increment	Cumulative
Goal	50 µg/m³		25 µg/m³	
Receptor Max	**60.8**	**67.5**	**20.3**	**31.6**
I1	22.9	52.1	7.7	26.5
I2	27.6	52.8	9.6	27.0
I3	60.8	67.5	20.3	31.6
I4	19.7	48.8	7.0	25.3

Table A5-3: Normal operations – TSP and dust deposition modelling predictions for adjacent industrial/commercial premises

Receptor	TSP (µg/m³)		Dust Deposition (g/m²/month)	
	Annual Ave		Annual Ave	
	Increment	Cumulative	Increment	Cumulative
Goal	90 µg/m³		2g/m²/m	4g/m²/m
Receptor Max	**20.3**	**60.3**	**0.3**	**2.3**
I1	8.1	48.1	0.1	2.1
I2	9.5	49.5	0.1	2.1
I3	20.3	60.3	0.3	2.3
I4	6.3	46.3	0.1	2.1

Figure A5-1: Proposal only 24-hour average PM_{10} contours

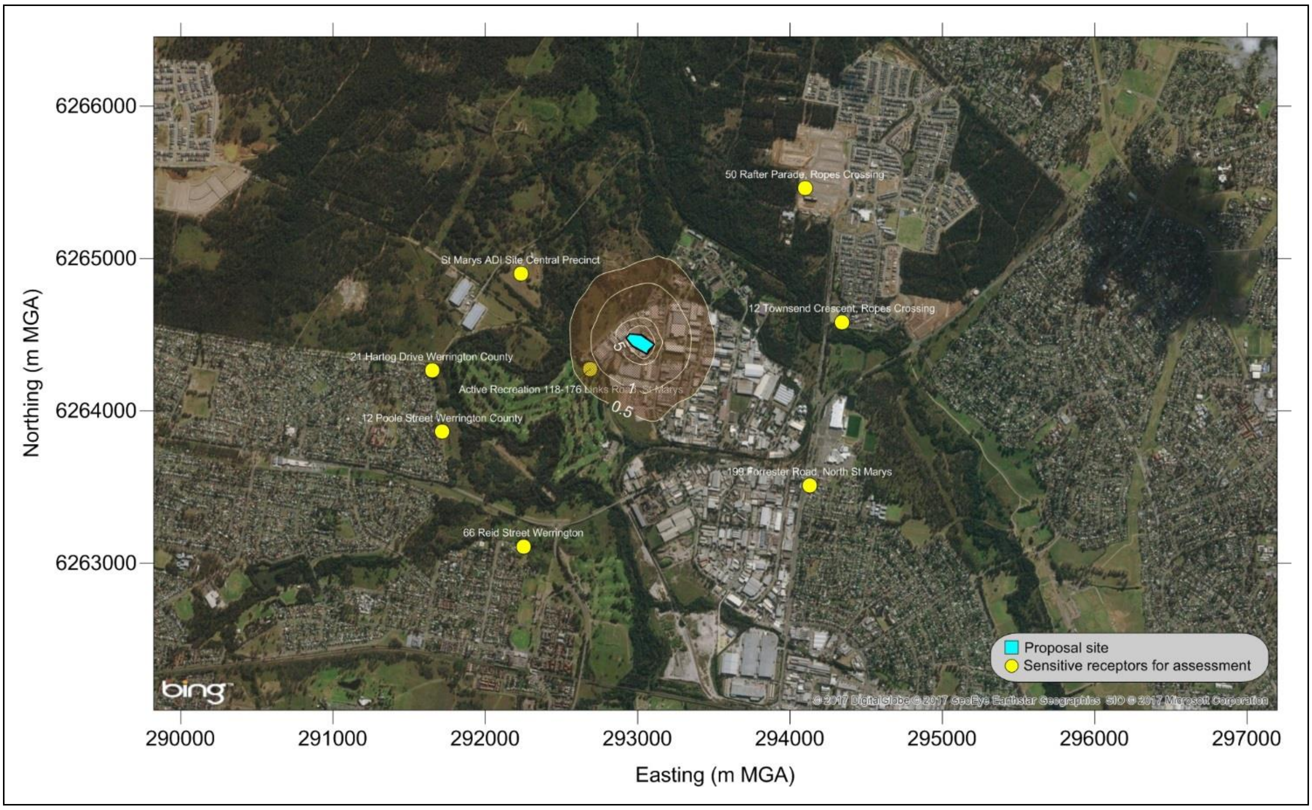


Figure A5-2: Project-only annual average PM_{10} contours

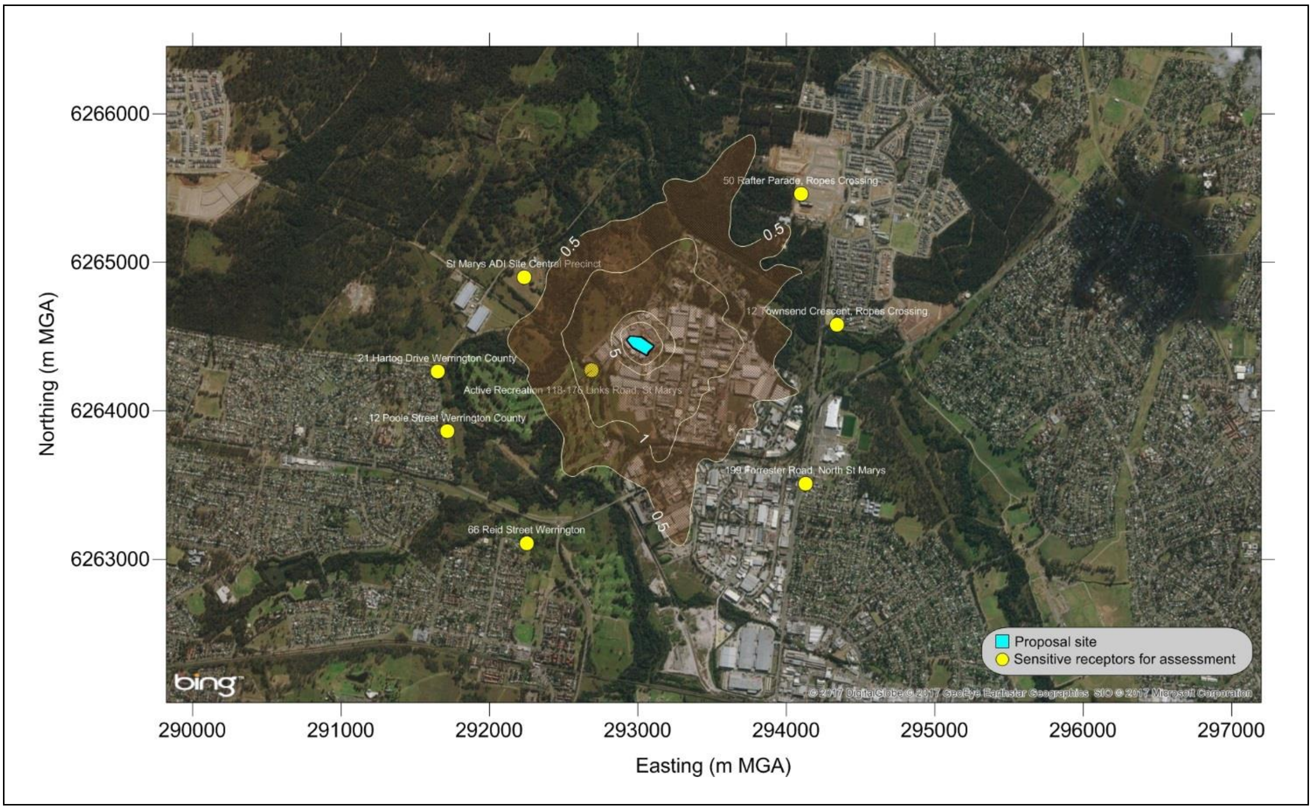


Figure A5-3: Project-only 24-hour average $PM_{2.5}$ contours

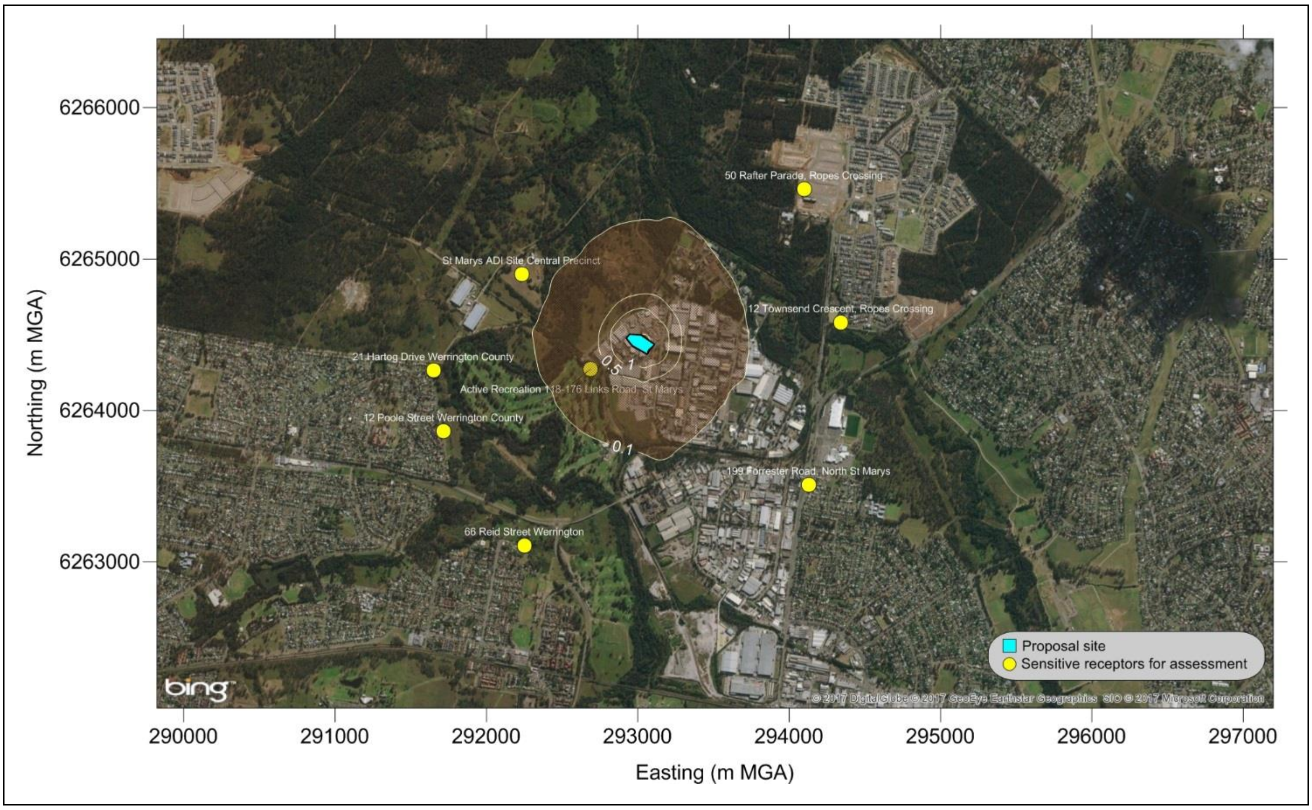


Figure A5-4: Project-only annual average $PM_{2.5}$ contours