Talison Lithium

Greenbushes Operations

S2 and S8 Waste Rock Landforms Air Quality Assessment

Final Draft Report

Version B

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Talison Lithium Greenbushes Operations

Draft Report

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Signature		

Executive Summary

Overview of assessment

Talison Lithium Australia Pty Ltd (Talison) own and operate the Greenbushes Operations (GBO) located immediately to the south of the Greenbushes townsite, approximately 250 kilometres (km) south of Perth, Western Australia.

Talison is expanding the GBO in response to market demand, increasing mining of spodumene ore and production of Lithium mineral spodumene concentrate. As part of the expansion Talison is proposing to construct an additional Waste Rock Landform (WRL) named S8. These expansion activities have the potential to increase GBO dust emissions and impact sensitive receptors and were considered in previous modelling (ETA 2024) and will now be revised to consider a redistribution of waste tonnage to other Waste Rock Landforms (S2 and S7).

This air quality assessment report has been prepared to accompany the environmental approvals application by Talison for the S8 WRL. The potential impacts of the Project were determined through a dispersion modelling study. The scope of the modelling assessment is summarised below.

Modelled meteorological period	1 January to 31 December 2019
Model selection	WRF/CALMET/CALPUFF model suite
Key Pollutants	Particulate matter (as TSP, PM_{10}, $PM_{2.5}$ and deposition)
Meteorological data	Three-dimensional prognostic meteorological data developed using the Weather Research and Forecasting (WRF) model.
Background Air Quality	Background air quality was based on Talison monitoring data and is assumed to be indicative for the Project location and setting.
Project Emissions	Emission estimation was undertaken with reference to the appropriate equations, or factors, from the *National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 3.1*. Operating parameters used to characterise sources were provided by Talison. The modelling includes fugitive dust emissions (as volume sources) and wind erosion (as area sources).
Receptors of Interest including Sensitive Receptors	Multiple set of receptors are included in the model to align with the various model applications: • Nearest sensitive receptor locations (residents) consistent with DWER guidelines for regulatory assessments. • Discrete receptor locations coinciding with GBO ambient monitoring locations.
Model Scenarios	The model scenarios included in the assessment consider the GBO in isolation of other emission sources (i.e. standalone), as well as cumulatively with the assumed background air quality (based on locally measured data).

Key findings

The key findings of the assessment are:

- For all scenarios, the predicted maximum 24-hour averaged concentrations are higher than the criterion for TSP, and PM_{10} for at-least one of the residential receptors within 1.5 km of S8 in isolation (and cumulative). $PM_{2.5}$ criterion were not always exceeded at any of these receptors for some scenarios.
- The model results indicate that there are often significant reductions in the predicted concentrations from the maximum to the 6^{th} highest at each of the receptors indicating that the elevated impacts at the receptors are limited.
- Predicted concentrations in this assessment are elevated when compared to previous assessments (ETA, 2024) however this is explained by:
    - Additional sources in the updated modelling including sources close to the town of Greenbushes and to the south of the current operations.
    - There are sources active in the north-west, close to Greenbushes, in the 'S2 only (2028)' scenario but not in 'S2 only (2030)' scenario which fits with the higher predicted concentrations at the Greenbushes receptors (R1 to R6).
    - Large emissions sources are further to the south-east in the 2030 scenarios which helps to explain higher emissions at R13 and R14 in the 'S2 only (2030)' scenario.
- Specifically;
    - Back-fill operations at Cornwall pit (CWH) are likely to be a major source of increased predicted GLCs at Greenbushes.
    - Expansion of the S2 WRL and creation of the S7 WRL to the south of operations is likely to impact residential receptors close to the S8 WRL.

A conservative approach has been used for this modelling assessment, and the levels of pollutant concentrations are likely to be lower (when measured in the environment) than predicted in this study. It is important to note that, as a risk-based assessment approach is normally applied to the assessment of air quality, a modelled result above the numerical ambient guideline value or assessment criteria is not an indicator of unacceptable impact or loss of environmental value, but is an indication that the potential risk for impact requires further consideration, such as ongoing ambient monitoring.

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1 Introduction

1.1 Background

Talison Lithium Australia Pty Ltd (Talison) own, and operate, the Greenbushes Operations (GBO) which is located immediately to the south of the Greenbushes townsite, approximately 250 kilometres (km) south of Perth, Western Australia (Figure 1-1). Mining is undertaken using traditional methods including drilling, blasting, loading ore and waste (in-pit) for haulage, crushing and processing (through one of several plants). The mining and processing is a continual process occurring for 24 hours a day, 7 days a week.

The GBO produces two categories of lithium concentrate:

- Technical Grade lithium mineral concentrate with low iron content, primarily for feedstock for glass and ceramic industries; and
- Chemical Grade concentrate used to produce batteries and greases.

Talison is expanding the GBO in response to market demand, increasing mining of spodumene ore and production of Lithium mineral spodumene concentrate. As part of the expansion Talison is proposing to construct an additional Waste Rock Landform (WRL) named S8. These expansion activities have the potential to increase GBO dust emissions and impact sensitive receptors and were considered in previous modelling (ETA 2024) and will now be revised to consider a redistribution of waste tonnage to other Waste Rock Landforms (S2 and S8).

This report revises the previous dust model (ETA 2024) dust emission and transport model for the existing activities and aforementioned S8 proposed expansion activities

Activities modelled by this study include:

- Development of a new WRL, including transport and storage of 19.1 Mtpa waste rock to the WRL.
- Wind erosion emissions from the new WRL.
- Existing modelling of processing, mining, and transport of ore.

Talison commissioned Environmental Technologies & Analytics (ETA) to undertake a desk-top air quality modelling study of the Project with the aim of determining potential air quality impacts, as documented in this report.

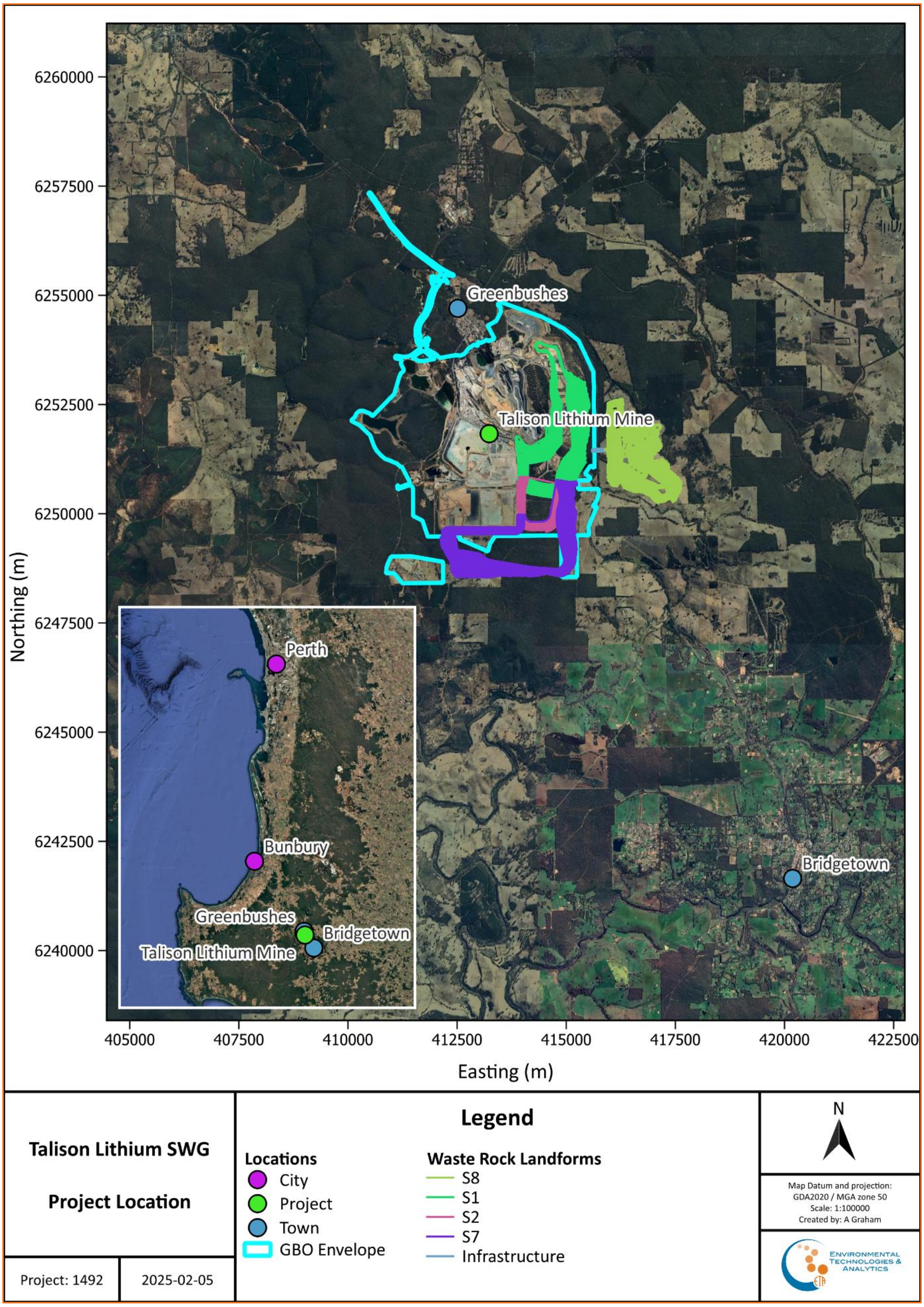


Figure 1-1: Project location and setting.

1.2 Scope of work

The objectives of this assessment include the development of a comprehensive air quality model to determine the potential change in air quality impacts at nearby receptors.

Reference has been made to the following key regulatory policy and guidance:

- Air Quality Modelling Guidance Notes (DoE, 2006)
- Guideline - Air Emissions, draft for external consultation (DWER, 2019)
- Guideline - Dust Emissions, draft for external consultation (DWER, 2021)
- Environmental Factor Guideline – Air Quality (EPA, 2020)
- Environmental Factor Guideline – Social Surrounds (EPA, 2016; EPA, 2023)
- *Environmental Protection Act, 1986, as amended*
- Environmental Protection Act Regulations 1987.

1.3 Structure of report

This report describes the methods and findings of a dispersion modelling assessment of the potential impacts to the air environment arising from the Talison operations. The assessment includes:

- The assessment methodology in Section 2.
- Atmospheric dispersion modelling of the emissions using CALPUFF in Section 3.
- Project emission estimation and inventory in Section 4.
- An evaluation of the potential impact from the Project in Section 5.
- Conclusions of the assessment are presented in Section 6.

The appendices contain supporting information, specifically:

- The analysis to determine the representative meteorological year for modelling.
- The detailed configuration for the Weather, Research & Forecast (WRF) model and CALMET (meteorological pre-processor model).
- Emission parameters and emission rates for each source modelled.

2 Assessment methodology

This section outlines the air quality study and assessment approach. It includes the methodology applied to define the meteorological characteristics of the Project area relevant to the assessment, the emission estimation, the dispersion, and the ambient assessment criteria selected for the purposes of determining the significance of the dispersion model results, and therefore the potential impact. The simplified study structure is shown in Figure 2-1 and detailed in the following subsections.

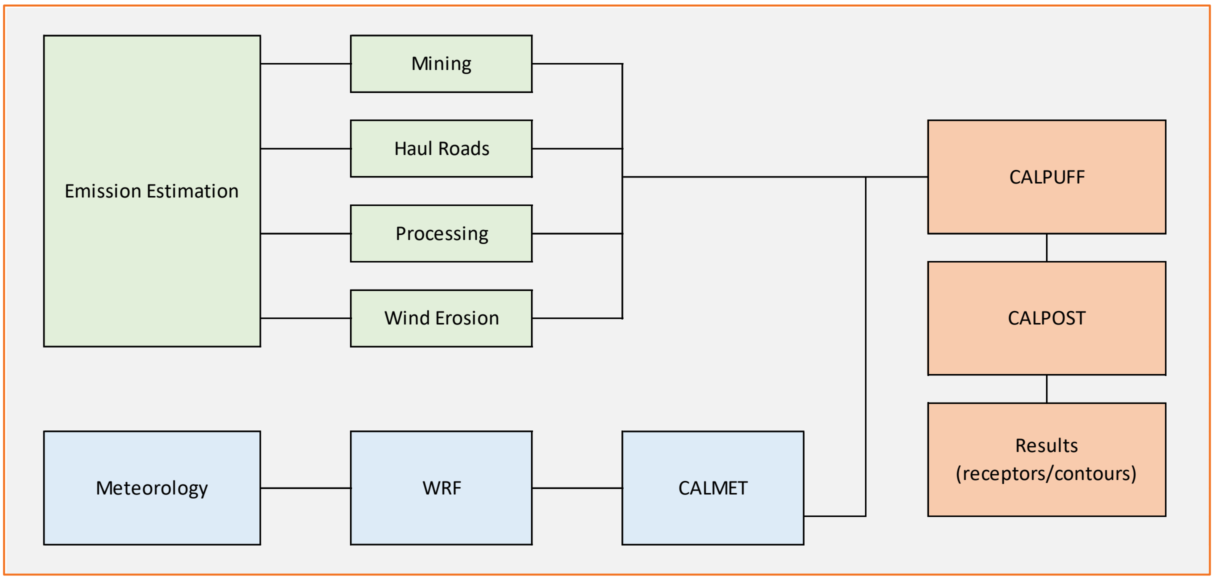


Figure 2-1: Air quality assessment – modelling approach.

2.1 Climate and Meteorology

This section outlines the key climate and meteorological characteristics of the region important for the dispersion, transformation and removal (or deposition) of pollutants from the atmosphere, and therefore ambient air quality.

The Project area is located approximately 10 km north of Bridgetown in the South West region of WA. The climate is classified according to the Köppen-Geiger climate classification system as Csa (Temperate, dry and warm summer) (Kottek et al, 2006). This is a Mediterranean climate characterised by warm, dry summers with cool and wet winters.

A summary of the long-term meteorological conditions as measured at the Bureau of Meteorology (BoM) Automatic Weather Station (AWS) at Bridgetown (009617) is shown in the following sections. Although this meteorological station is located 10 km from the Project the information is indicative of the broader region, including Greenbushes, and is appropriate for this assessment.

A review of 11 years (2012 to 2022) of historical surface observations obtained from the BoM Bridgetown AWS concluded the 2019 calendar year as being the most representative in comparison to the longer term climatic averages. The 2019 calendar year was selected for modelling on this basis. The analysis is detailed in Appendix A.

2.1.1 Temperature

Recorded temperature at the BoM Bridgetown AWS, as presented in Figure 2-2, clearly shows the Mediterranean style climate with the measured mean monthly daily maximum temperatures ranging from a high of 30.6 degrees Celsius (°C) in January to 18°C in July. The mean monthly minimum temperatures range from 7.9°C in January down to 0.3°C in July.

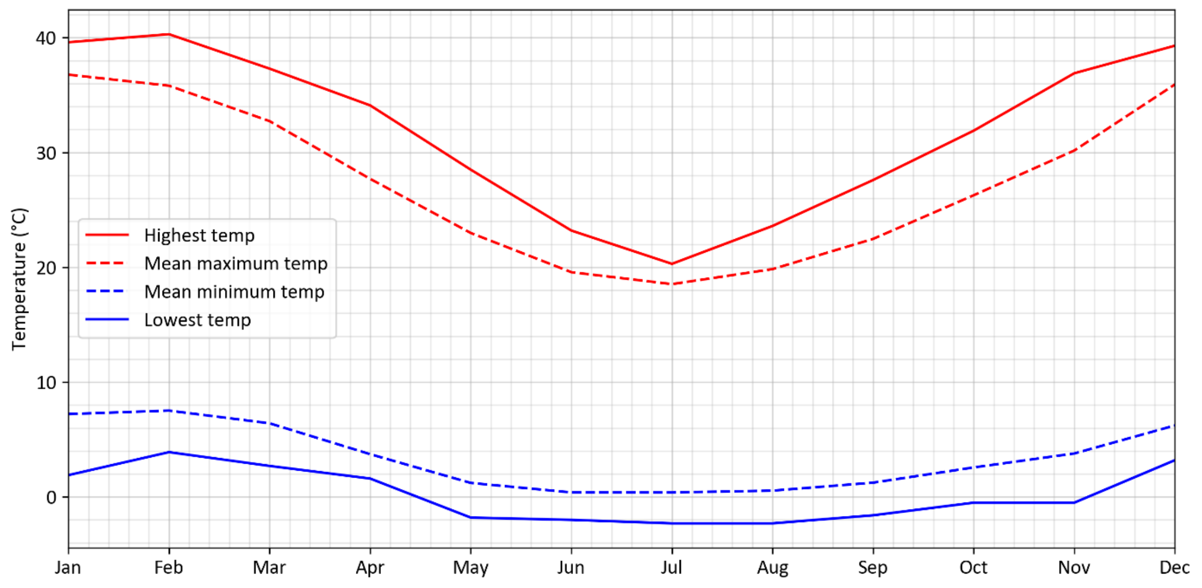


Figure 2-2: Mean Temperature 2012 to 2022 (BoM Bridgetown).

2.1.2 Humidity

As shown in Figure 2-3 the humidity at the BoM Bridgetown AWS is characterised by relatively low humidity during the summer months, increasing during the winter months. Across all months the average 9am relative humidity is higher than the 3pm relative humidity.

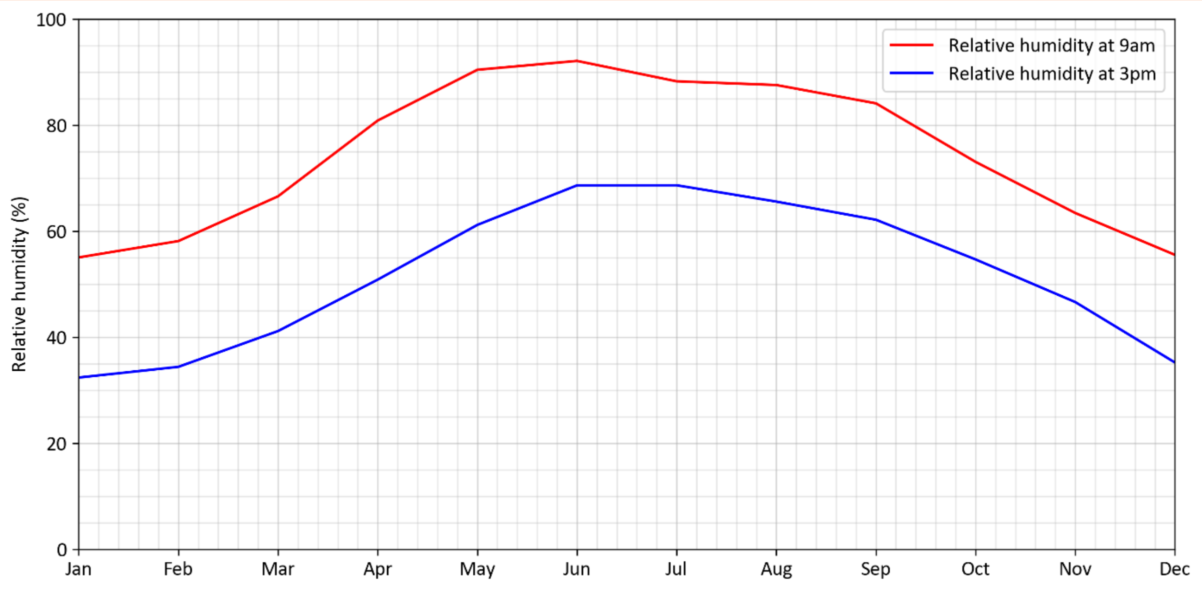


Figure 2-3: Mean Relative Humidity 2012 to 2022 (BoM Bridgetown).

2.1.3 Rainfall

The long-term rainfall data measured at the BoM Bridgetown AWS is presented in Figure 2-4 and this data highlights the Mediterranean climate of the region – relatively dry summers with wet winters. The rainfall patterns in the region are influenced by a range of factors, including ocean currents, atmospheric pressure systems, and local topography. The region experiences distinct seasons with the rainfall varying as follows:

- Summer (December to February): Summers in Bridgetown are generally hot and dry. The region receives the least amount of rainfall during this season, with sporadic and occasional thunderstorms. The average monthly rainfall during summer is relatively low, often below 20 millimetres (mm).
- Autumn (March to May): Autumn in Bridgetown brings mild temperatures and a slight increase in rainfall. The region experiences occasional showers and thunderstorms as the season progresses. Rainfall amounts gradually rise during autumn, with average monthly rainfall ranging between 22 mm and 98 mm.
- Winter (June to August): Winters in Bridgetown are cooler and wetter. This is the peak of the rain season, and the region receives the majority of its annual rainfall during this time. Rainfall intensifies, with regular rain events, drizzles, and occasional storms. Average monthly rainfall during winter ranges from 98 mm to 130 mm.
- Spring (September to November): Spring in Bridgetown brings warmer temperatures and a gradual decrease in rainfall. The region experiences occasional showers and thunderstorms at the beginning of the season, but as spring progresses, rainfall tapers off. Average monthly rainfall during spring ranges between 30 mm and 85 mm.

It's important to note that these descriptions provide a general overview of the seasonal rainfall patterns in Bridgetown. Weather patterns can vary from year to year, and some seasons may experience more or less rainfall than average.

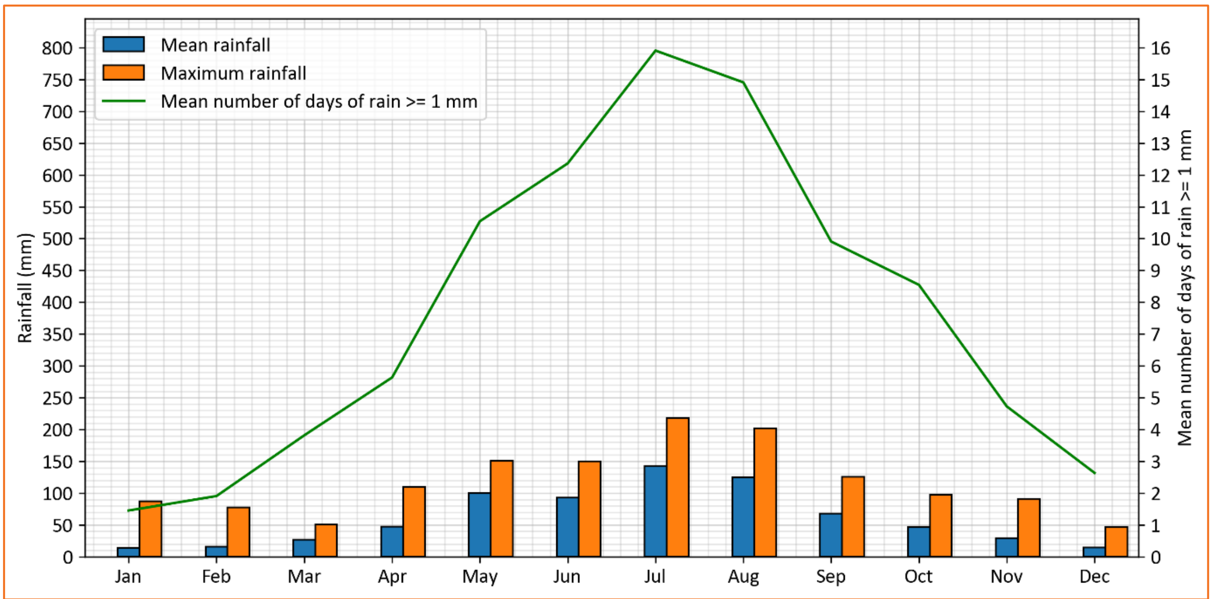


Figure 2-4: Rainfall 2012 to 2022 (BoM Bridgetown).

2.1.4 Wind speed and direction

Within the region there are two meteorological stations with wind speed and direction recorded at 10 m:

- Talison operate a meteorological station to the northwest of the operations. The station was originally located on Tailings Storage Facility 1 (TSF1), however was relocated due to the reclamation of TSF1 in December 2021. For this assessment data from the new station was utilised.
- The Bureau of Meteorology (BoM) operates an automatic weather station (AWS) at Bridgetown approximately 10 km to the south of the operations. For this assessment hourly data from the period 1 January 2012 to 31 December 2022 was used.

The annual wind roses for these two stations, derived from the available data, is presented in Figure 2-5. From this figure it can be seen that:

- There is a notable difference, in both wind speed and direction, between the two annual wind roses.
- The BoM Bridgetown data shows:
    - Prevailing winds from the south and the north-north-west.
    - A high percentage of winds below 2 m/s with minimal wind speeds above 6 m/s.
    - An overall average wind speed of 1.8 m/s.
- The Talison data shows:
    - Prevailing winds from the east to south, and from the northwest.
    - Minimal winds below 0.5 m/s (low percentage of calm winds).
    - A moderate proportion of winds above 4 m/s including wind speeds up to 10 m/s.
    - An overall average wind speed of 3.4 m/s.

The difference in wind speed and direction between the two AWS may be due to a range of factors including:

- Elevation: The Talison Station is at approximately 260 m above sea level (asl) while Bridgetown is approximately 170 m asl – a difference of 90 m.
- Topography: The Bridgetown BoM station is located within a valley to the northwest of the town which may result in channelling of the winds. The Talison station is located upon higher ground above nearby valleys, adjacent to two dams, indicating that it is in a relatively flat and open area.

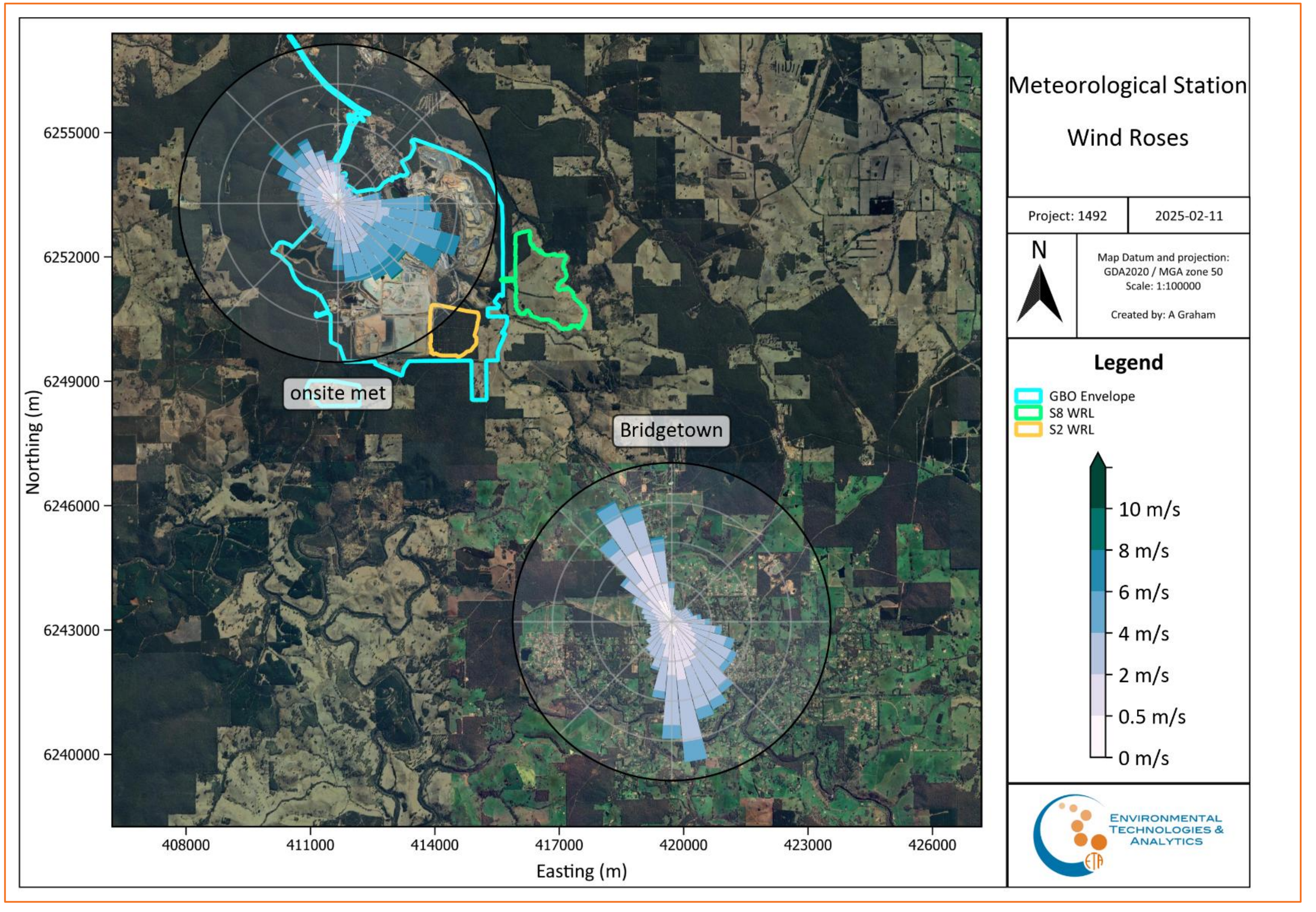


Figure 2-5: Annual wind roses from the BOM Bridgetown and ex-TSF on-site meteorological station

2.2 Pollutants of Interest

There are a number of potential emissions from the construction of the GBO expansion, and operation, of the Project including:

- Particulate matter from construction activities including:
  - Clearing
  - Removal and storage of topsoil
  - Wind erosion from open areas
  - Vehicle movements
- Particulate matter from mining and processing activities including:
  - Scrapers removing topsoil and subsoil
  - Excavators on waste and tailings
  - Bulldozers
  - Wheel generated dust from roads and haul roads
  - Wind erosion from stockpiles and open areas.

Construction related emissions vary both spatially and temporally and tend to be relatively short term (weeks or months) and are not considered in this modelling assessment. These are best addressed through the dust control and management plan. Likewise gaseous emissions are also not considered in this assessment due to the relatively low number of sources and their spatial variability.

Based on the description of the Project and key processes considered, the key pollutants of interest have been determined to be particulate emissions from mining and processing activities and these are summarised in Table 2-1.

Table 2-1: Air pollutants of interest from the Project.

Pollutant to be Assessed		
Particulate Matter	Airborne particles are a broad class of diverse substances that may be solid or liquid (liquid particles are often called aerosols) and are produced by a wide range of natural and human activities. Airborne particles are commonly classified by their size as total suspended particles (TSP), visibility reducing particles (PM_2), and inhalable particles (coarse fraction PM_{10} and fine fraction $PM_{2.5}$). **Project sources are principally from mining, handling of ore/waste, processing and wind generated surface erosion.**	
	PM_{10}	Inhalable particles are grouped into two size categories: those with a diameter of up to 10 µm (PM_{10}) and those with a diameter of up to 2.5 µm ($PM_{2.5}$). Inhalable particles are associated with increases in respiratory illnesses such as asthma, bronchitis and emphysema, with an increase in risk related to their size, chemical composition and concentration. Particles in the PM_{10} size fraction have been strongly associated with increases in the daily prevalence of respiratory symptoms, hospital admissions and mortality.
	$PM_{2.5}$	Particles in the $PM_{2.5}$ size fraction can be inhaled more deeply into the lungs than PM_{10}, and have been associated with health effects similar to those of PM_{10}. There is some evidence to suggest that $PM_{2.5}$ might be more deleterious to health than other size fractions. No lower limit for the onset of adverse health effects has yet been observed.
	TSP	Total suspended particulates (TSP) refers to the total amount of the PM suspended in air, typically up to 50 µm. These larger particles are primarily associated with amenity or visibility issues and are likely to be removed by gravitational settling

Pollutant to be Assessed		
		within a short time of being emitted (i.e. they settle to the ground or other surfaces fairly quickly).
	Deposited Dust	Deposited matter refers to any dust that falls out of suspension in the atmosphere.

2.3 Existing | background air quality

It is a requirement of the Department of Water and Environmental Regulation (DWER) that existing concentrations of each modelled pollutant be accounted for to ensure that potential cumulative impacts are presented (DoE, 2006). For this assessment the background concentrations were taken from the previous modelling report (ETA 2023), which was referenced to the air quality monitoring undertaken by Talison within the immediate region.

The nominated constant PM_{10} background concentrations are as follows:

- 13.8 µg/m^3 (24-hour average)
- 13.4 µg/m^3 (annual average)

For $PM_{2.5}$ the nominated constant background concentrations are taken as 15% of the PM_{10} concentrations, in line with the estimated emissions of $PM_{2.5}$ (Section 4.2). The 24-hour TSP background concentration is assumed to be double the PM_{10} concentration. The nominated $PM_{2.5}$ and TSP background concentrations are as follows:

- $PM_{2.5}$:
  - 2.1 µg/m^3 (24-hour average)
  - 2.0 µg/m^3 (annual average)
- TSP
  - 27.6 µg/m^3 (24-hour average)

These concentrations will be utilised in this assessment to represent background concentrations.

2.4 Sensitive receptors and environmental values

This modelling assessment considers the potential air quality impacts on relevant environmental values and sensitive receptors, consistent with EPA (EPA, 2005), and DWER (DWER, 2019), noting that the current DWER guidelines excludes the consideration of on-site project related receptors as sensitive receptors.

A sensitive receptor, as outlined in EPA (2005), is defined as a receptor that is '*potentially sensitive to emissions from industry and infrastructure including residential developments, hospitals…caravan parks, schools, nursing homes…playgrounds and some public buildings*.'.

The definition of environment in the *Environmental Protection Act, 1986* (as amended) (EP Act) includes social surroundings, where "*environment, subject to subsection (2) means living things, their physical, biological and social surroundings, and interactions between all of these (Subsection 3(1)).*" (EPA, 2016). Social surroundings, as outlined in the EPA guidelines (EPA, 2016; EPA 2023) includes Aboriginal heritage and culture, natural and historical heritage, amenity values.

The key receptor locations considered in the modelling are presented in Figure 2-6 relative to the Project. Receptor information is summarised in in Appendix C.

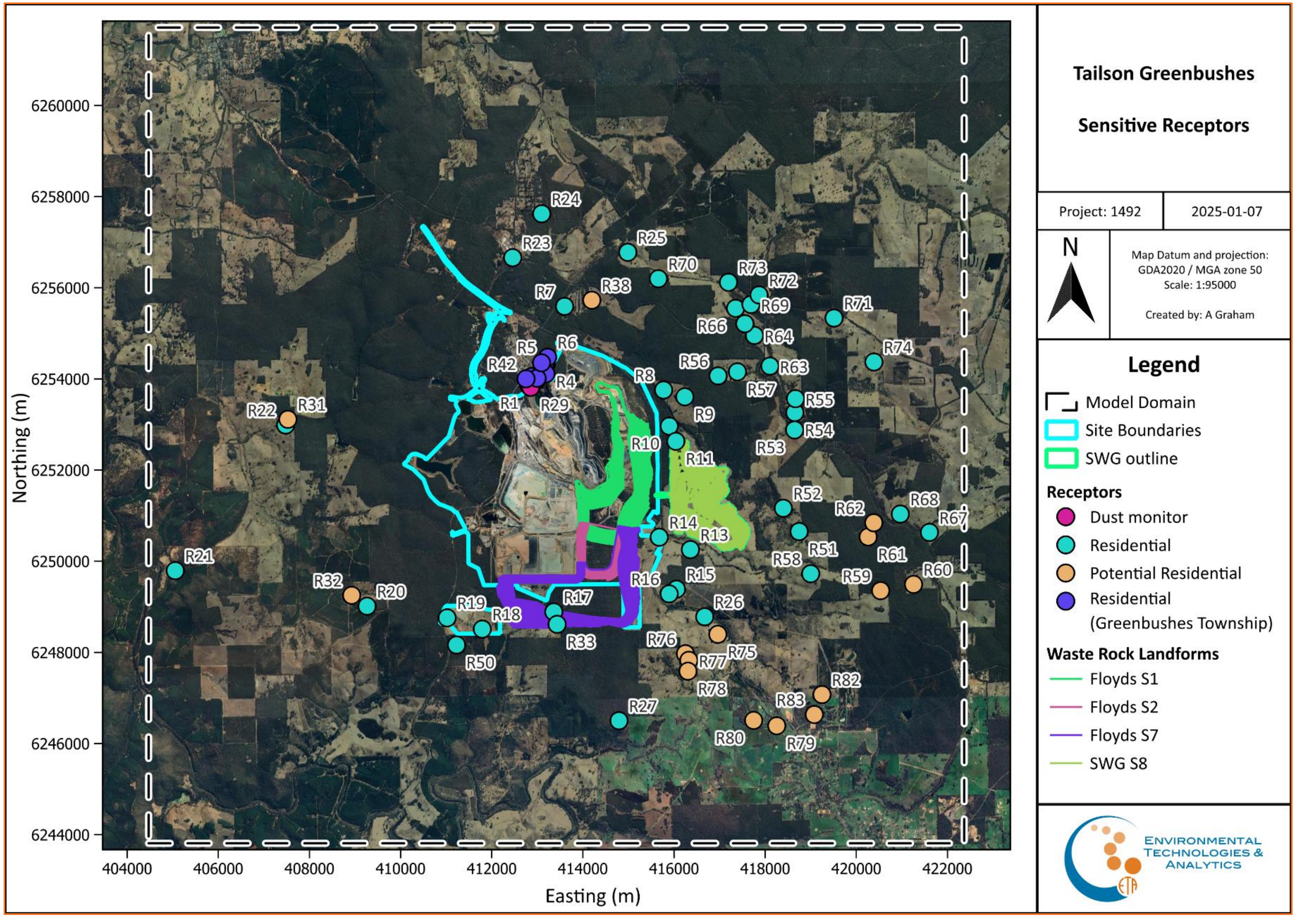


Figure 2-6: Receptor locations.

2.5 Impact assessment

Ground-level concentrations of particulates (as Total Suspended Particulates (TSP), PM_{10} and $PM_{2.5}$) and dust deposition, predicted at nominated receptors and the surrounding environment are compared with the relevant air quality assessment criteria as an indication of potential impact. This assessment has considered the potential impact attributable to the GBO, as well as the cumulative (background) impact (i.e. in conjunction with the existing emission sources in the area).

Modelling results, at nominated receptors, are compared to the numerical value of the criteria, and assessed as being either above or below the numerical value (nominated criteria). It is important to note that, as a risk-based assessment approach is normally applied to the assessment of air quality, a modelled result above the numerical value is not an indicator of unacceptable impact, but is an indication that the potential risk for impact requires further consideration.

2.5.1 Human Health Assessment and Amenity Criteria

Modelled ground level concentrations for particulates are compared to ambient air quality assessment criteria to determine the potential changes in impact resulting from the Project.

The assessment criteria adopted for this study (for particulates) are primarily based on the DWER (2019; 2021) guidelines, which also reference the numerical values from the ambient air quality standards specified in the Ambient Air Quality NEPM (NEPC, 2021).

In their current draft form, the DWER (2019) guidelines for TSP, PM_{10} and $PM_{2.5}$ (defined as *criteria pollutants* in the guideline) require the criteria to generally be *"…met at all existing and future offsite sensitive receptors in the modelling domain"*. DWER (2021) draft guideline addresses the settling or deposition of dust. At the time of this assessment both DWER guidelines are draft and subject to post-public consultation finalisation.

2.5.2 Impact on Vegetation Criteria

With respect to vegetation health, research on the effects of dust deposition has been undertaken in Australia by Doley (2006). Doley concluded that "*critical dust loads that result in significant alterations in the most sensitive plant functions vary with the particle size distribution and colour of the dust, from about 1 g/m^2 for carbon black with a median diameter of about 0.15 µm to about 8 g/m^2 for coarse road or limestone dusts with median diameters greater than about 50 µm. The critical loads vary with the plant function, and it is not possible to predict precisely the nature of one plant response from the knowledge of another*". For mineral dust, Farmer (1993) showed that direct physical effects of mineral dusts on vegetation became apparent only at relatively high surface loads (e.g. greater than 7 g/m^2).

For this study, 7 g/m^2/month is used as an indicative criterion for potential effects on vegetation. A modelling result that is higher than the assessment criteria is interpreted as an indication that results may need further consideration for the sensitive receptor, and is not necessarily a predicted impact or loss of environmental value.

2.5.3 Summary of Applied Assessment Criteria

A consolidated summary of the applicable assessment criteria and relevant receptor application is provided in Table 2-2.

Table 2-2: Summary of adopted assessment criteria.

Pollutant	Air quality assessment criteria					Reference
	Concentration [1]	Concentration [2]	Averaging Period	Allowable Exceedances	Environmental value protected	
PM_{10}	50 µg/m^3	46 µg/m^3	24-hour	exception event	Human health and amenity	DWER (2019) consistent with NEPM (NEPC, 2021)
	25 µg/m^3	23 µg/m^3	annual	none		
$PM_{2.5}$	25 µg/m^3	23 µg/m^3	24-hour	exception event		
	8 µg/m^3	8 µg/m^3	annual	none		
TSP	90 µg/m^3	82 µg/m^3	24-hour	none		DWER (2019)
Dust deposition	2 g/m^2/30 days		30-days	Maximum increase above background	Amenity | Nuisance	DWER (2021)
	4 g/m^2/30 days		30-days	Maximum		DWER (2021) referencing NSW EPA (2017)
	7 g/m^2/30 days		30-days	None	Ecological (vegetation/leaf) impact	Doley (2006)

Notes:
1 Concentrations referenced to 0ºC (excluding reference to dust deposition)
2 Concentrations referenced to 25ºC (excluding reference to dust deposition)

3 Modelling

In-line with the previous air quality assessment (ETA 2023), the CALPUFF model has been used to predict ground level concentrations across the model domain. The potential air quality impacts associated with the Project have been considered in isolation of other emission sources, for particulates. The model was configured to predict the ground-level concentrations on a rectangular grid. The model domain was defined with the Southwest corner of the model domain at 404,470 m Easting and 6,253,810 m Northing (UTM Zone 50).

The 2019 calendar year was selected based on the results of the statistical study presented in Appendix A.

Specifics for the modelling configuration are described further in this section.

3.1 Meteorological model (WRF and CALMET)

The meteorology component of a dispersion model is a key element for the effectiveness or representativeness of the dispersion model outputs. Both upper air and surface information are needed for modelling (or assumptions).

3.1.1 WRF model

In order to generate the 3-dimensional meteorology required by CALMET for the region, the Weather Research and Forecast (WRF V4.0) model (http://wrf-model.org/index.php) was utilised. WRF is the next-generation mesoscale numerical weather prediction system. The model was primarily designed to serve both operational forecasting and atmospheric research. WRF features multiple dynamical cores, a 3-dimensional variational data assimilation system and a software architecture allowing for computational parallelism and system extensibility. Further details on WRF configuration and validation are provided in Appendix B.

3.1.2 CALMET

The 3-Dimensional meteorological data generated by WRF was input to CALMET (Version 6.42 Level: 110325) for further processing to the finer resolution used in the dispersion modelling. This procedure will be referred to as the 'WRF-CALMET methodology'. The output from the CALMET meteorological model is then used to drive the pollution dispersion in the CALPUFF model.

CALMET is a three-dimensional meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional, spatially- and temporal-varying meteorological fields that are utilised in the CALPUFF dispersion model.

CALMET requires several datasets to resolve the surface and upper air meteorology occurring for each hour of the year:

- surface observations and upper air observations or gridded prognostic meteorological model data.
- land use and topographical data.

CALMET was run for a 180 x 180 grid domain at a spatial resolution of 100 m. Vertically, the model consisted of 11 levels extending to 3,000 m. The southwest corner coordinates of the domain were Easting of 404,470 m and a Northing of 6,253,810 m.

The 90 m resolution Shuttle Radar Topography Mission (SRTM) dataset was used as input into the CALMET model to indicate terrain heights within the model domain. CALMET also requires geophysical data including gridded fields of land use categories. The CALMET land use is sourced from the 100 m spatial resolution Copernicus Global Land “CGLOPS-1” dataset (Buchhorn et al, 2020), and converted to the 52-category United States Geological Service land use and land cover classification system required by CALMET (Figure 3-1).

The configuration of CALMET is detailed in Appendix C and selected CALMET results are provided in Appendix C.

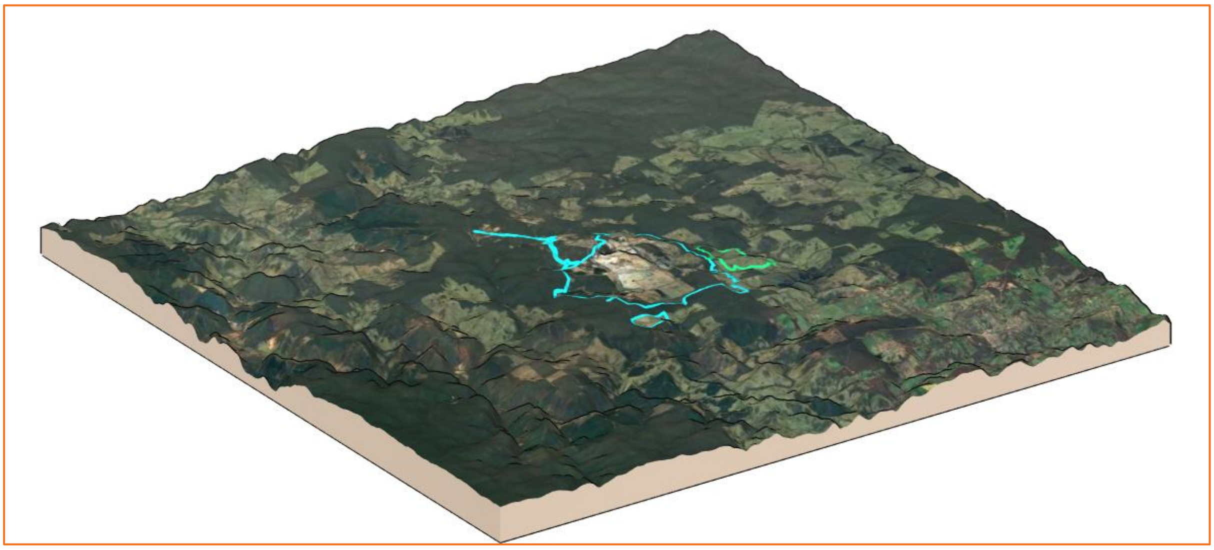


Figure 3-1: Image of terrain elevation used in CALMET (GDA94, Zone 50).

3.2 CALPUFF

CALPUFF is the dispersion module of the CALMET/CALPUFF suite of models. It is a multi-layer, multi species, non-steady-state puff dispersion model that can simulate the effects of time-varying and space-varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across released puffs and considers the complex arrangement of emissions from point, area, volume and line sources (Scire *et al*., 2000).

The CALPUFF model was set to calculate concentrations on a set grid (gridded receptors). The model domain was defined as 18 km in the east–west and 20 km north-south direction at a spacing of 100 m x 100 m.

3.3 Particle sizing | gravitational settling

Since particulate matter is subject to gravitational settling, assumptions need to be made regarding particle sizes. Source specific particle size distribution information is required to define the relative PM_{10} and $PM_{2.5}$ component of total emitted PM and to simulate gravitational settling of particles present in emissions. Project specific particle size distribution information was not available for the emission sources.

A particle size distribution for modelling PM/dust dispersion was therefore estimated using composite data from the USEPA for dust emissions from:

- Unpaved roads (USEPA, 2006)
- Aggregate handling and storage piles (USEPA, 2006b)
- Industrial wind erosion (USEPA, 2006c).

These categories are considered the most appropriate for mining sources and are relevant to the Project sources. The resulting distributions are shown as percentages for each size range in Table 3-1.

Table 3-1: Particle size distribution (%).

Size range (µm)	Representative size (µm)	TSP	PM_{10}	$PM_{2.5}$
<2.5	1.3	6	15	100
2.5 – 5.0	3.5	14	36	-
5.0 – 10.0	7.5	19	48	-
10.0 – 15.0	12.5	14	-	-
15.0 – 30.0	22.5	29	-	-
30.0 – 50.0	37.5	18	-	-

4 Emissions to air estimation

This section outlines the emission estimation process for the S8 WRL expansion. Six scenarios were considered:

- Waste deposal at S2 only for years 2028 and 2030.
- Waste deposal at S2 then S8 for years 2028 and 2034.
- Waste deposal at S8 then S2 for years 2029 and 2033.

Scenarios were based on run of mine tonnages supplied by Talison. Years for each model were chosen to ensure that emissions from both S2 and S8 waste dump areas are representative. Mining and Waste tonnages were provided by Talison, ore tonnages were referenced from the 2028 expansion scenario (ETA 2023) which has since received regulatory approval.

Emission estimates are sourced from this inventory for inclusion in the dispersion model. Emissions from all key sources associated with these operations have been identified according to accepted methods. The output from the emission estimation process is an hourly variable emission file for the Project.

4.1 Emission Source Inventory

Tonnages for each scenario are presented in Table 4-1. While tonnages are broadly similar across all scenarios, the location where tonnages come from is variable. Most sources are not active in every scenario. Yearly total forecast tonnages are 22 million tonnes for all scenarios between 2025 and 2032. Later years have slightly lower tonnages.

Table 4-1: Forecast tonnages for mining and waste dumps for each scenario.

Scenario	Year	Pit Ore	Pit Waste	Total	Waste onto WRLs
S2 Only	2028	2,783,132	19,216,868	22,000,000	18,477,402
S2 Only	2030	3,345,954	18,654,046	22,000,000	17,828,965
S8 then S2	2029	3,500,602	18,499,398	22,000,000	16,967,625
S8 then S2	2033	3,626,102	16,373,898	20,000,000	11,392,988
S2 and S8	2028	2,783,132	19,216,868	22,000,000	18,477,402
S2 and S8	2034	3,457,601	15,827,330	19,284,932	14,350,424

4.1.1 Previous modelling

A summary of the estimated tonnages for designated equipment at the GBO are presented in Table 4-1, and location of the sources, as modelled, are presented in Figure 4-1. Key changes in emissions sources with the addition of the S8 WRL are:

- Increased overall waste tonnage.
- Unloading of waste, and associated bulldozer activity, moves from Floyds WRL in the base case to S8 WRL in the 2032 scenario.
- Changes in haul routes mean that wheel generated dust from roads and haul roads locations and tonnages are changed.
- For wind erosion from stockpiles and open areas, two new open areas are used to represent S8 WRL while the Floyds WRL is considered to be revegetated in the 2032 scenario.

Table 4-2: Forecast equipment tonnages for proposed GBO operations (tpa) used for the assessment.

Source	2028 base case (approved)	2032 S8
Ore	11,714,600	11,714,600
Waste	15,639,900	19,100,000
Total	27,354,500	30,814,600

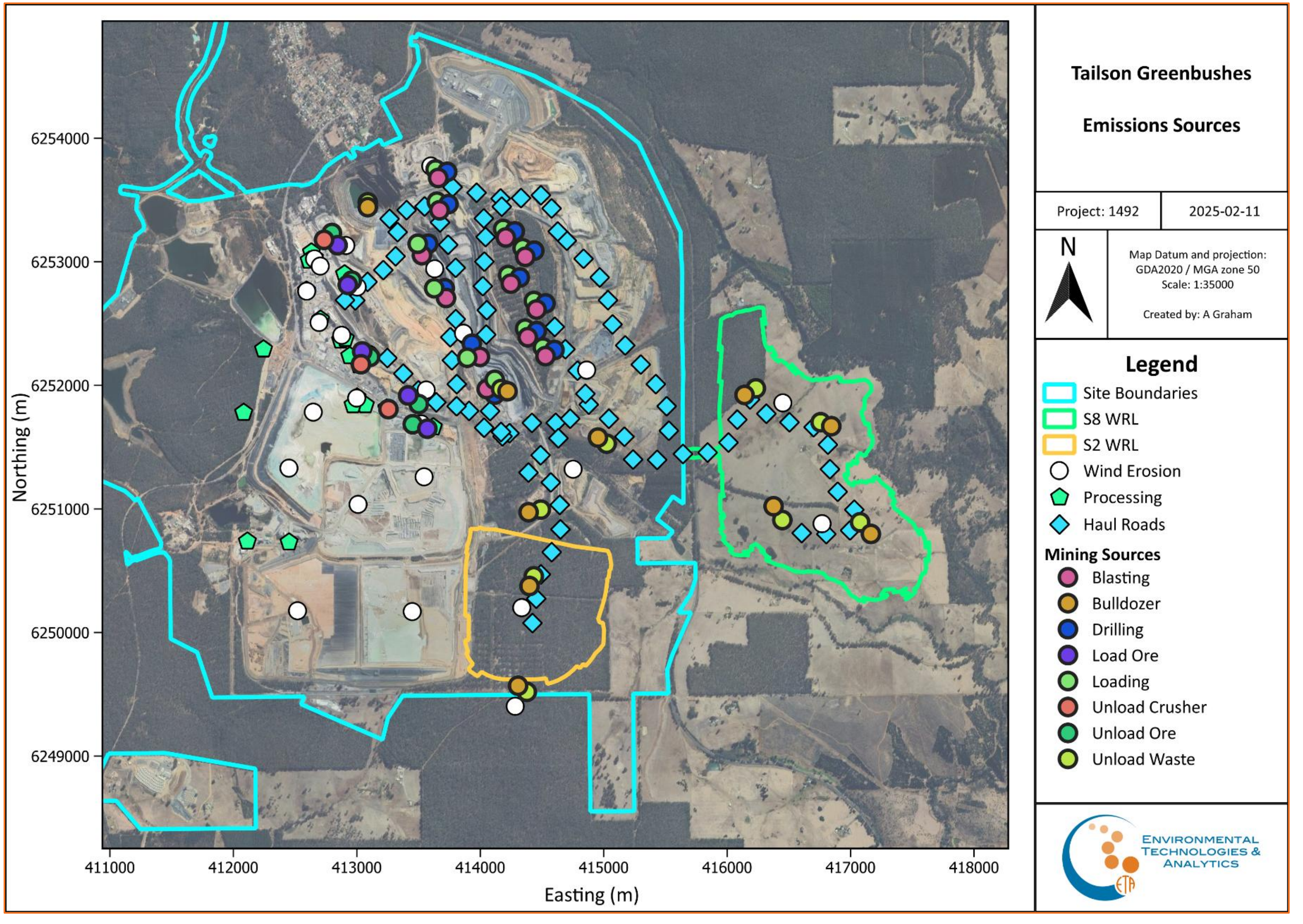


Figure 4-1: Location of modelled air emission sources for the GBO.

4.2 Emission Estimation

The primary reference source for the emissions estimation is based on the National Pollutant Inventory Emission Estimation Technique Manual for Mining Version 3.1, (EETM for mining) published by Environment Australia (EA, 2012).

4.2.1 Unloading waste

Emissions for unloading ore and waste have been calculated using the default values from Appendix A (Section 1.1.5) of the EETM for Mining (EA, 2012a) as follows :

- TSP: 0.012 kg/t
- PM_{10}: 0.0043 kg/t

The emission factor for $PM_{2.5}$ emissions is taken as 15% of the PM_{10} emissions. The statistics of the annual PM_{10} emissions for loading are contained in Appendix G.

4.2.2 Bulldozing

Emissions for the operation of bulldozers on both ore and waste have been determined using Equation 16 and Equation 17 outlined in Appendix A of the EETM for Mining (EA, 2012) and presented below as Equation 1 for TSP and Equation 2 for PM_{10}. The silt and moisture contents used were the defaults listed in the manual (2% moisture, 10% silt).

Equation 1: $$EF_{TSP\,(kg/hr)} = 2.6 \times \frac{s^{1.2}{}_{(\%)}}{M^{1.3}{}_{(\%)}}$$

Equation 2: $$EF_{PM_{10}\,(kg/hr)} = 0.34 \times \frac{s^{1.5}{}_{(\%)}}{M^{1.4}{}_{(\%)}}$$

Where: s = silt content (%)
M = moisture (%)

The emission factor for $PM_{2.5}$ emissions is taken as 15% of the PM_{10} emissions. The statistics of the annual PM_{10} emissions for bulldozing are contained in Appendix G.

4.2.3 Haul Roads

To determine emissions from wheel generated dust along the haul roads the default equation for 'unpaved roads from wheels' was utilised (Equation 3). The weight of the haul trucks was taken as 119 tonnes – being the average of an empty and fully laden CAT777 haul truck and the default silt content of 10% was utilised.

Equation 3: $$EF_{(kg/VKT)} = \frac{0.4536}{1.6093} \times k \times \left(\frac{s_{(\%)}}{12}\right)^a \times \left(\frac{W_{(t)}}{3}\right)^b$$

Where: k = constant (TSP = 4.9, PM_{10} = 1.5)
$s_{(\%)}$ = silt content (%)
$W_{(t)}$ = vehicle mass (t)
a = constant (TSP = 0.7, PM_{10} = 0.9)
b = constant (0.45)

The emission factor for $PM_{2.5}$ emissions is taken as 15% of the PM_{10} emissions. The statistics of the annual emissions for loading for PM_{10} are contained in Appendix G.

4.2.4 Wind erosion – Open areas

The default emission factor for wind erosion in the EETM for Mining is a constant emission of 0.2 kg/ha/hr which, while potentially suitable for the calculation of annual emissions, is not suitable for inclusion in atmospheric modelling. This assessment used the modified Shao equation outlined in SKM (2005) which is represented as Equation 4:

Equation 4:

$$PM_{10_{(g/m^2/s)}} = k \times \left\{WS^3 \times \left(1 - \left(WS_0{}^2/WS^2\right)\right)\right\} \qquad WS > WS_0$$

$$PM_{10_{(g/m^2/s)}} = 0 \qquad WS < WS_0$$

Where: WS = wind speed (m/s)
WS_0 = threshold for particulate matter lift off (m/s)
k is a constant

For this assessment the k factor was assigned a value of 8.80×10^{-7}.

The emission factor for TSP is taken as twice that of the PM_{10} emissions while $PM_{2.5}$ emissions are taken as 15% of the PM_{10} emissions.

4.2.5 Emission controls

Emissions controls (for dust abatement) were included in the emissions estimation, and the default control factors outlined in Table 4 in the EETM for Mining (EA, 2012) was applied. These controls for the new emissions sources are summarised in Table 4-3, along with the percentage reduction applied to each source type. Controls for previously modelled sources are detailed in (ETA 2023).

Table 4-3: Project dust abatement for new or adjusted sources in place (included in model).

Source	Dust abatement description	Emission Reduction
Unloading ore / waste	No reduction	-
Bulldozers	No reduction	-
Haul roads	Watering (level 2), gravel roads	80%
Wind erosion	Watering (pits/waste rock landform) Chemical surfactant (TSF)	50% 80%

Note:
- Indicates no suggested dust control specified.

Due to the relatively high rainfall of the Project location, especially during the winter months (Section 2.1.3), the hourly rainfall from the on-site meteorological station, for 2019, was incorporated into the emission estimation process. This facilitates the emission estimates to be reduced either within a particular hour to account for wet deposition or, for wind erosion from open areas, to account for the crusting of the surface material.

The reductions for rainfall followed a similar process to that detailed in Air Assessments (2014) in that:

- If the rainfall within an hour was more than 0.2 millimetres (mm) then emissions from all sources were set to zero.
- If the rainfall within a rolling 24-hour period was higher than that time period's evaporation rate, then only the wind erosion emissions for that 24-hour period were set to zero.

4.3 Emission summary

A summary of the estimated annual emissions (for the modelled year), for each particle size fraction, is shown in Table 4-4 for the earlier year for each scenario and Table 4-5 for the later year.

Table 4-4: Estimates of the emissions for the Project (kg/year) for each scenario.

Source	S2 Only (2028)	S2 Only (2028)	S2 Only (2028)	S8 then S2 (2029)	S8 then S2 (2029)	S8 then S2 (2029)	S2 and S8 (2028)	S2 and S8 (2028)	S2 and S8 (2028)
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Crushing	10,355	4,142	621	10,355	4,142	621	10,355	4,142	621
Screening	21,905	16,429	2,464	21,905	16,429	2,464	21,905	16,429	2,464
Stacking	2,862	1,145	172	2,862	1,145	172	2,862	1,145	172
Transfer	14,679	5,872	881	14,679	5,872	881	14,679	5,872	881
Ore Sorters	65,714	49,286	7,393	65,714	49,286	7,393	65,714	49,286	7,393
Load out	83,494	40,077	6,012	105,018	50,409	7,561	83,494	40,077	6,012
Drilling	27,051	27,006	4,051	47,127	47,047	7,057	26,771	26,726	4,009
Blasting	10,157	10,035	1,505	10,157	10,035	1,505	10,157	10,035	1,505
Load (pit)	660,000	601,920	90,288	555,000	506,160	75,924	660,000	601,920	90,288
Unload waste	532,149	190,687	28,603	252,159	90,357	13,554	403,339	144,530	21,680
Unload ore	83,494	40,077	6,012	105,018	50,409	7,561	83,494	40,077	6,012
Bulldozers	186,345	45,365	6,805	387,630	94,367	14,155	480,471	116,969	17,545
Load ore (crusher)	166,988	80,154	12,023	210,036	100,817	15,123	166,988	80,154	12,023
Unload ore (crusher)	83,494	40,077	6,012	105,018	50,409	7,561	83,494	40,077	6,012
Haul Roads	2,210,878	648,962	97,344	3,858,138	1,138,772	170,816	3,118,489	920,456	138,068
Wind erosion	158,429	79,214	11,882	158,429	79,214	11,882	158,429	79,214	11,882
TOTAL	4,317,994	1,880,448	282,067	5,909,245	2,294,870	344,230	5,390,641	2,177,109	326,566

Table 4-5: Estimates of the emissions for the Project (kg/year) for each scenario.

Source	S2 Only (2030)	S2 Only (2030)	S2 Only (2030)	S8 then S2 (2033)	S8 then S2 (2033)	S8 then S2 (2033)	S2 and S8 (2034)	S2 and S8 (2034)	S2 and S8 (2034)
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Crushing	10,355	4,142	621	10,355	4,142	621	10,355	4,142	621
Screening	21,905	16,429	2,464	21,905	16,429	2,464	21,905	16,429	2,464
Stacking	2,862	1,145	172	2,862	1,145	172	2,862	1,145	172
Transfer	14,679	5,872	881	14,679	5,872	881	14,679	5,872	881
Ore Sorters	65,714	49,286	7,393	65,714	49,286	7,393	65,714	49,286	7,393
Load out	83,494	40,077	6,012	105,018	50,409	7,561	83,494	40,077	6,012
Drilling	27,048	27,002	4,050	26,937	26,892	4,034	26,812	26,766	4,015
Blasting	10,157	10,035	1,505	10,185	10,063	1,509	10,157	10,035	1,505
Load (pit)	520,873	475,037	71,255	591,508	539,455	80,918	504,374	459,989	68,998
Unload waste	513,474	183,995	27,599	328,118	117,576	17,636	413,292	148,096	22,214
Unload ore	100,379	48,182	7,227	108,783	52,216	7,832	103,728	49,789	7,468
Bulldozers	116,096	28,263	4,239	95,371	23,218	3,483	94,769	23,071	3,461
Load ore (crusher)	200,757	96,363	14,455	217,566	104,432	15,665	207,456	99,579	14,937
Unload ore (crusher)	200,757	96,363	14,455	217,566	104,432	15,665	207,456	99,579	14,937
Haul Roads	2,904,360	857,254	128,588	2,187,015	645,521	96,828	2,424,530	715,627	107,344
Wind erosion	158,429	79,214	11,882	158,429	79,214	11,882	158,429	79,214	11,882
TOTAL	4,951,339	2,018,659	302,798	4,162,011	1,830,302	274,544	4,350,012	1,828,696	274,304

5 Predicted Air Quality Impact

This assessment has used the WRF/CALMET/CALPUFF modelling suite to estimate the air quality impacts associated with the Project. The results are presented for the GBO operations. The emissions are modelled for the representative meteorology year 2019 (Section 4.1).

To assess the potential air quality impact, modelled concentrations of particulates (as TSP, PM_{10}, $PM_{2.5}$ and deposition) are compared to the assessment criteria outlined in Table 2-2. The comparison of the modelling results to nominated ambient air quality assessment criteria has been done as an indicator for potential changes in conditions at the nominated receptor locations. It should be noted that the nominated receptors are locations of interest (consistent with EPA guidelines for Part IV assessments) and not all nominated receptors are locations are consistent with the DWER definition of a "sensitive receptor" for a Part V assessment. The assessment criteria applicable to a sensitive receptor has been applied at all receptor locations as a conservative comparison approach.

Six scenarios were considered:

- Waste disposal at S2 only for years 2028 and 2030.
- Waste disposal at S2 then S8 for years 2028 and 2034.
- Waste disposal at S8 and S2 for years 2029 and 2033.

The results are presented for GBO in isolation of emission sources (i.e. standalone) and cumulatively with background air quality included.

Receptors were considered in three groupings:

- Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
- Receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R26, R51, R52.
- Receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33.

5.1 S2 Only (2028) Scenario

5.1.1 Particulates as PM_{10}

The statistics of the predicted ground level concentrations of PM_{10} are presented in Table 5-1. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 615 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-1 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors is limited.

The model results at all receptors are presented in Appendix E. The predicted isopleths (contours) for ground level concentrations of particulates (as PM_{10}) are presented in Figure 5-1.

Table 5-1: S2 Only (2028) – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	99	56	43	23	7	7.4	112	70	57	37	21	21.2
R9	82	52	39	20	6	6.5	96	66	53	34	20	20.3
R10	119	59	51	28	10	9.4	133	73	65	42	24	23.2
R11	101	58	52	27	10	9.1	115	72	66	41	24	22.9
R13	113	54	49	18	4	6.2	127	68	63	32	18	20.0
R14	169	79	63	28	7	9.2	183	93	77	41	21	23.0
R15	78	43	33	12	2	3.8	91	57	46	26	16	17.6
R16	70	40	36	11	2	3.6	84	53	50	25	15	17.4
R51	67	18	14	7	2	2.3	80	32	28	21	16	16.1
R52	64	21	20	8	2	2.9	78	35	34	22	16	16.7
R13	113	54	49	18	4	6.2	127	68	63	32	18	20.0
R14	169	79	63	28	7	9.2	183	93	77	41	21	23.0
R15	78	43	33	12	2	3.8	91	57	46	26	16	17.6
R16	70	40	36	11	2	3.6	84	53	50	25	15	17.4
R17	144	37	28	11	1	3.6	158	51	42	25	15	17.4
R33	134	29	24	11	1	3.1	148	43	38	24	15	16.9
R1	535	341	305	190	82	67.6	549	355	319	204	96	81.4
R2	601	296	278	167	64	58.0	615	310	292	181	78	71.8
R3	473	171	138	79	33	29.1	487	185	152	92	47	42.9
R4	418	122	98	51	23	19.8	432	136	111	65	36	33.6
R5	403	116	91	47	21	18.3	417	129	105	61	34	32.1
R6	384	110	83	41	17	16.1	397	124	97	55	31	29.9
R39	441	194	183	109	42	37.3	455	207	196	123	56	51.1
R40	513	184	151	86	39	32.0	527	198	165	100	53	45.8
R41	550	246	217	134	54	46.7	564	260	231	148	68	60.5
R42	375	188	180	106	43	37.1	389	202	194	119	57	50.9
R43	388	115	91	49	20	18.6	402	129	105	63	34	32.4

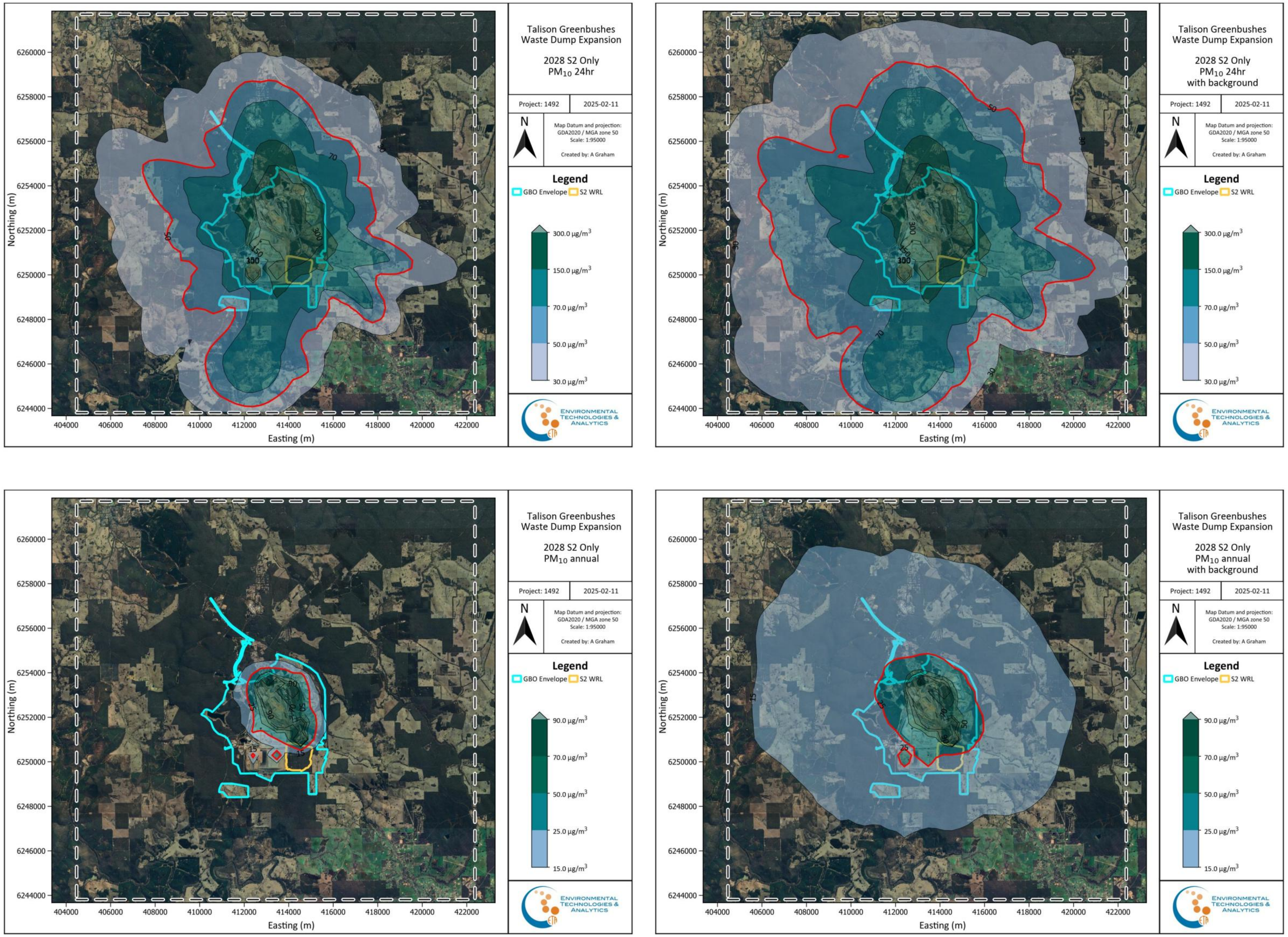


Figure 5-1: Modelling PM_{10} concentration contours for S2 only (2028)

5.1.2 Particulates as $PM_{2.5}$

The statistics of the predicted ground level concentrations of $PM_{2.5}$ are presented in Table 5-2. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 92 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R14.
  - And at the following receptors within 1.5 km of the S2 WRL: R14
- From Table 5-2 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 33% at receptor R9 up to 72% at receptor R5.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as $PM_{2.5}$) are presented in Figure 5-2.

Table 5-2: S2 Only (2028) – Predicted $PM_{2.5}$ concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	15	8	6	3	1	1.1	17	11	9	6	3	3.2
R9	12	8	6	3	1	1.0	14	10	8	5	3	3.1
R10	18	9	8	4	2	1.4	20	11	10	6	4	3.5
R11	15	9	8	4	1	1.4	17	11	10	6	4	3.5
R13	17	8	7	3	1	0.9	19	10	10	5	3	3.0
R14	25	12	9	4	1	1.4	27	14	12	6	3	3.5
R15	12	6	5	2	0	0.6	14	9	7	4	2	2.7
R16	10	6	5	2	0	0.5	13	8	8	4	2	2.6
R51	10	3	2	1	0	0.4	12	5	4	3	2	2.5
R52	10	3	3	1	0	0.4	12	5	5	3	2	2.5
R13	17	8	7	3	1	0.9	19	10	10	5	3	3.0
R14	25	12	9	4	1	1.4	27	14	12	6	3	3.5
R15	12	6	5	2	0	0.6	14	9	7	4	2	2.7
R16	10	6	5	2	0	0.5	13	8	8	4	2	2.6
R17	22	6	4	2	0	0.5	24	8	6	4	2	2.6
R33	20	4	4	2	0	0.5	22	6	6	4	2	2.6
R1	80	51	46	29	12	10.1	82	53	48	31	14	12.2
R2	90	44	42	25	10	8.7	92	47	44	27	12	10.8
R3	71	26	21	12	5	4.4	73	28	23	14	7	6.5
R4	63	18	15	8	3	3.0	65	20	17	10	6	5.1
R5	60	17	14	7	3	2.7	63	19	16	9	5	4.8
R6	58	17	13	6	3	2.4	60	19	15	8	5	4.5
R39	66	29	27	16	6	5.6	68	31	29	18	8	7.7
R40	77	28	23	13	6	4.8	79	30	25	15	8	6.9
R41	83	37	33	20	8	7.0	85	39	35	22	10	9.1
R42	56	28	27	16	6	5.6	58	30	29	18	9	7.7
R43	58	17	14	7	3	2.8	60	19	16	9	5	4.9

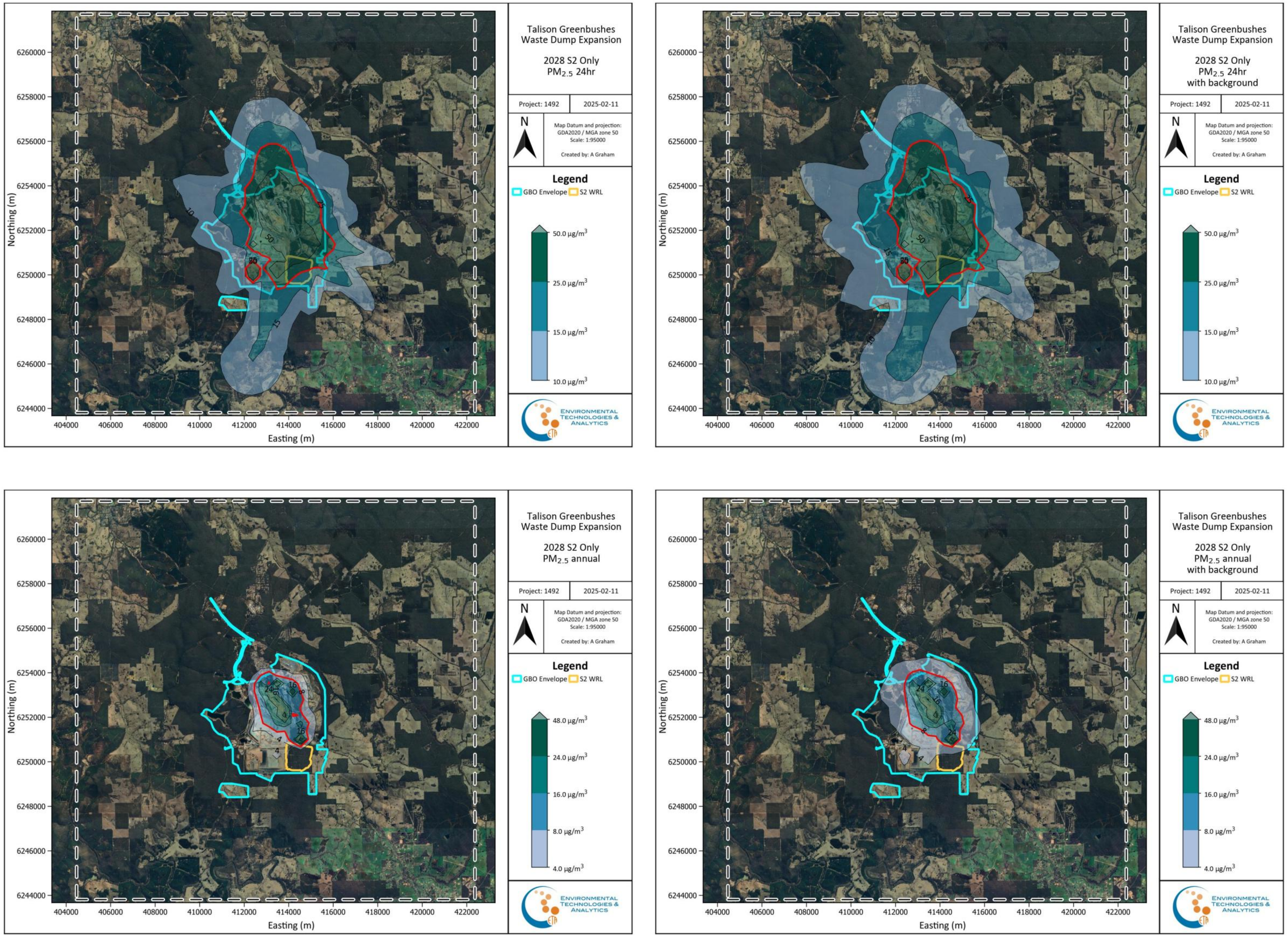


Figure 5-2: Modelled $PM_{2.5}$ concentration contours for S2 only (2028)

5.1.3 Total Suspended Particulates

The statistics of the predicted ground level concentrations of TSP are presented in Table 5-3. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 1,762 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
    - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
    - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
    - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-3 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 39% at receptor R1 up to 79% at receptor R6.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as $PM_{2.5}$) are presented in Figure 5-3.

Table 5-3: S2 Only (2028) - Predicted TSP concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	279	134	103	54	16	17.2	307	162	131	81	43	44.8
R9	246	114	94	47	14	14.8	273	142	122	75	42	42.4
R10	372	134	112	67	22	21.6	399	161	140	95	50	49.2
R11	296	139	114	64	20	21.0	323	166	142	92	48	48.6
R13	321	146	127	45	10	15.9	349	174	155	73	38	43.5
R14	504	207	177	76	16	24.4	532	235	204	103	44	52.0
R15	203	116	85	29	4	9.4	231	143	113	57	32	37.0
R16	175	104	94	25	4	8.8	203	132	121	52	31	36.4
R51	189	48	38	15	4	5.5	216	76	66	43	31	33.1
R52	171	57	50	18	5	6.7	199	84	78	46	32	34.3
R13	321	146	127	45	10	15.9	349	174	155	73	38	43.5
R14	504	207	177	76	16	24.4	532	235	204	103	44	52.0
R15	203	116	85	29	4	9.4	231	143	113	57	32	37.0
R16	175	104	94	25	4	8.8	203	132	121	52	31	36.4
R17	381	96	67	24	3	8.6	408	123	94	51	30	36.2
R33	354	75	60	23	2	7.5	382	103	88	51	30	35.1
R1	1,496	908	798	482	206	170.3	1,523	935	826	510	234	197.9
R2	1,734	807	723	427	158	145.7	1,762	835	751	454	186	173.3
R3	1,369	426	337	195	75	67.7	1,397	453	365	222	103	95.3
R4	1,197	277	251	116	46	44.3	1,224	304	279	144	73	71.9
R5	1,151	256	235	107	41	40.8	1,178	284	262	135	69	68.4
R6	1,088	229	198	96	34	35.6	1,115	256	225	124	61	63.2
R39	1,258	502	434	264	97	90.0	1,286	529	462	292	124	117.6
R40	1,489	458	366	205	84	74.4	1,517	486	394	233	112	102.0
R41	1,590	651	549	322	127	114.8	1,617	679	576	350	155	142.4
R42	1,051	493	462	253	100	89.1	1,078	521	489	281	128	116.7
R43	1,112	273	231	110	44	41.8	1,140	300	259	138	71	69.4

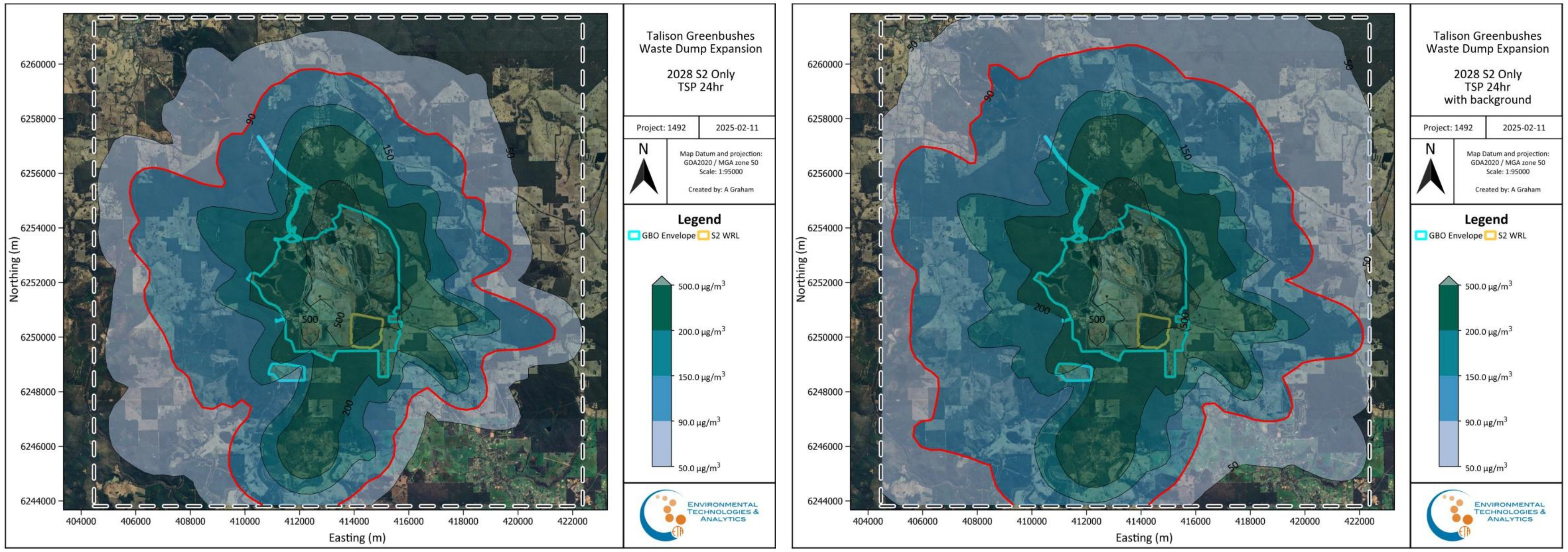


Figure 5-3: Modelled maximum 24hr averaged TSP concentration contours for S2 only (2028)

5.1.4 Dust deposition

The maximum monthly predicted deposition rates for the S2 Only (2028) scenario are presented in Table 5-4. From this table it is apparent that the receptors immediately to the north of the operations are predicted to have deposition rates that are above the maximum increase above background criteria of 2 g/m^2/month.

Table 5-4: S2 Only (2028) - Predicted dust deposition at receptors – in isolation (g/m^2/month).

Receptor	Maximum Deposition	Receptor	Maximum Deposition	Receptor	Maximum Deposition
R1	7.7	R25	0.2	R60	0.1
R2	6.5	R26	0.2	R61	0.1
R3	3.8	R27	0.1	R62	0.1
R4	2.7	R29	9.0	R63	0.2
R5	2.5	R31	0.1	R64	0.2
R6	2.1	R32	0.1	R65	0.2
R7	0.7	R33	0.3	R66	0.2
R8	0.7	R38	0.5	R67	0.1
R9	0.5	R39	4.9	R68	0.1
R10	0.9	R40	4.0	R69	0.1
R11	0.9	R41	5.9	R70	0.2
R13	0.5	R42	4.8	R71	0.1
R14	1.1	R43	2.6	R72	0.1
R15	0.3	R50	0.1	R73	0.1
R16	0.3	R51	0.2	R74	0.1
R17	0.4	R52	0.2	R75	0.1
R18	0.2	R53	0.2	R76	0.1
R19	0.1	R54	0.2	R77	0.1
R20	0.1	R55	0.1	R78	0.1
R21	0.0	R56	0.3	R79	0.1
R22	0.1	R57	0.2	R80	0.1
R23	0.4	R58	0.1	R82	0.1
R24	0.2	R59	0.1	R83	0.1

The predicted monthly dust deposition (based on annual average predicted flux rates) is presented in Figure 5-4. The contour plot shows that the monthly deposition criterion is limited to the site envelope.

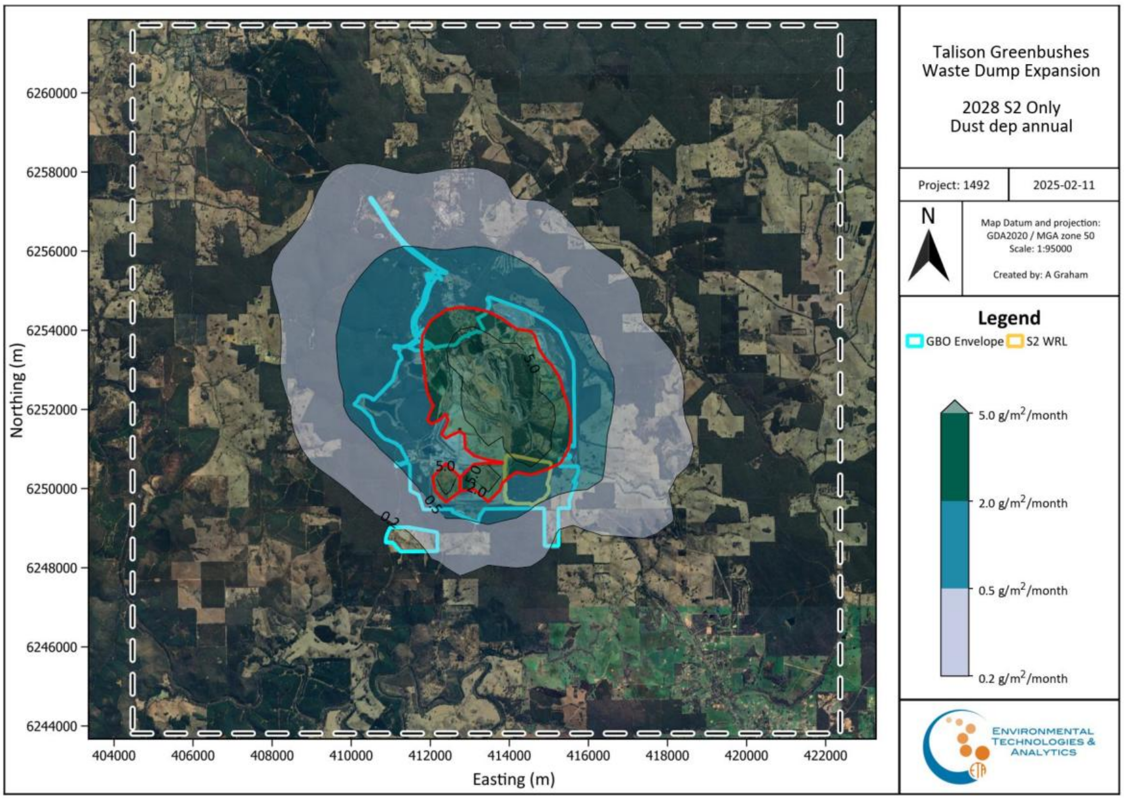


Figure 5-4: S2 Only - Total predicted monthly dust deposition (g/m²/month) – Project only.

5.2 S2 Only (2030) Scenario

5.2.1 Particulates as PM_{10}

The statistics of the predicted ground level concentrations of PM_{10} are presented in Table 5-5. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 387 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-5 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 17% at receptor R4 up to 71% at receptor R14.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as PM_{10}) are presented in Figure 5-5.

Table 5-5: S2 Only (2030) – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	63	41	34	20	5	5.6	77	54	48	34	19	19.4
R9	53	37	31	16	5	5.0	67	51	45	30	19	18.8
R10	74	61	46	23	9	8.0	88	74	60	37	23	21.8
R11	83	64	44	25	9	8.3	97	78	58	38	22	22.1
R13	225	66	47	22	6	7.7	239	80	60	36	20	21.5
R14	373	115	85	36	10	13.4	387	129	99	50	24	27.2
R15	76	53	41	15	3	4.9	90	67	54	28	16	18.7
R16	75	55	36	14	2	4.8	89	69	50	28	16	18.6
R51	53	19	15	7	2	2.4	66	33	29	21	16	16.2
R52	49	22	18	9	2	2.8	63	36	32	23	16	16.6
R13	225	66	47	22	6	7.7	239	80	60	36	20	21.5
R14	373	115	85	36	10	13.4	387	129	99	50	24	27.2
R15	76	53	41	15	3	4.9	90	67	54	28	16	18.7
R16	75	55	36	14	2	4.8	89	69	50	28	16	18.6
R17	129	49	40	13	2	4.5	143	63	54	26	15	18.3
R33	110	49	39	12	1	3.8	124	63	53	25	15	17.6
R1	163	118	105	59	28	22.7	177	132	119	72	42	36.5
R2	141	103	92	52	23	19.3	155	117	105	66	37	33.1
R3	105	86	69	38	16	13.1	119	100	83	52	29	26.9
R4	93	77	55	28	12	10.1	107	90	69	42	25	23.9
R5	91	75	52	27	11	9.5	105	88	66	40	25	23.3
R6	88	70	48	25	10	8.6	102	84	62	38	24	22.4
R39	120	88	79	41	19	15.6	133	101	93	55	32	29.4
R40	113	91	73	39	17	14.0	127	104	86	53	30	27.8
R41	128	93	86	46	20	17.3	142	107	99	60	34	31.1
R42	124	92	85	43	19	16.2	138	105	99	57	33	30.0
R43	88	71	53	27	11	9.6	102	85	67	41	24	23.4

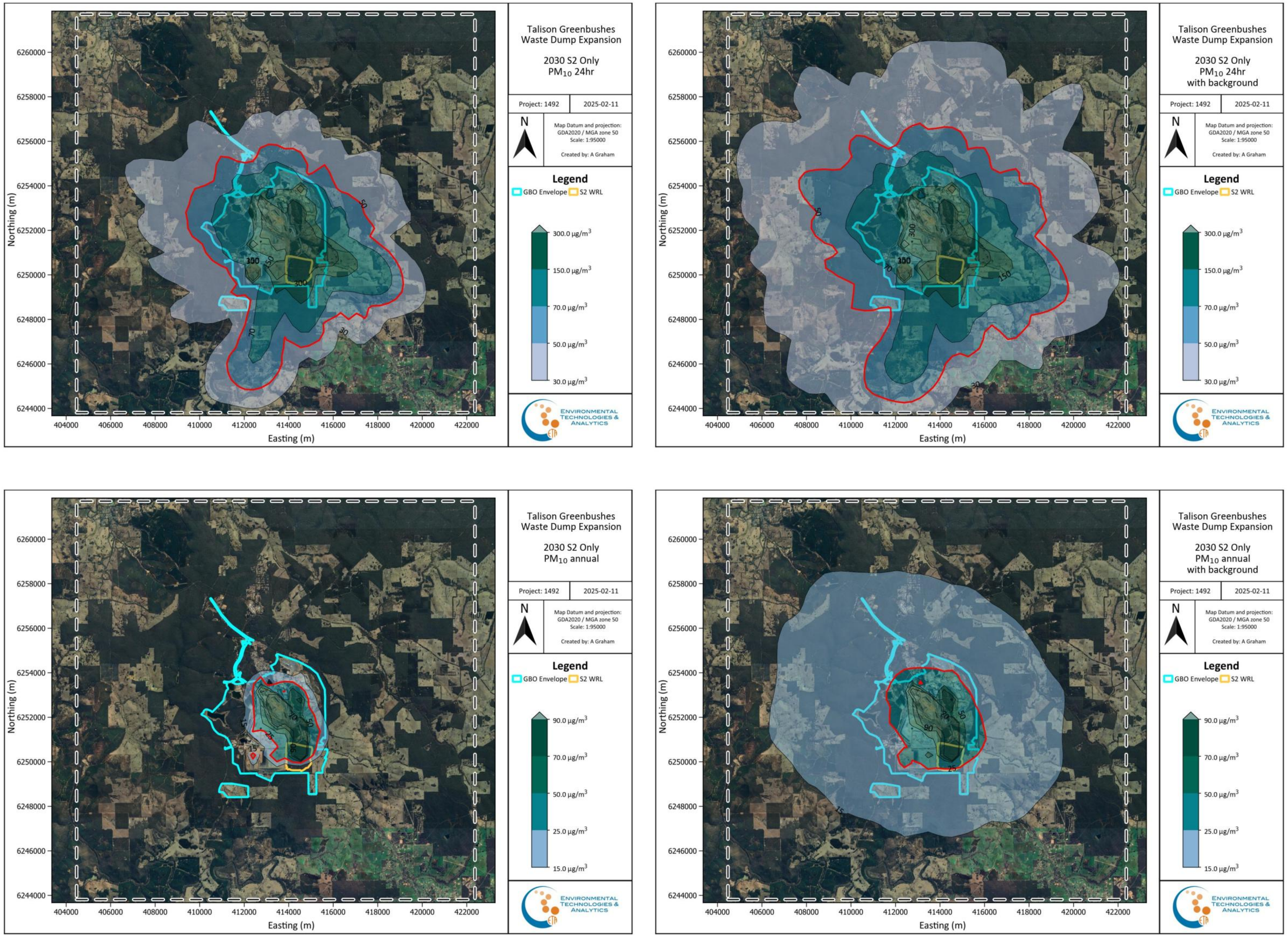


Figure 5-5: Modelled PM_{10} concentration contours for S2 only (2030)

5.2.2 Particulates as $PM_{2.5}$

The statistics of the predicted ground level concentrations of $PM_{2.5}$ are presented in Table 5-6. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 58 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1.
  - And at the following receptors within 1.5 km of the S8 WRL: R13, R14.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14
- The excursions of the criteria only occur for the maximum predicted concentration with significant reductions to the 6th highest predicted concentrations.
- This indicates that excursions are limited to a single occurence.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as $PM_{2.5}$) are presented in Figure 5-6.

Table 5-6: S2 Only (2030) – Predicted $PM_{2.5}$ concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	9	6	5	3	1	0.8	12	8	7	5	3	2.9
R9	8	6	5	2	1	0.7	10	8	7	4	3	2.8
R10	11	9	7	3	1	1.2	13	11	9	6	3	3.3
R11	12	10	7	4	1	1.2	15	12	9	6	3	3.3
R13	34	10	7	3	1	1.2	36	12	9	5	3	3.3
R14	56	17	13	5	2	2.0	58	19	15	7	4	4.1
R15	11	8	6	2	0	0.7	14	10	8	4	2	2.8
R16	11	8	5	2	0	0.7	13	10	8	4	2	2.8
R51	8	3	2	1	0	0.4	10	5	4	3	2	2.5
R52	7	3	3	1	0	0.4	10	5	5	3	2	2.5
R13	34	10	7	3	1	1.2	36	12	9	5	3	3.3
R14	56	17	13	5	2	2.0	58	19	15	7	4	4.1
R15	11	8	6	2	0	0.7	14	10	8	4	2	2.8
R16	11	8	5	2	0	0.7	13	10	8	4	2	2.8
R17	19	7	6	2	0	0.7	21	9	8	4	2	2.8
R33	17	7	6	2	0	0.6	19	9	8	4	2	2.7
R1	24	18	16	9	4	3.4	27	20	18	11	6	5.5
R2	21	15	14	8	3	2.9	23	18	16	10	6	5.0
R3	16	13	10	6	2	2.0	18	15	12	8	4	4.1
R4	14	12	8	4	2	1.5	16	14	10	6	4	3.6
R5	14	11	8	4	2	1.4	16	13	10	6	4	3.5
R6	13	11	7	4	1	1.3	15	13	9	6	4	3.4
R39	18	13	12	6	3	2.3	20	15	14	8	5	4.4
R40	17	14	11	6	3	2.1	19	16	13	8	5	4.2
R41	19	14	13	7	3	2.6	21	16	15	9	5	4.7
R42	19	14	13	6	3	2.4	21	16	15	9	5	4.5
R43	13	11	8	4	2	1.4	15	13	10	6	4	3.5

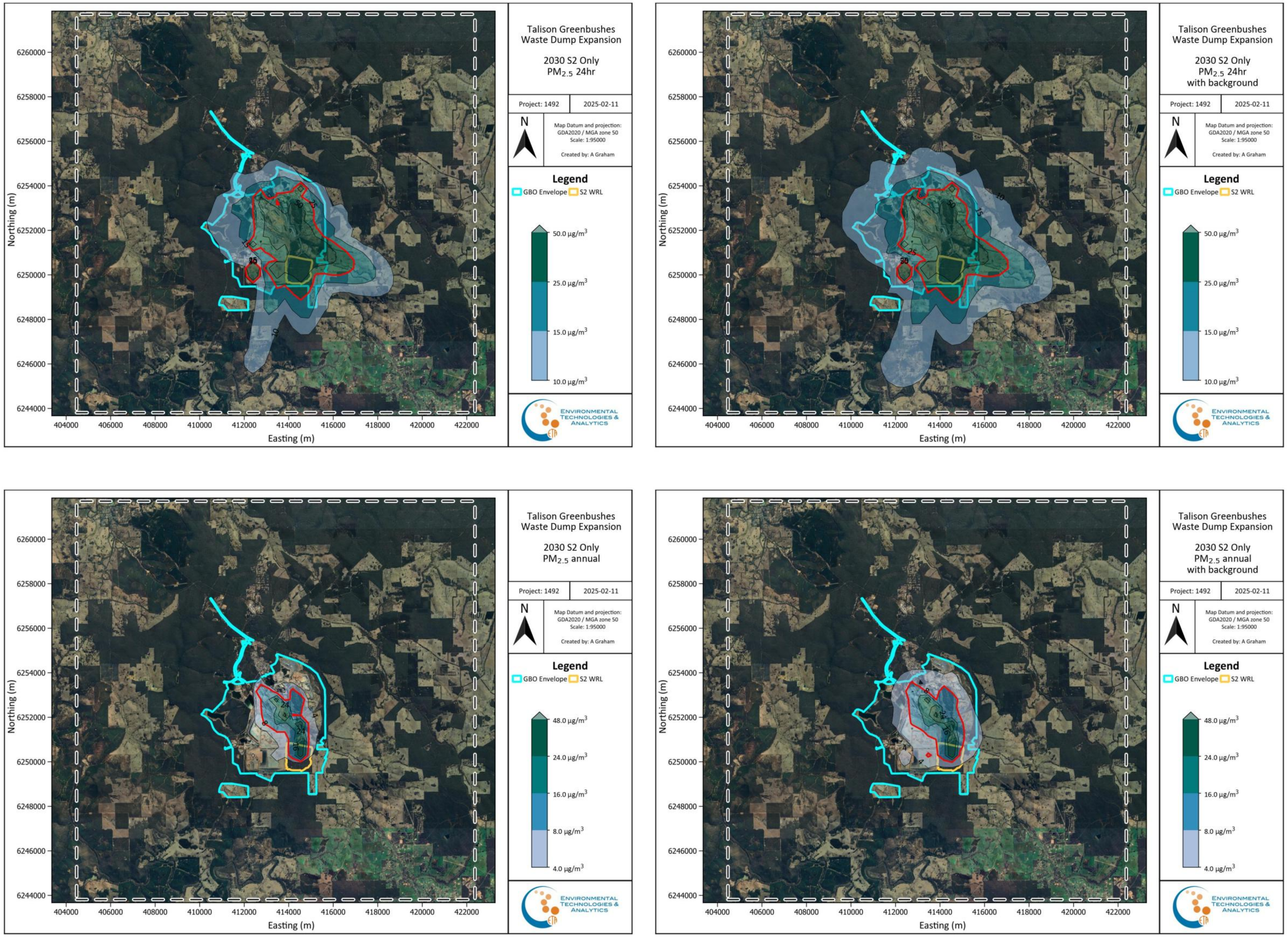


Figure 5-6: Modelled $PM_{2.5}$ concentration contours for S2 only (2030)

5.2.3 Total Suspended Particulates

The statistics of the predicted ground level concentrations of TSP are presented in Table 5-7. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 1,191 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-7 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 15% at receptor R1 up to 74% at receptor R13.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as TSP) are presented in Figure 5-7.

Table 5-7: S2 Only (2030) - Predicted TSP concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	151	89	82	43	11	12.6	178	117	109	70	38	40.2
R9	143	93	78	37	8	11.1	171	121	106	65	36	38.7
R10	214	173	130	58	16	18.7	241	201	157	86	44	46.3
R11	238	151	132	57	14	19.5	266	179	160	84	42	47.1
R13	677	175	137	54	15	20.6	704	203	165	82	43	48.2
R14	1,163	339	235	106	28	38.1	1,191	367	262	134	56	65.7
R15	215	143	105	39	6	12.9	243	170	133	67	34	40.5
R16	198	147	95	36	6	12.6	226	175	123	63	33	40.2
R51	133	53	38	17	4	5.8	160	81	65	44	32	33.4
R52	117	60	45	22	5	6.7	144	88	73	50	32	34.3
R13	677	175	137	54	15	20.6	704	203	165	82	43	48.2
R14	1,163	339	235	106	28	38.1	1,191	367	262	134	56	65.7
R15	215	143	105	39	6	12.9	243	170	133	67	34	40.5
R16	198	147	95	36	6	12.6	226	175	123	63	33	40.2
R17	337	127	103	31	4	11.4	364	155	130	58	31	39.0
R33	283	134	89	25	2	9.7	311	162	117	53	30	37.3
R1	285	241	201	113	51	41.0	313	268	228	141	79	68.6
R2	254	198	159	101	42	34.6	281	226	186	128	70	62.2
R3	215	158	133	67	27	24.1	243	185	161	95	55	51.7
R4	199	140	111	51	19	18.9	227	168	139	79	47	46.5
R5	194	134	109	49	18	17.9	222	161	136	76	46	45.5
R6	189	126	106	45	17	16.4	216	154	134	73	44	44.0
R39	224	170	143	79	33	28.3	251	198	170	106	61	55.9
R40	226	165	140	70	29	25.4	254	193	167	97	56	53.0
R41	239	193	147	89	38	31.2	266	220	175	116	66	58.8
R42	228	183	167	81	34	29.7	255	211	195	108	61	57.3
R43	189	136	107	49	19	18.2	217	163	134	77	46	45.8

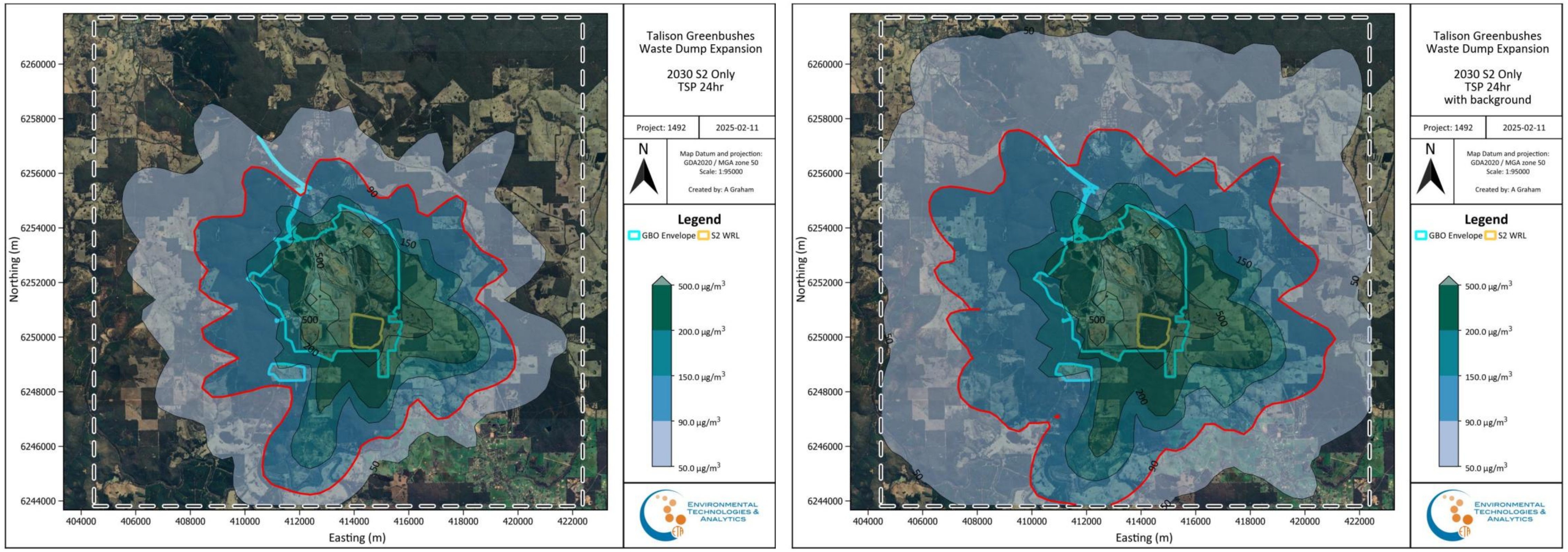


Figure 5-7: Modelled maximum 24hr averaged TSP concentration contours for S2 only (2030)

5.2.4 Dust deposition

The modelling predicts that the deposition rates will not exceed the maximum increase above background criteria of 2 g/m²/month at all identified sensitive receptors (Table 5-8).

Table 5-8: S2 Only 2030 - Predicted dust deposition at receptors – in isolation (g/m²/month).

Receptor	Maximum Deposition	Receptor	Maximum Deposition	Receptor	Maximum Deposition
R1	1.5	R25	0.2	R60	0.1
R2	1.2	R26	0.2	R61	0.1
R3	1.1	R27	0.1	R62	0.1
R4	1.0	R29	1.5	R63	0.1
R5	0.9	R31	0.1	R64	0.1
R6	0.9	R32	0.1	R65	0.1
R7	0.4	R33	0.4	R66	0.1
R8	0.5	R38	0.3	R67	0.0
R9	0.3	R39	1.2	R68	0.1
R10	0.8	R40	1.1	R69	0.1
R11	0.8	R41	1.2	R70	0.2
R13	0.6	R42	1.3	R71	0.1
R14	1.4	R43	1.0	R72	0.1
R15	0.4	R50	0.1	R73	0.1
R16	0.4	R51	0.2	R74	0.1
R17	0.5	R52	0.2	R75	0.2
R18	0.2	R53	0.1	R76	0.1
R19	0.2	R54	0.1	R77	0.1
R20	0.1	R55	0.1	R78	0.1
R21	0.0	R56	0.2	R79	0.1
R22	0.1	R57	0.2	R80	0.1
R23	0.2	R58	0.1	R82	0.1
R24	0.2	R59	0.1	R83	0.1

The predicted monthly dust deposition (based on annual average predicted flux rates) is presented in **Figure 5-8**. The contour plot shows that the monthly deposition criterion is limited to the site envelope.

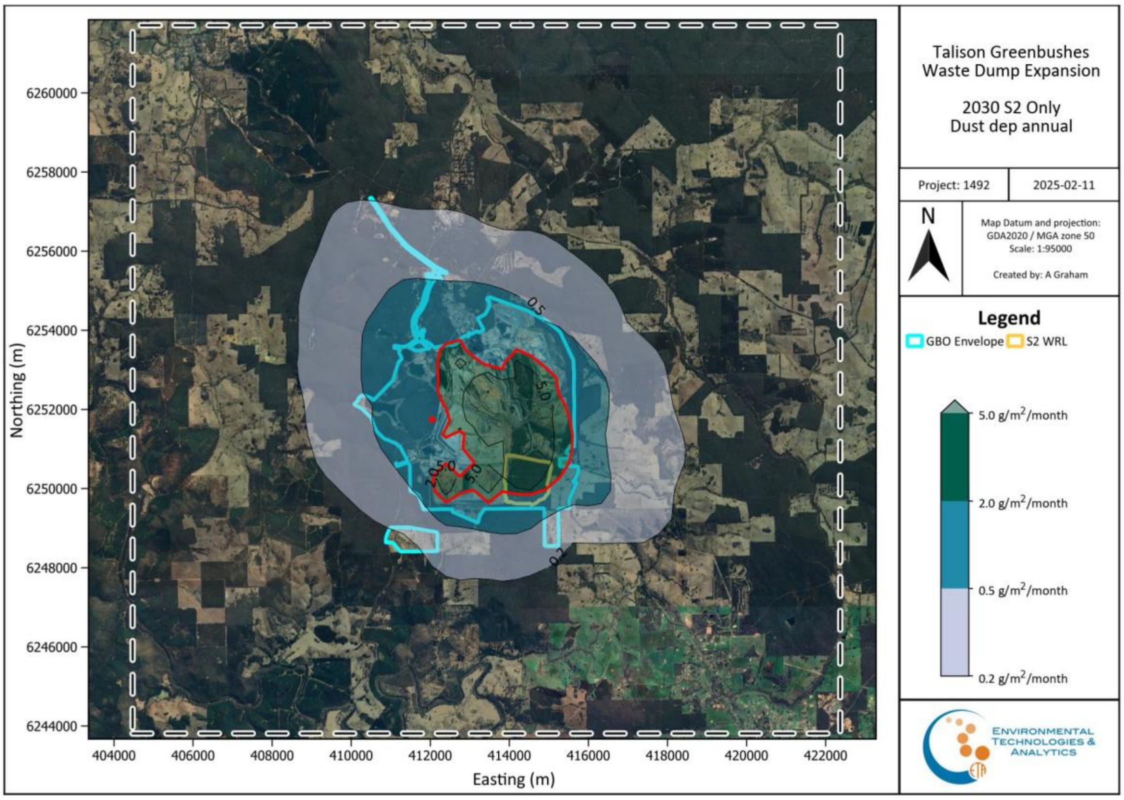


Figure 5-8: S2 Only - Total predicted monthly dust deposition (g/m²/month) – Project only.

5.3 S2 then S8 (2028) Scenario

5.3.1 Particulates as PM_{10}

The statistics of the predicted ground level concentrations of PM_{10} are presented in Table 5-9. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 547 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-9 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 14% at receptor R40 up to 65% at receptor R13.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as PM_{10}) are presented in Figure 5-9.

Table 5-9: S2 then S8 (2028) – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	92	61	51	29	12	10.6	106	74	64	43	26	24.4
R9	92	58	49	27	11	9.9	106	72	63	41	25	23.7
R10	145	81	67	40	20	16.2	159	95	81	53	33	30.0
R11	161	89	75	46	22	18.4	175	103	88	59	36	32.2
R13	187	65	57	29	11	10.4	201	79	71	43	25	24.2
R14	167	67	60	32	14	12.5	181	80	74	46	28	26.3
R15	86	41	35	15	4	4.9	99	55	48	29	18	18.7
R16	79	40	34	15	3	4.7	92	54	48	29	17	18.5
R51	78	34	29	15	4	4.5	92	48	43	28	17	18.3
R52	90	53	38	18	5	6.0	104	67	51	32	19	19.8
R13	187	65	57	29	11	10.4	201	79	71	43	25	24.2
R14	167	67	60	32	14	12.5	181	80	74	46	28	26.3
R15	86	41	35	15	4	4.9	99	55	48	29	18	18.7
R16	79	40	34	15	3	4.7	92	54	48	29	17	18.5
R17	74	37	29	13	2	4.0	88	51	42	26	16	17.8
R33	68	33	24	11	2	3.5	82	47	38	25	16	17.3
R1	533	331	311	174	89	65.4	547	345	325	187	102	79.2
R2	403	323	275	159	70	56.3	417	337	289	173	84	70.1
R3	213	180	143	79	38	30.2	227	194	157	92	52	44.0
R4	167	127	110	53	26	21.2	181	141	124	67	39	35.0
R5	162	119	103	50	24	19.8	175	133	117	64	38	33.6
R6	155	111	90	45	22	17.6	169	124	103	59	36	31.4
R39	323	210	175	103	48	38.1	336	224	189	117	61	51.9
R40	226	194	149	86	40	32.7	240	208	163	100	54	46.5
R41	329	254	217	131	57	46.6	343	268	231	145	71	60.4
R42	369	206	160	98	49	38.2	383	220	174	112	63	52.0
R43	159	123	111	52	24	20.1	172	137	125	66	38	33.9

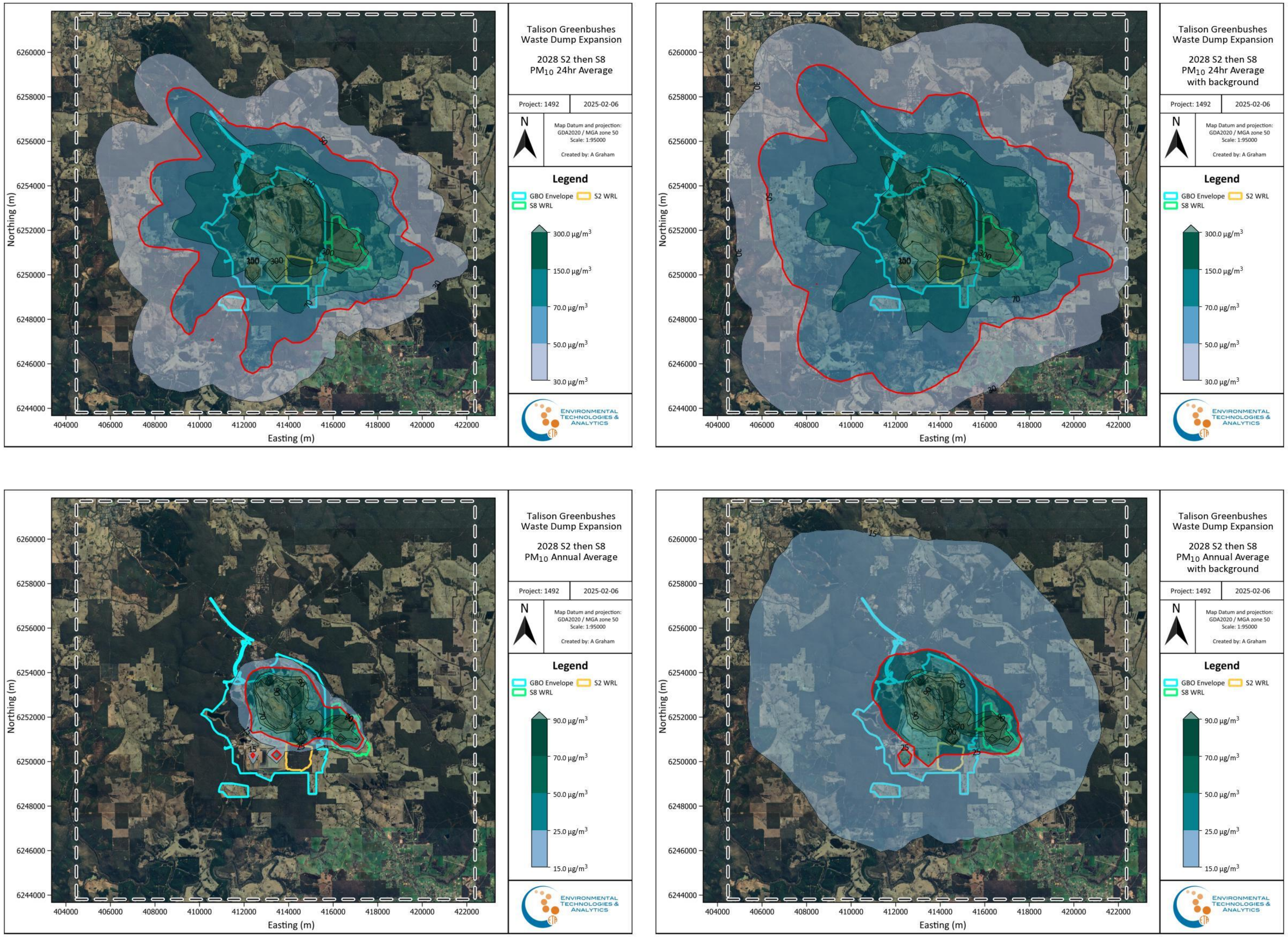


Figure 5-9: Modelled PM_{10} concentration contours for S2 then S8 (2028)

5.3.2 Particulates as $PM_{2.5}$

The statistics of the predicted ground level concentrations of $PM_{2.5}$ are presented in Table 5-10. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 82 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
    - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
    - And at the following receptors within 1.5 km of the S8 WRL: R11, R13, R14
    - And at the following receptors within 1.5 km of the S2 WRL: R13, R14

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as $PM_{2.5}$) are presented in Figure 5-10.

Table 5-10: S2 then S8 (2028) – Predicted $PM_{2.5}$ concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	14	9	8	4	2	1.6	16	11	10	6	4	3.7
R9	14	9	7	4	2	1.5	16	11	9	6	4	3.6
R10	22	12	10	6	3	2.4	24	14	12	8	5	4.5
R11	24	13	11	7	3	2.8	26	15	13	9	5	4.9
R13	28	10	9	4	2	1.6	30	12	11	6	4	3.7
R14	25	10	9	5	2	1.9	27	12	11	7	4	4.0
R15	13	6	5	2	1	0.7	15	8	7	4	3	2.8
R16	12	6	5	2	1	0.7	14	8	7	4	3	2.8
R51	12	5	4	2	1	0.7	14	7	7	4	3	2.8
R52	13	8	6	3	1	0.9	16	10	8	5	3	3.0
R13	28	10	9	4	2	1.6	30	12	11	6	4	3.7
R14	25	10	9	5	2	1.9	27	12	11	7	4	4.0
R15	13	6	5	2	1	0.7	15	8	7	4	3	2.8
R16	12	6	5	2	1	0.7	14	8	7	4	3	2.8
R17	11	6	4	2	0	0.6	13	8	6	4	2	2.7
R33	10	5	4	2	0	0.5	12	7	6	4	2	2.6
R1	80	50	47	26	13	9.8	82	52	49	28	15	11.9
R2	61	48	41	24	11	8.4	63	51	43	26	13	10.5
R3	32	27	21	12	6	4.5	34	29	24	14	8	6.6
R4	25	19	17	8	4	3.2	27	21	19	10	6	5.3
R5	24	18	15	7	4	3.0	26	20	18	10	6	5.1
R6	23	17	13	7	3	2.6	25	19	16	9	5	4.7
R39	48	32	26	15	7	5.7	50	34	28	18	9	7.8
R40	34	29	22	13	6	4.9	36	31	25	15	8	7.0
R41	49	38	33	20	9	7.0	52	40	35	22	11	9.1
R42	55	31	24	15	7	5.7	57	33	26	17	9	7.8
R43	24	19	17	8	4	3.0	26	21	19	10	6	5.1

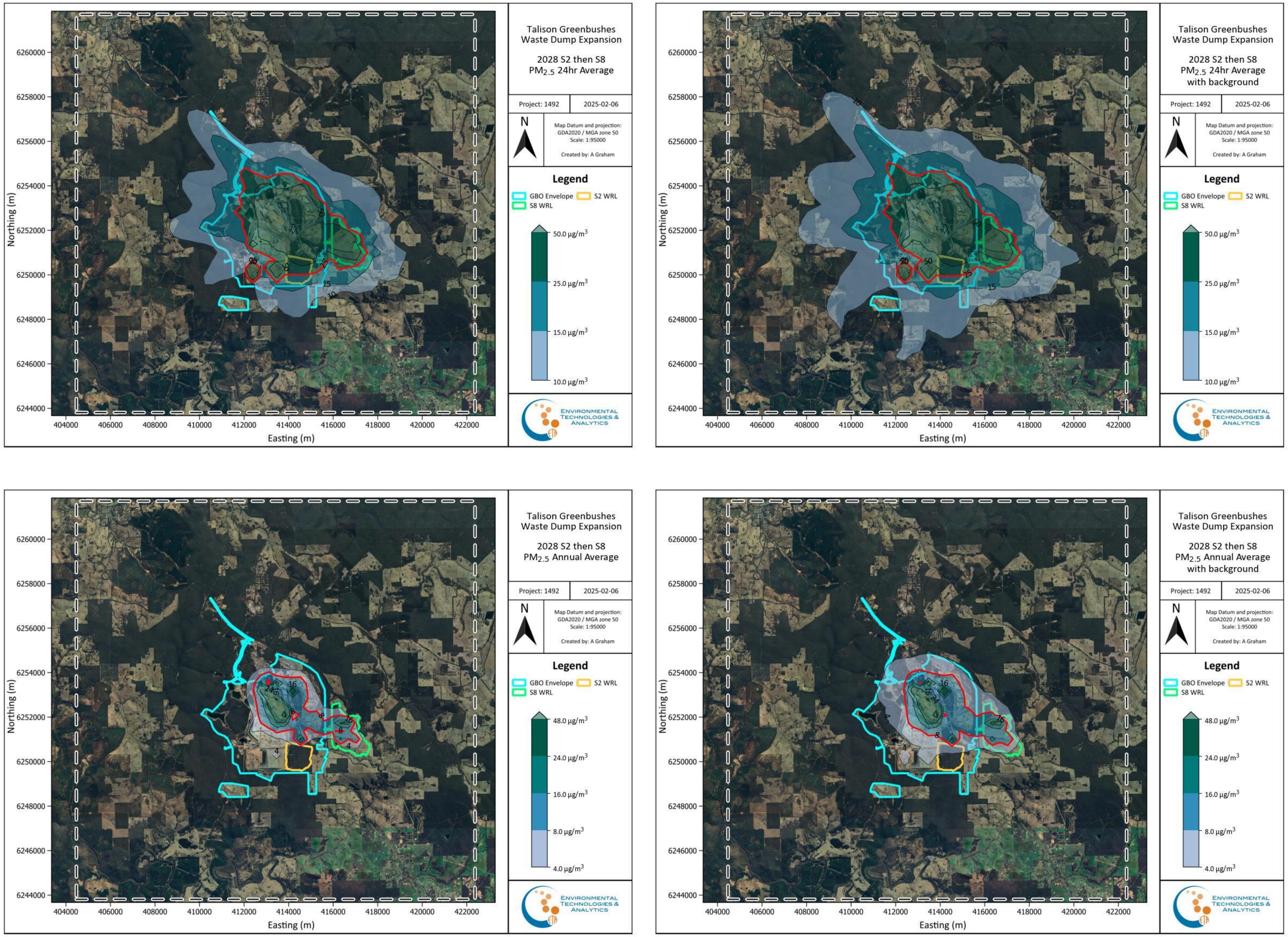


Figure 5-10: Modelled $PM_{2.5}$ concentration contours for S2 then S8 (2028)

5.3.3 Total Suspended Particulates

The statistics of the predicted ground level concentrations of TSP are presented in Table 5-11. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 1,491 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-11 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 8% at receptor R3 up to 67% at receptor R13.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as TSP) are presented in Figure 5-11.

Table 5-11: S2 then S8 (2028) - Predicted TSP concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	231	165	119	73	30	26.3	259	193	147	101	57	53.9
R9	207	158	119	71	28	24.6	234	185	147	98	56	52.2
R10	444	211	175	106	54	42.5	472	239	202	134	81	70.1
R11	503	225	206	125	62	50.4	531	253	233	153	89	78.0
R13	557	186	160	84	28	28.7	584	214	188	111	55	56.3
R14	478	174	157	92	39	34.0	506	201	185	119	66	61.6
R15	242	103	87	37	10	12.1	269	131	115	64	38	39.7
R16	221	106	82	35	9	11.6	248	133	110	63	36	39.2
R51	208	99	81	38	9	12.2	236	127	108	66	36	39.8
R52	237	151	108	51	12	16.5	264	179	136	79	39	44.1
R13	557	186	160	84	28	28.7	584	214	188	111	55	56.3
R14	478	174	157	92	39	34.0	506	201	185	119	66	61.6
R15	242	103	87	37	10	12.1	269	131	115	64	38	39.7
R16	221	106	82	35	9	11.6	248	133	110	63	36	39.2
R17	140	81	70	26	6	8.9	168	108	98	54	34	36.5
R33	145	71	63	23	5	7.8	173	99	91	51	33	35.4
R1	1,463	809	680	359	185	141.6	1,491	837	707	387	213	169.2
R2	1,102	737	626	369	145	124.3	1,129	765	653	397	172	151.9
R3	427	394	314	176	75	61.9	455	421	342	204	103	89.5
R4	345	274	246	118	51	42.8	373	301	274	145	79	70.4
R5	335	257	233	110	46	39.9	363	284	261	137	74	67.5
R6	324	220	204	100	41	35.7	352	248	231	127	69	63.3
R39	868	453	415	234	98	79.7	895	481	443	261	126	107.3
R40	475	399	353	192	84	67.1	503	426	381	220	112	94.7
R41	882	597	509	298	122	100.6	910	625	537	326	149	128.2
R42	999	417	386	220	97	78.5	1,026	444	413	247	125	106.1
R43	318	265	231	112	48	40.5	346	293	259	140	76	68.1

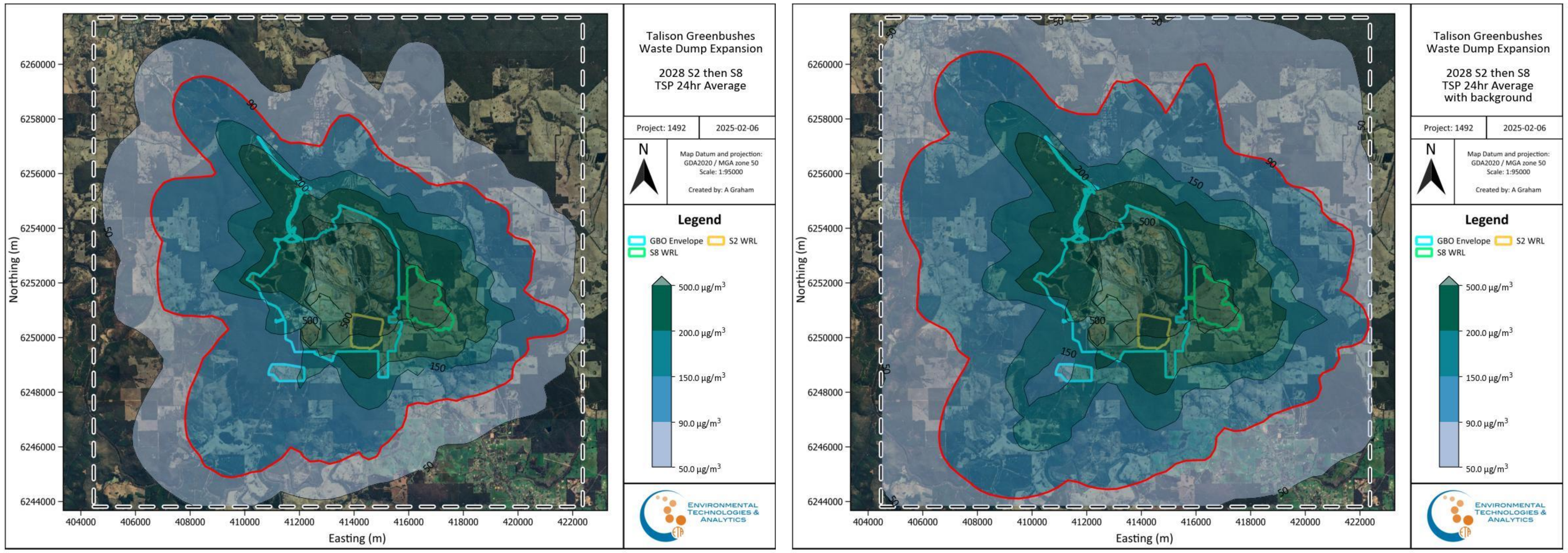


Figure 5-11: Modelled maximum 24hr averaged TSP concentration contours for S2 then S8 (2028)

5.3.4 Dust deposition

The maximum monthly predicted deposition rates for the S2 then S8 (2028) scenario are presented in Table 5-12. From this table it is apparent that the receptors immediately to the north of the operations are predicted to have deposition rates that are above the maximum increase above background criteria of 2 g/m^2/month.

Table 5-12: S2S8 Only 2028 - Predicted dust deposition at receptors – in isolation (g/m^2/month).

Receptor	Maximum Deposition	Receptor	Maximum Deposition	Receptor	Maximum Deposition
R1	6.8	R25	0.3	R60	0.1
R2	5.9	R26	0.3	R61	0.2
R3	3.9	R27	0.1	R62	0.2
R4	3.0	R29	7.6	R63	0.3
R5	2.8	R31	0.2	R64	0.3
R6	2.5	R32	0.1	R65	0.3
R7	0.9	R33	0.3	R66	0.2
R8	1.0	R38	0.8	R67	0.1
R9	0.7	R39	4.8	R68	0.1
R10	1.7	R40	4.0	R69	0.2
R11	1.9	R41	5.5	R70	0.3
R13	0.8	R42	4.7	R71	0.1
R14	1.3	R43	3.0	R72	0.2
R15	0.4	R50	0.1	R73	0.2
R16	0.4	R51	0.4	R74	0.1
R17	0.4	R52	0.5	R75	0.2
R18	0.2	R53	0.3	R76	0.1
R19	0.2	R54	0.3	R77	0.1
R20	0.1	R55	0.3	R78	0.1
R21	0.0	R56	0.5	R79	0.1
R22	0.2	R57	0.4	R80	0.1
R23	0.5	R58	0.2	R82	0.1
R24	0.3	R59	0.1	R83	0.1

The predicted monthly dust deposition (based on annual average predicted flux rates) is presented in **Figure 5-12**. The contour plot shows that the monthly deposition criterion is limited to the site envelope.

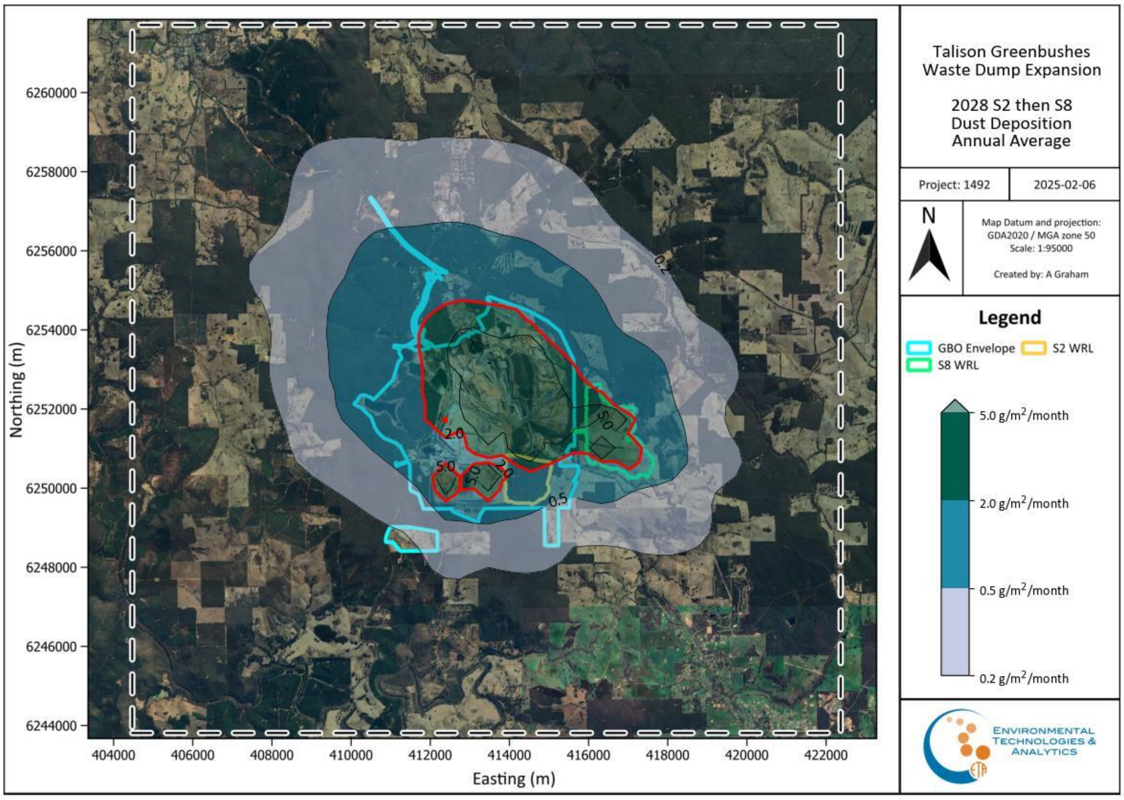


Figure 5-12: S2 then S8 (2028) - Total predicted monthly dust deposition (g/m²/month) – Project only.

5.4 S2 then S8 (2034) Scenario

5.4.1 Particulates as PM_{10}

The statistics of the predicted ground level concentrations of PM_{10} are presented in Table 5-13. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 193 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
    - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
    - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
    - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-13 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 8% at receptor R40 up to 69% at receptor R51.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as PM_{10}) are presented in Figure 5-13.

Table 5-13: S2 then S8 (2034) – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	63	39	31	21	4	5.6	77	53	45	35	18	19.4
R9	60	39	34	17	4	4.9	74	53	48	31	18	18.7
R10	81	56	44	23	9	7.8	95	70	58	37	22	21.6
R11	77	55	42	24	9	8.0	91	68	56	38	23	21.8
R13	99	52	46	20	6	6.5	112	66	60	34	19	20.3
R14	98	72	62	26	9	9.2	112	86	76	40	23	23.0
R15	76	43	33	13	3	4.3	90	57	47	27	17	18.1
R16	77	45	34	14	3	4.2	91	59	47	27	17	18.0
R51	51	16	14	7	2	2.3	64	30	28	21	16	16.1
R52	49	19	18	9	3	2.7	63	33	32	22	16	16.5
R13	99	52	46	20	6	6.5	112	66	60	34	19	20.3
R14	98	72	62	26	9	9.2	112	86	76	40	23	23.0
R15	76	43	33	13	3	4.3	90	57	47	27	17	18.1
R16	77	45	34	14	3	4.2	91	59	47	27	17	18.0
R17	99	50	42	11	2	4.1	113	64	55	25	15	17.9
R33	92	45	36	10	1	3.5	106	58	49	23	15	17.3
R1	179	134	117	60	28	23.4	193	148	131	74	42	37.2
R2	147	113	101	54	23	19.7	161	127	115	68	37	33.5
R3	103	94	76	36	14	13.4	117	108	89	50	28	27.2
R4	93	77	58	27	12	10.4	107	91	72	41	25	24.2
R5	91	73	55	26	11	9.8	104	87	69	39	25	23.6
R6	88	69	49	24	10	8.9	102	83	62	37	24	22.7
R39	130	98	89	41	18	16.0	144	112	103	55	32	29.8
R40	110	101	78	39	16	14.2	124	115	92	52	30	28.0
R41	134	104	94	47	20	17.7	148	118	108	60	34	31.5
R42	141	100	95	43	19	16.8	155	114	109	56	33	30.6
R43	87	74	58	26	11	10.0	101	87	71	40	25	23.8

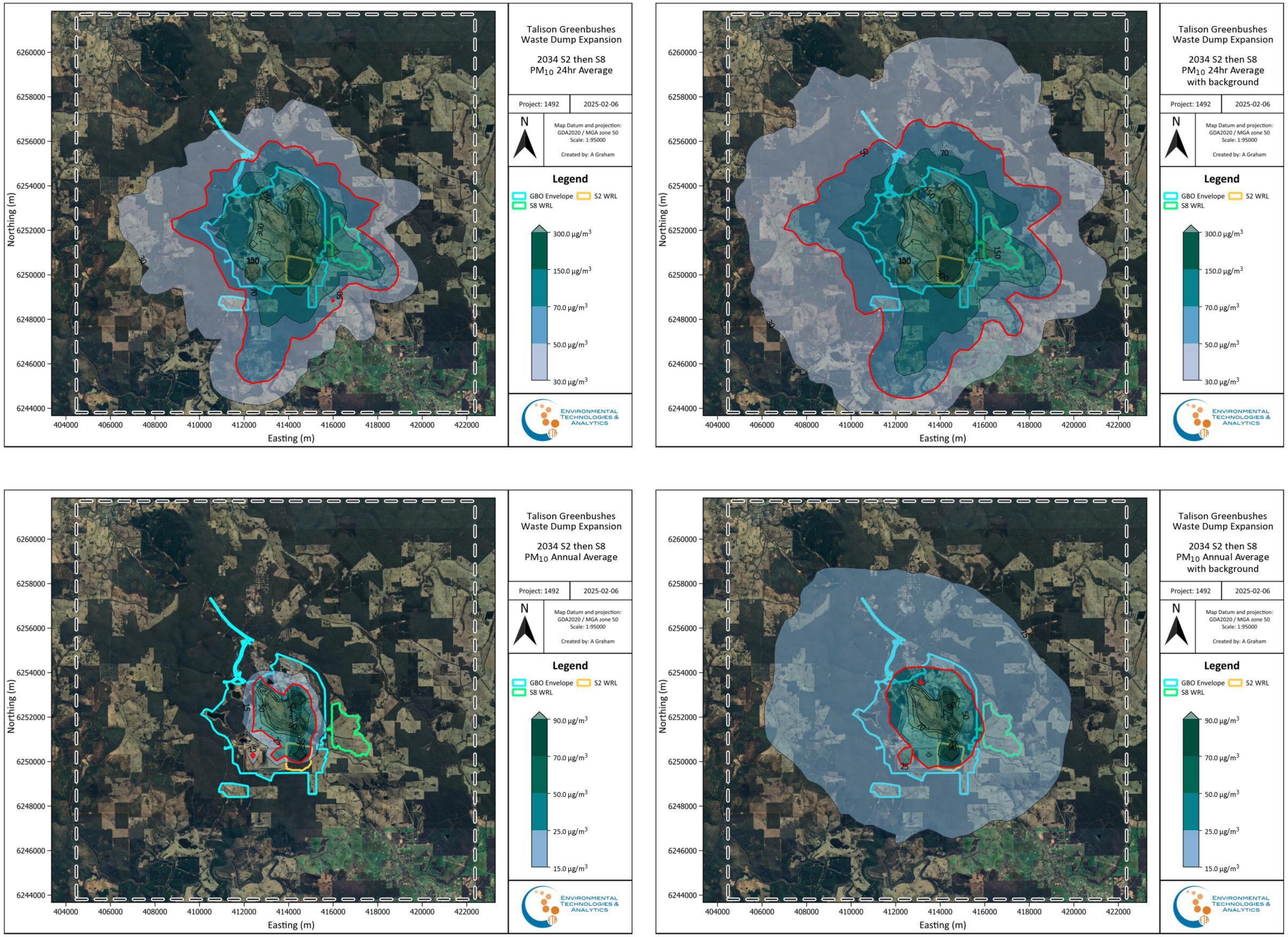


Figure 5-13: Modelled PM_{10} concentration contours for S2 then S8 (2034)

5.4.2 Particulates as $PM_{2.5}$

The statistics of the predicted ground level concentrations of $PM_{2.5}$ are presented in Table 5-14. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 29 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1.
  - No receptors within 1.5 km of the S8 WRL or S2 WRL were above the criteria threshold.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as $PM_{2.5}$) are presented in Figure 5-14.

Table 5-14: S2 then S8 (2034) – Predicted $PM_{2.5}$ concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	10	6	5	3	1	0.8	12	8	7	5	3	2.9
R9	9	6	5	3	1	0.7	11	8	7	5	3	2.8
R10	12	8	7	3	1	1.2	14	11	9	6	3	3.3
R11	12	8	6	4	1	1.2	14	10	8	6	3	3.3
R13	15	8	7	3	1	1.0	17	10	9	5	3	3.1
R14	15	11	9	4	1	1.4	17	13	11	6	3	3.5
R15	11	6	5	2	0	0.6	14	9	7	4	3	2.7
R16	12	7	5	2	0	0.6	14	9	7	4	3	2.7
R51	8	2	2	1	0	0.3	10	4	4	3	2	2.4
R52	7	3	3	1	0	0.4	9	5	5	3	2	2.5
R13	15	8	7	3	1	1.0	17	10	9	5	3	3.1
R14	15	11	9	4	1	1.4	17	13	11	6	3	3.5
R15	11	6	5	2	0	0.6	14	9	7	4	3	2.7
R16	12	7	5	2	0	0.6	14	9	7	4	3	2.7
R17	15	7	6	2	0	0.6	17	10	8	4	2	2.7
R33	14	7	5	1	0	0.5	16	9	7	4	2	2.6
R1	27	20	18	9	4	3.5	29	22	20	11	6	5.6
R2	22	17	15	8	3	2.9	24	19	17	10	6	5.0
R3	16	14	11	5	2	2.0	18	16	13	8	4	4.1
R4	14	12	9	4	2	1.6	16	14	11	6	4	3.7
R5	14	11	8	4	2	1.5	16	13	10	6	4	3.6
R6	13	10	7	4	1	1.3	15	12	9	6	4	3.4
R39	20	15	13	6	3	2.4	22	17	16	8	5	4.5
R40	16	15	12	6	2	2.1	19	17	14	8	4	4.2
R41	20	16	14	7	3	2.6	22	18	16	9	5	4.7
R42	21	15	14	6	3	2.5	23	17	16	8	5	4.6
R43	13	11	9	4	2	1.5	15	13	11	6	4	3.6

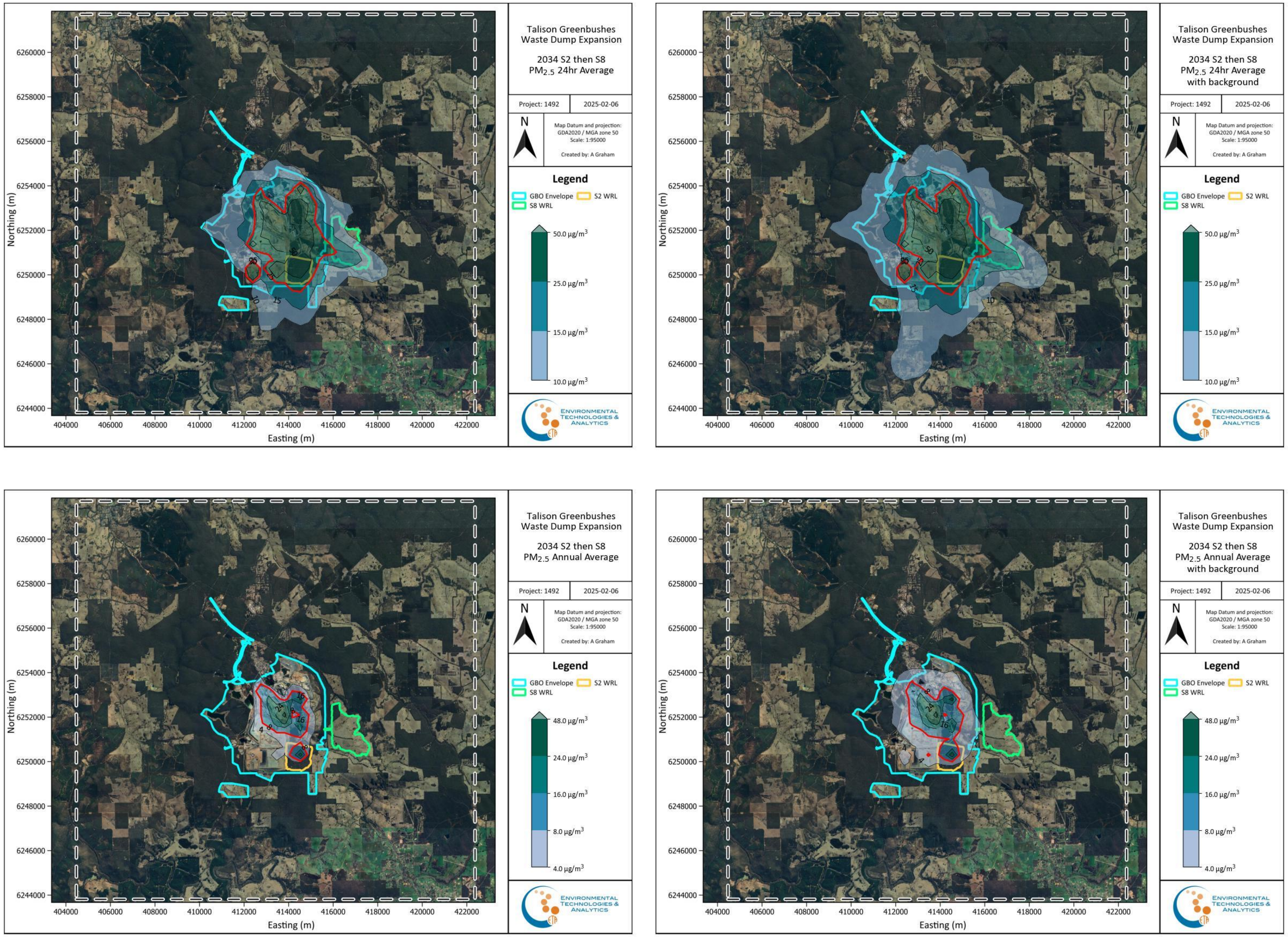


Figure 5-14: Modelled $PM_{2.5}$ concentration contours for S2 then S8 (2034)

5.4.3 Total Suspended Particulates

The statistics of the predicted ground level concentrations of TSP are presented in Table 5-15. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 451 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
    - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
    - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
    - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-15 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 12% at receptor R40 up to 67% at receptor R51.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as TSP) are presented in Figure 5-15.

Table 5-15: S2 then S8 (2034) - Predicted TSP concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	158	87	76	45	9	12.4	186	115	104	72	37	40.0
R9	142	81	67	43	8	10.9	169	109	95	71	35	38.5
R10	210	123	112	57	15	17.5	237	151	139	85	43	45.1
R11	194	132	108	57	17	17.7	222	159	135	84	44	45.3
R13	275	142	116	50	14	16.9	303	170	144	78	42	44.5
R14	272	183	173	74	23	24.8	299	211	201	101	51	52.4
R15	192	116	84	32	8	11.0	219	144	112	60	35	38.6
R16	191	119	82	34	7	10.8	218	147	110	62	35	38.4
R51	127	42	35	17	4	5.5	154	69	63	45	32	33.1
R52	115	51	48	21	5	6.5	143	79	75	48	32	34.1
R13	275	142	116	50	14	16.9	303	170	144	78	42	44.5
R14	272	183	173	74	23	24.8	299	211	201	101	51	52.4
R15	192	116	84	32	8	11.0	219	144	112	60	35	38.6
R16	191	119	82	34	7	10.8	218	147	110	62	35	38.4
R17	250	128	101	27	4	10.1	277	156	129	54	32	37.7
R33	232	122	80	24	3	8.6	260	149	108	51	31	36.2
R1	424	297	265	138	58	51.0	451	325	292	166	86	78.6
R2	333	268	223	121	47	42.1	360	296	251	149	74	69.7
R3	229	200	151	75	29	27.9	256	228	178	103	56	55.5
R4	212	161	118	62	22	21.3	240	188	146	90	49	48.9
R5	206	155	113	59	21	20.1	234	183	140	87	48	47.7
R6	200	148	101	52	19	18.2	227	175	129	80	46	45.8
R39	298	234	194	98	37	34.3	326	261	222	125	64	61.9
R40	242	213	153	81	30	29.3	270	241	181	109	58	56.9
R41	300	248	206	106	42	37.6	327	275	233	134	69	65.2
R42	331	233	205	101	41	36.3	358	261	232	129	69	63.9
R43	200	157	116	58	21	20.6	228	184	144	86	49	48.2

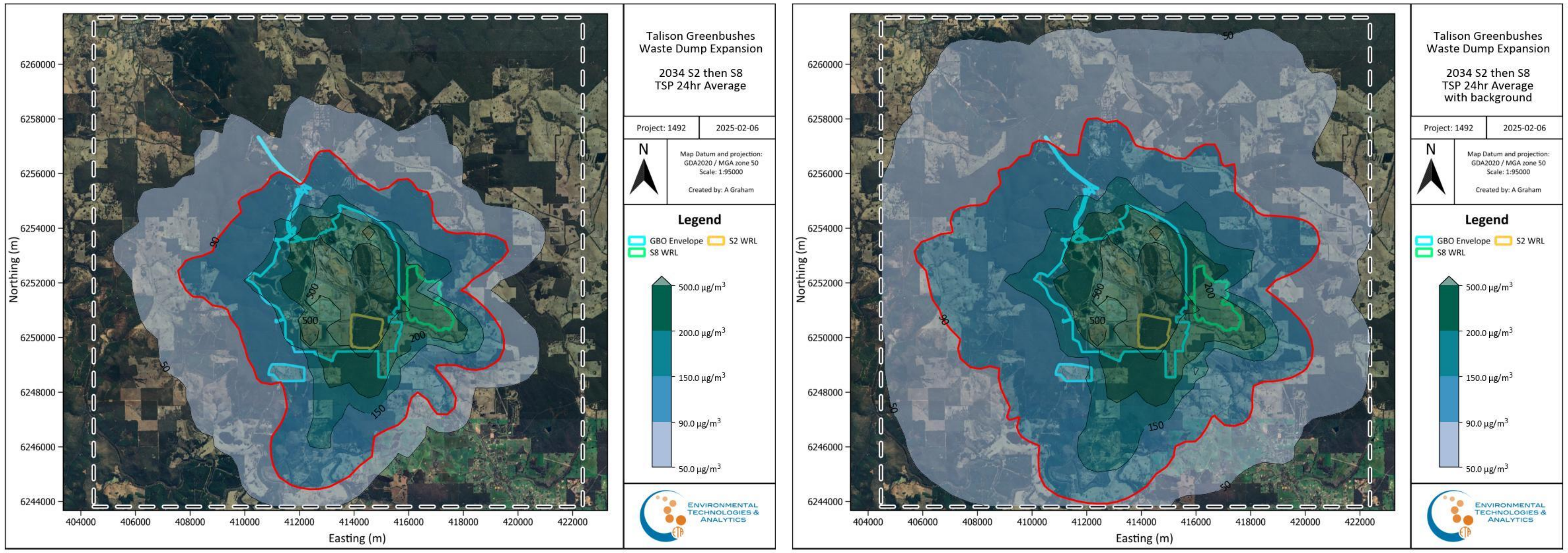


Figure 5-15: Modelled maximum 24hr averaged TSP concentration contours for S2 then S8 (2034)

5.4.4 Dust deposition

The modelling predicts that the deposition rates will not exceed the maximum increase above background criteria of 2 g/m^2/month at all identified sensitive receptors (Table 5-16).

Table 5-16: S2S8 Only 2034 - Predicted dust deposition at receptors – in isolation (g/m^2/month).

Receptor	Maximum Deposition	Receptor	Maximum Deposition	Receptor	Maximum Deposition
R1	1.6	R25	0.2	R60	0.1
R2	1.4	R26	0.2	R61	0.1
R3	1.2	R27	0.1	R62	0.1
R4	1.1	R29	1.6	R63	0.1
R5	1.0	R31	0.1	R64	0.1
R6	1.0	R32	0.1	R65	0.1
R7	0.4	R33	0.3	R66	0.1
R8	0.5	R38	0.4	R67	0.0
R9	0.4	R39	1.4	R68	0.1
R10	0.8	R40	1.2	R69	0.1
R11	0.8	R41	1.4	R70	0.2
R13	0.5	R42	1.5	R71	0.1
R14	1.1	R43	1.1	R72	0.1
R15	0.4	R50	0.1	R73	0.1
R16	0.3	R51	0.2	R74	0.1
R17	0.4	R52	0.2	R75	0.1
R18	0.2	R53	0.2	R76	0.1
R19	0.1	R54	0.1	R77	0.1
R20	0.1	R55	0.1	R78	0.1
R21	0.0	R56	0.2	R79	0.1
R22	0.1	R57	0.2	R80	0.1
R23	0.2	R58	0.1	R82	0.1
R24	0.2	R59	0.1	R83	0.1

The predicted monthly dust deposition (based on annual average predicted flux rates) is presented in **Figure 5-16**. The contour plot shows that the monthly deposition criterion is limited to the site envelope.

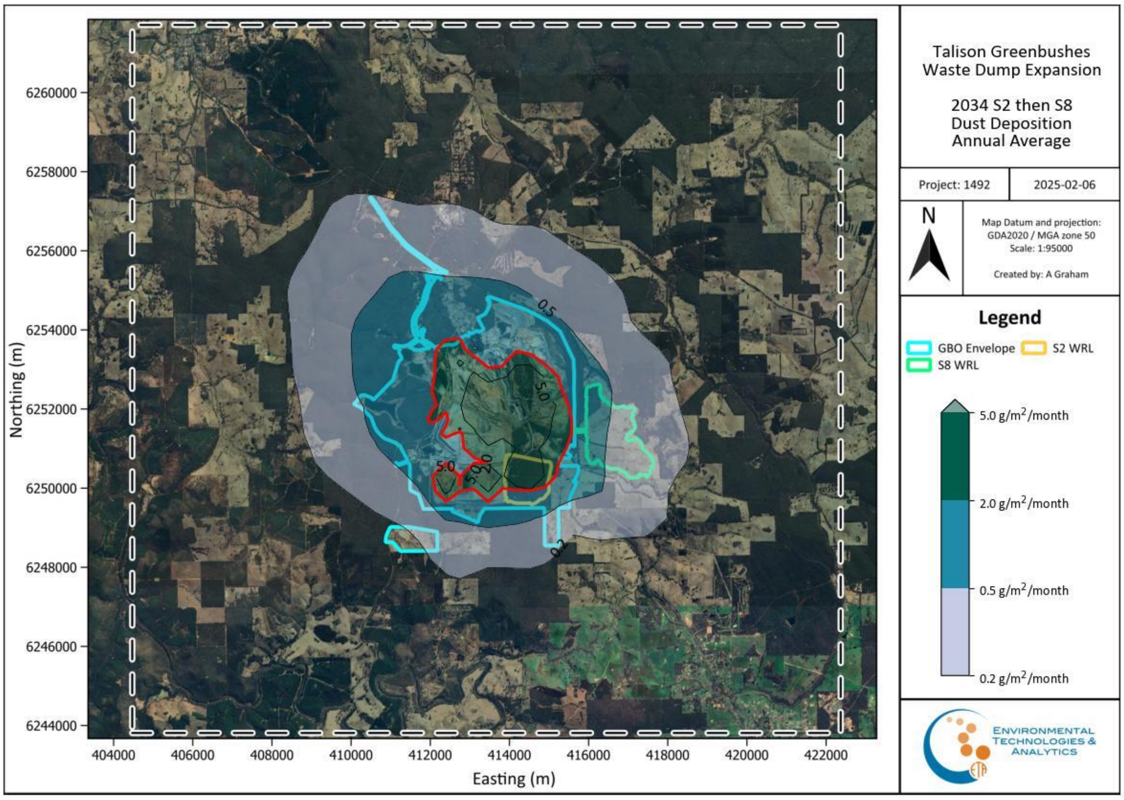


Figure 5-16: S2 then S8 (2034) - Total predicted monthly dust deposition (g/m^2/month) – Project only.

5.5 S8 and S2 (2029) Scenario

5.5.1 Particulates as PM_{10}

The statistics of the predicted ground level concentrations of PM_{10} are presented in Table 5-17. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 291 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-17 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 15% at receptor R6 up to 58% at receptor R51.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as PM_{10}) are presented in Figure 5-17.

Table 5-17: S8 and S2 (2029) – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	124	70	67	38	17	13.8	138	84	80	52	30	27.6
R9	95	59	54	33	15	11.8	109	72	68	47	29	25.6
R10	241	118	98	61	28	23.3	255	132	112	75	42	37.1
R11	277	142	114	72	33	28.7	291	155	128	86	47	42.5
R13	166	91	82	40	15	13.6	180	105	96	54	29	27.4
R14	204	107	78	44	20	17.0	218	121	92	58	33	30.8
R15	68	42	38	15	4	5.1	82	56	52	29	18	18.9
R16	59	41	38	15	4	4.9	73	55	51	28	18	18.7
R51	104	44	37	19	4	5.7	118	58	51	33	18	19.5
R52	114	66	52	23	6	7.7	127	80	66	37	20	21.5
R13	166	91	82	40	15	13.6	180	105	96	54	29	27.4
R14	204	107	78	44	20	17.0	218	121	92	58	33	30.8
R15	68	42	38	15	4	5.1	82	56	52	29	18	18.9
R16	59	41	38	15	4	4.9	73	55	51	28	18	18.7
R17	80	41	32	13	3	4.3	94	54	46	27	17	18.1
R33	74	36	29	12	2	3.8	88	50	43	26	16	17.6
R1	229	166	141	84	43	33.0	242	180	155	98	56	46.8
R2	210	149	129	70	38	29.4	224	163	143	84	52	43.2
R3	164	118	105	49	25	20.6	178	131	119	63	39	34.4
R4	137	103	98	42	20	16.5	151	117	112	56	34	30.3
R5	130	100	95	40	19	15.6	143	114	109	54	32	29.4
R6	117	99	91	37	18	14.5	131	113	105	51	31	28.3
R39	171	121	108	55	29	23.2	185	135	122	69	43	37.0
R40	178	127	116	53	27	22.4	192	141	129	67	41	36.2
R41	194	137	121	62	34	26.5	207	151	134	76	48	40.3
R42	178	121	111	58	30	23.6	192	135	125	72	44	37.4
R43	128	98	92	40	18	15.4	142	112	105	54	32	29.2

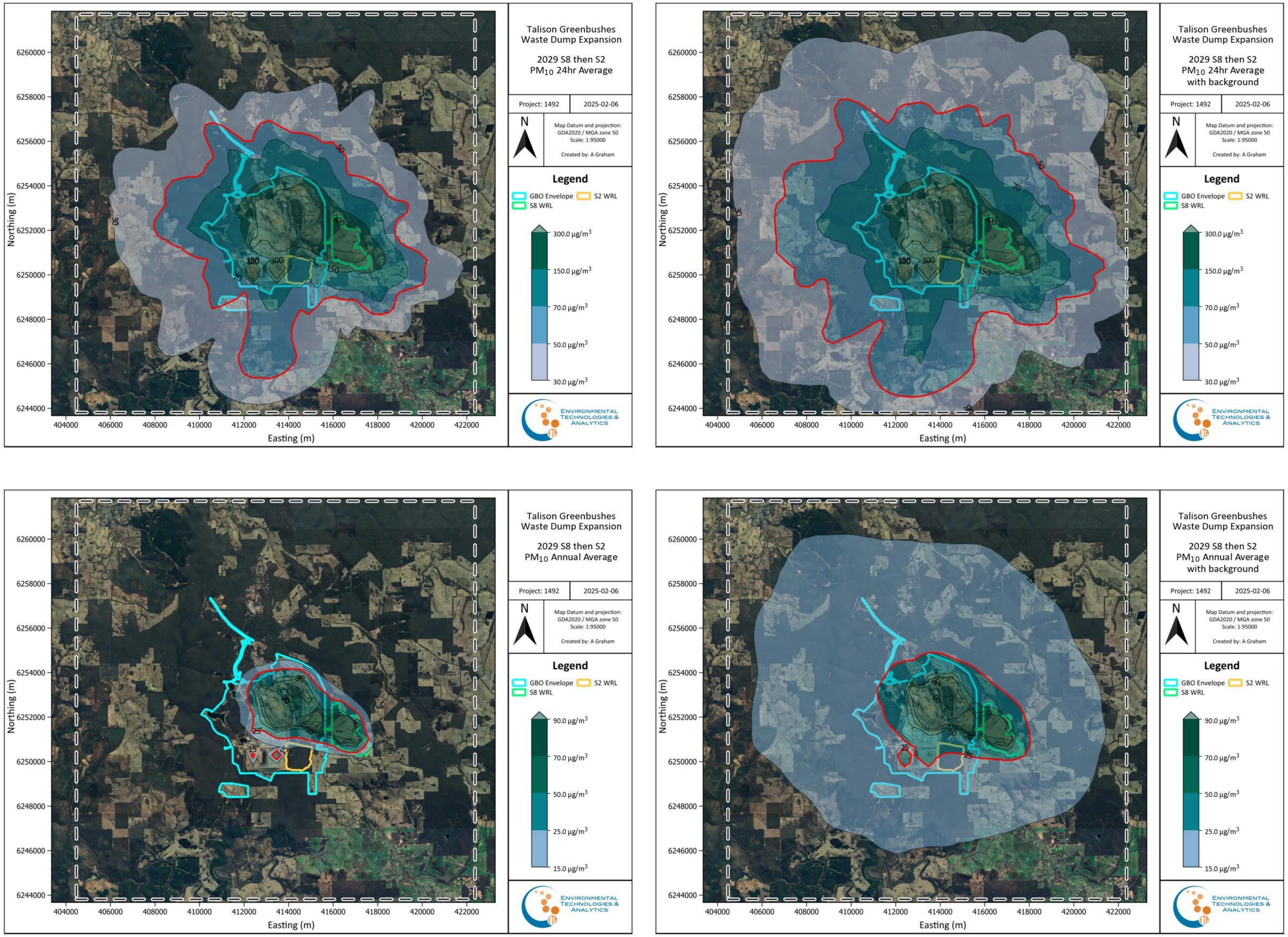


Figure 5-17: Modelled PM_{10} concentration contours for S8 and S2 (2029)

5.5.2 Particulates as $PM_{2.5}$

The statistics of the predicted ground level concentrations of $PM_{2.5}$ are presented in Table 5-18. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 44 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
    - The following Greenbushes township receptors: R1, R2, R3, R39, R40, R41, R42.
    - And at the following receptors within 1.5 km of the S8 WRL: R10, R11, R13, R14
    - And at the following receptors within 1.5 km of the S2 WRL: R13, R14

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as $PM_{2.5}$) are presented in Figure 5-18.

Table 5-18: S8 and S2 (2029) – Predicted $PM_{2.5}$ concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	19	11	10	6	2	2.1	21	13	12	8	5	4.2
R9	14	9	8	5	2	1.8	16	11	10	7	4	3.9
R10	36	18	15	9	4	3.5	38	20	17	11	6	5.6
R11	42	21	17	11	5	4.3	44	23	19	13	7	6.4
R13	25	14	12	6	2	2.0	27	16	14	8	4	4.1
R14	31	16	12	7	3	2.5	33	18	14	9	5	4.6
R15	10	6	6	2	1	0.8	12	8	8	4	3	2.9
R16	9	6	6	2	1	0.7	11	8	8	4	3	2.8
R51	16	7	6	3	1	0.9	18	9	8	5	3	3.0
R52	17	10	8	3	1	1.2	19	12	10	6	3	3.3
R13	25	14	12	6	2	2.0	27	16	14	8	4	4.1
R14	31	16	12	7	3	2.5	33	18	14	9	5	4.6
R15	10	6	6	2	1	0.8	12	8	8	4	3	2.9
R16	9	6	6	2	1	0.7	11	8	8	4	3	2.8
R17	12	6	5	2	0	0.6	14	8	7	4	3	2.7
R33	11	5	4	2	0	0.6	13	8	6	4	2	2.7
R1	34	25	21	13	6	5.0	36	27	23	15	9	7.1
R2	32	22	19	10	6	4.4	34	24	21	13	8	6.5
R3	25	18	16	7	4	3.1	27	20	18	9	6	5.2
R4	21	15	15	6	3	2.5	23	18	17	8	5	4.6
R5	20	15	14	6	3	2.3	22	17	16	8	5	4.4
R6	18	15	14	6	3	2.2	20	17	16	8	5	4.3
R39	26	18	16	8	4	3.5	28	20	18	10	6	5.6
R40	27	19	17	8	4	3.4	29	21	20	10	6	5.5
R41	29	21	18	9	5	4.0	31	23	20	11	7	6.1
R42	27	18	17	9	4	3.5	29	20	19	11	7	5.6
R43	19	15	14	6	3	2.3	21	17	16	8	5	4.4

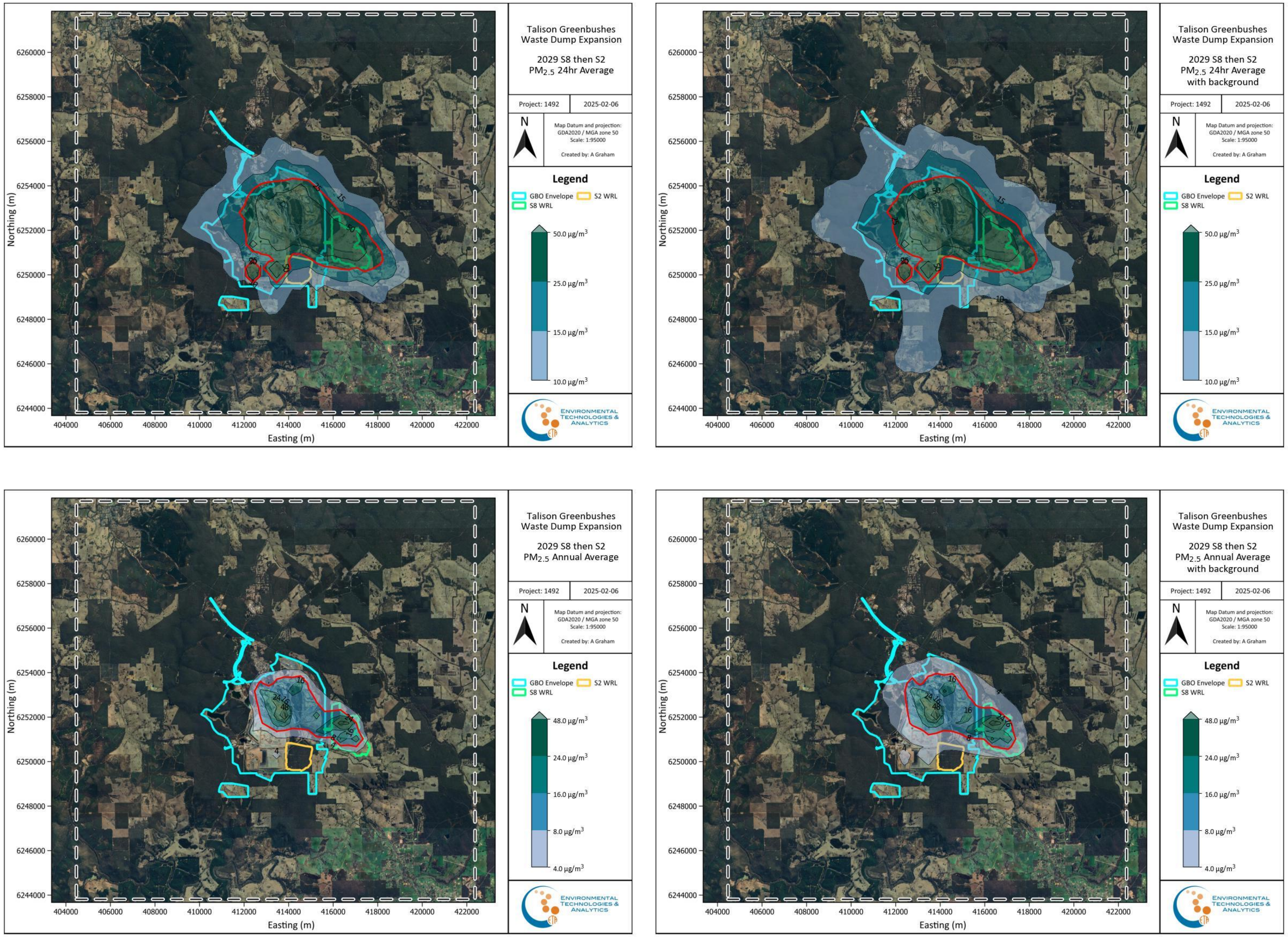


Figure 5-18: Modelled $PM_{2.5}$ concentration contours for S8 and S2 (2029)

5.5.3 Total Suspended Particulates

The statistics of the predicted ground level concentrations of TSP are presented in Table 5-19. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 942 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-19 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 22% at receptor R6 up to 55% at receptor R51.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as TSP) are presented in Figure 5-19.

Table 5-19: S8 and S2 (2029) - Predicted TSP concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	390	202	179	117	45	39.8	417	230	207	144	73	67.4
R9	298	170	149	99	41	33.5	325	198	177	127	69	61.1
R10	791	368	317	180	83	70.0	819	395	344	208	110	97.6
R11	914	440	381	230	106	88.1	942	468	408	257	133	115.7
R13	538	284	243	118	42	41.0	566	311	271	145	70	68.6
R14	662	338	249	133	59	51.0	690	366	277	161	86	78.6
R15	213	130	112	44	12	14.3	240	158	140	72	40	41.9
R16	184	122	112	42	11	13.6	212	150	139	70	39	41.2
R51	305	138	114	57	12	16.9	333	166	141	85	39	44.5
R52	328	210	165	71	18	23.1	356	237	192	99	46	50.7
R13	538	284	243	118	42	41.0	566	311	271	145	70	68.6
R14	662	338	249	133	59	51.0	690	366	277	161	86	78.6
R15	213	130	112	44	12	14.3	240	158	140	72	40	41.9
R16	184	122	112	42	11	13.6	212	150	139	70	39	41.2
R17	186	112	84	36	8	11.2	213	139	112	64	36	38.8
R33	173	101	76	34	7	9.9	201	129	104	61	35	37.5
R1	531	375	319	175	92	71.8	559	402	346	203	120	99.4
R2	494	333	300	148	80	64.3	521	360	328	175	108	91.9
R3	391	262	229	109	56	45.3	419	290	257	136	83	72.9
R4	338	229	209	91	45	37.1	365	256	236	118	73	64.7
R5	322	222	205	89	43	35.4	350	250	233	117	70	63.0
R6	296	231	196	90	38	33.3	323	259	224	117	66	60.9
R39	402	273	251	117	63	50.8	429	301	278	145	91	78.4
R40	423	279	247	116	60	48.9	450	306	275	144	88	76.5
R41	456	307	282	135	72	57.8	484	335	309	162	100	85.4
R42	399	277	250	124	65	51.5	426	305	278	152	92	79.1
R43	316	225	193	89	42	34.7	343	252	220	116	70	62.3

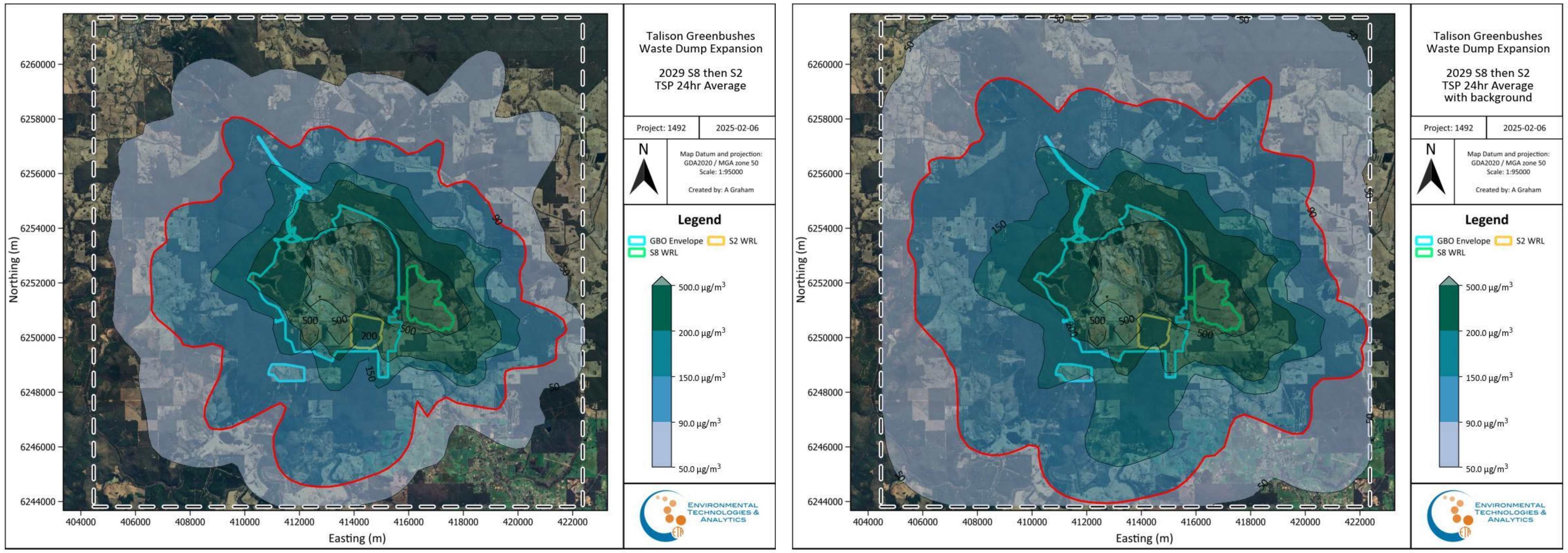


Figure 5-19: Modelled maximum 24hr averaged TSP concentration contours for S8 and S2 (2029)

5.5.4 Dust deposition

The maximum monthly predicted deposition rates for the S8 and S2 (2029) scenario are presented in Table 5-20. From this table it is apparent that the receptors immediately to the north of the operations are predicted to have deposition rates that are above the maximum increase above background criteria of 2 g/m^2/month.

Table 5-20: S8S2 Only 2029 - Predicted dust deposition at receptors – in isolation (g/m^2/month).

Receptor	Maximum Deposition	Receptor	Maximum Deposition	Receptor	Maximum Deposition
R1	2.5	R25	0.3	R60	0.1
R2	2.3	R26	0.3	R61	0.2
R3	2.1	R27	0.1	R62	0.2
R4	1.9	R29	2.5	R63	0.4
R5	1.9	R31	0.1	R64	0.3
R6	1.7	R32	0.1	R65	0.3
R7	0.9	R33	0.4	R66	0.3
R8	1.5	R38	0.7	R67	0.1
R9	1.0	R39	2.2	R68	0.2
R10	2.9	R40	2.2	R69	0.3
R11	4.0	R41	2.3	R70	0.4
R13	1.3	R42	2.3	R71	0.1
R14	1.8	R43	1.9	R72	0.2
R15	0.5	R50	0.2	R73	0.3
R16	0.4	R51	0.7	R74	0.1
R17	0.5	R52	0.9	R75	0.2
R18	0.2	R53	0.5	R76	0.1
R19	0.2	R54	0.5	R77	0.1
R20	0.1	R55	0.4	R78	0.1
R21	0.0	R56	0.6	R79	0.1
R22	0.1	R57	0.5	R80	0.1
R23	0.5	R58	0.3	R82	0.1
R24	0.3	R59	0.2	R83	0.1

The predicted monthly dust deposition (based on annual average predicted flux rates) is presented in **Figure 5-20**. The contour plot shows that the monthly deposition criterion is limited to the site envelope.

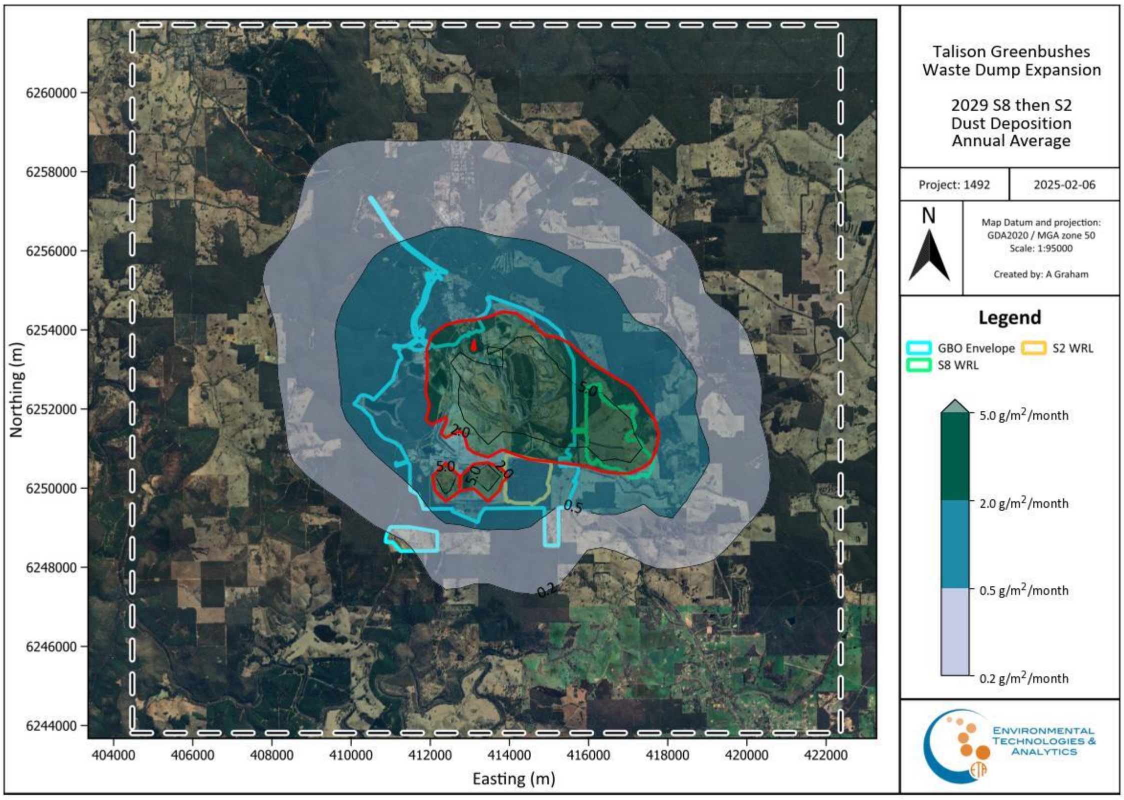


Figure 5-20: S8S2 Only - Total predicted monthly dust deposition (g/m^2/month) – Project only.

5.6 S8 and S2 (2033) Scenario

5.6.1 Particulates as PM_{10}

The statistics of the predicted ground level concentrations of PM_{10} are presented in Table 5-21. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 209 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
  - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
  - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
  - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-19 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 11% at receptors R5 and R6 up to 69% at receptor R51.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as PM_{10}) are presented in Figure 5-21.

Table 5-21: S8 and S2 (2033) – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	62	38	35	20	5	5.9	76	51	49	34	19	19.7
R9	60	39	35	17	5	5.3	74	53	49	30	18	19.1
R10	85	58	46	24	9	8.2	99	71	60	37	23	22.0
R11	81	52	46	25	9	8.3	94	66	59	39	23	22.1
R13	126	55	46	22	6	7.0	140	69	60	36	20	20.8
R14	138	74	62	30	10	10.2	152	88	76	44	24	24.0
R15	67	42	32	14	3	4.5	81	56	45	28	17	18.3
R16	68	46	33	13	3	4.4	81	60	47	27	17	18.2
R51	54	17	15	8	2	2.4	67	31	29	22	15	16.2
R52	57	20	19	9	2	2.9	71	34	32	23	16	16.7
R13	126	55	46	22	6	7.0	140	69	60	36	20	20.8
R14	138	74	62	30	10	10.2	152	88	76	44	24	24.0
R15	67	42	32	14	3	4.5	81	56	45	28	17	18.3
R16	68	46	33	13	3	4.4	81	60	47	27	17	18.2
R17	91	47	36	13	2	4.4	105	61	50	27	16	18.2
R33	83	40	29	11	1	3.8	97	54	42	25	15	17.6
R1	196	146	117	68	30	25.2	209	160	131	82	44	39.0
R2	167	130	101	59	24	21.5	181	144	115	73	38	35.3
R3	129	102	70	42	17	14.9	142	116	84	56	30	28.7
R4	111	99	59	32	12	11.8	124	113	73	46	26	25.6
R5	107	95	56	30	12	11.1	121	109	70	44	25	24.9
R6	102	88	55	28	11	10.2	115	102	69	41	24	24.0
R39	138	110	85	48	20	17.6	151	124	99	61	34	31.4
R40	138	111	72	44	18	16.0	151	125	86	58	32	29.8
R41	154	119	90	53	22	19.4	168	133	104	67	36	33.2
R42	142	115	91	51	21	18.4	156	129	105	64	35	32.2
R43	105	91	56	31	12	11.1	119	105	70	45	26	24.9

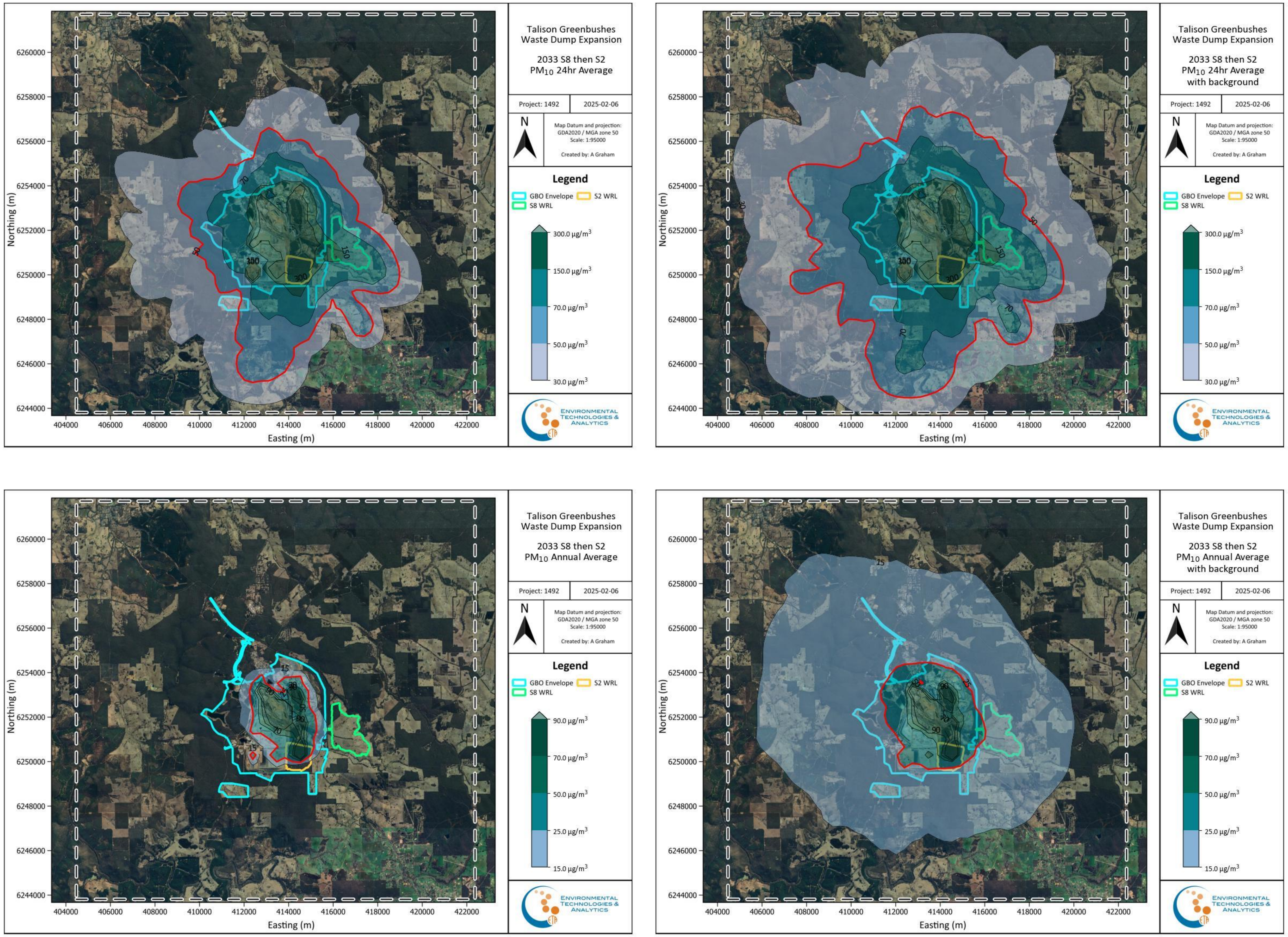


Figure 5-21: Modelled PM_{10} concentration contours for S8 and S2 (2033)

5.6.2 Particulates as $PM_{2.5}$

The statistics of the predicted ground level concentrations of $PM_{2.5}$ are presented in Table 5-22. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 31 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
    - The following Greenbushes township receptors: R1, R2, R41.
    - No receptors within 1.5 km of the S8 WRL or S2 WRL.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as $PM_{2.5}$) are presented in Figure 5-22.

Table 5-22: S8 and S2 (2033) – Predicted $PM_{2.5}$ concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	9	6	5	3	1	0.9	11	8	7	5	3	3.0
R9	9	6	5	2	1	0.8	11	8	7	5	3	2.9
R10	13	9	7	4	1	1.2	15	11	9	6	3	3.3
R11	12	8	7	4	1	1.2	14	10	9	6	3	3.3
R13	19	8	7	3	1	1.0	21	10	9	5	3	3.1
R14	21	11	9	4	2	1.5	23	13	11	7	4	3.6
R15	10	6	5	2	0	0.7	12	8	7	4	3	2.8
R16	10	7	5	2	0	0.7	12	9	7	4	3	2.8
R51	8	3	2	1	0	0.4	10	5	4	3	2	2.5
R52	9	3	3	1	0	0.4	11	5	5	3	2	2.5
R13	19	8	7	3	1	1.0	21	10	9	5	3	3.1
R14	21	11	9	4	2	1.5	23	13	11	7	4	3.6
R15	10	6	5	2	0	0.7	12	8	7	4	3	2.8
R16	10	7	5	2	0	0.7	12	9	7	4	3	2.8
R17	14	7	5	2	0	0.7	16	9	8	4	2	2.8
R33	12	6	4	2	0	0.6	15	8	6	4	2	2.7
R1	29	22	18	10	4	3.8	31	24	20	12	7	5.9
R2	25	20	15	9	4	3.2	27	22	17	11	6	5.3
R3	19	15	11	6	3	2.2	21	17	13	8	5	4.3
R4	17	15	9	5	2	1.8	19	17	11	7	4	3.9
R5	16	14	8	5	2	1.7	18	16	10	7	4	3.8
R6	15	13	8	4	2	1.5	17	15	10	6	4	3.6
R39	21	17	13	7	3	2.6	23	19	15	9	5	4.7
R40	21	17	11	7	3	2.4	23	19	13	9	5	4.5
R41	23	18	14	8	3	2.9	25	20	16	10	5	5.0
R42	21	17	14	8	3	2.8	23	19	16	10	5	4.9
R43	16	14	8	5	2	1.7	18	16	11	7	4	3.8

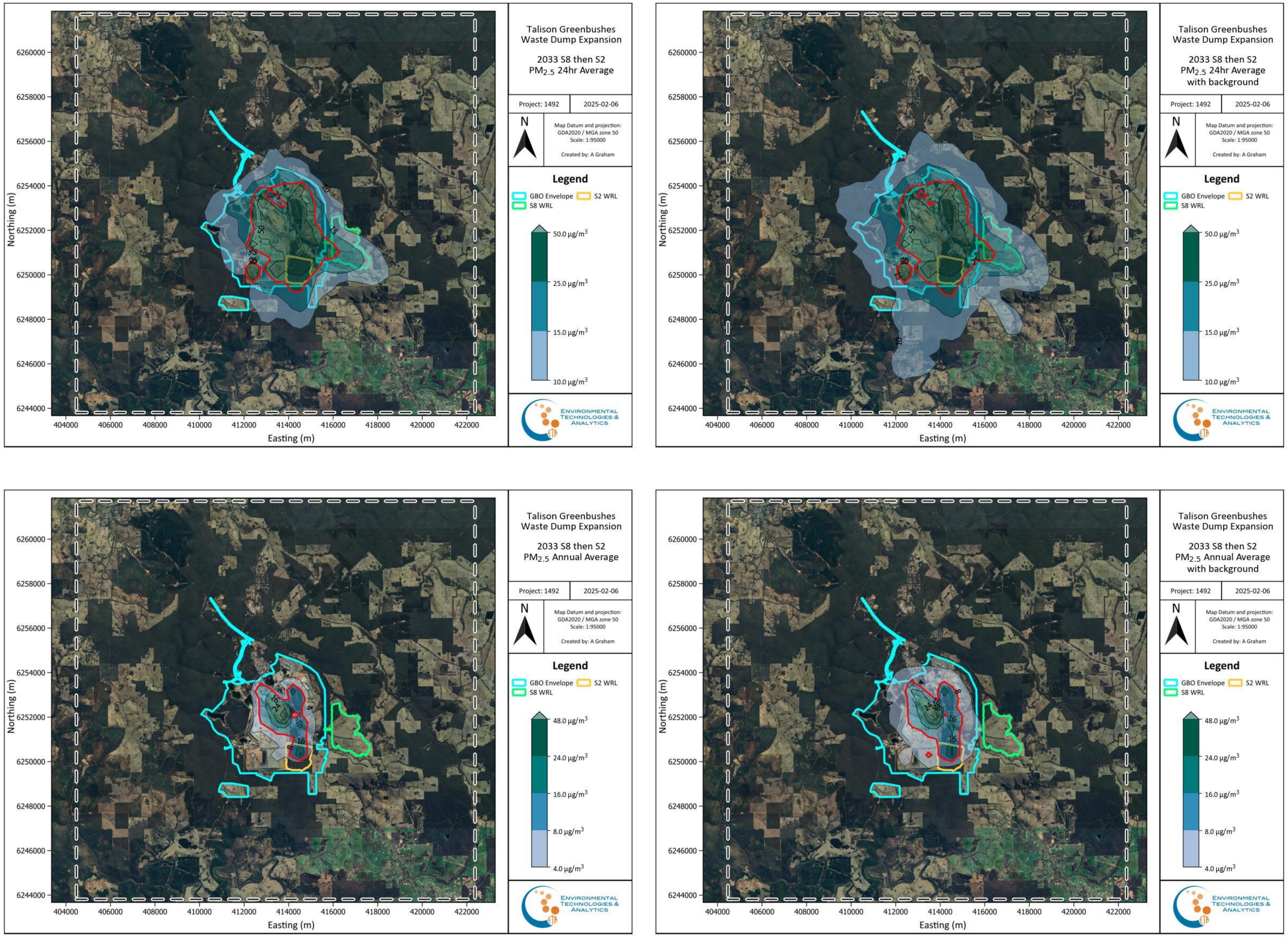


Figure 5-22: Modelled $PM_{2.5}$ concentration contours for S8 and S2 (2033)

5.6.3 Total Suspended Particulates

The statistics of the predicted ground level concentrations of TSP are presented in Table 5-23. The results at the residential receptors (Appendix C) indicate that:

- The maximum predicted 24-hour average cumulative concentration was 443 µg/m^3.
- The maximum predicted cumulative concentration is higher than the 24-hour criterion for GBO emissions in isolation at:
    - The following Greenbushes township receptors: R1, R2, R3, R4, R5, R6, R39, R40, R41, R42, R43.
    - And at the following receptors within 1.5 km of the S8 WRL: R8, R9, R10, R11, R13, R14, R15, R16, R51, R52.
    - And at the following receptors within 1.5 km of the S2 WRL: R13, R14, R15, R16, R17, R33
- From Table 5-19 it is apparent that there are significant reductions in the predicted concentrations from the maximum to the 6th highest at each of the receptors. The reductions vary from 21% at receptor R1 up to 68% at receptor R51.
- This indicates that rather than a continuous potential impact the model results indicate that elevated impacts at the receptors are limited.

The model results at all receptors are presented in Appendix E.

The predicted isopleths (contours) for ground level concentrations of particulates (as TSP) are presented in Figure 5-23.

Table 5-23: S8 and S2 (2033) - Predicted TSP concentrations at receptors (µg/m³).

Receptors	Isolation						Cumulative					
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R8	165	103	75	47	10	13.2	193	130	103	75	37	40.8
R9	145	96	72	40	9	11.8	173	124	100	67	37	39.4
R10	225	137	103	56	16	18.5	253	165	131	83	44	46.1
R11	219	140	110	57	17	18.9	247	168	137	84	45	46.5
R13	366	147	127	61	14	18.6	393	174	155	89	42	46.2
R14	402	218	176	85	27	27.8	430	245	204	113	55	55.4
R15	190	114	83	39	8	11.8	217	141	111	66	35	39.4
R16	192	126	81	35	7	11.5	220	153	108	62	35	39.1
R51	132	42	41	20	4	5.8	159	70	69	47	31	33.4
R52	133	55	47	22	4	6.8	160	82	75	50	32	34.4
R13	366	147	127	61	14	18.6	393	174	155	89	42	46.2
R14	402	218	176	85	27	27.8	430	245	204	113	55	55.4
R15	190	114	83	39	8	11.8	217	141	111	66	35	39.4
R16	192	126	81	35	7	11.5	220	153	108	62	35	39.1
R17	213	112	91	34	4	11.2	241	139	119	61	32	38.8
R33	195	104	73	29	3	9.5	223	131	101	57	31	37.1
R1	415	328	270	138	62	53.5	443	356	298	165	90	81.1
R2	389	265	234	126	49	44.6	416	292	262	154	76	72.2
R3	312	223	163	82	32	29.9	339	250	191	110	60	57.5
R4	271	184	131	62	24	23.1	298	211	159	89	51	50.7
R5	261	175	126	58	22	21.8	289	202	154	86	50	49.4
R6	247	158	121	54	19	19.8	275	185	149	82	46	47.4
R39	335	229	194	100	42	36.5	362	257	221	128	70	64.1
R40	327	240	168	84	34	31.5	354	267	196	112	61	59.1
R41	364	247	215	113	45	39.9	392	275	242	141	73	67.5
R42	330	239	205	103	43	38.5	357	266	233	131	71	66.1
R43	259	178	125	59	23	22.1	287	205	153	87	51	49.7

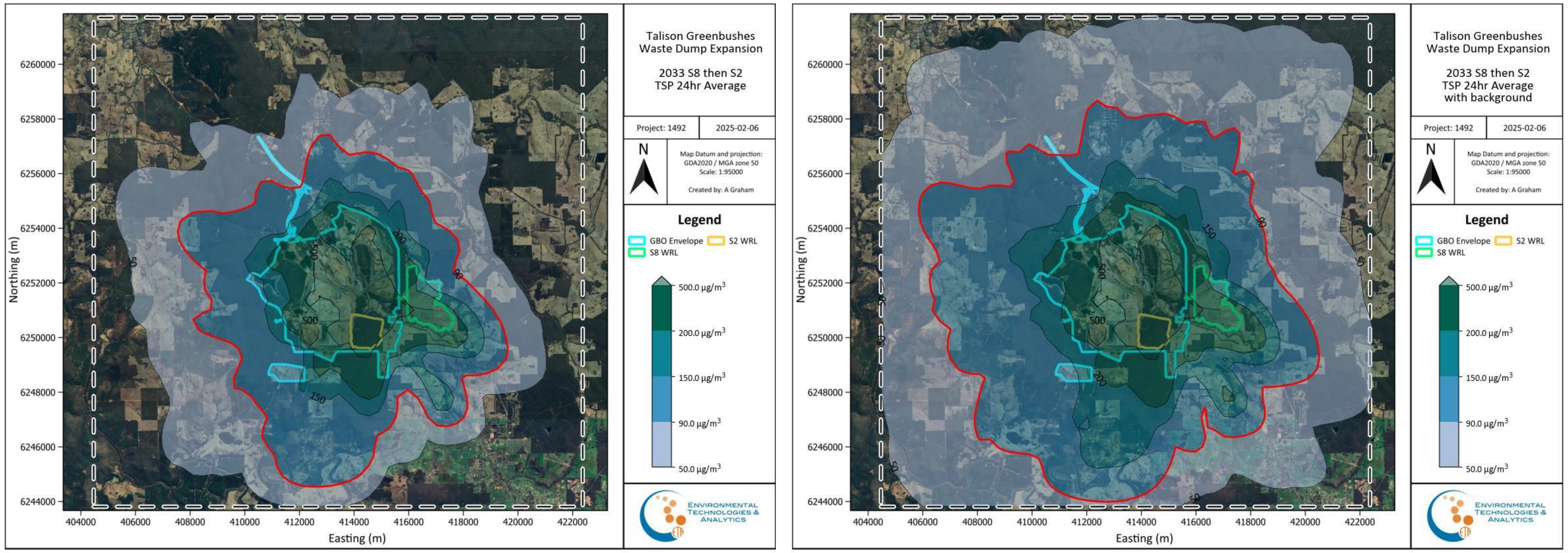


Figure 5-23: Modelled maximum 24hr averaged TSP concentration contours for S8 and S2 (2033)

5.6.4 Dust deposition

The maximum monthly predicted deposition rates for the S8 and S2 (2033) scenario are presented in Table 5-24. From this table it is apparent that the receptors immediately to the north of the operations are predicted to have deposition rates that are above the maximum increase above background criteria of 2 g/m^2/month.

Table 5-24: S8 and S2 (2033) - Predicted dust deposition at receptors – in isolation (g/m^2/month).

Receptor	Maximum Deposition	Receptor	Maximum Deposition	Receptor	Maximum Deposition
R1	2.5	R25	0.3	R60	0.1
R2	2.3	R26	0.3	R61	0.2
R3	2.1	R27	0.1	R62	0.2
R4	1.9	R29	2.5	R63	0.4
R5	1.9	R31	0.1	R64	0.3
R6	1.7	R32	0.1	R65	0.3
R7	0.9	R33	0.4	R66	0.3
R8	1.5	R38	0.7	R67	0.1
R9	1.0	R39	2.2	R68	0.2
R10	2.9	R40	2.2	R69	0.3
R11	4.0	R41	2.3	R70	0.4
R13	1.3	R42	2.3	R71	0.1
R14	1.8	R43	1.9	R72	0.2
R15	0.5	R50	0.2	R73	0.3
R16	0.4	R51	0.7	R74	0.1
R17	0.5	R52	0.9	R75	0.2
R18	0.2	R53	0.5	R76	0.1
R19	0.2	R54	0.5	R77	0.1
R20	0.1	R55	0.4	R78	0.1
R21	0.0	R56	0.6	R79	0.1
R22	0.1	R57	0.5	R80	0.1
R23	0.5	R58	0.3	R82	0.1
R24	0.3	R59	0.2	R83	0.1

The predicted monthly dust deposition (based on annual average predicted flux rates) is presented in **Figure 5-24**. The contour plot shows that the monthly deposition criterion is limited to the site envelope.

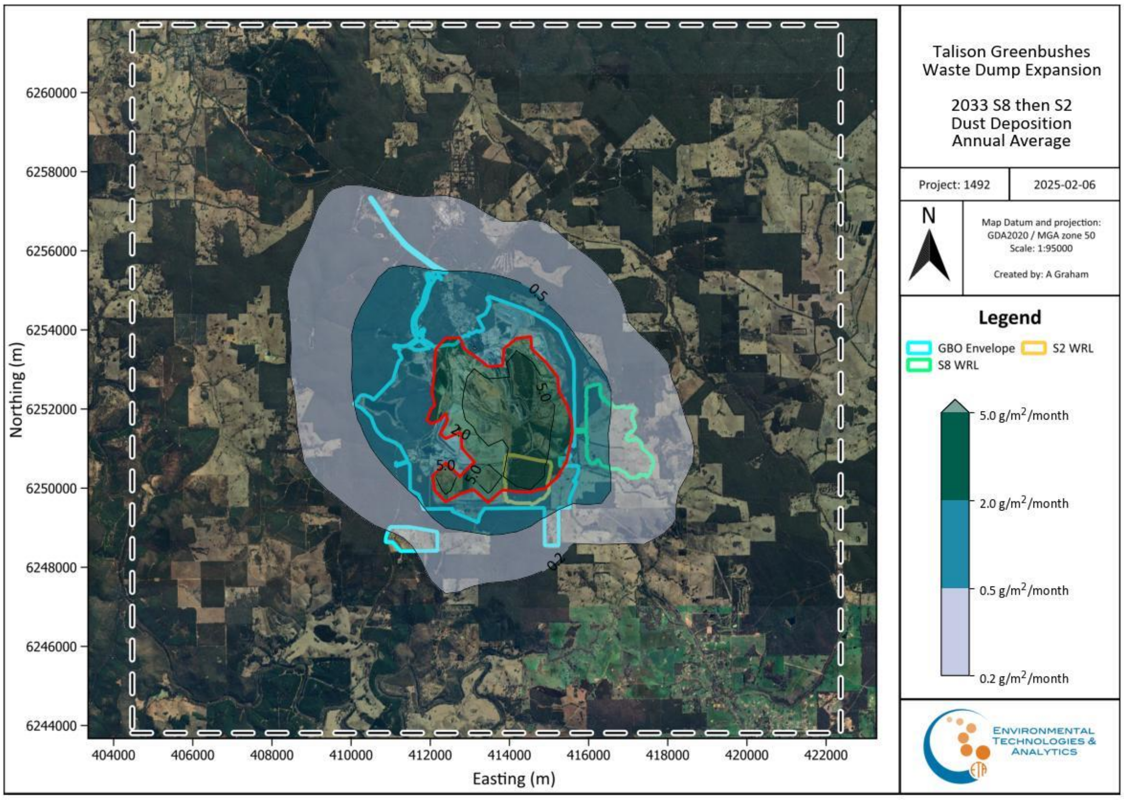


Figure 5-24: S8 and S2 (2033) - Total predicted monthly dust deposition (g/m²/month) – Project only.

6 Justification for Changes in Predicted Ground Level Concentrations Compared to Previous Modelling

Predicted ground level concentrations (GLCs) appear much higher in the updated modelling presented in this assessment for 2028 and 2029 scenarios when compared with predicted GLCs from prior modelling for the mine expansion and WRL S8 expansion (ETA 2023).

However, GLCs for 2030 and later are generally similar or slightly lower than predicted in previous modelling (ETA, 2023, ETA, 2024). These differences are despite no significant change to the modelled mined tonnes of material. The variations can be explained by new sources in the updated modelling including sources close to the town of Greenbushes and to the south of the current operations.

To illustrate the changes, sources with modelled total emissions greater than 5,000 kg/year of PM_{10} are plotted over the predicted PM_{10} GLC contours for the S2 only scenarios in 2028 and 2030 (Figure 6-1). Of note is that:

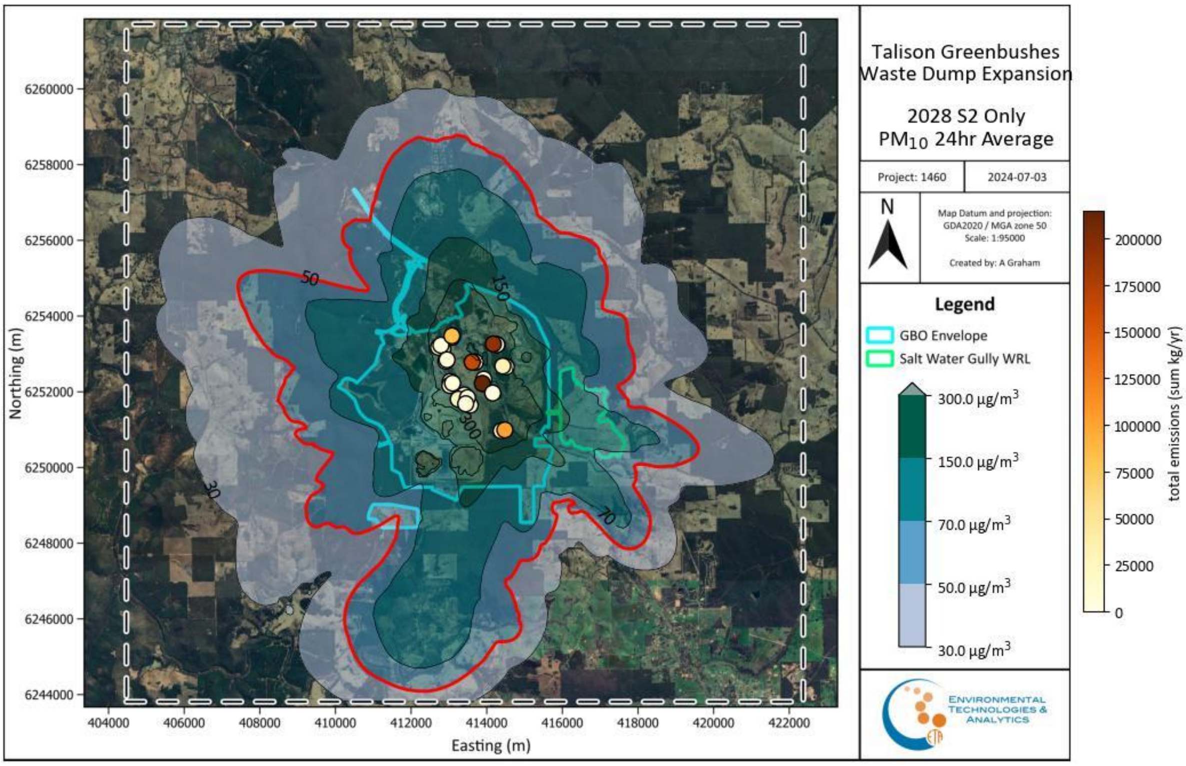
- There are significant sources active in the north-west, close to Greenbushes in the 'S2 only (2028)' scenario but not in the 'S2 only (2030)' scenario. This conforms with the higher predicted concentrations at the Greenbushes receptors (R1 to R6) in the 2028 scenario.
- Large emissions sources are further to the south-east in the 2030 scenarios which helps to explain elevated impacts at the R13 and R14 receptors in the 'S2 only (2030)' scenario.

To assess the changes between the updated models and the previous assessment (ETA, 2024), the maximum and average predicted PM_{10} GLCs were compared for the 'S2 only (2028)' and 'S2 only (2030)' scenarios and the previous ETA (2024) S8 expansion north road option (termed in the report as "scenario 1 option A"). The results are presented in Table 6-1 which indicates that:

- The current 'S2 only (2028)' scenario has higher PM_{10} GLC predictions for most receptors excluding R13 and R14 which are, on average, 2 to 4 µg/m^3 lower and over 100 µg/m^3 less than the maximum predicted concentrations.
- The current 'S2 only (2028)' scenario has higher predicted maximum PM_{10} GLCs than the WRL expansion option A scenario for all receptors except R11 and R52.
- The current 'S2 only (2030)' scenario has lower predicted maximum PM_{10} GLCs than the WRL expansion option A scenario for all receptors except R13, R14. R51, and R52. The current 'S2 only (2030)' scenario has higher predicted GLC's for R13 and R14.

Together, these result indicate that the changes in predicted GLC's can be explained by changes in sources which reflect changes in the future mine plan. Activities of particular significance are:

- Back-fill operations at Cornwall pit (CWH) which are well represented in 2028 and 2029 scenarios but absent from 2030+ scenarios.
- Expansion of the S2 WRL and creation of the S7 WRL to the south of operations.



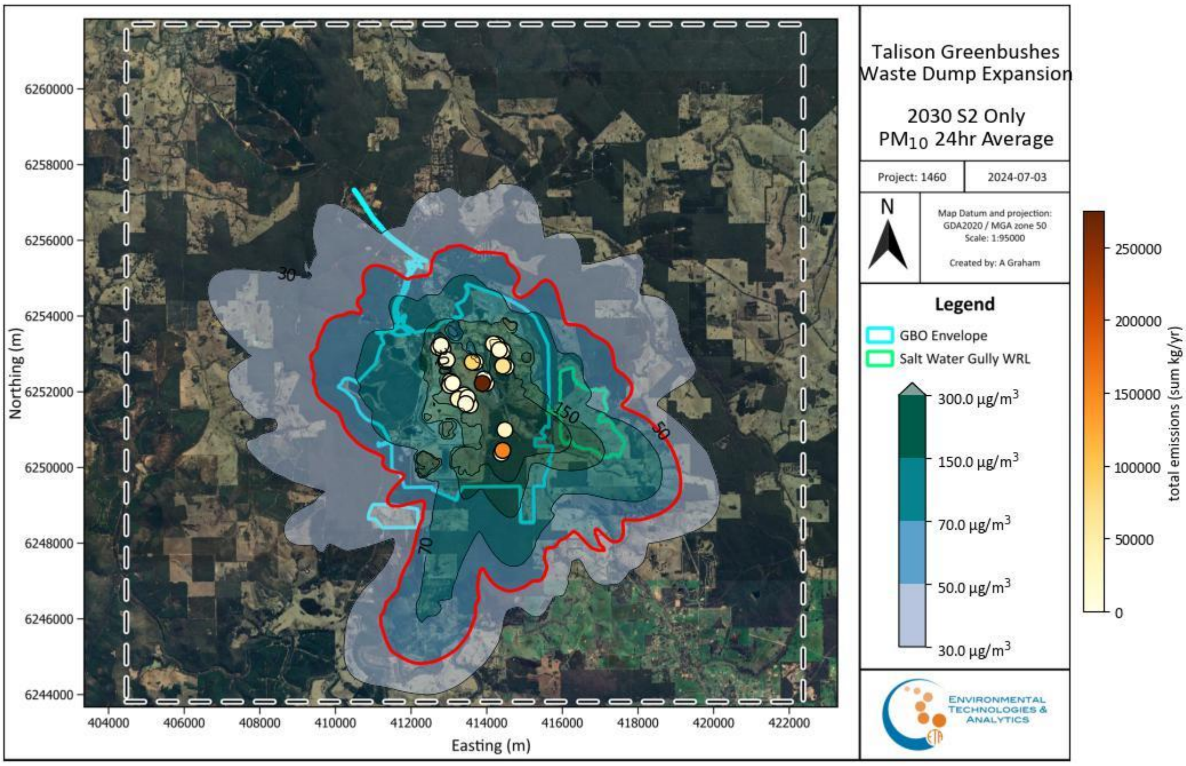


Figure 6-1: S2 only predicted maximum 24hr averaged PM_{10} concentration with significant emissions sources.

Table 6-1: Differences in maximum and average PM_{10} concentrations at important receptors between S2 2028, S2 2030, S8 expansion north road.

Receptor	Difference S2 2028 minus S2 2030		S2 2028 minus S8 expansion		S2 2030 minus S8 expansion	
	Maximum	Average	Maximum	Average	Maximum	Average
R1	372	45	308	37	-64	-8
R2	460	39	390	30	-70	-9
R3	368	16	341	12	-27	-4
R4	324	10	312	8	-13	-2
R5	312	9	303	6	-9	-2
R6	296	8	290	5	-6	-2
R39	321	22	278	17	-43	-4
R40	400	18	371	14	-29	-4
R41	422	29	361	23	-61	-7
R42	251	21	217	17	-34	-4
R43	299	9	291	7	-9	-2
R8	36	2	34	-1	-2	-2
R9	30	2	22	-0	-7	-2
R10	46	1	7	-3	-38	-4
R11	18	1	-25	-6	-43	-7
R13	-112	-2	12	-3	124	-1
R14	-204	-4	111	0	315	4
R15	2	-1	40	1	38	2
R16	-5	-1	37	1	42	2
R51	14	-0	5	-1	-9	-1
R52	15	0	-6	-1	-21	-1

7 Conclusions

Talison Lithium Australia Pty Ltd (Talison) own and operate the Greenbushes Operations (GBO) located immediately to the south of the Greenbushes townsite, approximately 250 kilometres (km) south of Perth, Western Australia.

Talison is expanding the GBO in response to market demand, increasing mining of spodumene ore and production of Lithium mineral spodumene concentrate. As part of the expansion Talison is proposing to construct an additional Waste Rock Landform (WRL) named S8 and redistributing waste tonnage to other Waste Rock Landforms (S2). Previous dust modelling (ETA, 2024) has been revised in this report to explore these changes.

This modelling assessment determined the potential air quality impacts of particulates (as TSP, PM_{10}, $PM_{2.5}$ and deposition) using the CALMET/CAPUFF modelling suite for determining predicted ground level concentrations for three scenarios with two different years modelled for each scenario. Modelling assessed the project in isolation, as well as cumulatively with background air quality. The 3-dimensional meteorological fields required by CALMET were generated using the WRF prognostic meteorological model. Fine resolution terrain elevation (SRTM) data with 90 m resolution was used in conjunction with CGLOPS-1 land-use data to characterise the geophysical environment.

Emissions were estimated using methodologies outlined in the NPI EET for Mining manual (EA, 2012) and input into the CALPUFF dispersion model as volume sources to simulate mining and haulage emissions, and area sources to simulate wind-blown dust emissions.

Modelled ground level concentrations for the key pollutants as particulates (as TSP, PM_{10}, $PM_{2.5}$ and dust deposition) have been compared to ambient air quality assessment criteria, derived from the draft DWER Air Emissions Guideline (DWER, 2019) and the draft Dust Emissions Guideline (DWER, 2021) to determine the potential impacts to environmental values. Receptor types considered in the assessment include residences (where the protection of human health, well-being and amenity is considered), and environmental receptors (primarily flora).

7.1 Modelling results – comparison to air quality assessment criteria

For the assessment of potential impacts on human health and amenity, and nuisance the model predicts that:

- For all scenarios, the predicted maximum 24-hour averaged concentrations are higher than the criterion for TSP, and PM_{10} for at-least one of the residential receptors within 1.5 km of S8 in isolation (and cumulative). $PM_{2.5}$ criterion were not always exceeded at any of these receptors for some scenarios.
- The model results indicate that there are often significant reductions in the predicted concentrations from the maximum to the 6^{th} highest at each of the receptors indicating that the elevated impacts at the receptors are limited.
- Predicted concentrations in this assessment are elevated when compared to previous assessments (ETA, 2024) however this is explained by:
    - Additional sources in the updated modelling including sources close to the town of Greenbushes and to the south of the current operations.
    - There are sources active in the north-west, close to Greenbushes, in the ‘S2 only (2028)’ scenario but not in ‘S2 only (2030)’ scenario which fits with the higher predicted concentrations at the Greenbushes receptors (R1 to R6).

    - Large emissions sources are further to the south-east in the 2030 scenarios which helps to explain higher emissions at R13 and R14 in the 'S2 only (2030)' scenario.
- Specifically;
    - Back-fill operations at Cornwall pit (CWH) are likely to be a major source of increased predicted GLCs at Greenbushes.
    - Expansion of the S2 WRL and creation of the S7 WRL to the south of operations is likely to impact residential receptors close to the S8 WRL.

A conservative approach has been used for this modelling assessment, and the levels of pollutant concentrations are likely to be lower (when measured in the environment) than predicted in this study. It is important to note that, as a risk-based assessment approach is normally applied to the assessment of air quality, a modelled result above the numerical ambient guideline value or assessment criteria is not an indicator of unacceptable impact or loss of environmental value, but is an indication that the potential risk for impact requires further consideration, such as ongoing ambient monitoring.

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9 Acronyms and Glossary

Acronym	Description
AFWA	Air Force Weather Agency
BoM	Bureau of Meteorology
BWh	Koppen-Geiger classification - hot desert climate, with no distinct rainy season
C	Degrees Celsius (temperature)
Csb	Temperate, dry and warm summer
DSD	Department of State Development
DWER	Department of Water and Environmental Regulation
EA	Environment Australia
EE	Emissions estimation
EET	Emissions Estimation Technique
EETM	Emissions Estimation Technique Manual
EF	Emission factor
ETA	Environmental Technologies & Analytics Pty Ltd
FAA	Federal Aviation Administration
FSL	Forecast Systems Laboratory
GDA94	Geocentric Datum of Australia 1994
g/m^2/month	Grams per square metre per month
g/s	Grams per second
h/yr	Hours per year
kg	Kilogram
kg/ha/yr	Kilograms per hectare per year
kg/t	Kilogram per tonne
kg/yr	Kilograms per year
kPa	KiloPascals
km	Kilometre
km/h	Kilometres per hour
LSM	Land Surface Model
m	Metre

Acronym	Description
m^2	Metres squared
m/s	Metres per second
mm	Millimetre
MOST	Monin-Obukhov Similarity Theory
Mt	Million tonnes
Mtpa	Million tonnes per annum
NCAR	National Center for Environmental Prediction
NCEP	National Center for Environmental Prediction
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NOAA	National Oceanic and Atmospheric Administration
NPI	National Pollutant Inventory
NSW	New South Wales, Australia
PBL	Planetary Boundary Layer
PM	Particulate matter, small particles and liquid droplets that can remain suspended in air.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of 2.5 µm or less.
PM_{10}	Particulate matter with an aerodynamic diameter of 10 µm or less.
ROM	Run of mine
SEA	Strategic Environmental Assessment
SRTM	Shuttle Radar Topography Mission
t	Tonnes
t/h	Tonnes per hour
tpa	Tonnes per annum
tph	Tonnes per hour

Acronym	Description
TS	Transfer station
TSP	Total suspended particulates
$\mu g/m^3$	Micro grams (one millionth of a gram) per cubic metre
µm	Micrometre
USEPA	United States Environment Protection Agency

Acronym	Description
USGS	United State Geological Services
WA	Western Australia, Australia
WHO	World Health Organisation
WRF	Weather Research & Forecast Model
>	Greater than value
<	Less than value

10 Appendices

Appendix A – Selection of Representative Meteorological Year for Modelling

This Appendix summarises the analysis undertaken to determine a representative modelling year, based on the review of long term measured data from the nearest BoM climate station at Bridgetown (2012 to 2022 inclusive).

A.1: Selection of Representative Meteorological Year for Modelling

For this assessment, air dispersion modelling has been conducted using the CALMET/CALPUFF suite of models with meteorological data produced from the WRF prognostic model. The CALMET meteorological model has been used to develop the required meteorological inputs, and the CALPUFF model has been used to predict the concentrations at ground-level across the model domain and at nominated discrete sensitive receptor locations. Meteorological measurements representative of the region has been used to verify and refine the meteorological inputs for the modelling.

Generally, a minimum of one year of meteorological data is acceptable for dispersion modelling in Australia. The data must, however, adequately represent worst-case meteorological conditions and the data should be assessed in terms of representativeness against climatic averages. In other words, the meteorology for selected years must be deemed representative of the "normal" range of conditions in the area.

To determine the year of meteorological data to use for the dispersion modelling, 11-years of historical hourly [1] surface observations from the nearest BoM station at Bridgetown (2012 to 2022 inclusive) were reviewed. The Chi^2 Goodness of Fit test was used to statistically identify the representative modelling year based on recorded meteorological parameters including wind speed, wind direction, temperature, and rainfall.

The statistical analysis shows that 2019 can be considered largely representative of longer-term average conditions. The meteorological variables affecting dispersion, namely wind speed, temperature and direction compare favourably to the long-term average conditions.

The results of the statistical analysis performed to support selection of the representative year is described in the following sub-sections.

Chi^2 Goodness of Fit test

The Chi^2 goodness of fit test was used to statistically identify the representative modelling year based on recorded meteorological parameters including wind speed, wind direction and temperature. The Chi^2 goodness of fit test is a non-parametric hypothesis test used to determine whether a variable is likely to come from a specified distribution or not. It is often used to evaluate whether sample data (in this case, an individual year) is representative of the full population (e.g. multiple years).

The null hypothesis is that there is no significant difference between hourly values in an individual year and the hourly averages for long term average values. If values fall within the vertical lines (at 5% confidence interval, two tailed), then accept the null hypothesis (Appendix Figure 1).

[1] Calculated from 1-minute data.

Wind Direction

The Chi^2 test results for wind direction for 2012 to 2022 at BoM Bridgetown are compared in Appendix Figure 2. From this figure it is apparent that the wind direction frequency distribution during 2016, 2017, 2018 and 2019 were not significantly different to the long-term wind direction frequency distribution.

Wind Speed

The basic statistics for average wind speed for the 8-year period and individual years are shown in Appendix Table 1. Overall, there is minimal difference between the chosen years though the average and standard deviations during 2021 are closest to long term averages. The frequency of stronger (>20 km/h and lighter (<5 km/h) winds during most years are generally within 1% of long-term average values.

Appendix Table 1: Annual wind speed statistics for Bridgetown (2012-2022).

Year	Mean	Standard Deviation	% <5 hm/h	% >20 km/h
11-yr average	6.3	5.4	44.1	0.8
2012	6.2	5.6	46.7	1.2
2013	6.6	5.6	42.3	1.3
2014	6.4	5.4	43.5	0.9
2015	6.2	5.3	45.4	0.0
2016	6.6	5.4	42.2	1.0
2017	6.3	5.2	43.3	0.9
2018	6.3	5.3	43.7	0.7
2019	6.0	5.3	45.8	0.8
2020	6.5	5.6	43.2	1.1
2021	6.3	5.4	44.6	0.6
2022	6.4	5.2	43.8	0.4

The Chi^2 test results for wind speed are presented in Appendix Figure 3. This figure indicates that 2014 to 2016 and 2019 to 2021 were representative of 11-year average conditions at the 5% confidence interval.

Temperature

The basic statistics for average temperature for the 11-year period and individual years are shown in Appendix Table 2. The average temperature for the years 2012 to 2022 are all within 0.5°C of the 1-year average.

Appendix Table 2: Annual temperature statistics for Bridgetown (2012-2022).

Year	Mean	Standard Deviation	% <5°C	% >35°C
11-yr average	15.0	6.7	5.6	0.5
2012	15.1	7.1	7.1	0.9
2013	15.4	6.6	4.5	0.4
2014	15.3	6.4	4.3	0.3
2015	15.3	7.1	6.8	0.0
2016	14.5	6.9	6.8	0.5
2017	14.6	6.6	5.9	0.4
2018	14.7	6.6	6.6	0.1
2019	15.0	7.1	6.9	0.8
2020	15.2	6.5	4.2	0.3
2021	14.8	6.6	4.6	0.5
2022	15.0	6.7	4.4	0.8

The Chi^2test results for temperature are presented in Appendix Figure 4. From this figure it is apparent that the hourly temperature frequency distributions during 2012 to 2022 were not significantly different to the long-term frequency distribution.

Rainfall

The annual rainfall at Busselton, available for the extended period 1988-2023, is displayed in Appendix Figure 5, noting that there is incomplete data for 1998, 2011, 2013, 2016, 2017 and 2019. There is some variation in rainfall between each year which is to be expected for the region. Post 2012, all years have annual rainfall that fall within the 10th and 90th percentile [2].

Conclusions

It is important to note that it is highly unusual for multiple climatological parameters to all fall within “representative” levels. With that in mind, the following conclusions can be made for the period reviewed:

- All years are representative of longer-term (11 year) temperature average frequency distribution at the 99% significance level.
- 2014, 2015, 2016, 2019,2020 and 2021 are representative of longer-term wind speed average frequency distribution at the 99% significance level.

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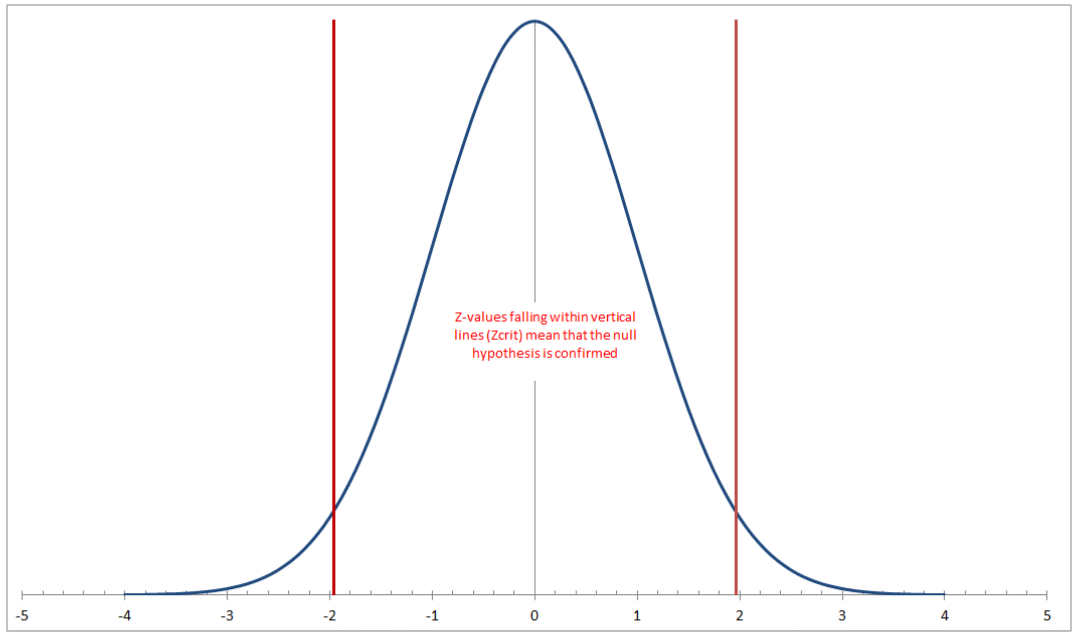
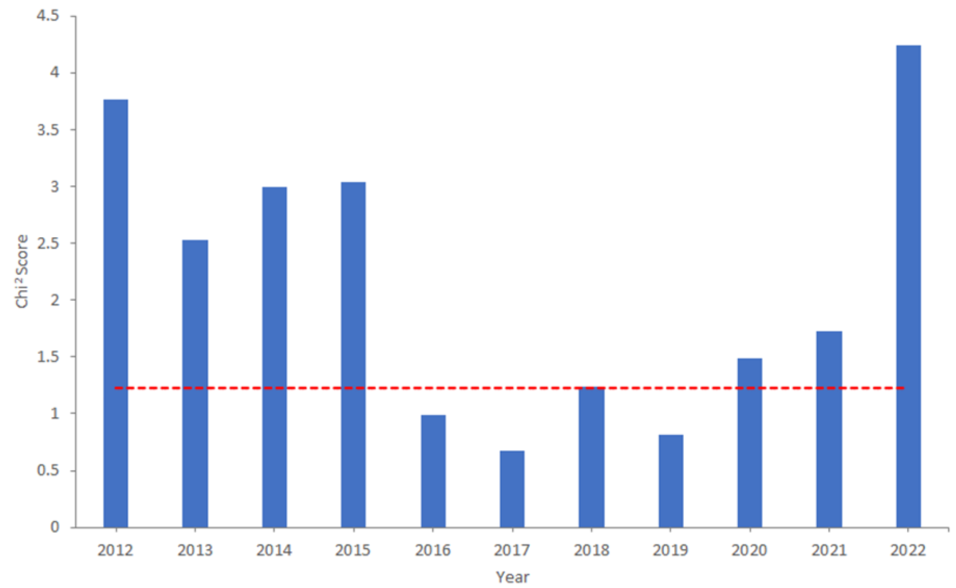
[2] The 10th and 90th percentile values are classed as well below and well above average according to the Bureau of Meteorology

- For wind direction, frequency distributions during 2016, 2017, 2018 and 2019 are representative of longer-term direction frequency distributions at the 99% significance level.
- For annual rainfall at Greenbushes, all years (post 2011) fall within the longer-term 10th and 90th percentile values.

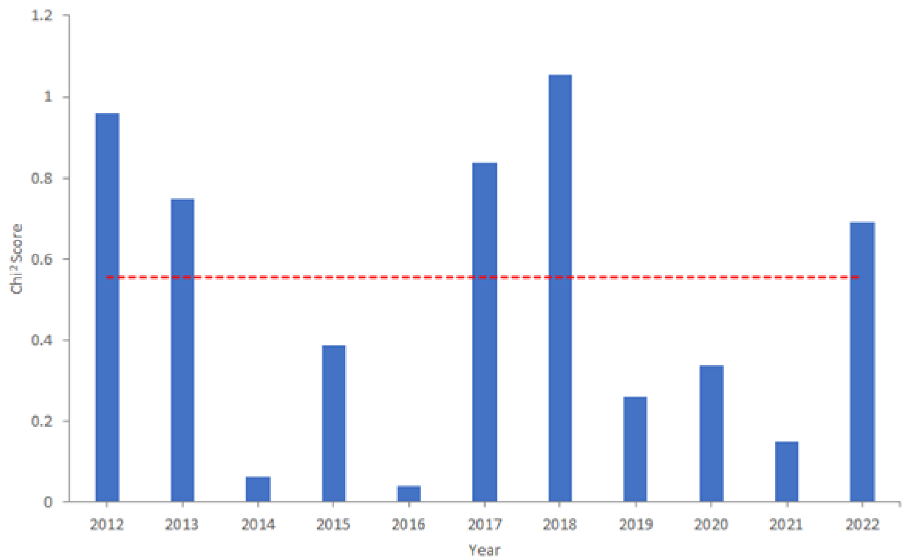
Based on the above analysis, only 2016 is representative of longer-term conditions for all parameters examined. While 2019 is representative for temperature, wind speed and wind direction, it was a statistically anomalously dry year. It was however decided to use the more recent 2019 as the modelling year as the meteorological variables affecting dispersion, namely wind speed, wind direction, temperature, compare favourably to the long-term average conditions.



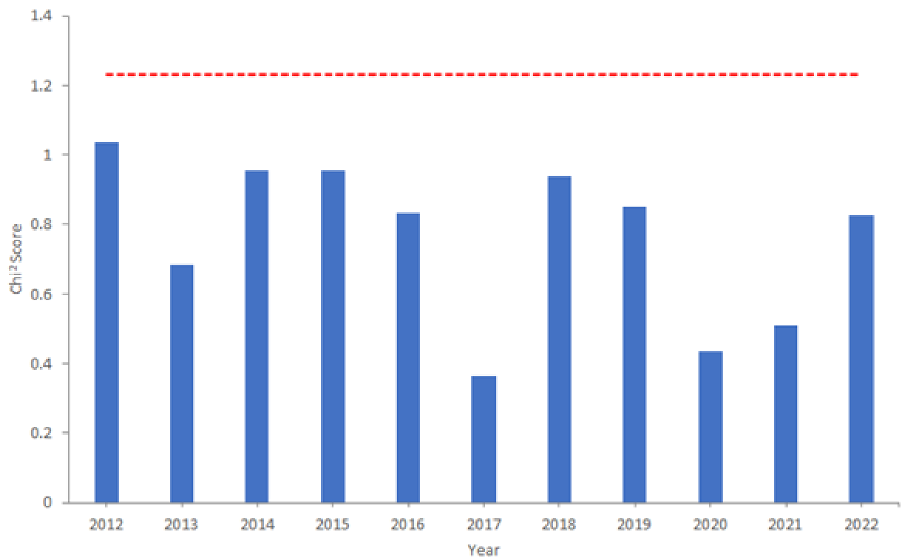
Appendix Figure 1: Null Hypothesis for Chi^2 test.



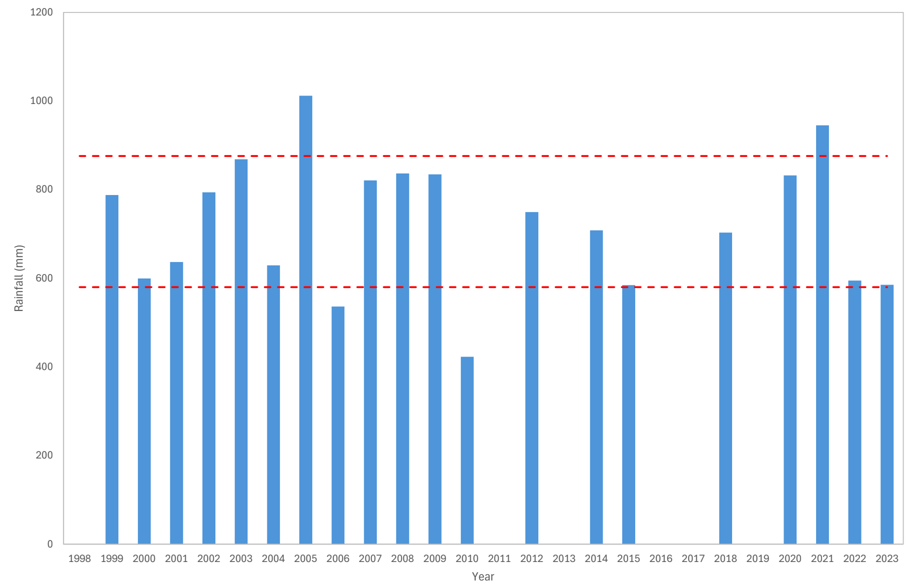
Appendix Figure 2: Chi^2 test result for wind direction at Bridgetown (2012-2022).



Appendix Figure 3: Chi^2 test result for wind speed at Bridgetown (2012-2022).



Appendix Figure 4: Chi^2 test result for temperature at Bridgetown (2012-2022).



Appendix Figure 5: Annual rainfall at Bridgetown (2012-2022).

Appendix B – Weather Research and Forecast (WRF) Model Configuration and Validation

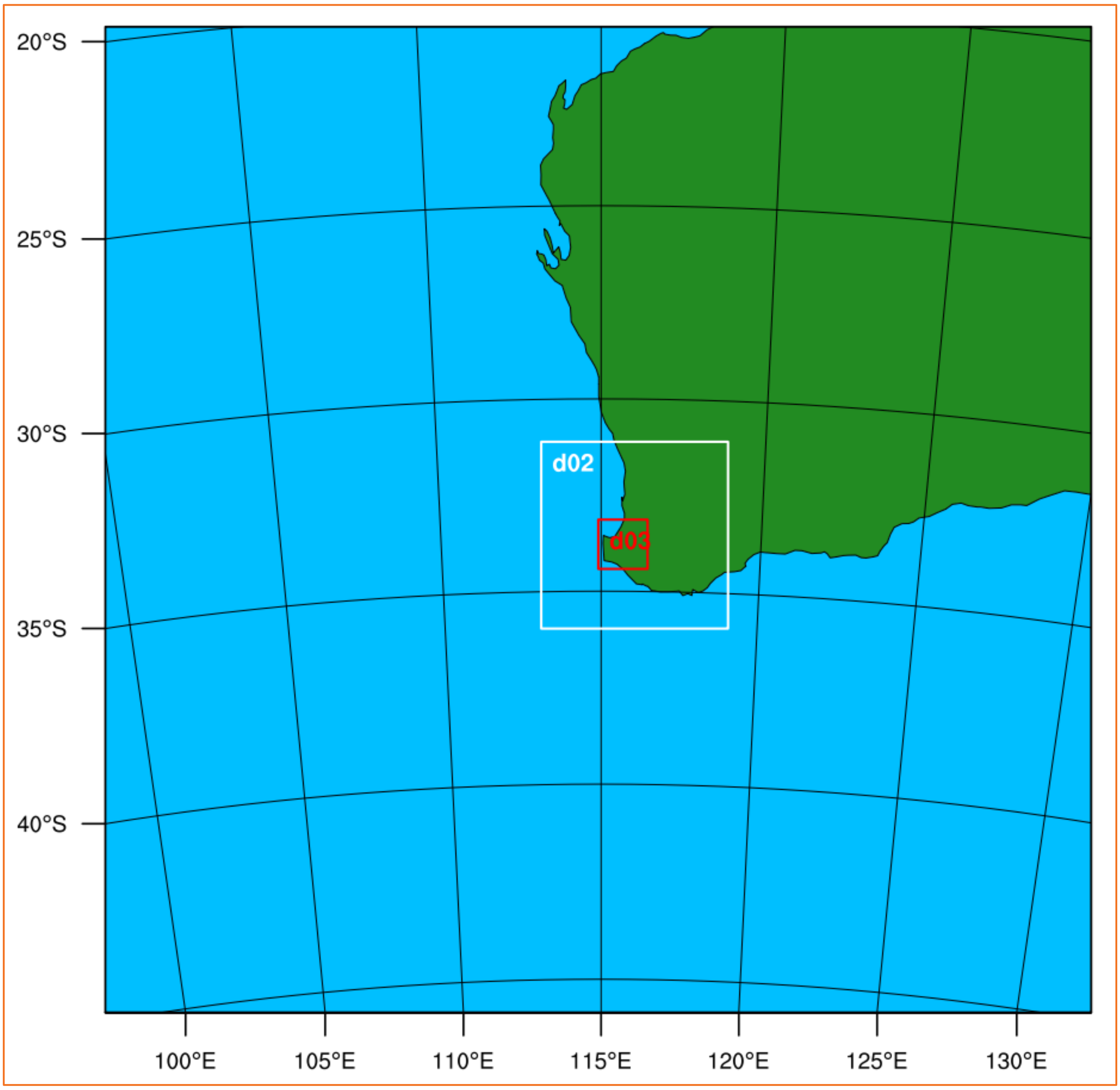
WRF was developed (and continues to be developed) in the United States by a collaborative partnership including the National Center for Atmospheric Research (NCAR), the National Oceanic and Atmospheric Administration (the National Center for Environmental Prediction (NCEP), the Forecast Systems Laboratory (FSL), the Air Force Weather Agency (AFWA), the Naval Research Laboratory, the University of Oklahoma, the Federal Aviation Administration (FAA) and others.

WRF is a fully compressible, Eulerian, non-hydrostatic meso-scale numerical model developed by the National Center for Atmospheric Research (NCAR) and the National Oceanic and Atmospheric Administration (NOAA) in the United States. WRF is suitable for a broad spectrum of applications across scales ranging from metres to thousands of kilometres. The model utilises global reanalysis[3] data to produce fine-scale 3-dimensional meteorological fields that considers local terrain and land-use effects.

WRF was run with a three-nest structure (30 km, 7.5 km, and 1.9 km horizontal grid space resolution) centred on 33.86319°S and 116.0635°E. This is shown in Appendix Figure 6. The model vertical resolution consists of 50 hybrid-eta levels[4].

Physics options in WRF are to represent atmospheric radiation, surface, and boundary layer as well as cloud and precipitation processes. WRF can be run with a variety of model physics options which can lead to varying results and hence it is crucial for the most appropriate model setup for a particular purpose over a given region/domain. The physics options selected for the modelling are based on the results of a sensitivity study undertaken over southwestern Western Australia, where simulations of 14 combinations of land surface model, longwave radiation scheme, shortwave radiation scheme, cumulus scheme, planetary boundary layer scheme, surface layer scheme and microphysics schemes were compared to observations (Kala et. al., 2015). The combination of physics options found to produce the most accurate results, were used in this study, and are summarised in Appendix Table 3.

[3] Global modelling using observed climate data for temperature, wind speed, and pressure. The observations are analysed; interpolated onto a system of grids and the model initialised with this data.
[4] Terrain-following close to the earth's surface and pressure levels higher in the atmosphere.



Appendix Figure 6: Three nest structure, WRF model.

Appendix Table 3: WRF Physics Options Selected for Model.

	Domain 1	Domain 2	Domain 3	Explanatory Notes
mp_physics	4	4	4	WRF Single–moment 5–class Scheme
ra_lw_physics	1	1	1	Rapid radiative transfer model scheme
ra_sw_physics	1	1	1	Dudhia scheme for cloud and clear sky absorption and scattering
Radt	10	10	10	Time step for radiation schemes
sf_sfclay_physics	1	1	1	MM5 based on MOST
sf_surface_physics	2	2	2	Noah land surface model with 6 soil layers
bl_pbl_physics	1	1	1	Non-local K-scheme with entrainment layer
bldt	0	0	0	Boundary layer time step (0=every time step)
cu_physics	1	1	0	Kain-Fritch scheme using mass flux approach for domain 1 only.
cudt	5	5	5	Cumulus physics time step (minutes)

Six-hourly global final analysis[5] synoptic data (from http://nomads.ncdc.noaa.gov/data/gfsanl/) was used to initialise the model and provide boundary conditions.

Land-use and terrain data was sourced from the United State Geological Services (USGS) database. Inspection of the land-use indicates an acceptable resolution and category for the model area with shrub land being the dominant vegetation type.

The selection of an appropriate Land Surface Model (LSM) is critically important to provide the boundary conditions at the land-atmosphere interface because:

- The Planetary Boundary Layer (PBL) schemes are sensitive to surface fluxes.
- The cloud/cumulus schemes are sensitive to the PBL structures.
- There is a need to capture mesoscale circulations forced by surface variability in albedo, soil moisture/temperature and land use.

The Noah Land-Surface Model was selected in this case to account for the sub-grid-scale fluxes. This sophisticated scheme provides 4 quantities to the parent atmospheric model (WRF), namely:

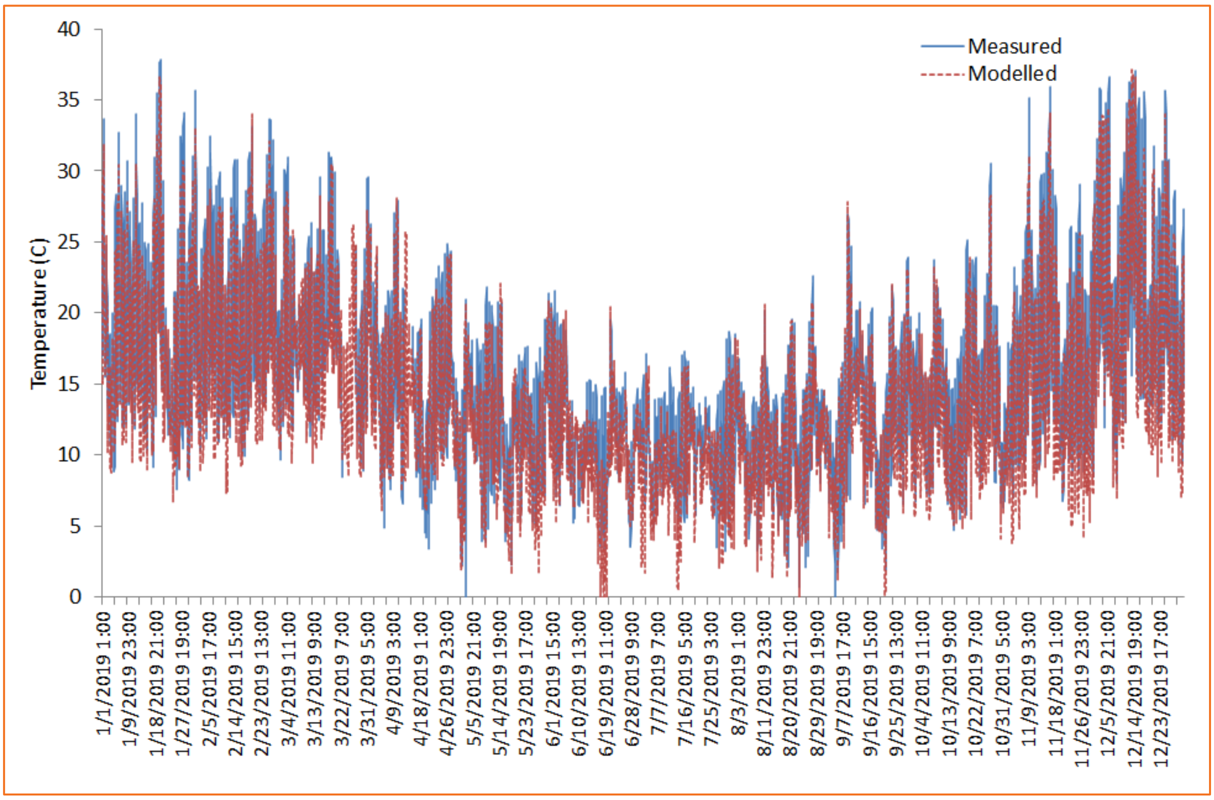
- surface sensible heat flux
- surface latent heat flux
- upward longwave radiation, and
- upward (reflected) shortwave radiation.

[5] Final analysis data is global modelled data that has been retrospectively corrected using surface, upper air and satellite measurements.

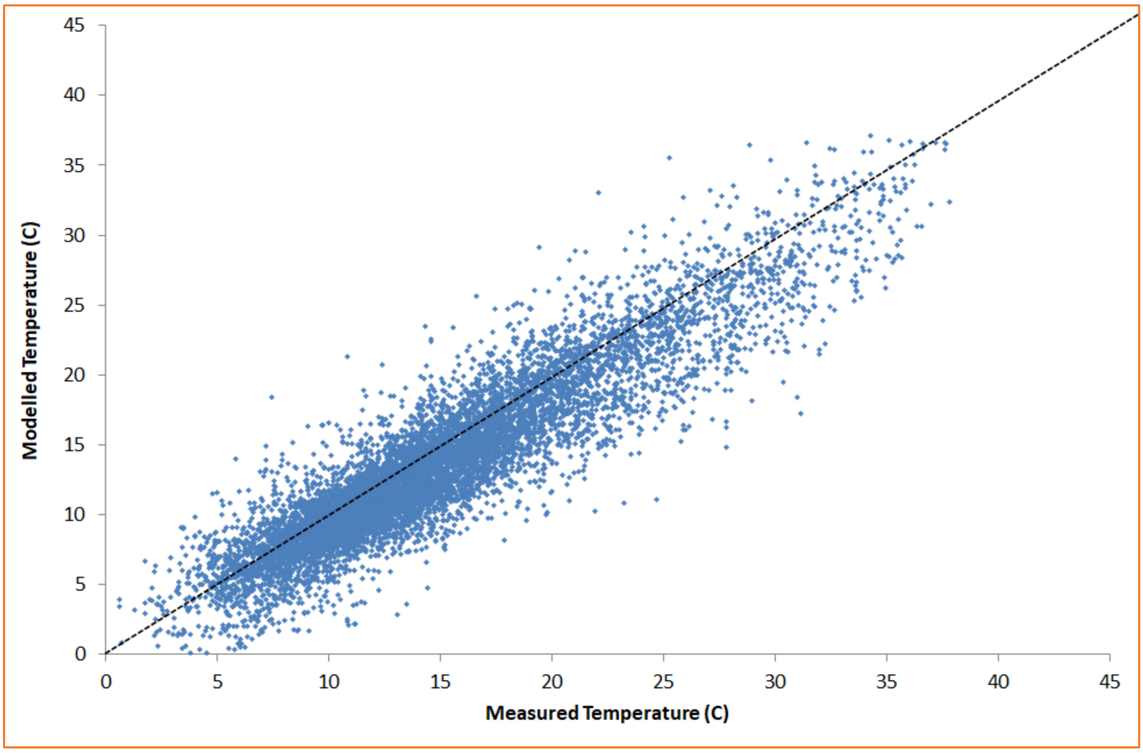
Model Validation

The accuracy of the meteorology generated by WRF was assessed by comparing model output against corresponding measurement data at the Talison weather station located at 413499 m East and 6251894m N. At an initial level of validation, the model output is visually compared against measured temperature, wind speed and wind direction.

The hourly temperature comparison between modelled and measured is shown in Appendix Figure 7. The model reflects the daily and seasonal trends, as well as maxima generally well. However, maximum temperatures are slightly overpredicted. This is not surprising given that the temperature measurement height is 6 m while the modelled height is 10 m. The scatterplot in Appendix Figure 8 shows good correspondence between modelled and measured values, although model underprediction at higher temperatures is evident.

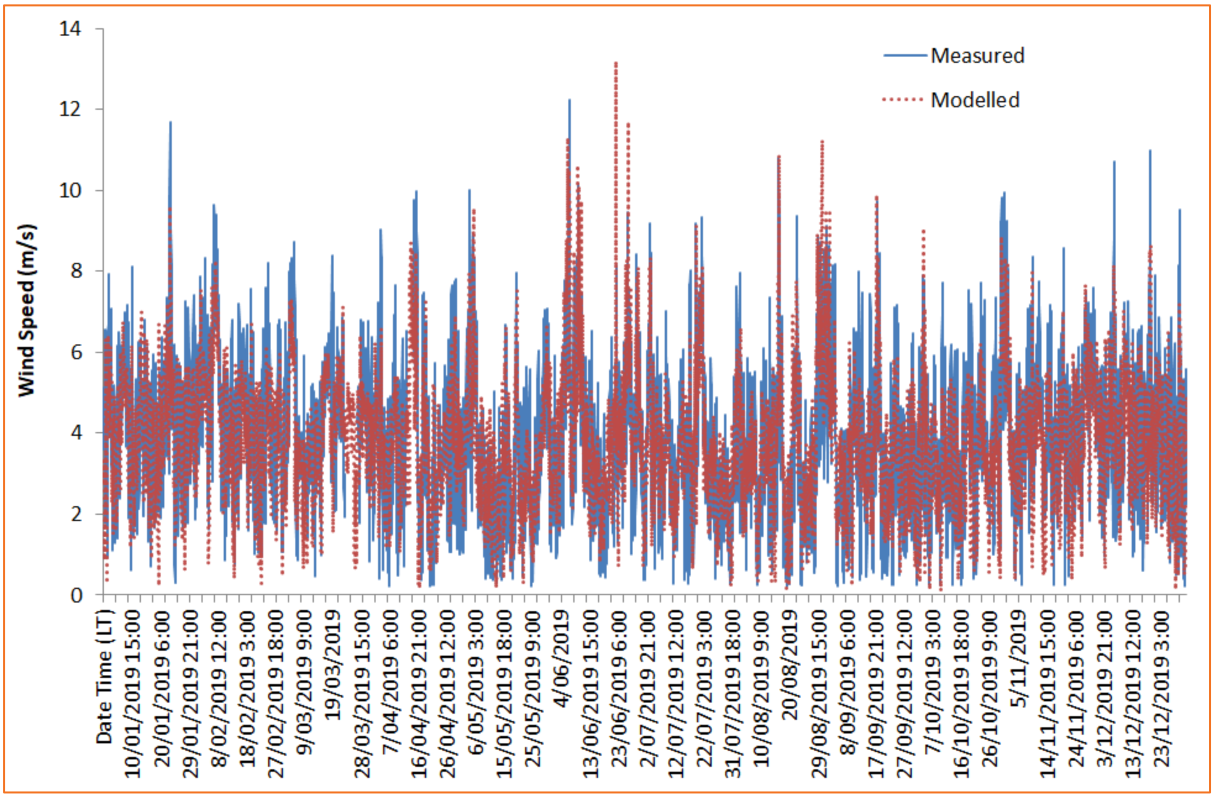


Appendix Figure 7: Time series of modelled at measured temperature at the onsite met station.

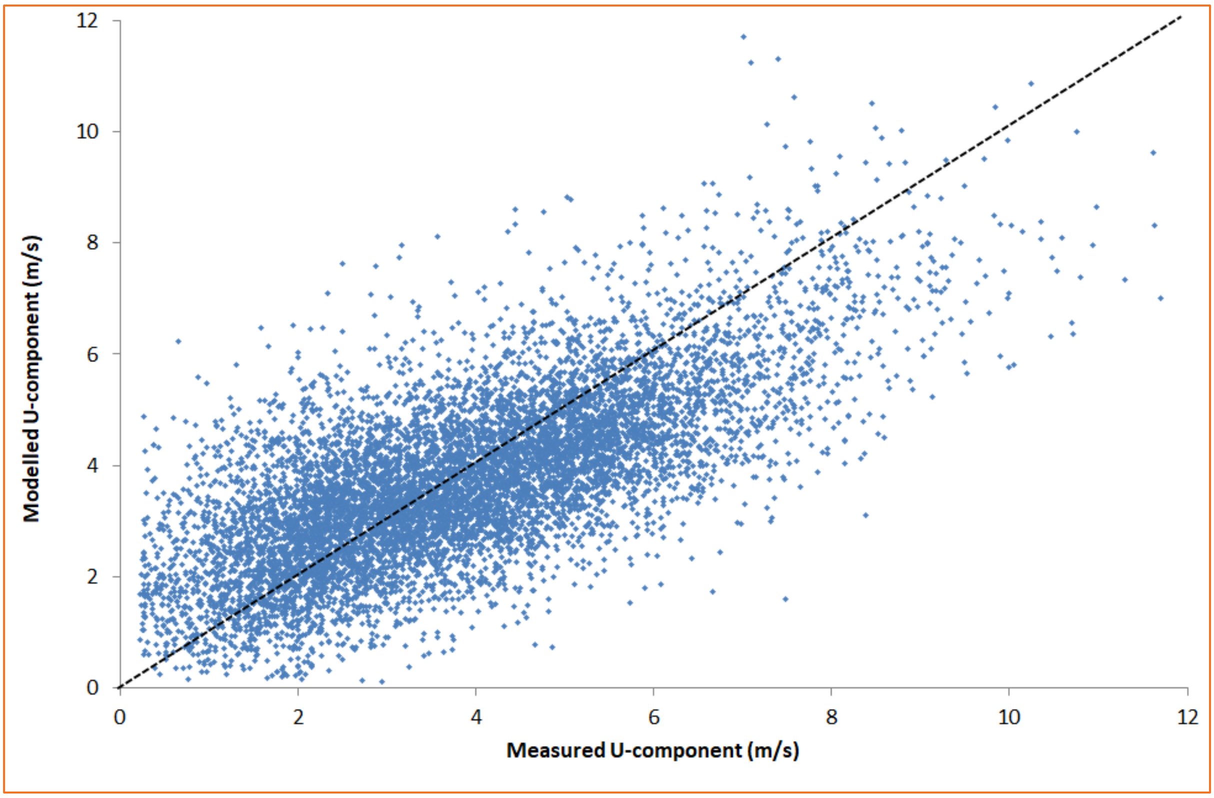


Appendix Figure 8: Scatterplot of modelled and measured temperature at the onsite met station

The time series of predicted and measured 10 m wind speed is shown in Appendix Figure 9. The model predictions reflect observational trends and predicts both lower and higher winds well. The scatterplot of wind speed shows that the model tends to underpredict higher wind speed on occasions (Appendix Figure 10).

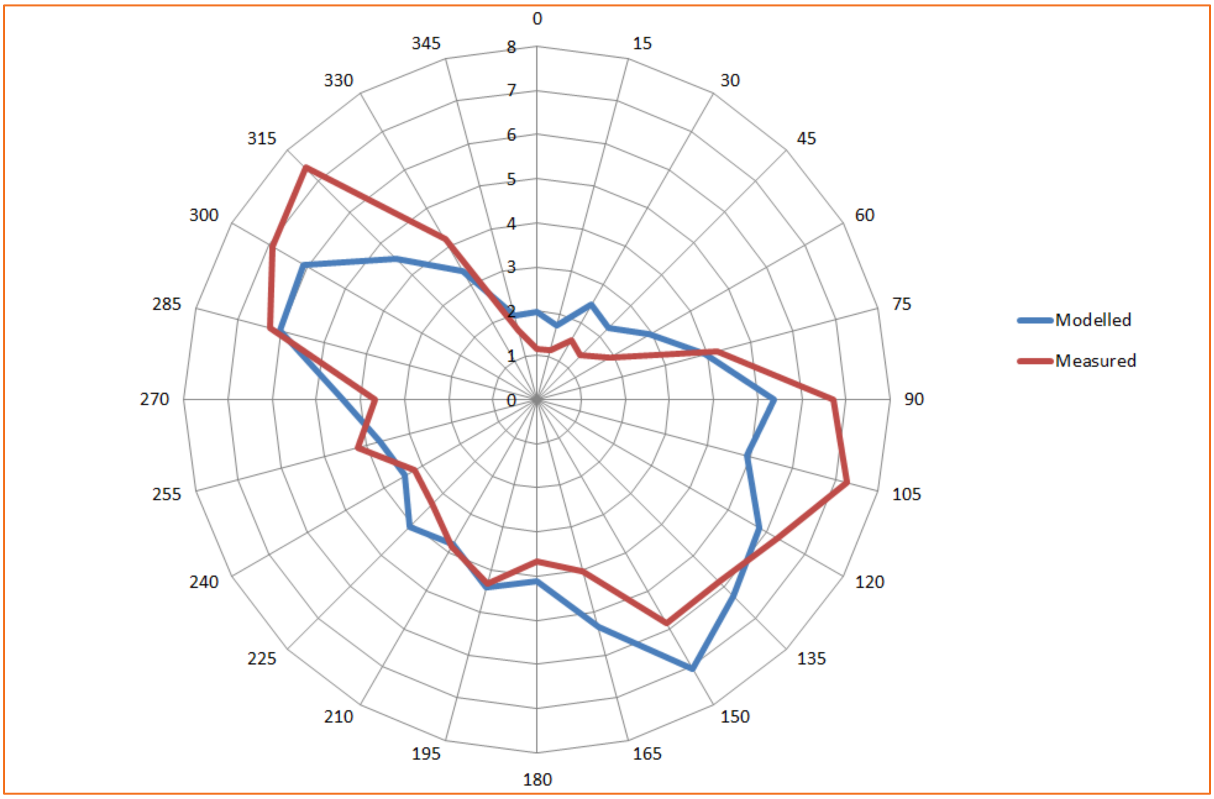


Appendix Figure 9: Time series of modelled at measured wind speed at the onsite met station.



Appendix Figure 10: Scatterplot of modelled and measured wind speed at the onsite met station.

The annual wind direction radar plots (Appendix Figure 11) show that while the model predicts the general wind directions well, the model slightly underpredicts the frequency of north-westerly and east-south-easterly flow.



Appendix Figure 11: Measured (left) and modelled (right) annual wind roses at the onsite met station.

More objective methods to evaluate model performance are assessed using statistical tests that have been specifically developed for this purpose. These tests used are discussed in detail below.

Model Bias

The model bias (MB) is the mean error and is given by:

$$MB = \frac{1}{n}\sum_{i=1}^{n}(O_i - P_i)$$

Where:

n	=	the number of pairs of observed data
O_i	=	the observed value for the i-th hour
P_i	=	the predicted value for the i-th hour

The ideal value for the bias is zero.

Gross Error

The gross error (GE) is the mean of absolute error and is given by:

$$GE = \frac{1}{n}\sum_{i=1}^{n} | O_i - P_i |$$

where:

n = the number of pairs of observed data
O_i = the observed value for the i-th hour
P_i = the predicted value for the i-th hour

The ideal value for gross error is zero. GE is greater than MB, representing the expected error for each hourly observation.

Root Mean Square Error (RMSE)

The Root Mean Square Error is given by:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(O_i - P_i)^2}$$

where:

N = the number of pairs of data
O_i = the observed (measured) value for the i-th hour
P_i = the predicted (modelled) value for the i-th hour

While the ideal RMSE value is 0, large errors in a small section of the data may produce a large RMSE even though errors may be small elsewhere.

Index of Agreement

The index of agreement (IOA) is the measure of how well the model estimates departure from the observed mean.

$$IOA = 1 - \left[\frac{N(RMSE)^2}{\sum_{i=1}^{n}\left\{\left|P_i - \bar{O}\right| + \left|O_i - \bar{O}\right|\right\}^2} \right]$$

where:

n = the number of pairs of observed data
O_i = the observed value for the i-th hour
$\bar{O}_i$ = the mean observed value

The index of agreement has a theoretical range of 0 to 1. The ideal value for IOA is 1.

A set of benchmarks were set for mesoscale model evaluation by Emery *et al.* (2001) and Teschke *et al.* (2001). The purpose of these benchmarks is not necessarily to give a passing or failing grade but to put the results into a proper context (Emery, et al., 2001).

Verification of WRF performance has been conducted by comparing hourly predictions at the onsite weather station against corresponding measurements between January 2019 and December 2019. Temperature, wind speed and wind direction compared (Appendix Table 4).

Appendix Table 4: Results of statistical validation test at the onsite met station

Variable	Performance Criteria	Benchmark Range	Statistic	
			Score	Benchmark
Wind Speed	RMSE	<±2 m/s	1.32	Within
	BIAS	<± 0.5 m/s	0.08	Within
	IOA	>0.6	0.83	Within
Wind Direction	Gross error	<30 °	26.04	Within
	BIAS	<10 °	5.50	Within
Temp	Gross error	<±2 K	2.0	Within
	BIAS	<± 0.5 K	1.24	Outside
	IOA	>0.8	0.95	Within

Based on the results shown in the table, it can be concluded that:

- The model predicts surface temperature with a moderate to high degree of skill. underprediction at higher temperatures has been identified (most likely due to incompatible modelled and measured heights). Two of the three benchmark criteria are met with the Bias values falling just outside the benchmark criterion.
- The model predicts wind speed with a high degree of skill. All three benchmarks are met.
- The model predicts wind direction with a high degree of accuracy. Both benchmark criteria are met.

The meteorological model performance can therefore be considered acceptable when compared to measurement data.

Appendix C – Sensitive Receptors

Appendix Table 4:Model Receptor Description.

ID	Easting	Northing	Receptor Type	Assessment Criteria	Pollutant Impact Assessed			
					PM_{10}	$PM_{2.5}$	TSP	Dust deposition
R1	412,813	6,253,855	Residential (Greenbushes Township)	Human health | amenity | nuisance	✓	✓	✓	✓
R2	412,980	6,253,966			✓	✓	✓	✓
R3	413,106	6,254,150			✓	✓	✓	✓
R4	413,196	6,254,323			✓	✓	✓	✓
R5	413,190	6,254,373			✓	✓	✓	✓
R6	413,227	6,254,476			✓	✓	✓	✓
R39	412,874	6,254,051			✓	✓	✓	✓
R40	413,189	6,254,112			✓	✓	✓	✓
R41	412,995	6,254,014			✓	✓	✓	✓
R42	412,753	6,254,002			✓	✓	✓	✓
R43	413,093	6,254,353			✓	✓	✓	✓
R7	413,599	6,255,592	Residential		✓	✓	✓	✓
R8	415,772	6,253,756			✓	✓	✓	✓
R9	416,238	6,253,607			✓	✓	✓	✓
R10	415,896	6,252,964			✓	✓	✓	✓
R11	416,041	6,252,630			✓	✓	✓	✓
R13	416,360	6,250,255			✓	✓	✓	✓
R14	415,676	6,250,526			✓	✓	✓	✓
R15	416,054	6,249,386			✓	✓	✓	✓
R16	415,894	6,249,284			✓	✓	✓	✓
R17	413,363	6,248,888			✓	✓	✓	✓
R18	411,793	6,248,510			✓	✓	✓	✓
R19	411,021	6,248,757			✓	✓	✓	✓
R20	409,264	6,249,013			✓	✓	✓	✓
R21	405,054	6,249,792			✓	✓	✓	✓
R22	407,477	6,252,988			✓	✓	✓	✓
R23	412,460	6,256,660			✓	✓	✓	✓
R24	413,097	6,257,623			✓	✓	✓	✓
R25	414,987	6,256,777			✓	✓	✓	✓
R26	416,674	6,248,781			✓	✓	✓	✓
R27	414,793	6,246,500			✓	✓	✓	✓
R33	413,435	6,248,615			✓	✓	✓	✓
R50	411,228	6,248,162			✓	✓	✓	✓
R51	418,746	6,250,651			✓	✓	✓	✓
R52	418,399	6,251,162			✓	✓	✓	✓
R53	418,648	6,252,880			✓	✓	✓	✓
R54	418,652	6,253,261			✓	✓	✓	✓
R55	418,666	6,253,566			✓	✓	✓	✓
R56	416,968	6,254,067			✓	✓	✓	✓

ID	Easting	Northing	Receptor Type	Assessment Criteria	Pollutant Impact Assessed			
					PM_{10}	$PM_{2.5}$	TSP	Dust deposition
R57	417,392	6,254,155			✓	✓	✓	✓
R58	419,000	6,249,725			✓	✓	✓	✓
R63	418,105	6,254,281			✓	✓	✓	✓
R64	417,766	6,254,954			✓	✓	✓	✓
R65	417,555	6,255,211			✓	✓	✓	✓
R66	417,352	6,255,549			✓	✓	✓	✓
R67	421,606	6,250,632			✓	✓	✓	✓
R68	420,967	6,251,035			✓	✓	✓	✓
R69	417,690	6,255,633			✓	✓	✓	✓
R70	415,657	6,256,198			✓	✓	✓	✓
R71	419,512	6,255,335			✓	✓	✓	✓
R72	417,866	6,255,842			✓	✓	✓	✓
R73	417,196	6,256,119			✓	✓	✓	✓
R74	420,388	6,254,371			✓	✓	✓	✓
R31	407,527	6,253,112	Potential Residential		✓	✓	✓	✓
R32	408,927	6,249,251			✓	✓	✓	✓
R38	414,197	6,255,727			✓	✓	✓	✓
R59	420,535	6,249,353			✓	✓	✓	✓
R60	421,257	6,249,491			✓	✓	✓	✓
R61	420,261	6,250,534			✓	✓	✓	✓
R62	420,385	6,250,843			✓	✓	✓	✓
R75	416,962	6,248,396			✓	✓	✓	✓
R76	416,250	6,247,970			✓	✓	✓	✓
R77	416,326	6,247,826			✓	✓	✓	✓
R78	416,307	6,247,587			✓	✓	✓	✓
R79	418,255	6,246,389			✓	✓	✓	✓
R80	417,748	6,246,507			✓	✓	✓	✓
R82	419,247	6,247,073			✓	✓	✓	✓
R83	419,079	6,246,635			✓	✓	✓	✓
R29	412,855	6,253,814	Dust monitor		✓	✓	✓	✓

Appendix D – CALMET Configuration

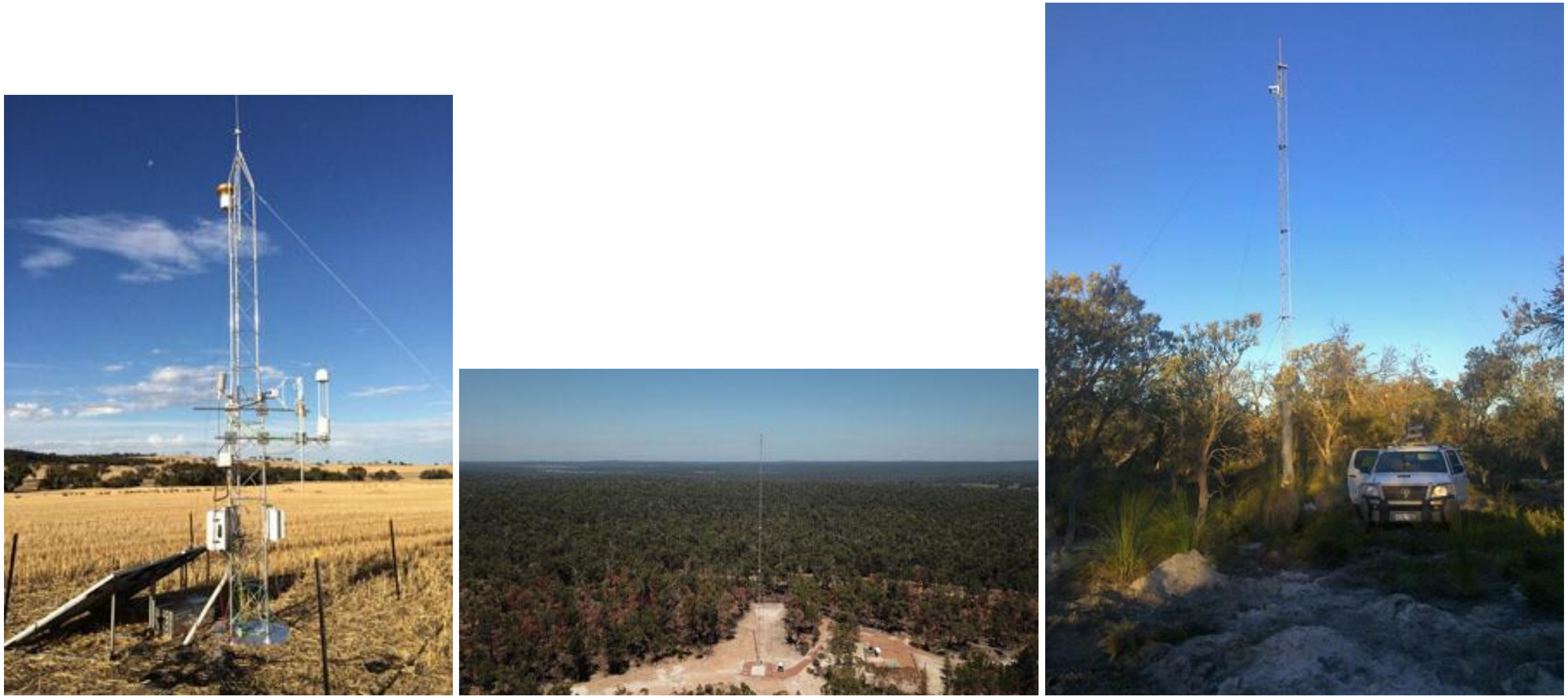
Selected CALMET model switches and settings used in the modelling are summarised in Appendix Table 5. These specifically show settings that deviate from the model default values.

Appendix Table 5: Selected CALMET Settings and switches.

Code	Setting	Explanatory Notes
NOOBS	2	Use MM4/MM5/3D.DAT for surface, overwater, and upper air data
ICLOUD	4	Gridded cloud cover from Prognostic Rel. Humidity
IWFCOD	1	Diagnostic wind module
IFRADJ	1	Froude number adjustment
ISLOPE	1	Compute slope flow effects
IEXTRP	1	No surface wind observation extrapolation to upper layers
IPROG	14	Use gridded prognostic wind field model output fields as input to the diagnostic wind field model as initial guess field
RMAX1	0.01	Maximum radius of influence over land in the surface layer
RMAX2	0.01	Maximum radius of influence over land aloft
TERRAD	3	Radius of influence of terrain features
R1	0.01	Relative weighting of the first guess field and observations in the SURFACE layer
R2	0.01	Relative weighting of the first guess field and observations in the layers ALOFT

The geophysical data used in CALMET is critical for simulating deflection, blocking, and channelling of the air flow. In addition, other parameters such as roughness length, albedo and Bowen ratio are important for the simulation of turbulence, and heat fluxes (used to determine the growth of the mixing height, *inter alia*).

The default United States Geological Service (USGS) geophysical parameters used in CALMET are based on North American vegetation types and is most likely unrepresentative of Australian vegetation types. It was therefore decided to calculate these parameters, where possible, for the local vegetation specifically, based on Ozflux flux tower measurement data at Ridgefield for cropland (Beringer, 2016), Collie for local forest (Beringer, 2018) and Gingin for shrubland/ Banksia woodland (Silberstein, 2015) (Appendix Figure 12). Measurements at these sites include wind speed, direction, friction velocity, heat fluxes (sensible and latent) as well as incoming and outgoing radiation.



Appendix Figure 12: Flux towers at Ridgefield (left), Collie (centre) and Gingin (right).

Roughness length is a critical parameter in dispersion modelling as it affects nocturnal mixing heights as well as dispersion rate of the plume through dispersion coefficients. The following relationship was used to calculate roughness length[6] (z_o) from friction velocity (u_*), wind speed (u) and anemometer height (z) at the three locations:

$$z_0 = (z - D)^{\frac{-kU(z)}{u*}}$$

The local seasonal roughness lengths thus determined are shown in Appendix Table 6. The reduction in roughness length during autumn and winter reflects the wheat cropland sowing period (bare soil) from April to June in WA. Z_0 remains relatively constant for shrub and forest due to evergreen nature of the vegetation.

The calculated values for cropland approximate the USGS values, while the calculated values for Australian forests are significantly lower than the default USGS value and more in line with values cited in Peel *et al* (2005) for south-western Western Australia.

Seasonal Bowen ratios[7] for 2019 were obtained from 30-minute average latent and sensible heat flux measurements for local cropland, forest and shrub land cover types (Siberstein, 2015; Beringer, 2016, 2018), and were calculated as follows:

$$\beta = \frac{Q_h}{Q_e}$$

Where Q_H and Q_e are sensible and latent heat fluxes, respectively.

The local seasonal Bowen ratios thus determined are shown in Appendix Table 6. The calculated values for cropland approximate the average USGS value, while the calculated values for Australian forests and shrubland are significantly higher than the corresponding default USGS value. These values reflect the low evapotranspiration rates seen for native Australian vegetation species. Reduction in Bowen ratio is seen during winter in response to increased rainfall during that season.

Local seasonal albedo[8] were calculated from the ratio of outgoing shortwave (i.e., reflected) radiation to incoming radiation and are shown in Appendix Table 6. The calculated values for cropland approximate the average USGS value, while the calculated values for Australian forests are slightly higher than the default USGS value. These values, which are consistent with the value cited in Peel *et al* (2005) for south-western Western Australia, confirms the higher reflectance of eucalyptus species compared to North American tree species.

Geophysical parameters for the remaining land-use categories were sourced from Hagermann (2002) and Peel *et al* (2005).

Seasonal geophysical (geo.dat) files were utilised in the modelling to reflect the changing geophysical parameters between the wet and dry seasons.

[6] Roughness length is related to the roughness characteristics of the terrain.
[7] Bowen ratio is important in determining the degree of convective turbulence.
[8] The albedo is the degree to which a surface will reflect incoming shortwave solar radiation and is used in the model to determine the radiation balance.

Appendix Table 6: Calculated seasonal roughness length (zo), albedo (α) and Bowen ratio (β)

	zo	α	β
Dry cropland			
Summer	0.21	0.23	0.99
Autumn	0.12	0.22	0.85
Winter	0.07	0.20	0.89
Spring	0.29	0.22	0.70
Forest			
Summer	0.68	0.14	2.09
Autumn	0.68	0.14	1.17
Winter	0.68	0.13	0.14
Spring	0.68	0.13	0.79
Shrubland			
Summer	0.32	0.14	2.40
Autumn	0.31	0.13	1.43
Winter	0.32	0.13	0.49
Spring	0.30	0.13	1.54

Appendix E – Predicted ground level concentrations at discrete receptors

Appendix Table 7: S2 Only 2028 – Predicted TSP concentrations at receptor locations (µg/m^3).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	1,495.8	907.6	798.5	482.4	206.3	170.3	1,523.4	935.2	826.1	510.0	233.9	197.9
R2	1,734.4	807.2	723.2	426.7	158.5	145.7	1,762.0	834.8	750.8	454.3	186.1	173.3
R3	1,368.9	425.9	337.4	194.7	75.0	67.7	1,396.5	453.5	365.0	222.3	102.6	95.3
R4	1,196.8	276.7	251.0	116.0	45.9	44.3	1,224.4	304.3	278.6	143.6	73.5	71.9
R5	1,150.8	256.1	234.8	107.1	41.4	40.8	1,178.4	283.7	262.4	134.7	69.0	68.4
R6	1,087.7	228.7	197.6	96.2	33.8	35.6	1,115.3	256.3	225.2	123.8	61.4	63.2
R7	539.5	120.0	97.2	43.5	13.1	15.4	567.1	147.6	124.8	71.1	40.7	43.0
R8	279.4	134.3	103.5	53.7	15.5	17.2	307.0	161.9	131.1	81.3	43.1	44.8
R9	245.7	114.5	94.2	47.3	14.5	14.8	273.3	142.1	121.8	74.9	42.1	42.4
R10	371.6	133.8	112.2	67.0	22.3	21.6	399.2	161.4	139.8	94.6	49.9	49.2
R11	295.5	138.5	114.0	63.9	20.3	21.0	323.1	166.1	141.6	91.5	47.9	48.6
R12	274.4	137.8	84.0	39.8	8.8	12.7	302.0	165.4	111.6	67.4	36.4	40.3
R13	321.2	146.1	126.9	45.5	10.3	15.9	348.8	173.7	154.5	73.1	37.9	43.5
R14	504.4	207.2	176.8	75.6	16.3	24.4	532.0	234.8	204.4	103.2	43.9	52.0
R15	203.4	115.8	84.9	29.1	4.0	9.4	231.0	143.4	112.5	56.7	31.6	37.0
R16	175.0	104.2	93.9	24.8	3.6	8.8	202.6	131.8	121.5	52.4	31.2	36.4
R17	380.6	95.5	66.9	23.9	2.6	8.6	408.2	123.1	94.5	51.5	30.2	36.2
R18	130.3	76.1	59.5	20.9	1.2	6.4	157.9	103.7	87.1	48.5	28.8	34.0
R19	183.2	87.5	67.2	20.2	1.6	6.9	210.8	115.1	94.8	47.8	29.2	34.5

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R20	123.1	76.9	42.1	14.9	2.2	5.4	150.7	104.5	69.7	42.5	29.8	33.0
R21	55.3	23.9	17.9	7.0	1.1	2.3	82.9	51.5	45.5	34.6	28.7	29.9
R22	107.1	63.1	45.5	17.5	3.8	6.0	134.7	90.7	73.1	45.1	31.4	33.6
R23	275.9	70.4	60.4	28.3	6.5	8.8	303.5	98.0	88.0	55.9	34.1	36.4
R24	212.4	59.4	38.4	20.5	4.1	6.4	240.0	87.0	66.0	48.1	31.7	34.0
R25	170.3	50.9	42.0	22.3	4.8	6.8	197.9	78.5	69.6	49.9	32.4	34.4
R26	148.1	74.0	47.9	19.8	2.6	6.1	175.7	101.6	75.5	47.4	30.2	33.7
R27	135.2	35.3	23.8	8.1	0.6	3.2	162.8	62.9	51.4	35.7	28.2	30.8
R28	135.2	35.3	23.8	8.1	0.6	3.2	162.8	62.9	51.4	35.7	28.2	30.8
R29	1,964.9	1,136.7	1,035.6	652.3	279.2	227.1	1,992.5	1,164.3	1,063.2	679.9	306.8	254.7
R30	211.6	102.6	80.0	35.6	8.6	11.6	239.2	130.2	107.6	63.2	36.2	39.2
R31	107.8	63.9	43.7	17.3	3.8	6.1	135.4	91.5	71.3	44.9	31.4	33.7
R32	114.2	71.4	37.2	14.2	2.4	5.2	141.8	99.0	64.8	41.8	30.0	32.8
R33	354.0	75.3	59.9	22.9	2.3	7.5	381.6	102.9	87.5	50.5	29.9	35.1
R34	176.6	105.5	89.7	24.6	3.5	8.7	204.2	133.1	117.3	52.2	31.1	36.3
R35	311.7	143.6	123.4	44.8	10.3	15.6	339.3	171.2	151.0	72.4	37.9	43.2
R36	246.6	114.5	94.1	47.6	14.5	14.9	274.2	142.1	121.7	75.2	42.1	42.5
R37	279.7	134.4	103.5	53.7	15.6	17.2	307.3	162.0	131.1	81.3	43.2	44.8
R38	366.6	83.0	69.9	40.8	10.8	12.5	394.2	110.6	97.5	68.4	38.4	40.1
R39	1,258.3	501.7	434.3	263.9	96.8	90.0	1,285.9	529.3	461.9	291.5	124.4	117.6
R40	1,489.5	458.0	366.0	205.1	84.3	74.4	1,517.1	485.6	393.6	232.7	111.9	102.0
R41	1,589.7	651.2	548.9	322.2	127.0	114.8	1,617.3	678.8	576.5	349.8	154.6	142.4
R42	1,050.6	493.2	461.6	253.2	100.1	89.1	1,078.2	520.8	489.2	280.8	127.7	116.7
R43	1,112.2	272.7	231.0	110.4	43.5	41.8	1,139.8	300.3	258.6	138.0	71.1	69.4

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R44	510.3	207.5	175.8	75.5	16.6	24.2	537.9	235.1	203.4	103.1	44.2	51.8
R45	294.3	134.9	109.2	63.5	20.7	20.8	321.9	162.5	136.8	91.1	48.3	48.4
R46	371.8	133.6	112.3	66.9	22.3	21.6	399.4	161.2	139.9	94.5	49.9	49.2
R47	203.6	116.0	85.4	29.2	4.0	9.4	231.2	143.6	113.0	56.8	31.6	37.0
R48	130.0	79.3	63.9	21.7	1.3	6.7	157.6	106.9	91.5	49.3	28.9	34.3
R49	184.8	88.2	67.8	20.3	1.7	7.0	212.4	115.8	95.4	47.9	29.3	34.6
R50	121.9	68.6	56.2	16.0	0.9	5.4	149.5	96.2	83.8	43.6	28.5	33.0
R51	188.6	48.1	38.5	15.4	3.5	5.5	216.2	75.7	66.1	43.0	31.1	33.1
R52	171.4	56.8	50.0	18.0	4.9	6.7	199.0	84.4	77.6	45.6	32.5	34.3
R53	123.5	57.4	51.9	18.2	3.3	6.2	151.1	85.0	79.5	45.8	30.9	33.8
R54	112.4	54.7	44.7	17.7	3.8	5.7	140.0	82.3	72.3	45.3	31.4	33.3
R55	97.9	54.6	37.3	15.5	3.5	5.2	125.5	82.2	64.9	43.1	31.1	32.8
R56	152.7	70.2	60.9	28.1	6.5	9.1	180.3	97.8	88.5	55.7	34.1	36.7
R57	126.2	63.1	48.5	23.4	4.9	7.4	153.8	90.7	76.1	51.0	32.5	35.0
R58	110.1	36.5	29.4	14.5	2.7	4.4	137.7	64.1	57.0	42.1	30.3	32.0
R59	73.2	18.8	14.8	7.2	1.3	2.4	100.8	46.4	42.4	34.8	28.9	30.0
R60	75.2	13.4	11.3	6.0	1.0	1.9	102.8	41.0	38.9	33.6	28.6	29.5
R61	116.8	22.8	18.6	8.0	1.8	2.9	144.4	50.4	46.2	35.6	29.4	30.5
R62	99.9	24.6	22.4	7.9	1.6	2.8	127.5	52.2	50.0	35.5	29.2	30.4
R63	114.1	58.5	40.2	18.8	3.2	5.6	141.7	86.1	67.8	46.4	30.8	33.2
R64	98.2	53.8	39.4	19.4	3.0	5.6	125.8	81.4	67.0	47.0	30.6	33.2
R65	116.9	50.2	36.5	18.0	2.9	5.7	144.5	77.8	64.1	45.6	30.5	33.3
R66	123.7	54.7	34.0	19.4	2.3	5.6	151.3	82.3	61.6	47.0	29.9	33.2
R67	76.0	17.4	14.7	4.9	1.0	1.9	103.6	45.0	42.3	32.5	28.6	29.5

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R68	76.4	22.4	20.5	6.8	1.5	2.4	104.0	50.0	48.1	34.4	29.1	30.0
R69	105.9	50.0	32.3	16.7	2.1	4.9	133.5	77.6	59.9	44.3	29.7	32.5
R70	133.8	63.0	46.0	22.8	4.5	7.2	161.4	90.6	73.6	50.4	32.1	34.8
R71	63.8	26.9	22.4	9.6	1.5	2.9	91.4	54.5	50.0	37.2	29.1	30.5
R72	99.7	48.1	29.6	15.7	1.8	4.6	127.3	75.7	57.2	43.3	29.4	32.2
R73	114.0	43.0	36.5	17.7	2.0	5.1	141.6	70.6	64.1	45.3	29.6	32.7
R74	41.5	24.2	22.4	8.6	1.4	2.6	69.1	51.8	50.0	36.2	29.0	30.2
R75	134.6	66.2	43.3	17.2	2.0	5.4	162.2	93.8	70.9	44.8	29.6	33.0
R76	93.0	50.4	42.1	14.7	1.6	4.5	120.6	78.0	69.7	42.3	29.2	32.1
R77	85.1	49.3	41.4	14.0	1.4	4.2	112.7	76.9	69.0	41.6	29.0	31.8
R78	71.2	37.5	34.3	12.4	1.2	3.7	98.8	65.1	61.9	40.0	28.8	31.3
R79	36.0	20.4	17.9	5.9	0.7	2.0	63.6	48.0	45.5	33.5	28.3	29.6
R80	39.7	24.7	21.2	6.5	0.8	2.2	67.3	52.3	48.8	34.1	28.4	29.8
R81	35.2	20.1	17.3	5.9	0.7	1.9	62.8	47.7	44.9	33.5	28.3	29.5
R82	64.7	20.8	18.8	7.3	0.8	2.2	92.3	48.4	46.4	34.9	28.4	29.8
R83	51.2	22.0	16.6	6.7	0.7	2.0	78.8	49.6	44.2	34.3	28.3	29.6

Appendix Table 8: S2 Only 2028 – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	535.2	341.4	305.0	190.1	82.2	67.6	549.0	355.2	318.8	203.9	96.0	81.4
R2	601.1	296.4	278.2	166.8	64.1	58.0	614.9	310.2	292.0	180.6	77.9	71.8
R3	472.9	171.2	138.1	78.7	32.7	29.1	486.7	185.0	151.9	92.5	46.5	42.9
R4	417.8	122.4	97.7	51.0	22.7	19.8	431.6	136.2	111.5	64.8	36.5	33.6
R5	402.8	115.5	91.3	47.3	20.5	18.3	416.6	129.3	105.1	61.1	34.3	32.1
R6	383.5	110.4	83.3	40.7	17.4	16.1	397.3	124.2	97.1	54.5	31.2	29.9
R7	198.1	54.2	43.6	20.2	6.8	7.1	211.9	68.0	57.4	34.0	20.6	20.9
R8	98.6	56.5	43.0	23.1	7.3	7.4	112.4	70.3	56.8	36.9	21.1	21.2
R9	82.4	52.5	39.2	20.0	6.5	6.5	96.2	66.3	53.0	33.8	20.3	20.3
R10	119.3	59.3	50.8	27.7	10.2	9.4	133.1	73.1	64.6	41.5	24.0	23.2
R11	101.3	58.5	52.1	26.8	10.0	9.1	115.1	72.3	65.9	40.6	23.8	22.9
R12	91.3	46.0	33.6	16.5	4.2	5.2	105.1	59.8	47.4	30.3	18.0	19.0
R13	113.1	54.3	49.5	18.3	4.3	6.2	126.9	68.1	63.3	32.1	18.1	20.0
R14	169.3	79.0	63.2	27.6	6.8	9.2	183.1	92.8	77.0	41.4	20.6	23.0
R15	77.7	43.3	32.7	11.8	1.9	3.8	91.5	57.1	46.5	25.6	15.7	17.6
R16	70.0	39.7	36.4	11.0	1.5	3.6	83.8	53.5	50.2	24.8	15.3	17.4
R17	144.3	37.3	28.0	11.2	1.2	3.6	158.1	51.1	41.8	25.0	15.0	17.4
R18	54.1	32.2	22.1	8.6	0.4	2.7	67.9	46.0	35.9	22.4	14.2	16.5
R19	59.6	32.8	26.5	8.5	0.7	2.8	73.4	46.6	40.3	22.3	14.5	16.6
R20	50.2	32.0	16.6	5.6	0.9	2.2	64.0	45.8	30.4	19.4	14.7	16.0
R21	22.7	10.3	7.8	2.8	0.5	1.0	36.5	24.1	21.6	16.6	14.3	14.8
R22	42.5	22.1	19.2	7.7	1.8	2.5	56.3	35.9	33.0	21.5	15.6	16.3

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	100.2	31.6	28.3	12.1	3.7	4.0	114.0	45.4	42.1	25.9	17.5	17.8
R24	77.4	27.1	17.9	8.8	1.9	2.9	91.2	40.9	31.7	22.6	15.7	16.7
R25	61.0	22.2	20.2	9.5	2.4	3.1	74.8	36.0	34.0	23.3	16.2	16.9
R26	51.2	26.5	21.7	7.8	1.2	2.5	65.0	40.3	35.5	21.6	15.0	16.3
R27	48.6	17.7	11.6	3.4	0.3	1.3	62.4	31.5	25.4	17.2	14.1	15.1
R28	48.6	17.7	11.6	3.4	0.3	1.3	62.4	31.5	25.4	17.2	14.1	15.1
R29	700.5	408.9	391.9	257.4	107.6	88.4	714.3	422.7	405.7	271.2	121.4	102.2
R30	70.6	35.7	31.6	15.2	3.7	4.8	84.4	49.5	45.4	29.0	17.5	18.6
R31	43.5	24.5	18.9	7.7	1.7	2.6	57.3	38.3	32.7	21.5	15.5	16.4
R32	45.6	30.6	16.2	5.8	1.1	2.1	59.4	44.4	30.0	19.6	14.9	15.9
R33	133.9	28.9	24.4	10.5	1.1	3.1	147.7	42.7	38.2	24.3	14.9	16.9
R34	69.7	39.8	34.7	10.7	1.6	3.5	83.5	53.6	48.5	24.5	15.4	17.3
R35	110.2	53.5	48.2	18.2	4.3	6.1	124.0	67.3	62.0	32.0	18.1	19.9
R36	82.7	52.7	39.3	20.1	6.5	6.5	96.5	66.5	53.1	33.9	20.3	20.3
R37	98.7	56.6	43.1	23.2	7.3	7.5	112.5	70.4	56.9	37.0	21.1	21.3
R38	128.8	44.6	30.4	18.2	5.3	5.7	142.6	58.4	44.2	32.0	19.1	19.5
R39	440.9	193.5	182.5	109.0	42.3	37.3	454.7	207.3	196.3	122.8	56.1	51.1
R40	513.0	184.1	151.1	86.4	39.3	32.0	526.8	197.9	164.9	100.2	53.1	45.8
R41	550.1	245.8	216.9	133.7	54.1	46.7	563.9	259.6	230.7	147.5	67.9	60.5
R42	375.4	188.2	180.0	105.6	42.8	37.1	389.2	202.0	193.8	119.4	56.6	50.9
R43	387.7	114.8	91.2	49.2	20.3	18.6	401.5	128.6	105.0	63.0	34.1	32.4
R44	171.0	78.8	63.5	27.6	6.7	9.1	184.8	92.6	77.3	41.4	20.5	22.9
R45	100.2	55.9	52.1	26.8	10.0	9.0	114.0	69.7	65.9	40.6	23.8	22.8
R46	119.4	59.3	50.8	27.7	10.2	9.4	133.2	73.1	64.6	41.5	24.0	23.2

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	77.8	43.3	32.9	11.8	1.9	3.8	91.6	57.1	46.7	25.6	15.7	17.6
R48	54.1	33.4	23.8	8.9	0.5	2.8	67.9	47.2	37.6	22.7	14.3	16.6
R49	60.1	33.0	26.7	8.5	0.7	2.9	73.9	46.8	40.5	22.3	14.5	16.7
R50	41.4	27.4	21.3	7.1	0.3	2.2	55.2	41.2	35.1	20.9	14.1	16.0
R51	66.6	17.9	14.2	7.3	1.9	2.3	80.4	31.7	28.0	21.1	15.7	16.1
R52	64.2	21.2	19.9	8.2	2.5	2.9	78.0	35.0	33.7	22.0	16.3	16.7
R53	43.6	22.6	21.6	8.7	1.7	2.7	57.4	36.4	35.4	22.5	15.5	16.5
R54	42.2	23.1	18.6	8.0	1.8	2.5	56.0	36.9	32.4	21.8	15.6	16.3
R55	38.5	22.0	16.8	7.8	1.7	2.3	52.3	35.8	30.6	21.6	15.5	16.1
R56	53.3	32.5	25.6	12.3	2.9	4.0	67.1	46.3	39.4	26.1	16.7	17.8
R57	48.9	30.4	20.9	10.2	2.2	3.2	62.7	44.2	34.7	24.0	16.0	17.0
R58	37.7	14.5	12.4	6.4	1.4	1.9	51.5	28.3	26.2	20.2	15.2	15.7
R59	25.3	7.4	6.2	3.4	0.5	1.0	39.1	21.2	20.0	17.2	14.3	14.8
R60	26.1	5.9	4.5	2.8	0.4	0.8	39.9	19.7	18.3	16.6	14.2	14.6
R61	42.5	8.8	7.4	3.8	1.0	1.2	56.3	22.6	21.2	17.6	14.8	15.0
R62	37.8	10.2	8.6	3.7	1.0	1.2	51.6	24.0	22.4	17.5	14.8	15.0
R63	43.3	20.2	17.3	8.0	1.5	2.5	57.1	34.0	31.1	21.8	15.3	16.3
R64	37.2	21.7	18.0	7.8	1.6	2.4	51.0	35.5	31.8	21.6	15.4	16.2
R65	39.6	21.5	16.6	7.9	1.5	2.5	53.4	35.3	30.4	21.7	15.3	16.3
R66	43.5	23.1	14.4	8.2	1.3	2.4	57.3	36.9	28.2	22.0	15.1	16.2
R67	28.5	7.0	5.7	2.3	0.5	0.8	42.3	20.8	19.5	16.1	14.3	14.6
R68	29.9	9.0	7.9	3.1	0.8	1.0	43.7	22.8	21.7	16.9	14.6	14.8
R69	36.4	20.9	13.0	7.2	1.1	2.1	50.2	34.7	26.8	21.0	14.9	15.9
R70	53.7	30.2	20.4	10.0	2.3	3.2	67.5	44.0	34.2	23.8	16.1	17.0

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	23.6	12.9	9.4	4.4	0.7	1.3	37.4	26.7	23.2	18.2	14.5	15.1
R72	34.3	20.1	12.8	6.9	1.0	2.0	48.1	33.9	26.6	20.7	14.8	15.8
R73	43.1	18.3	14.5	7.7	0.9	2.2	56.9	32.1	28.3	21.5	14.7	16.0
R74	17.8	10.3	9.6	3.9	0.7	1.2	31.6	24.1	23.4	17.7	14.5	15.0
R75	46.5	25.8	19.1	6.6	1.0	2.2	60.3	39.6	32.9	20.4	14.8	16.0
R76	32.0	20.2	18.2	6.3	0.7	1.9	45.8	34.0	32.0	20.1	14.5	15.7
R77	29.4	19.3	17.3	5.9	0.7	1.8	43.2	33.1	31.1	19.7	14.5	15.6
R78	24.2	16.5	14.2	5.3	0.6	1.6	38.0	30.3	28.0	19.1	14.4	15.4
R79	13.9	9.5	7.4	2.6	0.4	0.8	27.7	23.3	21.2	16.4	14.2	14.6
R80	15.8	9.7	8.9	2.9	0.4	1.0	29.6	23.5	22.7	16.7	14.2	14.8
R81	13.7	9.2	7.3	2.5	0.3	0.8	27.5	23.0	21.1	16.3	14.1	14.6
R82	23.3	9.9	7.6	3.1	0.4	0.9	37.1	23.7	21.4	16.9	14.2	14.7
R83	18.4	9.0	7.0	2.6	0.4	0.8	32.2	22.8	20.8	16.4	14.2	14.6

Appendix Table 9: S2 Only 2030 – Predicted TSP concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	285.0	240.9	200.9	113.2	51.1	41.0	312.6	268.5	228.5	140.8	78.7	68.6
R2	253.9	198.4	158.8	100.6	42.0	34.6	281.5	226.0	186.4	128.2	69.6	62.2
R3	215.1	157.9	133.1	67.5	27.3	24.1	242.7	185.5	160.7	95.1	54.9	51.7
R4	199.2	140.0	111.4	51.1	19.1	18.9	226.8	167.6	139.0	78.7	46.7	46.5
R5	194.3	133.7	108.8	48.6	18.1	17.9	221.9	161.3	136.4	76.2	45.7	45.5
R6	188.6	126.1	106.5	45.3	16.7	16.4	216.2	153.7	134.1	72.9	44.3	44.0
R7	123.2	81.7	69.6	24.8	7.8	9.1	150.8	109.3	97.2	52.4	35.4	36.7
R8	150.7	89.1	81.6	42.7	10.6	12.6	178.3	116.7	109.2	70.3	38.2	40.2
R9	143.3	93.2	78.3	37.1	8.2	11.1	170.9	120.8	105.9	64.7	35.8	38.7
R10	213.8	173.0	129.8	58.4	15.9	18.7	241.4	200.6	157.4	86.0	43.5	46.3
R11	238.2	151.4	132.2	56.8	14.5	19.5	265.8	179.0	159.8	84.4	42.1	47.1
R12	411.5	135.2	94.5	42.4	13.0	15.0	439.1	162.8	122.1	70.0	40.6	42.6
R13	676.8	175.2	137.1	54.3	15.1	20.6	704.4	202.8	164.7	81.9	42.7	48.2
R14	1,163.0	339.5	234.6	106.4	28.0	38.1	1,190.6	367.1	262.2	134.0	55.6	65.7
R15	215.3	142.5	105.4	39.4	6.3	12.9	242.9	170.1	133.0	67.0	33.9	40.5
R16	198.4	147.0	95.5	35.8	5.8	12.6	226.0	174.6	123.1	63.4	33.4	40.2
R17	336.6	127.0	102.5	30.5	3.7	11.4	364.2	154.6	130.1	58.1	31.3	39.0
R18	104.8	74.7	54.6	23.5	3.1	7.0	132.4	102.3	82.2	51.1	30.7	34.6
R19	141.3	60.9	44.2	24.7	3.9	6.9	168.9	88.5	71.8	52.3	31.5	34.5
R20	87.5	46.2	40.5	16.8	3.4	5.1	115.1	73.8	68.1	44.4	31.0	32.7
R21	27.8	18.0	15.6	6.4	1.2	1.9	55.4	45.6	43.2	34.0	28.8	29.5
R22	66.0	38.7	26.3	14.1	3.3	4.4	93.6	66.3	53.9	41.7	30.9	32.0

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	81.5	51.4	40.3	16.2	4.6	5.9	109.1	79.0	67.9	43.8	32.2	33.5
R24	62.4	43.5	35.3	12.3	3.6	4.3	90.0	71.1	62.9	39.9	31.2	31.9
R25	51.7	34.5	31.5	16.1	3.5	4.5	79.3	62.1	59.1	43.7	31.1	32.1
R26	160.1	92.0	62.4	22.3	3.3	7.7	187.7	119.6	90.0	49.9	30.9	35.3
R27	110.3	45.4	31.2	9.1	0.5	3.5	137.9	73.0	58.8	36.7	28.1	31.1
R28	110.3	45.4	31.2	9.1	0.5	3.5	137.9	73.0	58.8	36.7	28.1	31.1
R29	315.1	258.6	212.2	125.3	57.9	45.8	342.7	286.2	239.8	152.9	85.5	73.4
R30	467.1	125.3	100.9	41.9	11.9	14.9	494.7	152.9	128.5	69.5	39.5	42.5
R31	70.2	39.7	26.3	14.3	3.6	4.5	97.8	67.3	53.9	41.9	31.2	32.1
R32	73.4	49.0	37.8	15.9	3.4	5.0	101.0	76.6	65.4	43.5	31.0	32.6
R33	283.2	134.1	89.5	25.0	2.3	9.7	310.8	161.7	117.1	52.6	29.9	37.3
R34	195.6	143.3	93.8	35.0	5.7	12.2	223.2	170.9	121.4	62.6	33.3	39.8
R35	663.4	172.6	136.2	52.8	14.7	20.2	691.0	200.2	163.8	80.4	42.3	47.8
R36	143.4	93.6	78.4	37.3	8.3	11.1	171.0	121.2	106.0	64.9	35.9	38.7
R37	150.7	89.3	81.7	42.8	10.6	12.6	178.3	116.9	109.3	70.4	38.2	40.2
R38	99.1	67.2	53.8	24.0	6.1	7.6	126.7	94.8	81.4	51.6	33.7	35.2
R39	223.8	170.2	142.8	78.7	32.9	28.3	251.4	197.8	170.4	106.3	60.5	55.9
R40	226.1	165.3	139.8	69.5	28.8	25.4	253.7	192.9	167.4	97.1	56.4	53.0
R41	238.5	192.6	147.1	88.7	38.2	31.2	266.1	220.2	174.7	116.3	65.8	58.8
R42	227.6	183.1	167.0	80.6	33.9	29.7	255.2	210.7	194.6	108.2	61.5	57.3
R43	189.3	135.8	106.8	48.9	18.7	18.2	216.9	163.4	134.4	76.5	46.3	45.8
R44	1,137.7	336.6	237.1	106.5	27.5	37.8	1,165.3	364.2	264.7	134.1	55.1	65.4
R45	238.1	149.5	133.1	56.6	14.6	19.3	265.7	177.1	160.7	84.2	42.2	46.9
R46	213.4	172.5	130.0	58.3	15.9	18.6	241.0	200.1	157.6	85.9	43.5	46.2

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	215.3	143.3	105.6	39.5	6.3	13.0	242.9	170.9	133.2	67.1	33.9	40.6
R48	107.4	77.0	54.2	25.3	3.2	7.3	135.0	104.6	81.8	52.9	30.8	34.9
R49	143.6	61.3	45.4	25.0	4.0	7.0	171.2	88.9	73.0	52.6	31.6	34.6
R50	84.9	55.0	37.9	18.5	1.8	5.3	112.5	82.6	65.5	46.1	29.4	32.9
R51	132.7	53.0	37.5	16.7	4.3	5.8	160.3	80.6	65.1	44.3	31.9	33.4
R52	116.7	60.0	45.3	22.5	4.5	6.7	144.3	87.6	72.9	50.1	32.1	34.3
R53	100.3	48.8	32.7	17.4	3.3	5.0	127.9	76.4	60.3	45.0	30.9	32.6
R54	88.7	44.2	31.0	17.8	2.9	4.6	116.3	71.8	58.6	45.4	30.5	32.2
R55	83.0	34.8	29.2	14.4	2.5	4.3	110.6	62.4	56.8	42.0	30.1	31.9
R56	120.6	60.1	51.0	24.1	4.4	6.9	148.2	87.7	78.6	51.7	32.0	34.5
R57	114.7	53.6	40.3	20.0	3.6	5.8	142.3	81.2	67.9	47.6	31.2	33.4
R58	147.5	36.6	31.9	14.5	3.3	4.9	175.1	64.2	59.5	42.1	30.9	32.5
R59	66.7	18.5	14.5	7.4	1.6	2.5	94.3	46.1	42.1	35.0	29.2	30.1
R60	56.6	14.1	11.8	5.4	1.2	1.9	84.2	41.7	39.4	33.0	28.8	29.5
R61	65.7	24.2	17.8	8.2	1.8	2.9	93.3	51.8	45.4	35.8	29.4	30.5
R62	52.6	22.4	18.7	8.5	1.7	2.7	80.2	50.0	46.3	36.1	29.3	30.3
R63	79.4	45.4	31.3	12.9	2.6	4.5	107.0	73.0	58.9	40.5	30.2	32.1
R64	96.9	39.7	31.8	16.0	1.9	4.4	124.5	67.3	59.4	43.6	29.5	32.0
R65	85.8	37.8	34.9	15.3	1.9	4.4	113.4	65.4	62.5	42.9	29.5	32.0
R66	65.2	39.1	36.1	15.0	2.0	4.3	92.8	66.7	63.7	42.6	29.6	31.9
R67	43.0	15.1	13.2	5.4	1.1	1.8	70.6	42.7	40.8	33.0	28.7	29.4
R68	39.2	18.9	16.0	7.4	1.3	2.2	66.8	46.5	43.6	35.0	28.9	29.8
R69	73.1	37.5	28.4	13.4	1.7	3.9	100.7	65.1	56.0	41.0	29.3	31.5
R70	59.5	42.1	35.0	15.4	4.3	5.0	87.1	69.7	62.6	43.0	31.9	32.6

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	42.9	20.7	16.7	7.0	1.3	2.3	70.5	48.3	44.3	34.6	28.9	29.9
R72	71.0	34.9	25.9	12.5	1.6	3.6	98.6	62.5	53.5	40.1	29.2	31.2
R73	49.8	38.8	26.2	12.2	2.1	3.8	77.4	66.4	53.8	39.8	29.7	31.4
R74	45.1	16.9	13.6	7.7	1.2	2.0	72.7	44.5	41.2	35.3	28.8	29.6
R75	144.6	83.7	53.0	19.0	2.6	6.5	172.2	111.3	80.6	46.6	30.2	34.1
R76	105.7	60.1	44.2	17.9	1.8	5.5	133.3	87.7	71.8	45.5	29.4	33.1
R77	96.6	57.1	40.0	16.9	1.6	5.1	124.2	84.7	67.6	44.5	29.2	32.7
R78	80.7	47.1	39.8	14.7	1.3	4.5	108.3	74.7	67.4	42.3	28.9	32.1
R79	57.3	27.0	17.3	5.9	0.9	2.1	84.9	54.6	44.9	33.5	28.5	29.7
R80	65.2	27.6	22.4	6.5	1.0	2.4	92.8	55.2	50.0	34.1	28.6	30.0
R81	57.1	25.5	17.4	5.5	0.8	2.0	84.7	53.1	45.0	33.1	28.4	29.6
R82	44.6	25.3	19.5	6.0	0.9	2.1	72.2	52.9	47.1	33.6	28.5	29.7
R83	37.8	23.9	18.9	5.9	0.9	2.0	65.4	51.5	46.5	33.5	28.5	29.6

Appendix Table 10: S2 Only 2030 – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	163.2	118.5	104.9	58.7	28.4	22.7	177.0	132.3	118.7	72.5	42.2	36.5
R2	141.0	102.8	91.5	52.3	23.1	19.3	154.8	116.6	105.3	66.1	36.9	33.1
R3	105.2	85.9	69.1	37.8	15.5	13.1	119.0	99.7	82.9	51.6	29.3	26.9
R4	93.3	76.7	55.0	27.9	11.5	10.1	107.1	90.5	68.8	41.7	25.3	23.9
R5	90.8	74.5	52.1	26.6	10.7	9.5	104.6	88.3	65.9	40.4	24.5	23.3
R6	88.0	70.1	48.3	24.7	9.8	8.6	101.8	83.9	62.1	38.5	23.6	22.4
R7	55.2	40.0	30.9	13.1	4.6	4.5	69.0	53.8	44.7	26.9	18.4	18.3
R8	63.0	40.7	34.2	19.7	4.9	5.6	76.8	54.5	48.0	33.5	18.7	19.4
R9	52.8	37.0	30.9	16.0	4.7	5.0	66.6	50.8	44.7	29.8	18.5	18.8
R10	73.7	60.6	45.9	23.2	8.8	8.0	87.5	74.4	59.7	37.0	22.6	21.8
R11	83.0	63.9	44.3	24.5	8.6	8.3	96.8	77.7	58.1	38.3	22.4	22.1
R12	150.5	48.8	36.7	17.1	5.1	5.9	164.3	62.6	50.5	30.9	18.9	19.7
R13	225.0	65.7	46.5	21.8	6.0	7.7	238.8	79.5	60.3	35.6	19.8	21.5
R14	373.3	115.5	84.7	35.8	10.3	13.4	387.1	129.3	98.5	49.6	24.1	27.2
R15	76.1	53.4	40.7	14.5	2.6	4.9	89.9	67.2	54.5	28.3	16.4	18.7
R16	74.8	55.0	36.1	14.1	2.4	4.8	88.6	68.8	49.9	27.9	16.2	18.6
R17	129.1	48.9	40.4	12.5	1.7	4.5	142.9	62.7	54.2	26.3	15.5	18.3
R18	35.4	30.2	23.6	9.5	1.4	2.8	49.2	44.0	37.4	23.3	15.2	16.6
R19	44.1	25.2	19.8	9.6	1.6	2.8	57.9	39.0	33.6	23.4	15.4	16.6
R20	29.9	21.0	15.6	6.4	1.5	2.1	43.7	34.8	29.4	20.2	15.3	15.9
R21	12.2	7.4	5.8	2.7	0.6	0.8	26.0	21.2	19.6	16.5	14.4	14.6
R22	28.8	19.1	12.5	5.6	1.6	2.0	42.6	32.9	26.3	19.4	15.4	15.8

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	35.5	24.2	21.5	8.5	2.4	2.8	49.3	38.0	35.3	22.3	16.2	16.6
R24	27.7	18.2	16.8	6.0	1.8	2.1	41.5	32.0	30.6	19.8	15.6	15.9
R25	33.3	16.8	15.7	7.0	1.9	2.2	47.1	30.6	29.5	20.8	15.7	16.0
R26	56.4	36.3	23.5	8.8	1.5	3.0	70.2	50.1	37.3	22.6	15.3	16.8
R27	38.6	17.4	12.2	4.0	0.3	1.4	52.4	31.2	26.0	17.8	14.1	15.2
R28	38.6	17.4	12.2	4.0	0.3	1.4	52.4	31.2	26.0	17.8	14.1	15.2
R29	181.4	130.2	113.3	66.2	32.3	25.5	195.2	144.0	127.1	80.0	46.1	39.3
R30	163.5	44.4	37.8	16.4	4.9	5.7	177.3	58.2	51.6	30.2	18.7	19.5
R31	29.4	16.8	13.0	6.0	1.6	2.0	43.2	30.6	26.8	19.8	15.4	15.8
R32	27.9	19.1	16.1	6.8	1.5	2.0	41.7	32.9	29.9	20.6	15.3	15.8
R33	110.3	49.3	38.8	11.5	1.0	3.8	124.1	63.1	52.6	25.3	14.8	17.6
R34	71.2	53.8	35.4	13.5	2.4	4.6	85.0	67.6	49.2	27.3	16.2	18.4
R35	220.9	64.4	46.0	21.4	5.8	7.5	234.7	78.2	59.8	35.2	19.6	21.3
R36	52.9	37.1	31.0	16.0	4.8	5.0	66.7	50.9	44.8	29.8	18.6	18.8
R37	63.0	40.7	34.3	19.7	4.9	5.6	76.8	54.5	48.1	33.5	18.7	19.4
R38	48.0	31.8	27.2	11.9	3.5	3.8	61.8	45.6	41.0	25.7	17.3	17.6
R39	119.6	87.6	79.4	41.4	18.5	15.6	133.4	101.4	93.2	55.2	32.3	29.4
R40	112.8	90.6	72.7	39.0	16.7	14.0	126.6	104.4	86.5	52.8	30.5	27.8
R41	128.2	93.2	85.6	46.4	20.3	17.3	142.0	107.0	99.4	60.2	34.1	31.1
R42	124.1	91.7	85.3	42.9	19.0	16.2	137.9	105.5	99.1	56.7	32.8	30.0
R43	88.3	71.2	52.9	27.1	10.7	9.6	102.1	85.0	66.7	40.9	24.5	23.4
R44	365.4	114.6	85.5	35.4	10.1	13.3	379.2	128.4	99.3	49.2	23.9	27.1
R45	82.3	64.1	43.9	24.3	8.7	8.2	96.1	77.9	57.7	38.1	22.5	22.0
R46	73.7	60.6	46.0	23.2	8.8	8.0	87.5	74.4	59.8	37.0	22.6	21.8

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	76.1	53.5	40.8	14.6	2.6	4.9	89.9	67.3	54.6	28.4	16.4	18.7
R48	36.6	30.5	24.1	9.8	1.5	3.0	50.4	44.3	37.9	23.6	15.3	16.8
R49	44.7	25.1	20.4	10.1	1.6	2.9	58.5	38.9	34.2	23.9	15.4	16.7
R50	31.6	22.7	18.9	7.4	0.7	2.2	45.4	36.5	32.7	21.2	14.5	16.0
R51	52.7	19.1	15.1	7.3	2.1	2.4	66.5	32.9	28.9	21.1	15.9	16.2
R52	49.4	22.4	18.2	8.7	2.4	2.8	63.2	36.2	32.0	22.5	16.2	16.6
R53	36.1	17.6	13.8	7.5	1.5	2.2	49.9	31.4	27.6	21.3	15.3	16.0
R54	35.2	15.8	13.7	7.0	1.4	2.1	49.0	29.6	27.5	20.8	15.2	15.9
R55	34.8	16.9	12.6	6.7	1.3	1.9	48.6	30.7	26.4	20.5	15.1	15.7
R56	41.8	25.3	21.6	10.4	2.3	3.1	55.6	39.1	35.4	24.2	16.1	16.9
R57	38.2	20.1	18.7	8.4	1.9	2.6	52.0	33.9	32.5	22.2	15.7	16.4
R58	54.9	14.5	12.4	6.1	1.5	2.0	68.7	28.3	26.2	19.9	15.3	15.8
R59	25.6	7.6	6.1	3.2	0.7	1.0	39.4	21.4	19.9	17.0	14.5	14.8
R60	20.6	5.7	4.9	2.5	0.5	0.8	34.4	19.5	18.7	16.3	14.3	14.6
R61	26.7	9.6	7.8	3.6	1.1	1.2	40.5	23.4	21.6	17.4	14.9	15.0
R62	23.2	8.9	7.9	3.5	0.9	1.2	37.0	22.7	21.7	17.3	14.7	15.0
R63	34.3	17.7	15.0	5.8	1.4	2.0	48.1	31.5	28.8	19.6	15.2	15.8
R64	34.0	16.7	14.2	7.2	1.0	1.9	47.8	30.5	28.0	21.0	14.8	15.7
R65	33.2	16.6	14.1	7.1	0.9	2.0	47.0	30.4	27.9	20.9	14.7	15.8
R66	29.8	16.2	12.8	7.0	0.9	1.9	43.6	30.0	26.6	20.8	14.7	15.7
R67	18.2	6.5	5.0	2.5	0.6	0.8	32.0	20.3	18.8	16.3	14.4	14.6
R68	18.4	7.6	6.6	3.1	0.6	1.0	32.2	21.4	20.4	16.9	14.4	14.8
R69	29.8	13.9	12.9	6.2	0.8	1.7	43.6	27.7	26.7	20.0	14.6	15.5
R70	28.8	19.3	15.0	7.3	2.1	2.4	42.6	33.1	28.8	21.1	15.9	16.2

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	18.4	10.1	8.2	3.2	0.7	1.1	32.2	23.9	22.0	17.0	14.5	14.9
R72	29.0	13.0	12.4	5.7	0.7	1.6	42.8	26.8	26.2	19.5	14.5	15.4
R73	23.2	16.3	12.8	5.9	0.9	1.7	37.0	30.1	26.6	19.7	14.7	15.5
R74	19.5	7.3	6.0	3.5	0.6	0.9	33.3	21.1	19.8	17.3	14.4	14.7
R75	51.2	32.8	20.6	7.0	1.2	2.6	65.0	46.6	34.4	20.8	15.0	16.4
R76	42.0	24.2	17.8	6.7	0.8	2.2	55.8	38.0	31.6	20.5	14.6	16.0
R77	38.5	22.0	16.7	6.3	0.7	2.1	52.3	35.8	30.5	20.1	14.5	15.9
R78	31.6	20.5	14.9	5.9	0.6	1.8	45.4	34.3	28.7	19.7	14.4	15.6
R79	20.1	10.0	6.9	2.4	0.4	0.9	33.9	23.8	20.7	16.2	14.2	14.7
R80	23.5	11.7	8.7	2.8	0.4	1.0	37.3	25.5	22.5	16.6	14.2	14.8
R81	20.1	9.3	6.9	2.4	0.4	0.8	33.9	23.1	20.7	16.2	14.2	14.6
R82	15.0	10.0	8.7	2.8	0.5	0.9	28.8	23.8	22.5	16.6	14.3	14.7
R83	14.2	9.7	7.7	2.7	0.4	0.8	28.0	23.5	21.5	16.5	14.2	14.6

Appendix Table 11: S2 then S8 2028 – Predicted TSP concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	1,463.4	809.4	679.8	359.3	185.4	141.6	1,491.0	837.0	707.4	386.9	213.0	169.2
R2	1,101.9	736.9	625.7	369.4	144.7	124.3	1,129.5	764.5	653.3	397.0	172.3	151.9
R3	427.4	393.7	314.2	176.2	74.9	61.9	455.0	421.3	341.8	203.8	102.5	89.5
R4	345.2	273.7	246.0	117.6	51.3	42.8	372.8	301.3	273.6	145.2	78.9	70.4
R5	334.9	256.7	233.1	109.9	46.1	39.9	362.5	284.3	260.7	137.5	73.7	67.5
R6	324.0	220.0	203.9	99.6	41.0	35.7	351.6	247.6	231.5	127.2	68.6	63.3
R7	184.1	122.5	104.5	51.6	19.6	17.8	211.7	150.1	132.1	79.2	47.2	45.4
R8	231.4	165.2	119.2	73.0	29.9	26.3	259.0	192.8	146.8	100.6	57.5	53.9
R9	206.7	157.6	119.1	70.7	28.4	24.6	234.3	185.2	146.7	98.3	56.0	52.2
R10	444.2	211.1	174.8	106.0	53.6	42.5	471.8	238.7	202.4	133.6	81.2	70.1
R11	502.9	225.4	205.6	125.5	61.7	50.4	530.5	253.0	233.2	153.1	89.3	78.0
R12	1,375.9	687.0	597.1	356.6	201.7	182.0	1,403.5	714.6	624.7	384.2	229.3	209.6
R13	556.7	186.2	160.5	83.6	27.7	28.7	584.3	213.8	188.1	111.2	55.3	56.3
R14	478.1	173.7	157.3	91.9	38.8	34.0	505.7	201.3	184.9	119.5	66.4	61.6
R15	241.6	103.5	87.5	36.6	10.0	12.1	269.2	131.1	115.1	64.2	37.6	39.7
R16	220.7	105.9	82.4	35.0	8.6	11.6	248.3	133.5	110.0	62.6	36.2	39.2
R17	140.3	80.6	69.9	26.5	6.1	8.9	167.9	108.2	97.5	54.1	33.7	36.5
R18	144.2	68.4	56.8	21.0	3.7	7.2	171.8	96.0	84.4	48.6	31.3	34.8
R19	110.7	61.2	45.7	25.0	3.6	6.7	138.3	88.8	73.3	52.6	31.2	34.3
R20	124.6	48.7	35.0	19.8	3.2	5.3	152.2	76.3	62.6	47.4	30.8	32.9
R21	35.5	26.5	17.5	7.5	1.3	2.3	63.1	54.1	45.1	35.1	28.9	29.9
R22	95.7	56.4	37.4	18.5	4.4	5.8	123.3	84.0	65.0	46.1	32.0	33.4

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	108.1	74.3	71.1	31.9	10.6	10.7	135.7	101.9	98.7	59.5	38.2	38.3
R24	91.0	64.2	52.4	23.6	6.4	7.7	118.6	91.8	80.0	51.2	34.0	35.3
R25	89.3	59.2	53.5	27.6	9.3	8.4	116.9	86.8	81.1	55.2	36.9	36.0
R26	139.8	73.8	58.0	27.3	5.0	8.0	167.4	101.4	85.6	54.9	32.6	35.6
R27	109.4	43.2	37.4	10.5	1.6	3.8	137.0	70.8	65.0	38.1	29.2	31.4
R28	109.4	43.2	37.4	10.5	1.6	3.8	137.0	70.8	65.0	38.1	29.2	31.4
R29	1,712.3	979.9	879.9	494.6	223.4	181.0	1,739.9	1,007.5	907.5	522.2	251.0	208.6
R30	412.1	200.6	174.1	107.1	47.2	37.8	439.7	228.2	201.7	134.7	74.8	65.4
R31	94.6	53.0	38.1	18.7	4.4	5.9	122.2	80.6	65.7	46.3	32.0	33.5
R32	107.9	49.5	37.4	19.4	3.3	5.2	135.5	77.1	65.0	47.0	30.9	32.8
R33	145.4	71.5	63.5	23.1	5.0	7.8	173.0	99.1	91.1	50.7	32.6	35.4
R34	218.5	102.3	82.2	33.6	8.6	11.4	246.1	129.9	109.8	61.2	36.2	39.0
R35	555.1	186.8	155.5	83.2	28.0	28.5	582.7	214.4	183.1	110.8	55.6	56.1
R36	206.9	158.3	119.4	70.9	28.5	24.7	234.5	185.9	147.0	98.5	56.1	52.3
R37	231.8	165.3	119.3	72.9	30.1	26.3	259.4	192.9	146.9	100.5	57.7	53.9
R38	156.4	106.8	94.7	44.5	17.2	15.4	184.0	134.4	122.3	72.1	44.8	43.0
R39	867.6	453.5	415.4	233.8	98.1	79.7	895.2	481.1	443.0	261.4	125.7	107.3
R40	475.0	398.6	353.0	192.2	84.2	67.1	502.6	426.2	380.6	219.8	111.8	94.7
R41	882.2	597.1	509.0	298.3	121.6	100.6	909.8	624.7	536.6	325.9	149.2	128.2
R42	998.5	416.6	385.6	219.8	97.2	78.5	1,026.1	444.2	413.2	247.4	124.8	106.1
R43	318.2	265.2	231.5	112.0	48.3	40.5	345.8	292.8	259.1	139.6	75.9	68.1
R44	474.9	172.8	157.3	91.1	38.3	33.6	502.5	200.4	184.9	118.7	65.9	61.2
R45	481.7	217.0	201.3	121.5	59.9	48.9	509.3	244.6	228.9	149.1	87.5	76.5
R46	443.7	211.0	174.7	105.9	53.5	42.4	471.3	238.6	202.3	133.5	81.1	70.0

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	241.6	103.9	88.2	36.5	10.0	12.1	269.2	131.5	115.8	64.1	37.6	39.7
R48	144.1	70.3	57.2	22.5	4.1	7.4	171.7	97.9	84.8	50.1	31.7	35.0
R49	109.7	61.1	45.4	25.3	3.7	6.8	137.3	88.7	73.0	52.9	31.3	34.4
R50	124.4	57.5	50.7	18.3	2.5	5.9	152.0	85.1	78.3	45.9	30.1	33.5
R51	208.3	98.9	80.6	38.4	8.8	12.2	235.9	126.5	108.2	66.0	36.4	39.8
R52	236.6	151.0	108.4	51.1	11.8	16.5	264.2	178.6	136.0	78.7	39.4	44.1
R53	140.7	105.5	74.5	37.1	9.0	11.7	168.3	133.1	102.1	64.7	36.6	39.3
R54	131.5	86.4	68.5	32.6	7.8	10.8	159.1	114.0	96.1	60.2	35.4	38.4
R55	126.7	86.1	62.3	30.0	7.6	9.8	154.3	113.7	89.9	57.6	35.2	37.4
R56	173.6	105.6	73.5	41.0	14.5	13.9	201.2	133.2	101.1	68.6	42.1	41.5
R57	160.2	83.7	65.8	33.4	11.7	11.4	187.8	111.3	93.4	61.0	39.3	39.0
R58	161.4	62.9	51.3	30.9	4.2	8.6	189.0	90.5	78.9	58.5	31.8	36.2
R59	83.4	32.7	29.2	12.1	1.7	3.9	111.0	60.3	56.8	39.7	29.3	31.5
R60	60.3	29.7	24.7	9.4	1.3	3.0	87.9	57.3	52.3	37.0	28.9	30.6
R61	134.5	38.5	36.5	15.2	3.4	5.2	162.1	66.1	64.1	42.8	31.0	32.8
R62	131.7	42.8	40.3	16.1	3.5	5.1	159.3	70.4	67.9	43.7	31.1	32.7
R63	139.6	77.3	57.1	25.8	7.9	9.2	167.2	104.9	84.7	53.4	35.5	36.8
R64	123.4	61.0	50.5	25.3	7.1	8.1	151.0	88.6	78.1	52.9	34.7	35.7
R65	113.7	61.2	48.6	26.5	7.1	8.0	141.3	88.8	76.2	54.1	34.7	35.6
R66	93.5	55.4	44.9	25.4	6.9	7.5	121.1	83.0	72.5	53.0	34.5	35.1
R67	100.5	27.2	22.8	10.3	1.8	3.2	128.1	54.8	50.4	37.9	29.4	30.8
R68	104.4	41.4	32.1	12.5	2.4	4.2	132.0	69.0	59.7	40.1	30.0	31.8
R69	91.8	48.8	42.4	22.7	5.9	6.8	119.4	76.4	70.0	50.3	33.5	34.4
R70	93.5	65.5	57.9	28.9	9.3	9.2	121.1	93.1	85.5	56.5	36.9	36.8

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	70.9	39.6	29.2	15.4	3.1	4.5	98.5	67.2	56.8	43.0	30.7	32.1
R72	85.2	49.0	40.7	22.0	5.0	6.4	112.8	76.6	68.3	49.6	32.6	34.0
R73	71.2	52.6	40.3	22.1	6.1	6.6	98.8	80.2	67.9	49.7	33.7	34.2
R74	69.1	33.9	27.7	14.7	2.4	4.2	96.7	61.5	55.3	42.3	30.0	31.8
R75	132.6	71.0	54.3	25.3	3.6	7.1	160.2	98.6	81.9	52.9	31.2	34.7
R76	109.2	62.7	49.2	19.1	3.2	6.2	136.8	90.3	76.8	46.7	30.8	33.8
R77	102.6	59.1	47.8	18.8	2.9	5.9	130.2	86.7	75.4	46.4	30.5	33.5
R78	86.7	55.0	43.7	16.3	2.5	5.3	114.3	82.6	71.3	43.9	30.1	32.9
R79	53.8	27.1	23.3	9.0	1.1	2.6	81.4	54.7	50.9	36.6	28.7	30.2
R80	60.2	31.5	25.0	10.1	1.2	3.0	87.8	59.1	52.6	37.7	28.8	30.6
R81	52.2	26.8	22.1	8.8	1.0	2.6	79.8	54.4	49.7	36.4	28.6	30.2
R82	55.7	34.3	21.8	9.7	1.2	2.9	83.3	61.9	49.4	37.3	28.8	30.5
R83	49.7	29.5	19.5	8.9	1.2	2.6	77.3	57.1	47.1	36.5	28.8	30.2

Appendix Table 12: S2 then S8 2028 – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	533.0	331.1	311.2	173.6	88.6	65.4	546.8	344.9	325.0	187.4	102.4	79.2
R2	403.5	323.0	274.9	158.9	70.4	56.3	417.3	336.8	288.7	172.7	84.2	70.1
R3	213.1	179.8	142.8	78.7	37.8	30.2	226.9	193.6	156.6	92.5	51.6	44.0
R4	167.1	127.4	110.5	53.4	25.7	21.2	180.9	141.2	124.3	67.2	39.5	35.0
R5	161.7	119.4	103.1	49.9	23.8	19.8	175.5	133.2	116.9	63.7	37.6	33.6
R6	154.8	110.6	89.7	44.9	21.8	17.6	168.6	124.4	103.5	58.7	35.6	31.4
R7	84.9	63.7	52.1	23.7	9.8	8.4	98.7	77.5	65.9	37.5	23.6	22.2
R8	92.3	60.5	50.7	28.9	12.4	10.6	106.1	74.3	64.5	42.7	26.2	24.4
R9	91.9	57.8	48.9	27.2	11.3	9.9	105.7	71.6	62.7	41.0	25.1	23.7
R10	145.5	81.3	67.0	39.7	19.5	16.2	159.3	95.1	80.8	53.5	33.3	30.0
R11	161.4	89.0	74.5	45.6	22.1	18.4	175.2	102.8	88.3	59.4	35.9	32.2
R12	430.4	209.5	178.3	107.9	55.2	51.5	444.2	223.3	192.1	121.7	69.0	65.3
R13	186.9	65.2	56.7	29.2	11.0	10.4	200.7	79.0	70.5	43.0	24.8	24.2
R14	166.9	66.7	60.4	32.1	14.3	12.5	180.7	80.5	74.2	45.9	28.1	26.3
R15	85.6	40.7	34.5	15.4	3.9	4.9	99.4	54.5	48.3	29.2	17.7	18.7
R16	78.7	40.3	34.4	15.2	3.4	4.7	92.5	54.1	48.2	29.0	17.2	18.5
R17	74.0	37.3	28.7	12.5	2.5	4.0	87.8	51.1	42.5	26.3	16.3	17.8
R18	48.8	30.5	27.1	10.7	1.4	3.2	62.6	44.3	40.9	24.5	15.2	17.0
R19	46.5	33.3	25.9	9.5	1.5	3.0	60.3	47.1	39.7	23.3	15.3	16.8
R20	56.7	23.0	17.2	7.6	1.3	2.4	70.5	36.8	31.0	21.4	15.1	16.2
R21	20.3	11.0	8.1	3.3	0.6	1.1	34.1	24.8	21.9	17.1	14.4	14.9
R22	47.1	26.6	18.2	9.0	2.1	2.8	60.9	40.4	32.0	22.8	15.9	16.6

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	49.9	38.7	32.7	14.5	5.2	5.0	63.7	52.5	46.5	28.3	19.0	18.8
R24	36.5	32.2	26.3	10.7	3.3	3.5	50.3	46.0	40.1	24.5	17.1	17.3
R25	46.2	30.1	25.6	11.7	3.8	3.9	60.0	43.9	39.4	25.5	17.6	17.7
R26	49.6	28.1	25.0	11.7	2.0	3.2	63.4	41.9	38.8	25.5	15.8	17.0
R27	42.9	21.8	15.4	4.2	0.7	1.7	56.7	35.6	29.2	18.0	14.5	15.5
R28	42.9	21.8	15.4	4.2	0.7	1.7	56.7	35.6	29.2	18.0	14.5	15.5
R29	618.1	400.8	377.0	209.2	107.4	81.4	631.9	414.6	390.8	223.0	121.2	95.2
R30	134.6	66.0	58.2	36.7	13.6	12.5	148.4	79.8	72.0	50.5	27.4	26.3
R31	46.7	25.5	18.9	8.9	2.1	2.8	60.5	39.3	32.7	22.7	15.9	16.6
R32	49.8	23.5	15.4	8.1	1.3	2.3	63.6	37.3	29.2	21.9	15.1	16.1
R33	67.8	33.2	23.7	11.4	2.0	3.5	81.6	47.0	37.5	25.2	15.8	17.3
R34	77.8	38.9	34.1	15.2	3.5	4.6	91.6	52.7	47.9	29.0	17.3	18.4
R35	186.2	65.2	56.9	28.9	10.7	10.3	200.0	79.0	70.7	42.7	24.5	24.1
R36	91.9	58.0	49.0	27.2	11.4	9.9	105.7	71.8	62.8	41.0	25.2	23.7
R37	92.4	60.4	50.7	29.0	12.4	10.6	106.2	74.2	64.5	42.8	26.2	24.4
R38	72.1	49.3	43.2	20.7	7.7	7.1	85.9	63.1	57.0	34.5	21.5	20.9
R39	322.5	210.2	175.1	103.3	47.6	38.1	336.3	224.0	188.9	117.1	61.4	51.9
R40	226.1	194.1	149.5	85.9	40.2	32.7	239.9	207.9	163.3	99.7	54.0	46.5
R41	329.4	254.4	217.0	130.9	57.0	46.6	343.2	268.2	230.8	144.7	70.8	60.4
R42	368.7	206.1	159.9	98.2	49.2	38.2	382.5	219.9	173.7	112.0	63.0	52.0
R43	158.5	123.5	111.3	52.2	24.4	20.1	172.3	137.3	125.1	66.0	38.2	33.9
R44	165.9	66.4	60.5	32.0	14.2	12.3	179.7	80.2	74.3	45.8	28.0	26.1
R45	154.4	85.9	72.6	44.3	21.7	17.9	168.2	99.7	86.4	58.1	35.5	31.7
R46	145.3	81.2	66.9	39.7	19.5	16.1	159.1	95.0	80.7	53.5	33.3	29.9

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	85.7	40.8	34.5	15.5	3.8	4.9	99.5	54.6	48.3	29.3	17.6	18.7
R48	49.0	31.5	27.9	11.0	1.4	3.3	62.8	45.3	41.7	24.8	15.2	17.1
R49	46.1	33.1	26.1	9.7	1.6	3.0	59.9	46.9	39.9	23.5	15.4	16.8
R50	44.1	29.6	21.1	8.6	0.9	2.6	57.9	43.4	34.9	22.4	14.7	16.4
R51	78.0	34.0	29.5	14.6	3.5	4.5	91.8	47.8	43.3	28.4	17.3	18.3
R52	89.8	52.8	37.7	18.4	5.0	6.0	103.6	66.6	51.5	32.2	18.8	19.8
R53	52.4	39.4	29.0	14.9	3.6	4.5	66.2	53.2	42.8	28.7	17.4	18.3
R54	49.7	34.3	29.6	13.6	3.5	4.2	63.5	48.1	43.4	27.4	17.3	18.0
R55	48.6	31.4	25.9	12.1	3.3	3.9	62.4	45.2	39.7	25.9	17.1	17.7
R56	73.2	44.0	31.2	16.4	5.8	5.7	87.0	57.8	45.0	30.2	19.6	19.5
R57	65.5	33.7	25.7	13.2	4.7	4.7	79.3	47.5	39.5	27.0	18.5	18.5
R58	60.3	23.3	20.1	11.7	1.8	3.3	74.1	37.1	33.9	25.5	15.6	17.1
R59	31.6	12.5	10.7	5.3	0.7	1.6	45.4	26.3	24.5	19.1	14.5	15.4
R60	23.3	10.6	9.1	3.7	0.6	1.2	37.1	24.4	22.9	17.5	14.4	15.0
R61	51.5	14.6	13.8	6.4	1.5	2.0	65.3	28.4	27.6	20.2	15.3	15.8
R62	50.9	15.4	14.1	6.2	1.4	2.0	64.7	29.2	27.9	20.0	15.2	15.8
R63	58.2	26.5	23.6	10.0	3.4	3.7	72.0	40.3	37.4	23.8	17.2	17.5
R64	51.2	26.7	19.7	10.6	2.7	3.4	65.0	40.5	33.5	24.4	16.5	17.2
R65	47.8	26.2	21.8	11.1	2.8	3.3	61.6	40.0	35.6	24.9	16.6	17.1
R66	40.0	23.4	19.4	11.0	2.7	3.2	53.8	37.2	33.2	24.8	16.5	17.0
R67	38.5	10.2	8.5	4.3	0.9	1.3	52.3	24.0	22.3	18.1	14.7	15.1
R68	41.4	14.2	11.4	5.5	1.1	1.7	55.2	28.0	25.2	19.3	14.9	15.5
R69	38.6	21.3	18.1	9.6	2.2	2.9	52.4	35.1	31.9	23.4	16.0	16.7
R70	45.0	31.6	27.3	14.6	4.0	4.1	58.8	45.4	41.1	28.4	17.8	17.9

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	31.6	14.1	12.9	6.2	1.3	1.9	45.4	27.9	26.7	20.0	15.1	15.7
R72	35.8	20.5	17.4	9.4	2.2	2.7	49.6	34.3	31.2	23.2	16.0	16.5
R73	32.8	23.3	17.9	9.4	2.3	2.9	46.6	37.1	31.7	23.2	16.1	16.7
R74	30.3	13.8	11.3	6.0	1.1	1.8	44.1	27.6	25.1	19.8	14.9	15.6
R75	46.5	25.5	23.8	10.0	1.6	2.9	60.3	39.3	37.6	23.8	15.4	16.7
R76	39.0	26.4	22.0	8.4	1.3	2.6	52.8	40.2	35.8	22.2	15.1	16.4
R77	38.2	24.8	20.4	7.9	1.2	2.5	52.0	38.6	34.2	21.7	15.0	16.3
R78	32.4	20.8	18.2	6.9	1.1	2.2	46.2	34.6	32.0	20.7	14.9	16.0
R79	18.9	11.2	9.6	3.9	0.6	1.1	32.7	25.0	23.4	17.7	14.4	14.9
R80	21.1	12.5	11.3	4.4	0.6	1.3	34.9	26.3	25.1	18.2	14.4	15.1
R81	18.4	10.7	9.6	3.9	0.5	1.1	32.2	24.5	23.4	17.7	14.3	14.9
R82	20.7	13.9	9.5	4.3	0.6	1.2	34.5	27.7	23.3	18.1	14.4	15.0
R83	18.2	12.6	8.3	3.7	0.6	1.1	32.0	26.4	22.1	17.5	14.4	14.9

Appendix Table 13: S2 then S8 2034 – Predicted TSP concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	423.8	297.0	264.6	138.1	58.3	51.0	451.4	324.6	292.2	165.7	85.9	78.6
R2	332.7	268.2	223.0	121.0	46.8	42.1	360.3	295.8	250.6	148.6	74.4	69.7
R3	228.7	200.2	150.8	75.4	28.8	27.9	256.3	227.8	178.4	103.0	56.4	55.5
R4	212.0	160.6	118.1	62.2	21.9	21.3	239.6	188.2	145.7	89.8	49.5	48.9
R5	206.3	155.4	112.6	59.0	20.6	20.1	233.9	183.0	140.2	86.6	48.2	47.7
R6	199.6	147.5	101.0	52.4	18.8	18.2	227.2	175.1	128.6	80.0	46.4	45.8
R7	128.3	88.5	62.7	27.8	8.8	9.7	155.9	116.1	90.3	55.4	36.4	37.3
R8	158.3	87.2	76.0	44.5	9.1	12.4	185.9	114.8	103.6	72.1	36.7	40.0
R9	141.7	81.5	67.0	43.5	7.7	10.9	169.3	109.1	94.6	71.1	35.3	38.5
R10	209.7	123.0	111.6	57.2	15.0	17.5	237.3	150.6	139.2	84.8	42.6	45.1
R11	194.0	131.5	107.6	56.8	16.9	17.7	221.6	159.1	135.2	84.4	44.5	45.3
R12	313.0	106.8	94.7	38.0	10.0	13.1	340.6	134.4	122.3	65.6	37.6	40.7
R13	275.0	142.0	116.0	50.2	14.3	16.9	302.6	169.6	143.6	77.8	41.9	44.5
R14	271.8	183.0	173.0	73.7	23.4	24.8	299.4	210.6	200.6	101.3	51.0	52.4
R15	191.7	116.2	84.0	32.2	7.6	11.0	219.3	143.8	111.6	59.8	35.2	38.6
R16	190.8	119.5	82.3	34.1	7.0	10.8	218.4	147.1	109.9	61.7	34.6	38.4
R17	249.6	128.3	101.5	26.8	4.0	10.1	277.2	155.9	129.1	54.4	31.6	37.7
R18	108.2	65.2	62.4	20.4	2.8	6.6	135.8	92.8	90.0	48.0	30.4	34.2
R19	100.6	55.6	47.3	21.7	2.9	6.3	128.2	83.2	74.9	49.3	30.5	33.9
R20	70.6	52.5	33.3	14.7	2.5	4.5	98.2	80.1	60.9	42.3	30.1	32.1
R21	29.7	16.3	12.9	6.7	1.2	1.8	57.3	43.9	40.5	34.3	28.8	29.4
R22	82.7	44.9	31.7	14.8	3.3	4.7	110.3	72.5	59.3	42.4	30.9	32.3

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	87.8	51.4	42.0	17.9	5.2	6.3	115.4	79.0	69.6	45.5	32.8	33.9
R24	71.3	43.6	34.7	13.1	3.5	4.6	98.9	71.2	62.3	40.7	31.1	32.2
R25	60.7	35.8	32.8	14.7	3.8	4.7	88.3	63.4	60.4	42.3	31.4	32.3
R26	104.7	61.9	56.0	19.9	4.2	6.4	132.3	89.5	83.6	47.5	31.8	34.0
R27	90.1	46.3	31.0	6.3	0.7	3.4	117.7	73.9	58.6	33.9	28.3	31.0
R28	90.1	46.3	31.0	6.3	0.7	3.4	117.7	73.9	58.6	33.9	28.3	31.0
R29	457.5	324.6	283.3	157.0	69.3	57.1	485.1	352.2	310.9	184.6	96.9	84.7
R30	280.2	96.9	79.5	35.1	10.1	11.9	307.8	124.5	107.1	62.7	37.7	39.5
R31	80.5	40.3	33.8	15.1	3.6	4.8	108.1	67.9	61.4	42.7	31.2	32.4
R32	65.4	49.8	38.5	13.6	2.6	4.4	93.0	77.4	66.1	41.2	30.2	32.0
R33	232.2	121.6	80.1	23.9	2.9	8.6	259.8	149.2	107.7	51.5	30.5	36.2
R34	185.0	114.6	80.1	32.6	7.1	10.5	212.6	142.2	107.7	60.2	34.7	38.1
R35	273.5	139.3	112.6	49.3	13.6	16.5	301.1	166.9	140.2	76.9	41.2	44.1
R36	142.2	81.6	67.4	43.6	7.7	11.0	169.8	109.2	95.0	71.2	35.3	38.6
R37	158.4	87.4	76.0	44.6	9.1	12.4	186.0	115.0	103.6	72.2	36.7	40.0
R38	89.9	66.0	54.5	25.5	7.2	8.2	117.5	93.6	82.1	53.1	34.8	35.8
R39	298.4	233.7	193.9	97.7	36.8	34.3	326.0	261.3	221.5	125.3	64.4	61.9
R40	242.0	213.5	153.0	80.9	30.2	29.3	269.6	241.1	180.6	108.5	57.8	56.9
R41	299.6	247.6	205.8	106.3	41.7	37.6	327.2	275.2	233.4	133.9	69.3	65.2
R42	330.6	233.4	204.5	101.3	41.1	36.3	358.2	261.0	232.1	128.9	68.7	63.9
R43	200.0	156.8	116.0	58.3	21.1	20.6	227.6	184.4	143.6	85.9	48.7	48.2
R44	265.5	182.3	171.6	73.0	23.6	24.7	293.1	209.9	199.2	100.6	51.2	52.3
R45	190.0	130.3	106.3	56.5	17.1	17.5	217.6	157.9	133.9	84.1	44.7	45.1
R46	209.7	122.9	111.3	57.1	15.0	17.5	237.3	150.5	138.9	84.7	42.6	45.1

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	192.5	116.9	84.1	32.3	7.6	11.0	220.1	144.5	111.7	59.9	35.2	38.6
R48	108.4	67.0	63.1	21.6	3.2	6.9	136.0	94.6	90.7	49.2	30.8	34.5
R49	100.5	56.3	47.1	22.5	2.9	6.4	128.1	83.9	74.7	50.1	30.5	34.0
R50	87.3	51.7	44.5	16.0	1.6	5.2	114.9	79.3	72.1	43.6	29.2	32.8
R51	126.7	41.8	35.0	17.0	4.3	5.5	154.3	69.4	62.6	44.6	31.9	33.1
R52	115.2	50.9	47.8	20.7	4.8	6.5	142.8	78.5	75.4	48.3	32.4	34.1
R53	111.9	47.8	41.2	17.0	3.1	5.4	139.5	75.4	68.8	44.6	30.7	33.0
R54	108.0	47.0	34.6	14.5	2.8	5.0	135.6	74.6	62.2	42.1	30.4	32.6
R55	98.9	45.8	29.2	14.6	2.5	4.5	126.5	73.4	56.8	42.2	30.1	32.1
R56	97.6	54.6	50.8	24.2	3.9	6.7	125.2	82.2	78.4	51.8	31.5	34.3
R57	84.2	49.1	45.6	18.1	3.2	5.4	111.8	76.7	73.2	45.7	30.8	33.0
R58	122.2	35.2	33.0	14.9	3.0	4.6	149.8	62.8	60.6	42.5	30.6	32.2
R59	56.0	19.8	16.6	7.9	1.4	2.4	83.6	47.4	44.2	35.5	29.0	30.0
R60	40.5	15.6	13.4	6.1	1.2	1.9	68.1	43.2	41.0	33.7	28.8	29.5
R61	52.6	22.3	19.5	8.8	2.0	2.8	80.2	49.9	47.1	36.4	29.6	30.4
R62	44.1	21.7	19.9	8.0	1.8	2.7	71.7	49.3	47.5	35.6	29.4	30.3
R63	69.2	44.6	31.8	13.2	2.6	4.2	96.8	72.2	59.4	40.8	30.2	31.8
R64	64.5	39.9	33.3	15.3	1.9	4.2	92.1	67.5	60.9	42.9	29.5	31.8
R65	61.1	36.6	31.4	17.0	1.8	4.4	88.7	64.2	59.0	44.6	29.4	32.0
R66	64.9	35.9	29.9	16.8	2.0	4.3	92.5	63.5	57.5	44.4	29.6	31.9
R67	32.4	14.2	13.1	5.5	1.1	1.8	60.0	41.8	40.7	33.1	28.7	29.4
R68	32.6	18.8	17.7	7.0	1.4	2.2	60.2	46.4	45.3	34.6	29.0	29.8
R69	53.5	35.5	29.5	15.7	1.7	3.9	81.1	63.1	57.1	43.3	29.3	31.5
R70	74.3	53.5	34.1	16.3	3.7	5.3	101.9	81.1	61.7	43.9	31.3	32.9

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	36.7	22.4	17.1	6.9	1.3	2.2	64.3	50.0	44.7	34.5	28.9	29.8
R72	51.2	33.3	28.2	14.7	1.5	3.6	78.8	60.9	55.8	42.3	29.1	31.2
R73	64.7	32.5	27.6	14.0	1.8	4.0	92.3	60.1	55.2	41.6	29.4	31.6
R74	55.0	20.3	14.4	7.1	1.1	2.2	82.6	47.9	42.0	34.7	28.7	29.8
R75	109.3	60.2	52.6	16.9	3.2	5.6	136.9	87.8	80.2	44.5	30.8	33.2
R76	86.7	63.1	44.0	14.6	2.1	5.0	114.3	90.7	71.6	42.2	29.7	32.6
R77	80.5	58.1	41.0	13.6	1.9	4.7	108.1	85.7	68.6	41.2	29.5	32.3
R78	72.5	49.0	36.6	12.2	1.8	4.1	100.1	76.6	64.2	39.8	29.4	31.7
R79	37.4	21.6	16.4	6.0	0.9	2.0	65.0	49.2	44.0	33.6	28.5	29.6
R80	46.7	27.5	18.5	7.1	1.0	2.2	74.3	55.1	46.1	34.7	28.6	29.8
R81	35.7	21.3	15.0	6.0	0.9	1.9	63.3	48.9	42.6	33.6	28.5	29.5
R82	29.5	23.4	21.5	5.4	1.2	2.1	57.1	51.0	49.1	33.0	28.8	29.7
R83	27.2	21.7	18.6	5.6	1.2	2.0	54.8	49.3	46.2	33.2	28.8	29.6

Appendix Table 14: S2 then S8 2034 – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	179.2	133.8	117.3	60.4	28.4	23.4	193.0	147.6	131.1	74.2	42.2	37.2
R2	147.2	113.1	101.3	54.4	23.3	19.7	161.0	126.9	115.1	68.2	37.1	33.5
R3	103.5	93.9	75.6	36.3	14.5	13.4	117.3	107.7	89.4	50.1	28.3	27.2
R4	92.9	77.1	58.4	27.2	11.7	10.4	106.7	90.9	72.2	41.0	25.5	24.2
R5	90.6	72.8	54.9	25.5	11.1	9.8	104.4	86.6	68.7	39.3	24.9	23.6
R6	88.5	69.0	48.6	23.5	9.8	8.9	102.3	82.8	62.4	37.3	23.6	22.7
R7	57.4	41.4	28.2	12.8	4.4	4.6	71.2	55.2	42.0	26.6	18.2	18.4
R8	63.5	38.7	31.5	21.1	4.2	5.6	77.3	52.5	45.3	34.9	18.0	19.4
R9	60.3	38.8	34.1	17.4	3.9	4.9	74.1	52.6	47.9	31.2	17.7	18.7
R10	80.7	56.0	44.0	23.1	8.6	7.8	94.5	69.8	57.8	36.9	22.4	21.6
R11	77.3	54.6	42.4	24.1	8.9	8.0	91.1	68.4	56.2	37.9	22.7	21.8
R12	114.5	38.3	35.5	16.5	4.3	5.3	128.3	52.1	49.3	30.3	18.1	19.1
R13	98.6	51.8	46.0	19.9	5.5	6.5	112.4	65.6	59.8	33.7	19.3	20.3
R14	98.0	72.3	61.9	26.2	9.3	9.2	111.8	86.1	75.7	40.0	23.1	23.0
R15	76.2	43.0	32.9	13.5	3.3	4.3	90.0	56.8	46.7	27.3	17.1	18.1
R16	77.1	44.9	33.6	13.6	3.1	4.2	90.9	58.7	47.4	27.4	16.9	18.0
R17	99.4	49.9	41.6	11.2	1.7	4.1	113.2	63.7	55.4	25.0	15.5	17.9
R18	46.0	27.9	23.7	8.9	1.0	2.7	59.8	41.7	37.5	22.7	14.8	16.5
R19	42.2	25.9	20.8	8.0	1.1	2.6	56.0	39.7	34.6	21.8	14.9	16.4
R20	30.2	21.3	12.9	6.0	1.1	1.9	44.0	35.1	26.7	19.8	14.9	15.7
R21	14.0	7.1	4.9	2.7	0.5	0.8	27.8	20.9	18.7	16.5	14.3	14.6
R22	36.2	18.7	13.6	6.3	1.5	2.0	50.0	32.5	27.4	20.1	15.3	15.8

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	36.5	22.2	20.2	8.6	2.6	2.9	50.3	36.0	34.0	22.4	16.4	16.7
R24	29.9	18.6	15.5	6.0	1.7	2.1	43.7	32.4	29.3	19.8	15.5	15.9
R25	35.4	17.9	15.3	7.0	2.0	2.2	49.2	31.7	29.1	20.8	15.8	16.0
R26	39.9	24.3	22.3	7.8	1.8	2.5	53.7	38.1	36.1	21.6	15.6	16.3
R27	33.4	22.7	11.9	2.8	0.3	1.4	47.2	36.5	25.7	16.6	14.1	15.2
R28	33.4	22.7	11.9	2.8	0.3	1.4	47.2	36.5	25.7	16.6	14.1	15.2
R29	193.3	141.9	126.0	69.9	31.8	26.1	207.1	155.7	139.8	83.7	45.6	39.9
R30	101.6	33.3	30.2	14.0	4.1	4.8	115.4	47.1	44.0	27.8	17.9	18.6
R31	35.6	19.1	13.7	6.4	1.6	2.1	49.4	32.9	27.5	20.2	15.4	15.9
R32	27.8	19.6	14.1	6.0	1.2	1.8	41.6	33.4	27.9	19.8	15.0	15.6
R33	92.3	44.6	35.6	9.6	1.4	3.5	106.1	58.4	49.4	23.4	15.2	17.3
R34	74.3	43.1	32.8	13.3	3.0	4.1	88.1	56.9	46.6	27.1	16.8	17.9
R35	98.0	50.7	44.9	19.4	5.4	6.4	111.8	64.5	58.7	33.2	19.2	20.2
R36	60.5	38.9	34.1	17.4	4.0	5.0	74.3	52.7	47.9	31.2	17.8	18.8
R37	63.6	38.8	31.4	21.1	4.2	5.6	77.4	52.6	45.2	34.9	18.0	19.4
R38	50.0	31.3	24.0	12.1	3.8	3.8	63.8	45.1	37.8	25.9	17.6	17.6
R39	130.4	98.3	89.4	40.9	18.3	16.0	144.2	112.1	103.2	54.7	32.1	29.8
R40	109.9	101.4	78.1	38.7	16.0	14.2	123.7	115.2	91.9	52.5	29.8	28.0
R41	134.4	104.3	94.0	46.6	20.2	17.7	148.2	118.1	107.8	60.4	34.0	31.5
R42	140.9	100.1	94.9	42.7	19.4	16.8	154.7	113.9	108.7	56.5	33.2	30.6
R43	87.5	73.5	57.6	26.1	11.0	10.0	101.3	87.3	71.4	39.9	24.8	23.8
R44	95.9	71.0	61.7	25.9	9.0	9.2	109.7	84.8	75.5	39.7	22.8	23.0
R45	76.5	54.4	42.7	23.9	8.9	7.9	90.3	68.2	56.5	37.7	22.7	21.7
R46	80.7	56.0	44.1	23.2	8.6	7.8	94.5	69.8	57.9	37.0	22.4	21.6

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	76.5	43.2	33.0	13.6	3.3	4.3	90.3	57.0	46.8	27.4	17.1	18.1
R48	46.3	27.9	25.1	9.3	1.1	2.8	60.1	41.7	38.9	23.1	14.9	16.6
R49	42.0	25.9	20.8	8.1	1.2	2.6	55.8	39.7	34.6	21.9	15.0	16.4
R50	33.2	22.6	19.1	6.8	0.6	2.1	47.0	36.4	32.9	20.6	14.4	15.9
R51	50.6	15.8	13.9	7.2	1.9	2.3	64.4	29.6	27.7	21.0	15.7	16.1
R52	49.0	19.5	17.9	8.5	2.5	2.7	62.8	33.3	31.7	22.3	16.3	16.5
R53	40.1	20.1	17.8	7.6	1.6	2.4	53.9	33.9	31.6	21.4	15.4	16.2
R54	42.1	18.8	16.2	6.7	1.5	2.2	55.9	32.6	30.0	20.5	15.3	16.0
R55	40.8	18.8	14.7	6.0	1.3	2.0	54.6	32.6	28.5	19.8	15.1	15.8
R56	42.4	25.8	23.1	10.1	2.3	3.0	56.2	39.6	36.9	23.9	16.1	16.8
R57	35.8	22.5	19.2	7.9	1.7	2.5	49.6	36.3	33.0	21.7	15.5	16.3
R58	45.9	13.5	12.9	6.4	1.3	1.9	59.7	27.3	26.7	20.2	15.1	15.7
R59	22.0	7.9	6.8	3.2	0.6	1.0	35.8	21.7	20.6	17.0	14.4	14.8
R60	16.3	6.3	5.4	2.8	0.5	0.8	30.1	20.1	19.2	16.6	14.3	14.6
R61	22.6	8.3	7.7	3.8	1.0	1.2	36.4	22.1	21.5	17.6	14.8	15.0
R62	20.4	9.0	7.9	3.6	0.9	1.2	34.2	22.8	21.7	17.4	14.7	15.0
R63	30.8	18.7	13.8	6.3	1.3	1.9	44.6	32.5	27.6	20.1	15.1	15.7
R64	27.7	17.2	15.1	6.7	0.8	1.9	41.5	31.0	28.9	20.5	14.6	15.7
R65	25.8	16.7	13.6	7.3	0.8	1.9	39.6	30.5	27.4	21.1	14.6	15.7
R66	27.9	15.1	13.6	7.5	0.9	1.9	41.7	28.9	27.4	21.3	14.7	15.7
R67	15.0	6.2	5.0	2.5	0.6	0.8	28.8	20.0	18.8	16.3	14.4	14.6
R68	16.3	7.6	6.9	3.2	0.7	1.0	30.1	21.4	20.7	17.0	14.5	14.8
R69	24.1	13.8	11.9	6.7	0.7	1.7	37.9	27.6	25.7	20.5	14.5	15.5
R70	35.7	24.7	15.6	7.2	1.8	2.5	49.5	38.5	29.4	21.0	15.6	16.3

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	16.2	11.1	7.2	3.1	0.6	1.0	30.0	24.9	21.0	16.9	14.4	14.8
R72	23.3	13.0	11.6	6.2	0.7	1.6	37.1	26.8	25.4	20.0	14.5	15.4
R73	28.0	14.1	12.0	6.7	0.9	1.8	41.8	27.9	25.8	20.5	14.7	15.6
R74	22.8	8.7	6.7	3.1	0.6	1.0	36.6	22.5	20.5	16.9	14.4	14.8
R75	42.2	22.5	20.2	7.1	1.4	2.3	56.0	36.3	34.0	20.9	15.2	16.1
R76	34.5	23.1	18.0	5.5	0.9	2.1	48.3	36.9	31.8	19.3	14.7	15.9
R77	31.4	21.9	16.4	5.2	0.9	1.9	45.2	35.7	30.2	19.0	14.7	15.7
R78	27.4	18.6	14.3	4.8	0.8	1.7	41.2	32.4	28.1	18.6	14.6	15.5
R79	15.0	8.7	6.7	2.5	0.4	0.8	28.8	22.5	20.5	16.3	14.2	14.6
R80	18.2	10.7	7.9	2.9	0.5	0.9	32.0	24.5	21.7	16.7	14.3	14.7
R81	14.3	8.7	6.4	2.5	0.4	0.8	28.1	22.5	20.2	16.3	14.2	14.6
R82	11.7	9.7	8.5	2.3	0.6	0.9	25.5	23.5	22.3	16.1	14.4	14.7
R83	11.7	8.8	7.1	2.5	0.5	0.8	25.5	22.6	20.9	16.3	14.3	14.6

Appendix Table 15: S8 and S2 2029 – Predicted TSP concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	531.1	374.8	318.8	174.9	92.1	71.8	558.7	402.4	346.4	202.5	119.7	99.4
R2	493.7	332.6	300.5	147.7	80.3	64.3	521.3	360.2	328.1	175.3	107.9	91.9
R3	391.5	262.4	229.4	108.7	55.8	45.3	419.1	290.0	257.0	136.3	83.4	72.9
R4	337.8	228.5	208.9	90.9	45.3	37.1	365.4	256.1	236.5	118.5	72.9	64.7
R5	322.2	222.4	205.1	89.5	42.5	35.4	349.8	250.0	232.7	117.1	70.1	63.0
R6	295.9	231.2	196.2	89.9	38.2	33.3	323.5	258.8	223.8	117.5	65.8	60.9
R7	219.0	121.5	104.9	57.1	21.4	19.0	246.6	149.1	132.5	84.7	49.0	46.6
R8	389.9	202.2	178.9	116.7	45.4	39.8	417.5	229.8	206.5	144.3	73.0	67.4
R9	297.6	170.0	149.5	99.2	41.4	33.5	325.2	197.6	177.1	126.8	69.0	61.1
R10	790.9	367.6	316.7	180.2	82.5	70.0	818.5	395.2	344.3	207.8	110.1	97.6
R11	914.4	440.1	380.5	229.6	105.8	88.1	942.0	467.7	408.1	257.2	133.4	115.7
R12	1,701.8	1,222.5	1,012.4	566.3	278.9	255.1	1,729.4	1,250.1	1,040.0	593.9	306.5	282.7
R13	538.3	283.7	243.0	117.9	42.1	41.0	565.9	311.3	270.6	145.5	69.7	68.6
R14	662.0	338.3	249.0	133.4	58.9	51.0	689.6	365.9	276.6	161.0	86.5	78.6
R15	212.7	130.2	112.5	44.3	12.3	14.3	240.3	157.8	140.1	71.9	39.9	41.9
R16	184.1	122.2	111.5	42.1	11.3	13.6	211.7	149.8	139.1	69.7	38.9	41.2
R17	185.6	111.7	84.3	36.5	8.3	11.2	213.2	139.3	111.9	64.1	35.9	38.8
R18	120.8	74.8	62.8	25.9	4.5	7.9	148.4	102.4	90.4	53.5	32.1	35.5
R19	134.7	64.4	60.8	26.8	4.8	8.0	162.3	92.0	88.4	54.4	32.4	35.6
R20	92.0	59.8	47.6	20.0	3.8	6.1	119.6	87.4	75.2	47.6	31.4	33.7
R21	43.3	26.3	17.0	9.8	1.4	2.7	70.9	53.9	44.6	37.4	29.0	30.3
R22	102.6	57.4	37.3	18.3	4.9	6.0	130.2	85.0	64.9	45.9	32.5	33.6

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	113.8	78.6	70.5	39.4	11.4	11.5	141.4	106.2	98.1	67.0	39.0	39.1
R24	94.3	56.9	52.7	25.8	6.8	8.2	121.9	84.5	80.3	53.4	34.4	35.8
R25	103.1	70.4	60.5	29.2	9.8	9.6	130.7	98.0	88.1	56.8	37.4	37.2
R26	148.0	97.7	85.1	33.0	6.5	10.0	175.6	125.3	112.7	60.6	34.1	37.6
R27	129.3	48.4	43.6	10.2	1.9	4.6	156.9	76.0	71.2	37.8	29.5	32.2
R28	129.3	48.4	43.6	10.2	1.9	4.6	156.9	76.0	71.2	37.8	29.5	32.2
R29	593.6	422.1	348.5	193.4	103.2	81.2	621.2	449.7	376.1	221.0	130.8	108.8
R30	712.1	611.5	488.8	255.2	77.1	79.4	739.7	639.1	516.4	282.8	104.7	107.0
R31	101.9	51.9	37.9	17.5	4.7	6.0	129.5	79.5	65.5	45.1	32.3	33.6
R32	85.6	65.8	48.7	19.7	3.9	6.1	113.2	93.4	76.3	47.3	31.5	33.7
R33	173.5	101.0	76.2	33.7	7.0	9.9	201.1	128.6	103.8	61.3	34.6	37.5
R34	186.5	120.3	110.6	41.8	11.5	13.4	214.1	147.9	138.2	69.4	39.1	41.0
R35	539.8	281.1	248.7	117.2	41.4	40.8	567.4	308.7	276.3	144.8	69.0	68.4
R36	299.8	171.3	150.3	99.7	41.5	33.7	327.4	198.9	177.9	127.3	69.1	61.3
R37	390.7	202.3	179.0	116.9	45.5	39.9	418.3	229.9	206.6	144.5	73.1	67.5
R38	171.4	117.4	102.9	48.6	19.8	17.1	199.0	145.0	130.5	76.2	47.4	44.7
R39	401.7	273.2	250.9	117.1	63.2	50.8	429.3	300.8	278.5	144.7	90.8	78.4
R40	422.6	278.8	247.4	116.4	59.9	48.9	450.2	306.4	275.0	144.0	87.5	76.5
R41	456.5	306.9	281.6	134.9	72.5	57.8	484.1	334.5	309.2	162.5	100.1	85.4
R42	398.8	277.5	250.0	124.4	64.7	51.5	426.4	305.1	277.6	152.0	92.3	79.1
R43	315.8	224.6	192.8	88.6	42.2	34.7	343.4	252.2	220.4	116.2	69.8	62.3
R44	648.0	336.0	245.0	130.1	57.5	50.1	675.6	363.6	272.6	157.7	85.1	77.7
R45	893.7	432.2	371.9	225.6	102.7	85.9	921.3	459.8	399.5	253.2	130.3	113.5
R46	789.7	366.9	316.3	180.0	82.5	69.9	817.3	394.5	343.9	207.6	110.1	97.5

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	212.3	130.2	112.5	44.3	12.3	14.3	239.9	157.8	140.1	71.9	39.9	41.9
R48	124.1	76.8	67.9	27.9	4.6	8.2	151.7	104.4	95.5	55.5	32.2	35.8
R49	135.0	64.9	61.2	27.2	5.0	8.1	162.6	92.5	88.8	54.8	32.6	35.7
R50	115.7	64.2	53.3	23.1	3.0	6.5	143.3	91.8	80.9	50.7	30.6	34.1
R51	305.2	138.5	113.8	57.2	11.6	16.9	332.8	166.1	141.4	84.8	39.2	44.5
R52	328.1	209.6	164.5	71.4	18.2	23.1	355.7	237.2	192.1	99.0	45.8	50.7
R53	187.6	117.9	94.3	52.2	11.9	15.2	215.2	145.5	121.9	79.8	39.5	42.8
R54	147.4	103.9	89.9	45.5	10.9	13.7	175.0	131.5	117.5	73.1	38.5	41.3
R55	135.9	91.5	83.1	40.3	9.4	12.2	163.5	119.1	110.7	67.9	37.0	39.8
R56	147.2	108.8	91.6	51.7	21.0	16.9	174.8	136.4	119.2	79.3	48.6	44.5
R57	141.5	96.5	82.5	48.0	13.3	14.3	169.1	124.1	110.1	75.6	40.9	41.9
R58	218.2	93.2	79.1	44.3	5.4	11.8	245.8	120.8	106.7	71.9	33.0	39.4
R59	118.2	46.2	37.9	20.2	1.7	5.3	145.8	73.8	65.5	47.8	29.3	32.9
R60	96.6	33.6	27.8	13.1	1.5	4.1	124.2	61.2	55.4	40.7	29.1	31.7
R61	142.6	54.8	46.5	21.0	4.2	6.7	170.2	82.4	74.1	48.6	31.8	34.3
R62	128.0	55.4	47.0	20.1	4.2	6.4	155.6	83.0	74.6	47.7	31.8	34.0
R63	129.2	80.4	71.3	37.7	8.4	11.6	156.8	108.0	98.9	65.3	36.0	39.2
R64	114.0	72.6	61.0	36.8	8.2	10.1	141.6	100.2	88.6	64.4	35.8	37.7
R65	104.5	69.7	59.6	30.7	8.8	9.8	132.1	97.3	87.2	58.3	36.4	37.4
R66	87.3	70.1	58.8	30.4	8.8	9.2	114.9	97.7	86.4	58.0	36.4	36.8
R67	93.3	36.4	26.6	12.9	2.1	4.0	120.9	64.0	54.2	40.5	29.7	31.6
R68	92.8	51.7	38.5	17.5	3.0	5.2	120.4	79.3	66.1	45.1	30.6	32.8
R69	90.3	67.1	53.1	26.3	6.9	8.4	117.9	94.7	80.7	53.9	34.5	36.0
R70	112.3	74.1	65.0	31.8	12.3	10.8	139.9	101.7	92.6	59.4	39.9	38.4

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	77.9	40.0	34.8	19.1	3.0	5.2	105.5	67.6	62.4	46.7	30.6	32.8
R72	86.0	65.5	50.0	25.2	6.0	7.8	113.6	93.1	77.6	52.8	33.6	35.4
R73	85.4	68.6	50.6	25.8	7.6	8.2	113.0	96.2	78.2	53.4	35.2	35.8
R74	59.6	41.4	36.4	18.5	2.9	4.9	87.2	69.0	64.0	46.1	30.5	32.5
R75	117.2	91.8	71.2	25.5	5.0	8.5	144.8	119.4	98.8	53.1	32.6	36.1
R76	96.8	78.4	52.6	21.3	3.4	6.7	124.4	106.0	80.2	48.9	31.0	34.3
R77	92.2	76.1	49.4	20.2	2.9	6.4	119.8	103.7	77.0	47.8	30.5	34.0
R78	87.4	69.6	46.9	18.5	2.5	5.9	115.0	97.2	74.5	46.1	30.1	33.5
R79	39.6	31.0	27.2	9.5	1.3	2.9	67.2	58.6	54.8	37.1	28.9	30.5
R80	45.8	35.0	30.0	11.5	1.4	3.2	73.4	62.6	57.6	39.1	29.0	30.8
R81	38.2	29.7	25.7	9.3	1.2	2.8	65.8	57.3	53.3	36.9	28.8	30.4
R82	79.6	39.4	33.6	10.5	1.8	3.7	107.2	67.0	61.2	38.1	29.4	31.3
R83	62.0	35.4	30.5	9.6	1.4	3.2	89.6	63.0	58.1	37.2	29.0	30.8

Appendix Table 16: S8 and S2 2029 – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	228.6	166.4	140.8	83.9	42.7	33.0	242.4	180.2	154.6	97.7	56.5	46.8
R2	209.8	149.1	128.7	69.9	37.8	29.4	223.6	162.9	142.5	83.7	51.6	43.2
R3	164.0	117.7	105.4	49.1	25.4	20.6	177.8	131.5	119.2	62.9	39.2	34.4
R4	136.9	103.3	98.0	42.4	19.8	16.5	150.7	117.1	111.8	56.2	33.6	30.3
R5	129.5	99.9	95.0	40.2	18.7	15.6	143.3	113.7	108.8	54.0	32.5	29.4
R6	117.3	98.8	91.2	37.3	17.6	14.5	131.1	112.6	105.0	51.1	31.4	28.3
R7	88.5	55.2	42.4	21.4	8.7	7.7	102.3	69.0	56.2	35.2	22.5	21.5
R8	124.1	70.2	66.6	38.3	16.6	13.8	137.9	84.0	80.4	52.1	30.4	27.6
R9	95.4	58.6	54.2	32.9	15.1	11.8	109.2	72.4	68.0	46.7	28.9	25.6
R10	240.9	117.8	98.4	61.3	27.9	23.3	254.7	131.6	112.2	75.1	41.7	37.1
R11	277.1	141.7	114.4	71.8	33.3	28.7	290.9	155.5	128.2	85.6	47.1	42.5
R12	487.6	368.9	312.4	169.0	77.3	73.8	501.4	382.7	326.2	182.8	91.1	87.6
R13	166.3	91.2	82.2	39.8	14.9	13.6	180.1	105.0	96.0	53.6	28.7	27.4
R14	204.0	107.3	78.3	43.9	19.5	17.0	217.8	121.1	92.1	57.7	33.3	30.8
R15	67.9	42.3	37.7	15.4	4.4	5.1	81.7	56.1	51.5	29.2	18.2	18.9
R16	59.5	41.4	37.6	14.6	4.0	4.9	73.3	55.2	51.4	28.4	17.8	18.7
R17	80.2	40.5	32.3	13.0	3.2	4.3	94.0	54.3	46.1	26.8	17.0	18.1
R18	40.8	31.1	24.3	10.2	1.9	3.1	54.6	44.9	38.1	24.0	15.7	16.9
R19	52.4	27.2	23.9	9.7	1.6	3.1	66.2	41.0	37.7	23.5	15.4	16.9
R20	38.1	21.2	17.8	7.5	1.5	2.3	51.9	35.0	31.6	21.3	15.3	16.1
R21	18.5	10.3	6.9	3.5	0.6	1.1	32.3	24.1	20.7	17.3	14.4	14.9
R22	42.1	22.6	15.3	7.7	1.9	2.5	55.9	36.4	29.1	21.5	15.7	16.3

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	47.9	31.2	26.9	15.2	4.7	4.6	61.7	45.0	40.7	29.0	18.5	18.4
R24	39.0	23.6	20.8	9.8	3.0	3.3	52.8	37.4	34.6	23.6	16.8	17.1
R25	43.1	27.8	23.0	11.0	3.9	3.8	56.9	41.6	36.8	24.8	17.7	17.6
R26	47.2	31.6	28.6	11.6	2.5	3.6	61.0	45.4	42.4	25.4	16.3	17.4
R27	44.5	20.8	16.1	3.7	0.7	1.7	58.3	34.6	29.9	17.5	14.5	15.5
R28	44.5	20.8	16.1	3.7	0.7	1.7	58.3	34.6	29.9	17.5	14.5	15.5
R29	254.8	186.6	153.0	93.9	47.3	37.4	268.6	200.4	166.8	107.7	61.1	51.2
R30	212.9	187.9	144.0	80.0	24.7	24.5	226.7	201.7	157.8	93.8	38.5	38.3
R31	41.5	23.2	15.6	7.5	2.0	2.5	55.3	37.0	29.4	21.3	15.8	16.3
R32	36.0	23.5	18.6	7.4	1.6	2.3	49.8	37.3	32.4	21.2	15.4	16.1
R33	74.5	36.0	29.1	11.9	2.3	3.8	88.3	49.8	42.9	25.7	16.1	17.6
R34	60.1	41.2	35.7	14.4	3.8	4.8	73.9	55.0	49.5	28.2	17.6	18.6
R35	166.7	91.1	84.2	39.6	14.9	13.6	180.5	104.9	98.0	53.4	28.7	27.4
R36	96.0	58.9	54.6	33.3	15.1	11.9	109.8	72.7	68.4	47.1	28.9	25.7
R37	124.4	70.3	66.7	38.2	16.6	13.8	138.2	84.1	80.5	52.0	30.4	27.6
R38	65.3	48.2	37.4	18.8	8.1	6.7	79.1	62.0	51.2	32.6	21.9	20.5
R39	171.4	121.4	107.8	54.8	29.1	23.2	185.2	135.2	121.6	68.6	42.9	37.0
R40	177.9	126.8	115.6	53.4	27.2	22.4	191.7	140.6	129.4	67.2	41.0	36.2
R41	193.7	137.4	120.5	61.9	33.9	26.5	207.5	151.2	134.3	75.7	47.7	40.3
R42	178.0	121.0	111.0	58.1	29.7	23.6	191.8	134.8	124.8	71.9	43.5	37.4
R43	128.0	98.1	91.6	40.2	18.2	15.4	141.8	111.9	105.4	54.0	32.0	29.2
R44	199.8	105.7	77.8	43.6	19.2	16.7	213.6	119.5	91.6	57.4	33.0	30.5
R45	270.8	139.2	112.1	70.9	32.7	28.0	284.6	153.0	125.9	84.7	46.5	41.8
R46	240.6	117.6	98.3	61.3	27.8	23.3	254.4	131.4	112.1	75.1	41.6	37.1

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	67.8	42.3	37.7	15.4	4.4	5.1	81.6	56.1	51.5	29.2	18.2	18.9
R48	41.7	31.2	25.0	10.4	1.9	3.2	55.5	45.0	38.8	24.2	15.7	17.0
R49	52.5	27.3	24.1	9.8	1.6	3.1	66.3	41.1	37.9	23.6	15.4	16.9
R50	40.2	25.3	19.4	8.6	1.2	2.5	54.0	39.1	33.2	22.4	15.0	16.3
R51	104.2	44.4	37.1	19.4	4.0	5.7	118.0	58.2	50.9	33.2	17.8	19.5
R52	113.6	66.3	52.4	23.2	6.2	7.7	127.4	80.1	66.2	37.0	20.0	21.5
R53	62.2	41.5	33.2	16.4	4.4	5.3	76.0	55.3	47.0	30.2	18.2	19.1
R54	51.9	34.5	28.9	15.7	3.8	4.8	65.7	48.3	42.7	29.5	17.6	18.6
R55	46.4	31.0	27.1	14.2	3.7	4.3	60.2	44.8	40.9	28.0	17.5	18.1
R56	56.4	39.2	33.0	18.3	7.2	6.1	70.2	53.0	46.8	32.1	21.0	19.9
R57	52.1	34.1	30.3	16.5	4.8	5.1	65.9	47.9	44.1	30.3	18.6	18.9
R58	75.1	32.7	27.1	15.3	1.9	4.0	88.9	46.5	40.9	29.1	15.7	17.8
R59	40.6	15.3	12.7	7.0	0.6	1.9	54.4	29.1	26.5	20.8	14.4	15.7
R60	33.1	11.2	9.5	5.1	0.6	1.4	46.9	25.0	23.3	18.9	14.4	15.2
R61	49.8	18.3	16.1	7.1	1.6	2.3	63.6	32.1	29.9	20.9	15.4	16.1
R62	45.4	18.6	16.5	6.8	1.7	2.3	59.2	32.4	30.3	20.6	15.5	16.1
R63	45.8	30.5	25.5	13.1	3.5	4.1	59.6	44.3	39.3	26.9	17.3	17.9
R64	42.8	25.6	23.5	12.9	2.8	3.7	56.6	39.4	37.3	26.7	16.6	17.5
R65	39.8	23.8	22.8	11.7	2.9	3.6	53.6	37.6	36.6	25.5	16.7	17.4
R66	36.5	23.0	21.9	10.7	3.2	3.4	50.3	36.8	35.7	24.5	17.0	17.2
R67	32.9	12.3	9.3	4.6	0.9	1.4	46.7	26.1	23.1	18.4	14.7	15.2
R68	33.6	17.5	13.3	5.7	1.2	1.8	47.4	31.3	27.1	19.5	15.0	15.6
R69	33.7	21.4	20.0	9.8	2.4	3.1	47.5	35.2	33.8	23.6	16.2	16.9
R70	44.1	29.4	23.4	12.4	4.5	4.1	57.9	43.2	37.2	26.2	18.3	17.9

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	24.1	15.3	12.4	6.4	1.3	1.9	37.9	29.1	26.2	20.2	15.1	15.7
R72	31.9	20.6	19.2	9.0	2.1	2.9	45.7	34.4	33.0	22.8	15.9	16.7
R73	36.5	22.7	19.2	9.3	2.8	3.0	50.3	36.5	33.0	23.1	16.6	16.8
R74	23.6	14.3	12.7	6.4	1.3	1.8	37.4	28.1	26.5	20.2	15.1	15.6
R75	37.7	31.5	25.0	10.8	2.0	3.1	51.5	45.3	38.8	24.6	15.8	16.9
R76	31.5	28.0	18.5	8.2	1.2	2.5	45.3	41.8	32.3	22.0	15.0	16.3
R77	30.2	26.3	17.4	8.1	1.2	2.4	44.0	40.1	31.2	21.9	15.0	16.2
R78	29.9	24.3	15.5	7.3	1.1	2.2	43.7	38.1	29.3	21.1	14.9	16.0
R79	14.9	12.4	9.7	3.3	0.6	1.1	28.7	26.2	23.5	17.1	14.4	14.9
R80	15.7	13.6	11.1	4.2	0.6	1.2	29.5	27.4	24.9	18.0	14.4	15.0
R81	13.9	11.9	9.2	3.2	0.5	1.1	27.7	25.7	23.0	17.0	14.3	14.9
R82	26.5	13.9	11.6	4.0	0.7	1.4	40.3	27.7	25.4	17.8	14.5	15.2
R83	21.2	12.0	10.7	3.7	0.6	1.2	35.0	25.8	24.5	17.5	14.4	15.0

Appendix Table 17: S8 and S2 2033 – Predicted TSP concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	415.4	328.4	270.4	137.9	62.0	53.5	443.0	356.0	298.0	165.5	89.6	81.1
R2	388.6	264.9	234.5	126.1	48.7	44.6	416.2	292.5	262.1	153.7	76.3	72.2
R3	311.8	222.9	163.2	82.3	32.1	29.9	339.4	250.5	190.8	109.9	59.7	57.5
R4	270.8	183.6	131.4	61.5	23.8	23.1	298.4	211.2	159.0	89.1	51.4	50.7
R5	261.4	174.9	126.0	58.1	22.1	21.8	289.0	202.5	153.6	85.7	49.7	49.4
R6	247.5	157.8	121.0	54.3	18.7	19.8	275.1	185.4	148.6	81.9	46.3	47.4
R7	150.3	97.7	70.1	31.1	9.8	10.5	177.9	125.3	97.7	58.7	37.4	38.1
R8	165.3	102.8	75.0	47.1	9.8	13.2	192.9	130.4	102.6	74.7	37.4	40.8
R9	145.4	96.3	72.0	39.7	9.4	11.8	173.0	123.9	99.6	67.3	37.0	39.4
R10	225.0	137.1	103.4	55.7	16.3	18.5	252.6	164.7	131.0	83.3	43.9	46.1
R11	219.2	140.4	109.8	56.6	17.2	18.9	246.8	168.0	137.3	84.2	44.8	46.5
R12	329.9	120.3	101.5	46.1	9.6	14.5	357.5	147.9	129.1	73.7	37.2	42.1
R13	365.8	146.6	127.2	60.9	14.1	18.6	393.4	174.2	154.8	88.5	41.7	46.2
R14	402.0	217.8	176.3	85.1	27.1	27.8	429.6	245.4	203.9	112.7	54.7	55.4
R15	189.6	113.8	83.0	38.8	7.8	11.8	217.2	141.4	110.6	66.4	35.4	39.4
R16	192.1	125.9	80.6	34.8	7.0	11.5	219.7	153.5	108.2	62.4	34.6	39.1
R17	213.3	111.8	91.0	33.8	4.0	11.2	240.9	139.4	118.6	61.4	31.6	38.8
R18	123.9	73.5	60.0	27.2	3.8	7.5	151.5	101.1	87.6	54.8	31.4	35.1
R19	112.6	68.5	52.9	24.8	4.2	7.4	140.2	96.1	80.5	52.4	31.8	35.0
R20	77.8	60.3	49.1	17.9	3.5	5.5	105.4	87.9	76.7	45.5	31.1	33.1
R21	35.5	20.7	16.6	7.0	1.3	2.1	63.1	48.3	44.2	34.6	28.9	29.7
R22	78.0	47.8	34.5	15.2	3.2	4.9	105.6	75.4	62.1	42.8	30.8	32.5

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	98.5	53.9	46.7	19.1	5.2	6.5	126.1	81.5	74.3	46.7	32.8	34.1
R24	84.6	48.2	34.0	14.4	3.4	4.8	112.2	75.8	61.6	42.0	31.0	32.4
R25	87.3	46.5	38.4	17.5	4.3	5.4	114.9	74.1	66.0	45.1	31.9	33.0
R26	150.1	72.7	54.0	21.7	4.4	7.0	177.7	100.3	81.6	49.3	32.0	34.6
R27	95.2	42.5	32.9	8.3	0.6	3.3	122.8	70.1	60.5	35.9	28.2	30.9
R28	95.2	42.5	32.9	8.3	0.6	3.3	122.8	70.1	60.5	35.9	28.2	30.9
R29	456.5	348.5	306.6	153.3	68.8	59.7	484.1	376.1	334.2	180.9	96.4	87.3
R30	311.5	100.6	92.5	42.2	9.1	13.2	339.1	128.2	120.1	69.8	36.7	40.8
R31	81.9	53.1	35.4	15.8	3.6	5.0	109.5	80.7	63.0	43.4	31.2	32.6
R32	71.7	56.1	46.6	17.7	3.2	5.3	99.3	83.7	74.2	45.3	30.8	32.9
R33	194.9	103.8	73.2	29.2	3.1	9.5	222.5	131.4	100.8	56.8	30.7	37.1
R34	188.6	120.2	78.0	33.9	7.1	11.2	216.2	147.8	105.6	61.5	34.7	38.8
R35	361.5	145.1	124.8	59.6	13.9	18.2	389.1	172.7	152.4	87.2	41.5	45.8
R36	146.0	96.6	72.1	39.9	9.4	11.8	173.6	124.2	99.7	67.5	37.0	39.4
R37	165.3	102.8	75.1	47.1	9.9	13.2	192.9	130.4	102.7	74.7	37.5	40.8
R38	125.0	78.4	58.8	28.4	7.5	9.1	152.6	106.0	86.4	56.0	35.1	36.7
R39	334.6	229.2	193.8	100.5	42.0	36.5	362.2	256.8	221.4	128.1	69.6	64.1
R40	326.8	239.5	168.0	84.5	33.8	31.5	354.4	267.1	195.6	112.1	61.4	59.1
R41	364.2	247.5	214.8	113.5	45.5	39.9	391.8	275.1	242.4	141.1	73.1	67.5
R42	329.6	238.7	205.2	103.3	43.4	38.5	357.2	266.3	232.8	130.9	71.0	66.1
R43	259.1	177.6	125.3	59.2	23.3	22.1	286.7	205.2	152.9	86.8	50.9	49.7
R44	395.6	213.9	174.3	84.8	27.2	27.6	423.2	241.5	201.9	112.4	54.8	55.2
R45	217.2	139.7	108.2	56.8	17.1	18.6	244.8	167.3	135.8	84.4	44.7	46.2
R46	224.9	136.9	103.4	55.6	16.3	18.5	252.5	164.5	131.0	83.2	43.9	46.1

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	190.0	114.1	83.0	39.1	7.8	11.9	217.6	141.7	110.6	66.7	35.4	39.5
R48	126.1	76.4	61.5	28.9	4.3	7.8	153.7	104.0	89.1	56.5	31.9	35.4
R49	112.2	68.4	54.3	25.0	4.6	7.5	139.8	96.0	81.9	52.6	32.2	35.1
R50	106.2	61.9	49.3	19.4	2.1	5.8	133.8	89.5	76.9	47.0	29.7	33.4
R51	131.9	42.1	41.0	19.9	3.7	5.8	159.5	69.7	68.6	47.5	31.3	33.4
R52	132.6	54.7	47.3	22.2	4.3	6.8	160.2	82.3	74.9	49.8	31.9	34.4
R53	60.4	47.6	40.7	19.4	3.2	5.4	88.0	75.2	68.3	47.0	30.8	33.0
R54	60.4	47.7	36.8	17.1	3.1	5.1	88.0	75.3	64.4	44.7	30.7	32.7
R55	59.3	45.3	32.4	15.2	2.8	4.7	86.9	72.9	60.0	42.8	30.4	32.3
R56	95.0	63.3	51.7	24.1	4.9	7.3	122.6	90.9	79.3	51.7	32.5	34.9
R57	83.8	49.0	41.6	20.0	3.8	6.0	111.4	76.6	69.2	47.6	31.4	33.6
R58	128.4	41.6	35.6	16.1	2.9	4.9	156.0	69.2	63.2	43.7	30.5	32.5
R59	61.8	22.4	20.5	8.3	1.4	2.5	89.4	50.0	48.1	35.9	29.0	30.1
R60	45.0	17.3	14.8	6.4	1.2	2.0	72.6	44.9	42.4	34.0	28.8	29.6
R61	60.8	24.2	20.5	9.5	1.9	3.0	88.4	51.8	48.1	37.1	29.5	30.6
R62	53.9	23.6	21.7	9.7	1.6	2.8	81.5	51.2	49.3	37.3	29.2	30.4
R63	68.2	44.0	34.9	15.2	3.0	4.6	95.8	71.6	62.5	42.8	30.6	32.2
R64	68.4	43.7	29.1	16.1	2.5	4.6	96.0	71.3	56.7	43.7	30.1	32.2
R65	72.5	46.0	30.3	17.1	1.9	4.7	100.1	73.6	57.9	44.7	29.5	32.3
R66	70.1	42.0	29.1	17.6	2.1	4.6	97.7	69.6	56.7	45.2	29.7	32.2
R67	39.4	17.4	14.1	6.6	1.0	1.9	67.0	45.0	41.7	34.2	28.6	29.5
R68	42.1	21.5	19.5	7.6	1.3	2.4	69.7	49.1	47.1	35.2	28.9	30.0
R69	66.5	37.2	26.6	15.2	1.9	4.1	94.1	64.8	54.2	42.8	29.5	31.7
R70	90.1	49.9	37.4	18.5	4.1	5.9	117.7	77.5	65.0	46.1	31.7	33.5

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	34.2	22.2	19.0	8.4	1.3	2.4	61.8	49.8	46.6	36.0	28.9	30.0
R72	65.1	35.2	25.5	14.5	1.9	3.9	92.7	62.8	53.1	42.1	29.5	31.5
R73	63.6	35.3	29.7	15.8	2.0	4.2	91.2	62.9	57.3	43.4	29.6	31.8
R74	31.7	21.9	15.9	7.7	1.3	2.3	59.3	49.5	43.5	35.3	28.9	29.9
R75	162.1	67.4	52.7	18.5	3.3	6.2	189.7	95.0	80.3	46.1	30.9	33.8
R76	89.5	67.0	46.3	16.2	1.9	5.4	117.1	94.6	73.9	43.8	29.5	33.0
R77	90.9	63.2	43.7	15.2	1.8	5.1	118.5	90.8	71.3	42.8	29.4	32.7
R78	72.0	54.2	37.5	12.9	1.8	4.4	99.6	81.8	65.1	40.5	29.4	32.0
R79	54.9	23.7	19.3	6.2	1.1	2.2	82.5	51.3	46.9	33.8	28.7	29.8
R80	67.7	24.4	21.1	6.9	1.1	2.5	95.3	52.0	48.7	34.5	28.7	30.1
R81	52.2	22.5	18.5	6.0	1.0	2.1	79.8	50.1	46.1	33.6	28.6	29.7
R82	37.2	24.9	19.6	6.1	1.1	2.3	64.8	52.5	47.2	33.7	28.7	29.9
R83	43.1	22.1	19.3	6.0	1.2	2.1	70.7	49.7	46.9	33.6	28.8	29.7

Appendix Table 18: S8 and S2 2033 – Predicted PM_{10} concentrations at receptor locations (µg/m³).

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average	Maximum	6th Highest	10th Highest	90th Percentile	70th Percentile	Average
R1	195.6	146.2	117.3	67.9	29.7	25.2	209.4	160.0	131.1	81.7	43.5	39.0
R2	167.3	130.1	101.0	58.9	24.4	21.5	181.1	143.9	114.8	72.7	38.2	35.3
R3	128.6	102.3	70.2	42.0	16.7	14.9	142.4	116.1	84.0	55.8	30.5	28.7
R4	110.6	98.9	59.0	32.0	12.4	11.8	124.4	112.7	72.8	45.8	26.2	25.6
R5	107.1	94.8	55.9	30.0	11.6	11.1	120.9	108.6	69.7	43.8	25.4	24.9
R6	101.7	87.8	54.9	27.6	10.7	10.2	115.5	101.6	68.7	41.4	24.5	24.0
R7	68.0	44.8	33.2	15.9	5.2	5.2	81.8	58.6	47.0	29.7	19.0	19.0
R8	62.3	37.6	34.9	20.2	5.0	5.9	76.1	51.4	48.7	34.0	18.8	19.7
R9	60.0	38.9	35.4	16.5	4.6	5.3	73.8	52.7	49.2	30.3	18.4	19.1
R10	84.9	57.6	45.9	23.6	8.7	8.2	98.7	71.4	59.7	37.4	22.5	22.0
R11	80.7	51.8	45.6	25.1	9.2	8.3	94.5	65.6	59.4	38.9	23.0	22.1
R12	123.5	43.7	37.1	19.2	3.9	5.8	137.3	57.5	50.9	33.0	17.7	19.6
R13	126.3	55.1	46.4	22.5	5.9	7.0	140.1	68.9	60.2	36.3	19.7	20.8
R14	137.9	74.5	61.9	29.9	10.4	10.2	151.7	88.3	75.7	43.7	24.2	24.0
R15	67.1	41.8	31.7	14.1	3.2	4.5	80.9	55.6	45.5	27.9	17.0	18.3
R16	67.6	46.4	33.3	13.3	2.9	4.4	81.4	60.2	47.1	27.1	16.7	18.2
R17	91.1	46.9	36.3	13.4	1.9	4.4	104.9	60.7	50.1	27.2	15.7	18.2
R18	51.5	28.6	24.7	10.5	1.4	3.0	65.3	42.4	38.5	24.3	15.2	16.8
R19	43.8	29.6	25.4	9.2	1.5	2.9	57.6	43.4	39.2	23.0	15.3	16.7
R20	33.4	23.6	18.2	6.8	1.2	2.2	47.2	37.4	32.0	20.6	15.0	16.0
R21	17.3	8.6	7.0	2.9	0.5	0.9	31.1	22.4	20.8	16.7	14.3	14.7
R22	32.0	22.1	14.9	6.7	1.5	2.1	45.8	35.9	28.7	20.5	15.3	15.9

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R23	40.8	25.3	20.4	9.8	2.6	3.1	54.6	39.1	34.2	23.6	16.4	16.9
R24	36.3	20.6	15.4	7.1	1.6	2.3	50.1	34.4	29.2	20.9	15.4	16.1
R25	39.4	22.1	17.8	8.3	2.1	2.6	53.2	35.9	31.6	22.1	15.9	16.4
R26	54.6	28.2	21.3	8.2	1.8	2.8	68.4	42.0	35.1	22.0	15.6	16.6
R27	35.5	18.1	12.4	3.4	0.3	1.4	49.3	31.9	26.2	17.2	14.1	15.2
R28	35.5	18.1	12.4	3.4	0.3	1.4	49.3	31.9	26.2	17.2	14.1	15.2
R29	216.6	154.0	129.3	74.2	32.2	28.0	230.4	167.8	143.1	88.0	46.0	41.8
R30	114.1	36.2	33.7	16.4	3.7	5.2	127.9	50.0	47.5	30.2	17.5	19.0
R31	33.7	20.7	15.5	6.6	1.5	2.2	47.5	34.5	29.3	20.4	15.3	16.0
R32	31.0	22.9	19.1	6.9	1.3	2.1	44.8	36.7	32.9	20.7	15.1	15.9
R33	83.3	40.1	28.6	10.8	1.3	3.8	97.1	53.9	42.4	24.6	15.1	17.6
R34	66.3	45.2	31.9	13.1	2.9	4.3	80.1	59.0	45.7	26.9	16.7	18.1
R35	125.0	54.5	45.6	22.2	5.8	6.9	138.8	68.3	59.4	36.0	19.6	20.7
R36	60.2	39.0	35.5	16.7	4.6	5.4	74.0	52.8	49.3	30.5	18.4	19.2
R37	62.3	37.7	34.9	20.1	5.0	5.9	76.1	51.5	48.7	33.9	18.8	19.7
R38	55.8	36.0	27.5	13.1	3.5	4.3	69.6	49.8	41.3	26.9	17.3	18.1
R39	137.7	110.3	85.4	47.6	20.3	17.6	151.5	124.1	99.2	61.4	34.1	31.4
R40	137.7	111.3	72.4	43.7	18.0	16.0	151.5	125.1	86.2	57.5	31.8	29.8
R41	154.1	119.3	90.5	52.8	21.9	19.4	167.9	133.1	104.3	66.6	35.7	33.2
R42	142.3	115.1	91.5	50.6	21.2	18.4	156.1	128.9	105.3	64.4	35.0	32.2
R43	105.4	90.7	56.2	30.7	12.2	11.1	119.2	104.5	70.0	44.5	26.0	24.9
R44	135.6	73.2	61.4	29.5	10.3	10.1	149.4	87.0	75.2	43.3	24.1	23.9
R45	80.0	51.7	45.4	25.2	9.1	8.2	93.8	65.5	59.2	39.0	22.9	22.0
R46	84.9	57.6	45.8	23.5	8.7	8.2	98.7	71.4	59.6	37.3	22.5	22.0

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R47	67.3	41.9	31.7	14.1	3.2	4.5	81.1	55.7	45.5	27.9	17.0	18.3
R48	51.5	28.6	25.7	10.7	1.6	3.1	65.3	42.4	39.5	24.5	15.4	16.9
R49	43.7	29.3	25.2	9.4	1.5	3.0	57.5	43.1	39.0	23.2	15.3	16.8
R50	37.5	25.0	19.8	7.8	0.8	2.3	51.3	38.8	33.6	21.6	14.6	16.1
R51	53.7	17.3	15.2	7.8	1.7	2.4	67.5	31.1	29.0	21.6	15.5	16.2
R52	56.8	20.4	18.6	9.3	2.1	2.9	70.6	34.2	32.4	23.1	15.9	16.7
R53	27.9	20.0	17.3	8.4	1.7	2.4	41.7	33.8	31.1	22.2	15.5	16.2
R54	24.6	20.1	16.7	7.5	1.6	2.3	38.4	33.9	30.5	21.3	15.4	16.1
R55	24.3	18.9	14.3	7.0	1.4	2.1	38.1	32.7	28.1	20.8	15.2	15.9
R56	40.5	27.4	23.3	10.8	2.6	3.3	54.3	41.2	37.1	24.6	16.4	17.1
R57	35.0	21.7	18.4	8.2	1.9	2.7	48.8	35.5	32.2	22.0	15.7	16.5
R58	48.7	15.7	12.5	6.6	1.3	2.0	62.5	29.5	26.3	20.4	15.1	15.8
R59	24.1	9.3	7.6	3.5	0.6	1.1	37.9	23.1	21.4	17.3	14.4	14.9
R60	17.9	6.9	6.5	2.8	0.5	0.8	31.7	20.7	20.3	16.6	14.3	14.6
R61	25.5	9.4	8.3	3.9	0.9	1.3	39.3	23.2	22.1	17.7	14.7	15.1
R62	23.5	9.5	8.2	3.8	0.8	1.2	37.3	23.3	22.0	17.6	14.6	15.0
R63	28.1	19.5	13.5	6.6	1.5	2.0	41.9	33.3	27.3	20.4	15.3	15.8
R64	26.8	17.9	14.2	6.8	1.2	2.0	40.6	31.7	28.0	20.6	15.0	15.8
R65	28.6	17.5	14.7	7.9	1.0	2.1	42.4	31.3	28.5	21.7	14.8	15.9
R66	31.3	16.1	13.5	7.9	0.9	2.0	45.1	29.9	27.3	21.7	14.7	15.8
R67	17.2	6.7	5.6	2.7	0.6	0.8	31.0	20.5	19.4	16.5	14.4	14.6
R68	19.2	8.8	7.7	3.5	0.6	1.0	33.0	22.6	21.5	17.3	14.4	14.8
R69	27.6	16.2	12.8	6.7	0.7	1.8	41.4	30.0	26.6	20.5	14.5	15.6
R70	37.7	27.3	16.5	8.7	1.9	2.7	51.5	41.1	30.3	22.5	15.7	16.5

Receptor	Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative	Cumulative
R71	14.5	9.6	7.7	3.6	0.7	1.1	28.3	23.4	21.5	17.4	14.5	14.9
R72	27.0	15.5	11.9	6.6	0.7	1.7	40.8	29.3	25.7	20.4	14.5	15.5
R73	29.0	13.0	11.7	7.2	0.9	1.9	42.8	26.8	25.5	21.0	14.7	15.7
R74	13.2	9.1	6.9	3.4	0.7	1.0	27.0	22.9	20.7	17.2	14.5	14.8
R75	59.2	24.7	20.5	7.1	1.5	2.5	73.0	38.5	34.3	20.9	15.3	16.3
R76	33.3	25.5	19.1	6.1	0.9	2.2	47.1	39.3	32.9	19.9	14.7	16.0
R77	33.1	24.2	18.0	5.7	0.8	2.0	46.9	38.0	31.8	19.5	14.6	15.8
R78	27.1	20.6	15.7	5.1	0.7	1.8	40.9	34.4	29.5	18.9	14.5	15.6
R79	20.6	9.7	7.7	2.5	0.5	0.9	34.4	23.5	21.5	16.3	14.3	14.7
R80	24.9	10.9	8.9	2.8	0.5	1.0	38.7	24.7	22.7	16.6	14.3	14.8
R81	19.5	9.5	7.6	2.4	0.5	0.9	33.3	23.3	21.4	16.2	14.3	14.7
R82	15.1	9.5	8.4	3.0	0.5	0.9	28.9	23.3	22.2	16.8	14.3	14.7
R83	16.8	8.8	7.7	2.6	0.5	0.9	30.6	22.6	21.5	16.4	14.3	14.7

Appendix F– CALMET Output

This section summarises the model's performance in predicting the meteorological conditions compared to the measured data for the project area.

Wind Direction and Speed

Selected meteorological variable were extracted from the gridded CALMET output for a point corresponding to the project site (412,830 m Easting and 6,251,640 m Northing). The general features of the 10 m winds illustrated in the annual and seasonal wind rose diagrams for the 12-month period from January 2019 – December 2019[9] are shown in Appendix Figure 13.

The wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points – N, NNE, NE, etc. The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds.

The major features of the wind rose are as follows:

- Annual wind direction is predominantly from the southeast with secondary maxima from the northwest.
- During summer, the predominant wind direction is southeasterly due to the ridging effect of the South Indian Ocean anticyclone.
- Autumn is characterised by winds from the southeast, northeast and slightly increased frequency of north-westerly winds.
- During the winter months, winds are predominantly from the west and northwest in response to the northward shift of the westerly wind belt during that season.
- Spring winds are from the northwest with increased frequency of southeasterly winds.
- Average wind speeds are 3.7 m/s with strongest hourly wind speed of 13.4 m/s.
- Light winds (< 1 m/s) occur for 2.5% (216 hours) of the year.
- Stronger winds (> 6 m/s) occur for 7 % (619 hours) of the year.

The time-date [10] diagrams for wind direction and wind speed are shown in Appendix Figure 14. The diagrams depict wind direction (as arrows) and speed (as contours) by hour of the day on the x-axis and day of the year on the y-axis. The figures show that winds are generally from the east in the summer and from the west and northwest in the winter. Wind speeds show a cyclical pattern, with lighter winds occurring on average every 16 days. Wind speeds do not show any clear diurnal pattern.

The spatial variation of wind direction, as modelled by WRF-CALMET, is shown in Appendix Figure 14. Terrain influence on the prevailing airflow is evident, with channelling effects along the valleys.

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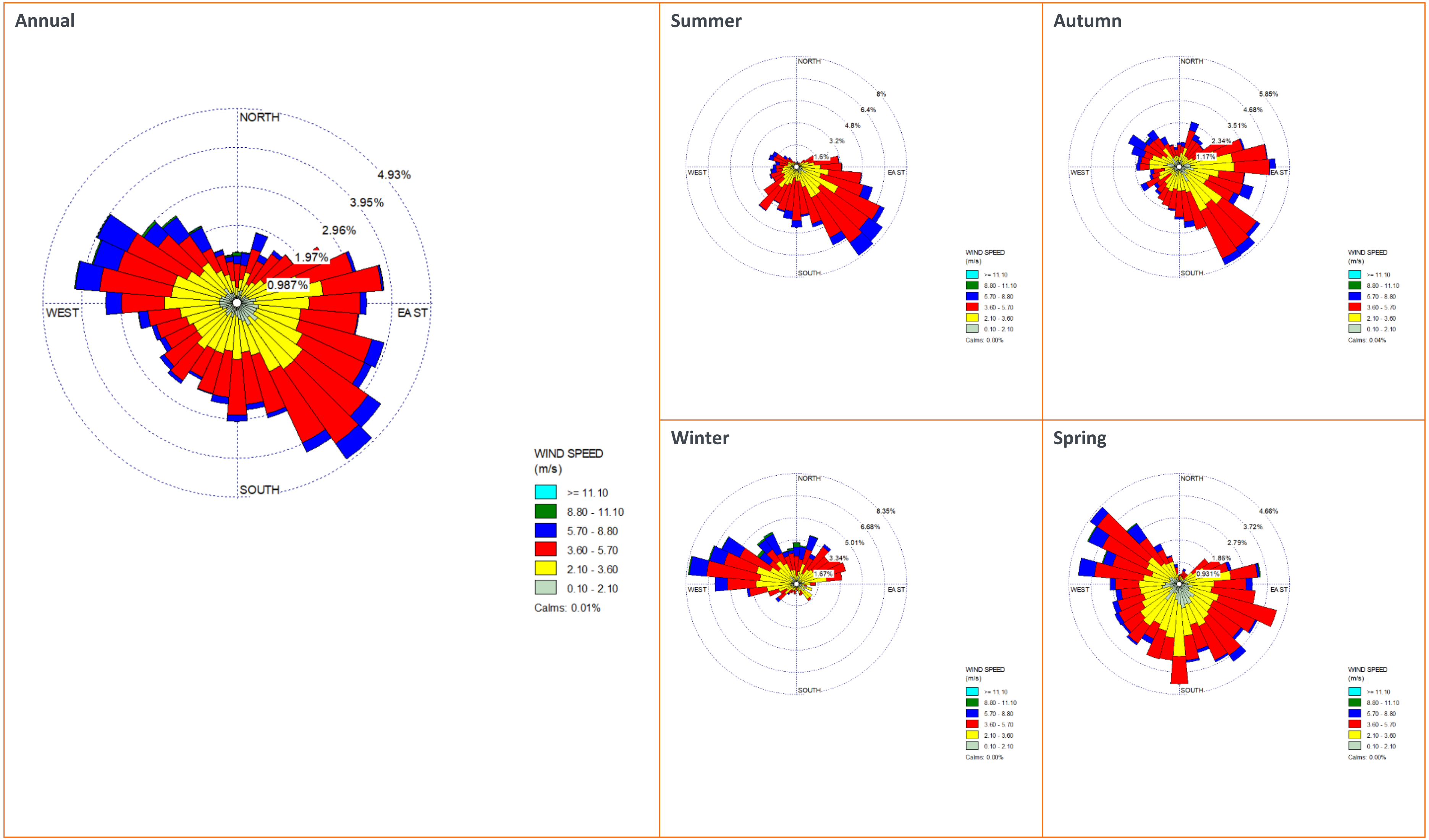
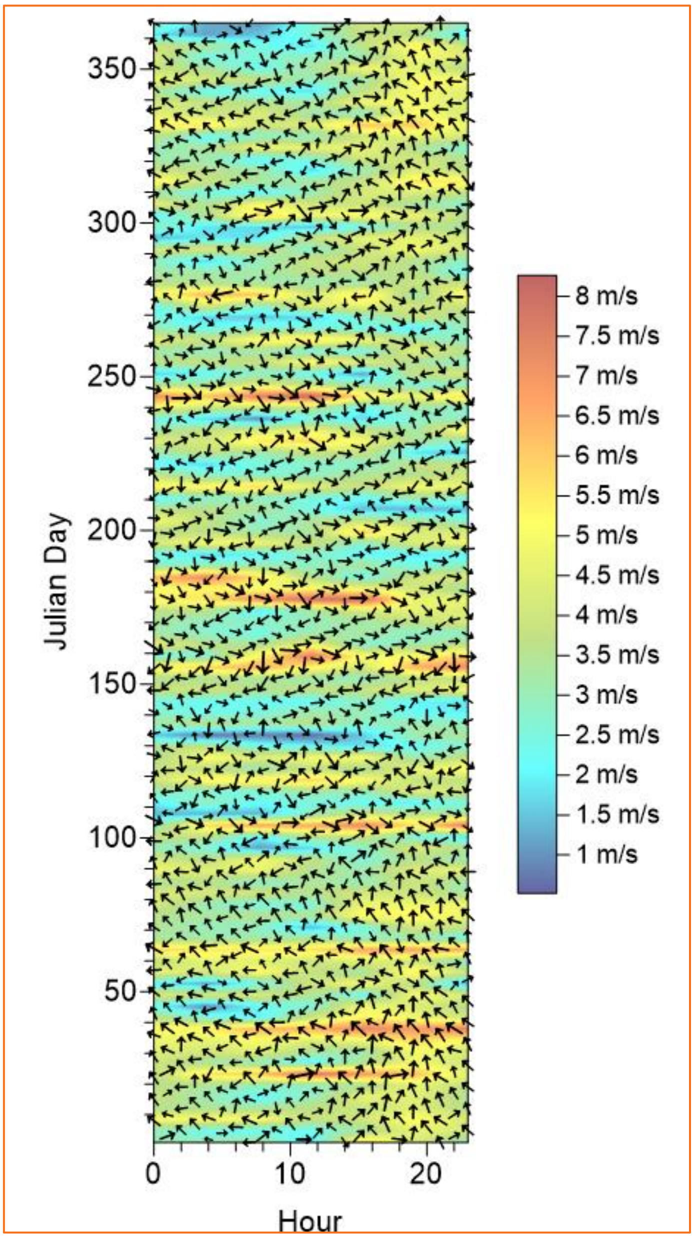
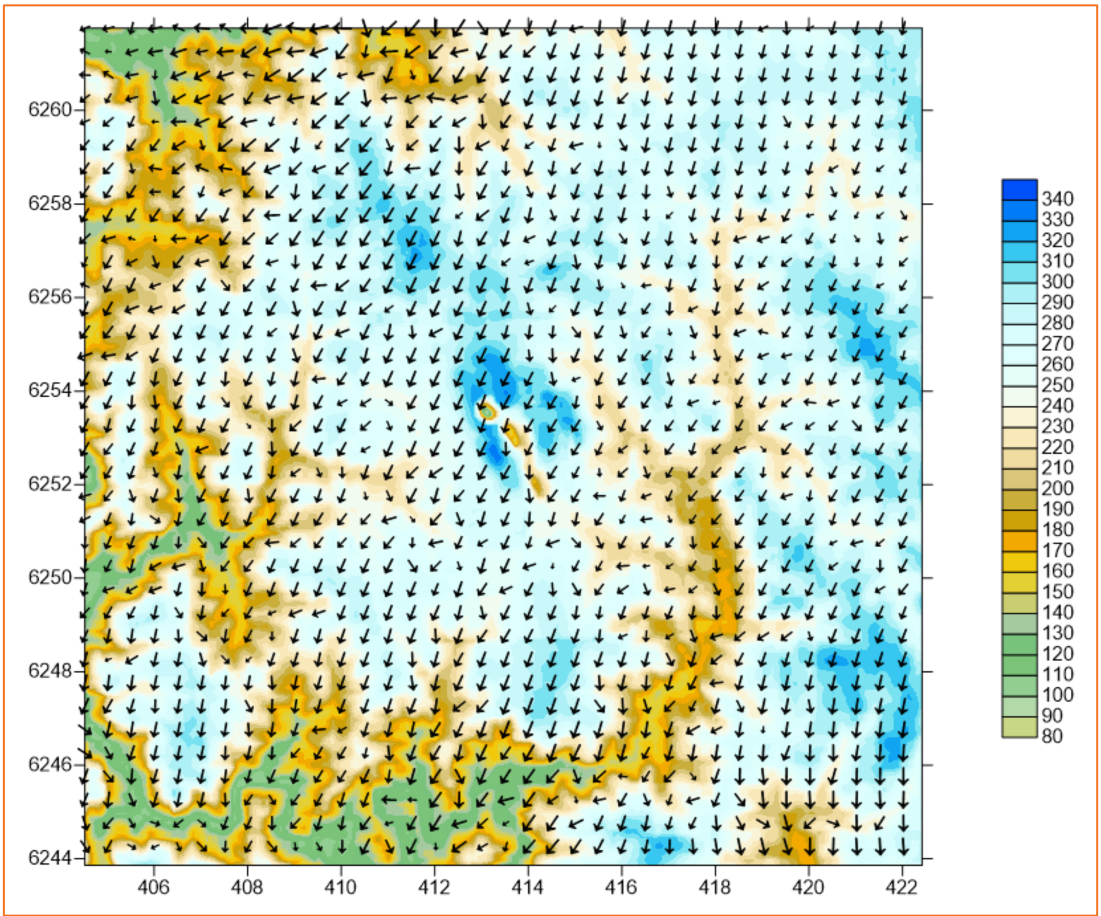
[9] The selected representative meteorological year (as determined in Appendix A).
[10] These diagrams are useful for displaying large amounts of data in a meaningful and understandable form.



Appendix Figure 13: Annual and seasonal wind roses generated from WRF/CALMET for Greenbushes.



Appendix Figure 14: Date-time plot of wind direction (arrows) and wind speed (contours) generated from WRF/CALMET.



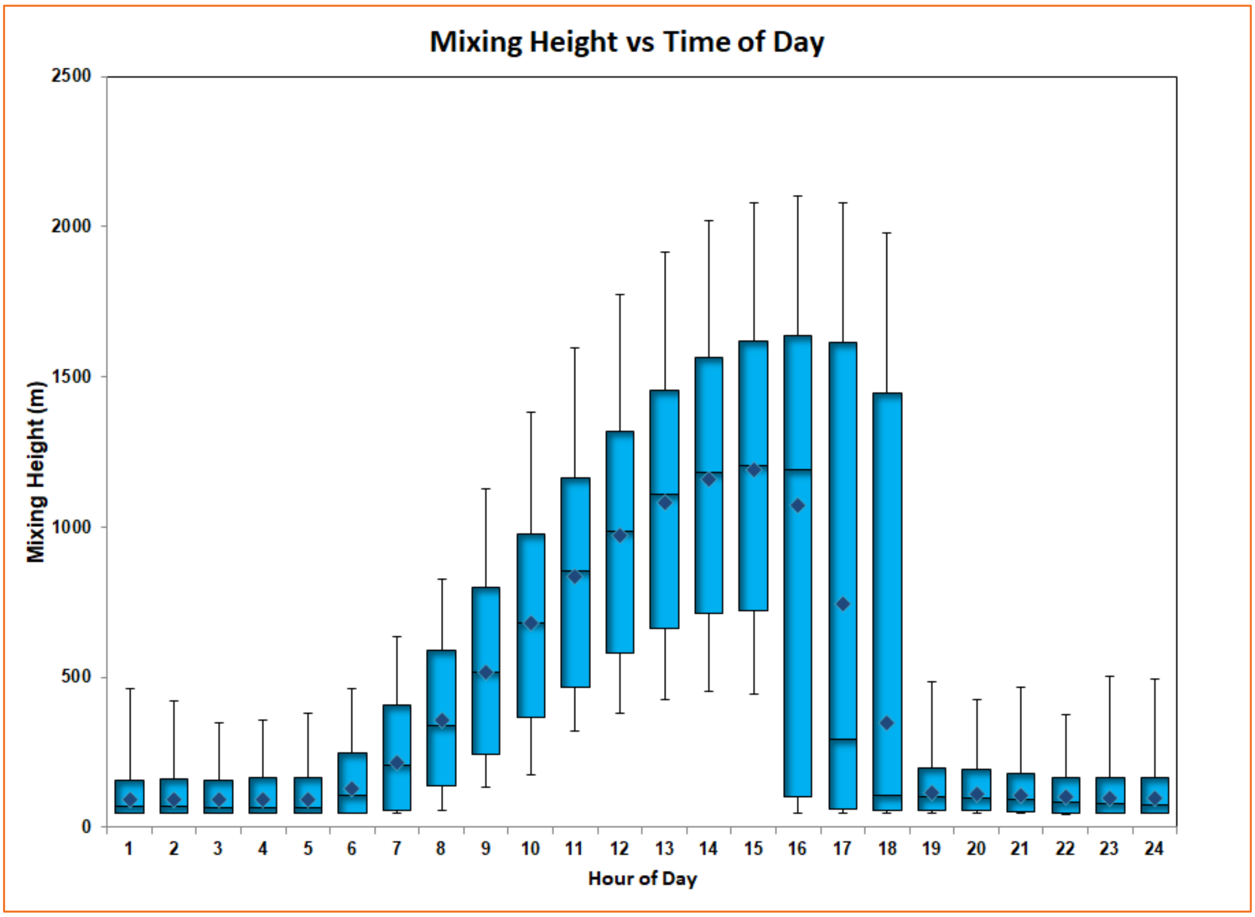
Appendix Figure 15: Snapshot of surface wind vectors

Mixing Height

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

A series of internal algorithms within CALMET is used to calculate mixing heights for the subject site where it is assumed that mixing height is formed through mechanical means (wind speed) at night and through a mixture of mechanical and convective means (wind speed and solar radiation) during the day (Scire et al. 2011). During the night and early morning when the convective mixed layer is absent or small, the full depth of the planetary boundary layer (PBL) may be controlled by mechanical turbulence. During the day, the height of the PBL during convective conditions is then taken as the maximum of the estimated (or measured if available) convective boundary layer height and the estimated (or measured if available) mechanical mixing height. It is calculated from the early morning potential temperature sounding (prior to sunrise), and the time varying surface heat flux to calculate the time evolution of the convective boundary layer.

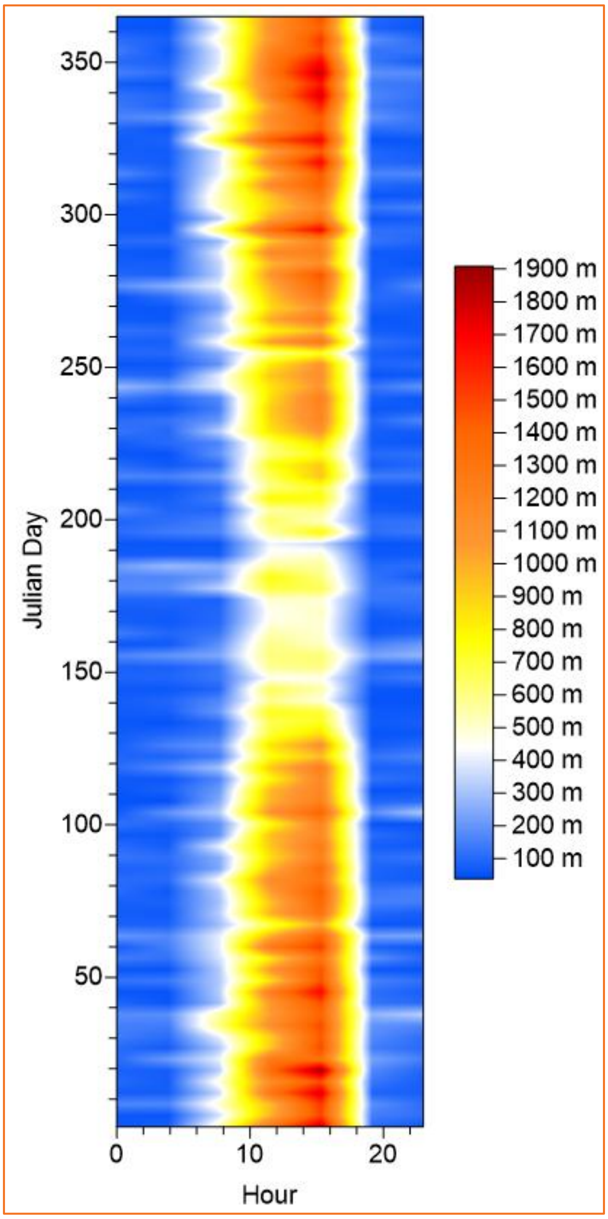
The hourly variation of mixing height at the facility is summarised in Appendix Figure 16[11] with the diurnal cycle evident. At night, mixing height is normally low and after sunrise it typically increases to between 700 m and 1,500 m in response to convective mixing generated by solar heating of the Earth's surface. A rapid reduction in mixing height commences around sunset when convective mixing ceases and a mechanical mixing regime is re-established.



Appendix Figure 16: Simulated annual statistics of hourly mixing heights, Greenbushes.

The date-time plot of mixing height shows that, as expected, mixing heights are greatest during the summer months when solar radiation and resulting convection is greatest (Appendix Figure 17).

[11] The blue bars depict the 10th and 90th percentile values while the diamond shape show the average conditions. The whiskers indicate minimum and maximum values of the data, and the line within the blue bar indicates the median.



Appendix Figure 17: Date-time plot of mixing height generated from WRF/CALMET.

Stability

An important aspect of pollutant dispersion is the level of turbulence in the lowest 1 km or so of the atmosphere, known as the planetary boundary layer (PBL). Turbulence controls how effectively a plume is diffused into the surrounding air and hence diluted. It acts by increasing the cross-sectional area of the plume due to random motions. With stronger turbulence, the rate of plume diffusion increases. Weak turbulence limits diffusion and contributes to high plume concentrations downwind of a source.

Turbulence is generated by both thermal and mechanical effects to varying degrees. Thermally driven turbulence occurs when the surface is being heated, in turn transferring heat to the air above by convection. Mechanical turbulence is caused by the frictional effects of wind moving over the earth's surface and depends on the roughness of the surface as well as the flow characteristics.

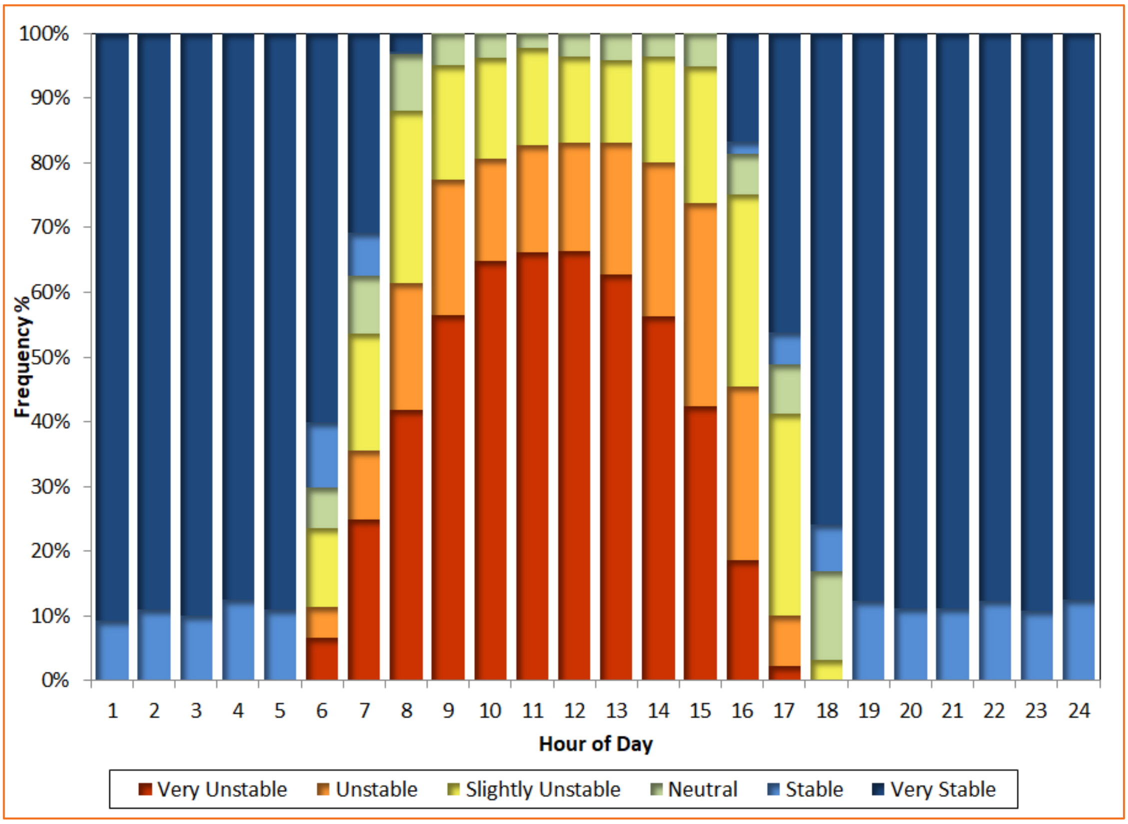
Turbulence in the boundary layer is influenced by the vertical temperature gradient, which is one of several indicators of stability. Plume models use indicators of atmospheric stability in conjunction with other meteorological data to estimate the dispersion conditions in the atmosphere.

Stability can be described across a spectrum ranging from highly unstable through neutral to highly stable. A highly unstable boundary layer is characterised by strong surface heating and relatively light winds, leading to intense convective turbulence and enhanced plume diffusion. At the other extreme, very stable conditions are often associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Under these conditions, plumes can remain relatively undiluted for considerable distances downwind. Neutral conditions are linked to windy and/or cloudy weather, and short periods around sunset and sunrise, when surface rates of heating or cooling are very low.

The stability of the atmosphere plays a significant role In determining the dispersion of a plume and it is important to have it correctly represented in the dispersion model. CALPUFF uses the Monin-Obukhov Similarity Theory (MOST) to characterise turbulence and other processes in the PBL. One of the measures of the PBL is the Monin-Obukhov length (L), which approximates the height at which turbulence is generated equally by thermal and mechanical effects (Seinfeld and Pandis 2006). It is a measure of the relative importance of mechanical and thermal forcing on atmospheric turbulence.

Because values of L diverge to + and–- infinity as stability approaches neutral from the stable and unstable sides, respectively, it is often more convenient to use the inverse of L (i.e. 1/L) when describing stability.

The hourly averaged 1/L computed from all data in the CALMET surface file is presented in Appendix Figure 18. This plot indicates that the PBL is stable to very stable overnight becoming very unstable (reaching maximum instability between 10:00 am and 2:00 pm) as radiation from the sun heats the surface layer of the atmosphere and drives convection.

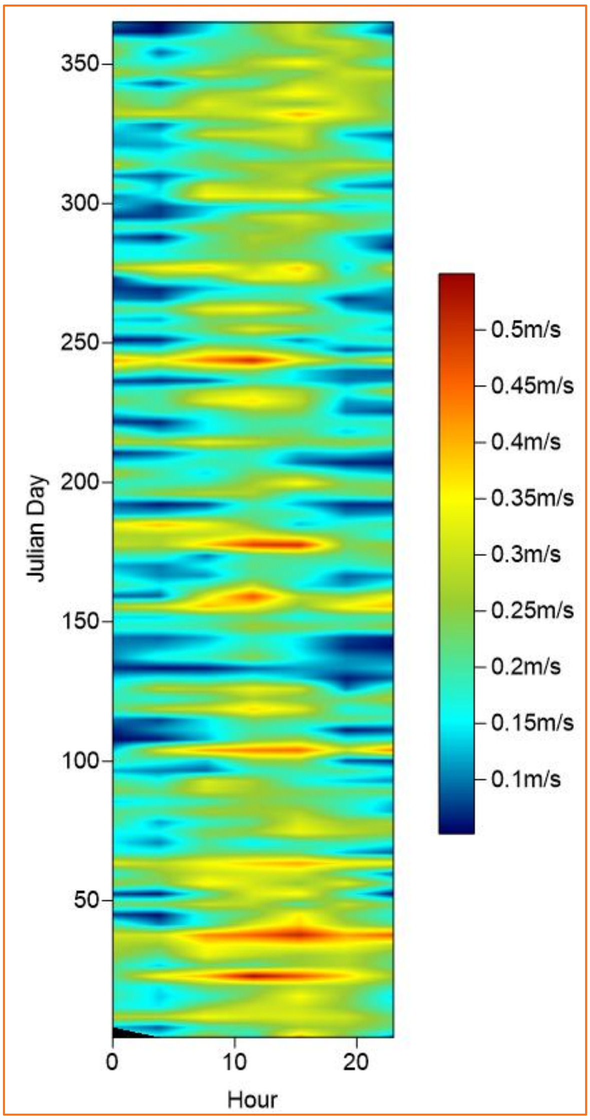


Appendix Figure 18: Simulated annual statistics of hourly stability, Greenbushes

Friction Velocity

An important quantity in wind erosion studies is threshold friction velocity u_{*t}, which describes the capacity of the surface to resist wind erosion. u_{*t} is the minimum friction velocity (u_*) required for the initiation of mobilization of sand particles from the ground into the atmosphere. Friction velocity is affected by a range of factors, such as wind speed, vegetation cover, and other roughness elements.

The time-day diagram of CALMET-generated friction velocity shows that the highest friction velocity (and therefore dust lift-off potential) mainly occurs during the day (Appendix Figure 19).



Appendix Figure 19: Hour-Date-time plot of friction velocity generated from WRF/CALMET.

Appendix G – Emission Parameters

A summary of the volume sources (statistical characteristics for emission rates) input into the model are shown in the tables below.

Appendix Table 19:Emissions Parameters S2 Only 2028

Name	Easting	Northing	Effective Height	Sigma Y	Sigma Z
Bull1	416141	6251923	2.0	125	0.93
Bull2	416845	6251670	2.0	125	0.93
Bull3	417166	6250798	2.0	125	0.93
Bull4	416377	6251022	2.0	125	0.93
Bull10	414954	6251578	2.0	125	0.93
Bull5	414392	6250974	2.0	125	0.93
Bull6	414399	6250376	2.0	125	0.93
Bull8	414307	6249569	2.0	125	0.93
Bull_CWH	413089	6253443	2.0	125	0.93
Bull9	414221	6251953	2.0	125	0.93
UnW1	416234	6251976	2.0	125	0.93
UnW2	416758	6251702	2.0	125	0.93
UnW3	417078	6250893	2.0	125	0.93
UnW4	416448	6250910	2.0	125	0.93
UnW10	415025	6251528	2.0	125	0.93
UnW5	414491	6250995	2.0	125	0.93
UnW6	414434	6250455	2.0	125	0.93
UnW8	414377	6249520	2.0	125	0.93
UnW_CWH	413089	6253482	2.0	125	0.93
UnW9	414170	6251971	2.0	125	0.93
Load1	413494	6253147	5.0	125	2.33
Load2	413627	6252787	5.0	125	2.33
Load3	413895	6252224	5.0	125	2.33
Load4	414118	6252046	5.0	125	2.33
Load5	414186	6253267	5.0	125	2.33
Load6	414344	6253110	5.0	125	2.33
Load7	414227	6252894	5.0	125	2.33
Load8	414435	6252684	5.0	125	2.33
Load9	414364	6252460	5.0	125	2.33
Load10	414508	6252307	5.0	125	2.33
Load11	413649	6253487	5.0	125	2.33
Load12	413638	6253749	5.0	125	2.33

Name	Easting	Northing	Effective Height	Sigma Y	Sigma Z
Blast1	413528	6253054	20.0	22	9.30
Blast2	413723	6252708	20.0	22	9.30
Blast3	413998	6252231	20.0	22	9.30
Blast4	414053	6251970	20.0	22	9.30
Blast5	414207	6253198	20.0	22	9.30
Blast6	414365	6253041	20.0	22	9.30
Blast7	414248	6252824	20.0	22	9.30
Blast8	414456	6252614	20.0	22	9.30
Blast9	414385	6252390	20.0	22	9.30
Blast10	414529	6252238	20.0	22	9.30
Blast11	413670	6253418	20.0	22	9.30
Blast12	413660	6253679	20.0	22	9.30
Drill1	413579	6253147	1.5	125	0.70
Drill2	413713	6252787	1.5	125	0.70
Drill3	413933	6252337	1.5	125	0.70
Drill4	414118	6251926	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill6	414438	6253091	1.5	125	0.70
Drill7	414321	6252874	1.5	125	0.70
Drill8	414529	6252664	1.5	125	0.70
Drill9	414458	6252440	1.5	125	0.70
Drill10	414602	6252287	1.5	125	0.70
Drill11	413743	6253468	1.5	125	0.70
Drill12	413733	6253729	1.5	125	0.70
LO1	412845	6253135	5.0	125	2.33
LO2	412927	6252814	5.0	125	2.33
LO3	413044	6252276	5.0	125	2.33
LO4	413416	6251919	5.0	125	2.33
LO5	413572	6251650	5.0	125	2.33
UnO1	412799	6253234	5.0	125	2.33
UnO2	412960	6252849	5.0	125	2.33
UnO3	413107	6252231	5.0	125	2.33
UnO4	413502	6251849	5.0	125	2.33
UnO5	413454	6251686	5.0	125	2.33
UnCr1	412735	6253178	5.0	125	2.33
UnCr2	413034	6252172	5.0	125	2.33
UnCr3	413256	6251808	5.0	125	2.33

Appendix Table 20:Emissions Parameters S2 Only 2030

name	easting	northing	effective height	sigma y	sigma z
Bull1	416141	6251923	2.0	125	0.93
Bull2	416845	6251670	2.0	125	0.93
Bull3	417166	6250798	2.0	125	0.93
Bull4	416377	6251022	2.0	125	0.93
Bull10	414954	6251578	2.0	125	0.93
Bull5	414392	6250974	2.0	125	0.93
Bull6	414399	6250376	2.0	125	0.93
Bull8	414307	6249569	2.0	125	0.93
Bull_CWH	413089	6253443	2.0	125	0.93
Bull9	414221	6251953	2.0	125	0.93
UnW1	416234	6251976	2.0	125	0.93
UnW2	416758	6251702	2.0	125	0.93
UnW3	417078	6250893	2.0	125	0.93
UnW4	416448	6250910	2.0	125	0.93
UnW10	415025	6251528	2.0	125	0.93
UnW5	414491	6250995	2.0	125	0.93
UnW6	414434	6250455	2.0	125	0.93
UnW8	414377	6249520	2.0	125	0.93
UnW_CWH	413089	6253482	2.0	125	0.93
UnW9	414170	6251971	2.0	125	0.93
Load1	413494	6253147	5.0	125	2.33
Load2	413627	6252787	5.0	125	2.33
Load3	413895	6252224	5.0	125	2.33
Load4	414118	6252046	5.0	125	2.33
Load5	414186	6253267	5.0	125	2.33
Load6	414344	6253110	5.0	125	2.33
Load7	414227	6252894	5.0	125	2.33
Load8	414435	6252684	5.0	125	2.33
Load9	414364	6252460	5.0	125	2.33
Load10	414508	6252307	5.0	125	2.33
Load11	413649	6253487	5.0	125	2.33
Load12	413638	6253749	5.0	125	2.33
Blast1	413528	6253054	20.0	22	9.30
Blast2	413723	6252708	20.0	22	9.30
Blast3	413998	6252231	20.0	22	9.30

name	easting	northing	effective height	sigma y	sigma z
Blast4	414053	6251970	20.0	22	9.30
Blast5	414207	6253198	20.0	22	9.30
Blast6	414365	6253041	20.0	22	9.30
Blast7	414248	6252824	20.0	22	9.30
Blast8	414456	6252614	20.0	22	9.30
Blast9	414385	6252390	20.0	22	9.30
Blast10	414529	6252238	20.0	22	9.30
Blast11	413670	6253418	20.0	22	9.30
Blast12	413660	6253679	20.0	22	9.30
Drill1	413579	6253147	1.5	125	0.70
Drill2	413713	6252787	1.5	125	0.70
Drill3	413933	6252337	1.5	125	0.70
Drill4	414118	6251926	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill6	414438	6253091	1.5	125	0.70
Drill7	414321	6252874	1.5	125	0.70
Drill8	414529	6252664	1.5	125	0.70
Drill9	414458	6252440	1.5	125	0.70
Drill10	414602	6252287	1.5	125	0.70
Drill11	413743	6253468	1.5	125	0.70
Drill12	413733	6253729	1.5	125	0.70
LO1	412845	6253135	5.0	125	2.33
LO2	412927	6252814	5.0	125	2.33
LO3	413044	6252276	5.0	125	2.33
LO4	413416	6251919	5.0	125	2.33
LO5	413572	6251650	5.0	125	2.33
UnO1	412799	6253234	5.0	125	2.33
UnO2	412960	6252849	5.0	125	2.33
UnO3	413107	6252231	5.0	125	2.33
UnO4	413502	6251849	5.0	125	2.33
UnO5	413454	6251686	5.0	125	2.33
UnCr1	412735	6253178	5.0	125	2.33
UnCr2	413034	6252172	5.0	125	2.33
UnCr3	413256	6251808	5.0	125	2.33

Appendix Table 21:Emissions Parameters S2 and S8 2028

name	easting	northing	effective height	sigma y	sigma z
Bull1	416141	6251923	2.0	125	0.93
Bull2	416845	6251670	2.0	125	0.93
Bull3	417166	6250798	2.0	125	0.93
Bull4	416377	6251022	2.0	125	0.93
Bull10	414954	6251578	2.0	125	0.93
Bull5	414392	6250974	2.0	125	0.93
Bull6	414399	6250376	2.0	125	0.93
Bull8	414307	6249569	2.0	125	0.93
Bull_CWH	413089	6253443	2.0	125	0.93
Bull9	414221	6251953	2.0	125	0.93
UnW1	416234	6251976	2.0	125	0.93
UnW2	416758	6251702	2.0	125	0.93
UnW3	417078	6250893	2.0	125	0.93
UnW4	416448	6250910	2.0	125	0.93
UnW10	415025	6251528	2.0	125	0.93
UnW5	414491	6250995	2.0	125	0.93
UnW6	414434	6250455	2.0	125	0.93
UnW8	414377	6249520	2.0	125	0.93
UnW_CWH	413089	6253482	2.0	125	0.93
UnW9	414170	6251971	2.0	125	0.93
Load1	413494	6253147	5.0	125	2.33
Load2	413627	6252787	5.0	125	2.33
Load3	413895	6252224	5.0	125	2.33
Load4	414118	6252046	5.0	125	2.33
Load5	414186	6253267	5.0	125	2.33
Load6	414344	6253110	5.0	125	2.33
Load7	414227	6252894	5.0	125	2.33
Load8	414435	6252684	5.0	125	2.33
Load9	414364	6252460	5.0	125	2.33
Load10	414508	6252307	5.0	125	2.33
Load11	413649	6253487	5.0	125	2.33
Load12	413638	6253749	5.0	125	2.33
Blast1	413528	6253054	20.0	22	9.30
Blast2	413723	6252708	20.0	22	9.30
Blast3	413998	6252231	20.0	22	9.30
Blast4	414053	6251970	20.0	22	9.30
Blast5	414207	6253198	20.0	22	9.30
Blast6	414365	6253041	20.0	22	9.30

name	easting	northing	effective height	sigma y	sigma z
Blast7	414248	6252824	20.0	22	9.30
Blast8	414456	6252614	20.0	22	9.30
Blast9	414385	6252390	20.0	22	9.30
Blast10	414529	6252238	20.0	22	9.30
Blast11	413670	6253418	20.0	22	9.30
Blast12	413660	6253679	20.0	22	9.30
Drill1	413579	6253147	1.5	125	0.70
Drill2	413713	6252787	1.5	125	0.70
Drill3	413933	6252337	1.5	125	0.70
Drill4	414118	6251926	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill6	414438	6253091	1.5	125	0.70
Drill7	414321	6252874	1.5	125	0.70
Drill8	414529	6252664	1.5	125	0.70
Drill9	414458	6252440	1.5	125	0.70
Drill10	414602	6252287	1.5	125	0.70
Drill11	413743	6253468	1.5	125	0.70
Drill12	413733	6253729	1.5	125	0.70
LO1	412845	6253135	5.0	125	2.33
LO2	412927	6252814	5.0	125	2.33
LO3	413044	6252276	5.0	125	2.33
LO4	413416	6251919	5.0	125	2.33
LO5	413572	6251650	5.0	125	2.33
UnO1	412799	6253234	5.0	125	2.33
UnO2	412960	6252849	5.0	125	2.33
UnO3	413107	6252231	5.0	125	2.33
UnO4	413502	6251849	5.0	125	2.33
UnO5	413454	6251686	5.0	125	2.33
UnCr1	412735	6253178	5.0	125	2.33
UnCr2	413034	6252172	5.0	125	2.33
UnCr3	413256	6251808	5.0	125	2.33

Appendix Table 22:Emissions Parameters S2 and S8 2034

name	easting	northing	effective height	sigma y	sigma z
Bull1	416141	6251923	2.0	125	0.93
Bull2	416845	6251670	2.0	125	0.93

name	easting	northing	effective height	sigma y	sigma z
Bull3	417166	6250798	2.0	125	0.93
Bull4	416377	6251022	2.0	125	0.93
Bull10	414954	6251578	2.0	125	0.93
Bull5	414392	6250974	2.0	125	0.93
Bull6	414399	6250376	2.0	125	0.93
Bull8	414307	6249569	2.0	125	0.93
Bull_CWH	413089	6253443	2.0	125	0.93
Bull9	414221	6251953	2.0	125	0.93
UnW1	416234	6251976	2.0	125	0.93
UnW2	416758	6251702	2.0	125	0.93
UnW3	417078	6250893	2.0	125	0.93
UnW4	416448	6250910	2.0	125	0.93
UnW10	415025	6251528	2.0	125	0.93
UnW5	414491	6250995	2.0	125	0.93
UnW6	414434	6250455	2.0	125	0.93
UnW8	414377	6249520	2.0	125	0.93
UnW_CWH	413089	6253482	2.0	125	0.93
UnW9	414170	6251971	2.0	125	0.93
Load1	413494	6253147	5.0	125	2.33
Load2	413627	6252787	5.0	125	2.33
Load3	413895	6252224	5.0	125	2.33
Load4	414118	6252046	5.0	125	2.33
Load5	414186	6253267	5.0	125	2.33
Load6	414344	6253110	5.0	125	2.33
Load7	414227	6252894	5.0	125	2.33
Load8	414435	6252684	5.0	125	2.33
Load9	414364	6252460	5.0	125	2.33
Load10	414508	6252307	5.0	125	2.33
Load11	413649	6253487	5.0	125	2.33
Load12	413638	6253749	5.0	125	2.33
Blast1	413528	6253054	20.0	22	9.30
Blast2	413723	6252708	20.0	22	9.30
Blast3	413998	6252231	20.0	22	9.30
Blast4	414053	6251970	20.0	22	9.30
Blast5	414207	6253198	20.0	22	9.30
Blast6	414365	6253041	20.0	22	9.30
Blast7	414248	6252824	20.0	22	9.30
Blast8	414456	6252614	20.0	22	9.30

name	easting	northing	effective height	sigma y	sigma z
Blast9	414385	6252390	20.0	22	9.30
Blast10	414529	6252238	20.0	22	9.30
Blast11	413670	6253418	20.0	22	9.30
Blast12	413660	6253679	20.0	22	9.30
Drill1	413579	6253147	1.5	125	0.70
Drill2	413713	6252787	1.5	125	0.70
Drill3	413933	6252337	1.5	125	0.70
Drill4	414118	6251926	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill6	414438	6253091	1.5	125	0.70
Drill7	414321	6252874	1.5	125	0.70
Drill8	414529	6252664	1.5	125	0.70
Drill9	414458	6252440	1.5	125	0.70
Drill10	414602	6252287	1.5	125	0.70
Drill11	413743	6253468	1.5	125	0.70
Drill12	413733	6253729	1.5	125	0.70
LO1	412845	6253135	5.0	125	2.33
LO2	412927	6252814	5.0	125	2.33
LO3	413044	6252276	5.0	125	2.33
LO4	413416	6251919	5.0	125	2.33
LO5	413572	6251650	5.0	125	2.33
UnO1	412799	6253234	5.0	125	2.33
UnO2	412960	6252849	5.0	125	2.33
UnO3	413107	6252231	5.0	125	2.33
UnO4	413502	6251849	5.0	125	2.33
UnO5	413454	6251686	5.0	125	2.33
UnCr1	412735	6253178	5.0	125	2.33
UnCr2	413034	6252172	5.0	125	2.33
UnCr3	413256	6251808	5.0	125	2.33

Appendix Table 23:Emissions Parameters S8 then S2 2029

name	easting	northing	effective height	sigma y	sigma z
Bull1	416141	6251923	2.0	125	0.93
Bull2	416845	6251670	2.0	125	0.93
Bull3	417166	6250798	2.0	125	0.93
Bull4	416377	6251022	2.0	125	0.93

name	easting	northing	effective height	sigma y	sigma z
Bull10	414954	6251578	2.0	125	0.93
Bull5	414392	6250974	2.0	125	0.93
Bull6	414399	6250376	2.0	125	0.93
Bull8	414307	6249569	2.0	125	0.93
Bull_CWH	413089	6253443	2.0	125	0.93
Bull9	414221	6251953	2.0	125	0.93
UnW1	416234	6251976	2.0	125	0.93
UnW2	416758	6251702	2.0	125	0.93
UnW3	417078	6250893	2.0	125	0.93
UnW4	416448	6250910	2.0	125	0.93
UnW10	415025	6251528	2.0	125	0.93
UnW5	414491	6250995	2.0	125	0.93
UnW6	414434	6250455	2.0	125	0.93
UnW8	414377	6249520	2.0	125	0.93
UnW_CWH	413089	6253482	2.0	125	0.93
UnW9	414170	6251971	2.0	125	0.93
Load1	413494	6253147	5.0	125	2.33
Load2	413627	6252787	5.0	125	2.33
Load3	413895	6252224	5.0	125	2.33
Load4	414118	6252046	5.0	125	2.33
Load5	414186	6253267	5.0	125	2.33
Load6	414344	6253110	5.0	125	2.33
Load7	414227	6252894	5.0	125	2.33
Load8	414435	6252684	5.0	125	2.33
Load9	414364	6252460	5.0	125	2.33
Load10	414508	6252307	5.0	125	2.33
Load11	413649	6253487	5.0	125	2.33
Load12	413638	6253749	5.0	125	2.33
Blast1	413528	6253054	20.0	22	9.30
Blast2	413723	6252708	20.0	22	9.30
Blast3	413998	6252231	20.0	22	9.30
Blast4	414053	6251970	20.0	22	9.30
Blast5	414207	6253198	20.0	22	9.30
Blast6	414365	6253041	20.0	22	9.30
Blast7	414248	6252824	20.0	22	9.30
Blast8	414456	6252614	20.0	22	9.30
Blast9	414385	6252390	20.0	22	9.30
Blast10	414529	6252238	20.0	22	9.30

name	easting	northing	effective height	sigma y	sigma z
Blast11	413670	6253418	20.0	22	9.30
Blast12	413660	6253679	20.0	22	9.30
Drill1	413579	6253147	1.5	125	0.70
Drill2	413713	6252787	1.5	125	0.70
Drill3	413933	6252337	1.5	125	0.70
Drill4	414118	6251926	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill6	414438	6253091	1.5	125	0.70
Drill7	414321	6252874	1.5	125	0.70
Drill8	414529	6252664	1.5	125	0.70
Drill9	414458	6252440	1.5	125	0.70
Drill10	414602	6252287	1.5	125	0.70
Drill11	413743	6253468	1.5	125	0.70
Drill12	413733	6253729	1.5	125	0.70
LO1	412845	6253135	5.0	125	2.33
LO2	412927	6252814	5.0	125	2.33
LO3	413044	6252276	5.0	125	2.33
LO4	413416	6251919	5.0	125	2.33
LO5	413572	6251650	5.0	125	2.33
UnO1	412799	6253234	5.0	125	2.33
UnO2	412960	6252849	5.0	125	2.33
UnO3	413107	6252231	5.0	125	2.33
UnO4	413502	6251849	5.0	125	2.33
UnO5	413454	6251686	5.0	125	2.33
UnCr1	412735	6253178	5.0	125	2.33
UnCr2	413034	6252172	5.0	125	2.33
UnCr3	413256	6251808	5.0	125	2.33

Appendix Table 24:Emissions Parameters S8 then S2 2033

name	easting	northing	effective height	sigma y	sigma z
Bull1	416141	6251923	2.0	125	0.93
Bull2	416845	6251670	2.0	125	0.93
Bull3	417166	6250798	2.0	125	0.93
Bull4	416377	6251022	2.0	125	0.93
Bull10	414954	6251578	2.0	125	0.93
Bull5	414392	6250974	2.0	125	0.93

name	easting	northing	effective height	sigma y	sigma z
Bull6	414399	6250376	2.0	125	0.93
Bull8	414307	6249569	2.0	125	0.93
Bull_CWH	413089	6253443	2.0	125	0.93
Bull9	414221	6251953	2.0	125	0.93
UnW1	416234	6251976	2.0	125	0.93
UnW2	416758	6251702	2.0	125	0.93
UnW3	417078	6250893	2.0	125	0.93
UnW4	416448	6250910	2.0	125	0.93
UnW10	415025	6251528	2.0	125	0.93
UnW5	414491	6250995	2.0	125	0.93
UnW6	414434	6250455	2.0	125	0.93
UnW8	414377	6249520	2.0	125	0.93
UnW_CWH	413089	6253482	2.0	125	0.93
UnW9	414170	6251971	2.0	125	0.93
Load1	413494	6253147	5.0	125	2.33
Load2	413627	6252787	5.0	125	2.33
Load3	413895	6252224	5.0	125	2.33
Load4	414118	6252046	5.0	125	2.33
Load5	414186	6253267	5.0	125	2.33
Load6	414344	6253110	5.0	125	2.33
Load7	414227	6252894	5.0	125	2.33
Load8	414435	6252684	5.0	125	2.33
Load9	414364	6252460	5.0	125	2.33
Load10	414508	6252307	5.0	125	2.33
Load11	413649	6253487	5.0	125	2.33
Load12	413638	6253749	5.0	125	2.33
Blast1	413528	6253054	20.0	22	9.30
Blast2	413723	6252708	20.0	22	9.30
Blast3	413998	6252231	20.0	22	9.30
Blast4	414053	6251970	20.0	22	9.30
Blast5	414207	6253198	20.0	22	9.30
Blast6	414365	6253041	20.0	22	9.30
Blast7	414248	6252824	20.0	22	9.30
Blast8	414456	6252614	20.0	22	9.30
Blast9	414385	6252390	20.0	22	9.30
Blast10	414529	6252238	20.0	22	9.30
Blast11	413670	6253418	20.0	22	9.30
Blast12	413660	6253679	20.0	22	9.30

name	easting	northing	effective height	sigma y	sigma z
Drill1	413579	6253147	1.5	125	0.70
Drill2	413713	6252787	1.5	125	0.70
Drill3	413933	6252337	1.5	125	0.70
Drill4	414118	6251926	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill5	414280	6253247	1.5	125	0.70
Drill6	414438	6253091	1.5	125	0.70
Drill7	414321	6252874	1.5	125	0.70
Drill8	414529	6252664	1.5	125	0.70
Drill9	414458	6252440	1.5	125	0.70
Drill10	414602	6252287	1.5	125	0.70
Drill11	413743	6253468	1.5	125	0.70
Drill12	413733	6253729	1.5	125	0.70
LO1	412845	6253135	5.0	125	2.33
LO2	412927	6252814	5.0	125	2.33
LO3	413044	6252276	5.0	125	2.33
LO4	413416	6251919	5.0	125	2.33
LO5	413572	6251650	5.0	125	2.33
UnO1	412799	6253234	5.0	125	2.33
UnO2	412960	6252849	5.0	125	2.33
UnO3	413107	6252231	5.0	125	2.33
UnO4	413502	6251849	5.0	125	2.33
UnO5	413454	6251686	5.0	125	2.33
UnCr1	412735	6253178	5.0	125	2.33
UnCr2	413034	6252172	5.0	125	2.33
UnCr3	413256	6251808	5.0	125	2.33