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NEWMONT BODDINGTON
AIR DISPERSION MODELLING & MONITORING REVIEW

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EXECUTIVE SUMMARY

Newmont Boddington Gold mine Pty Ltd (Newmont or NBG) operates the Boddington Gold Mine (BGM) located approximately 130 km southeast of Perth, Western Australia. The BGM mine is an open cut mine, targeting low grade hard rock ores which lie beneath previously mined pits. The annual gold production rate is estimated to be around 1 million ounces (Moz), with total reserves of the mine estimated at 20.1 Moz. Copper concentrate is also produced and exported at an estimated production rate of approximately 30,000 tonnes per annum (tpa). This report presents an assessment of the potential ambient air quality impacts and dust deposition rates associated with fugitive particulate emissions from Newmont's BGM operations.

Newmont has requested that Ramboll undertake a number of tasks relating to the characterisation of impacts from dust in the region. This includes the revision of an air dispersion modelling assessment of atmospheric emissions from the BGM to assess the potential impacts on ambient air quality and deposition of dust in the region. The assessment will primarily be focused on fugitive emissions from major dust generating activities such as drilling and blasting, material handling (stockpiling, reclaiming, conveyor transfers), crushing and screening, vehicle movements on unpaved surfaces and wind erosion of residue drying areas, unpaved surfaces and stockpiles. The approach, methodology and results of the air dispersion modelling are detailed as well as the predicted impacts. Air dispersion modelling was completed using the CALPUFF dispersion model.

BGM's mining and processing operations has air quality monitoring equipment including a tapered element oscillating microbalance (TEOM) at Communications Hill, two portable Osiris dust monitoring trailers and deposition gauges at various locations. Ramboll has reviewed the dust monitoring data from the monitoring undertaken in the region and validated the air dispersion model with respect to the monitoring data to more accurately characterise emissions from NBG operations. A range of emissions scenarios based on historical and current deposition data monitored at the RDA were assessed.

A review of ambient air quality monitoring data collected by Newmont has also been undertaken as part of this study. The monitoring indicates that on average, concentrations monitored at Communications Hill have decreased over the past five years. These concentrations are probably more indicative of activities at the mining operations and less to do with activities at RDA as meteorological conditions likely to result in significant dust emissions from the RDA (dry warm conditions with high wind speeds) are less frequent from the from the direction of the RDA to the Communications Hill monitor. Monitored peak concentrations generally occur during the summer/autumn months. A review of dust deposition monitoring data provided by BGM indicates that significantly elevated deposition of dust occurred at deposition monitors located at the RDA in 2021.

Air dispersion modelling was completed to predict short-term (24-hour) and long-term (annual) ambient ground level concentrations (GLCs) of Total Suspended Particulate (TSP), particulate matter less than 10 μm in equivalent aerodynamic diameter (PM_{10}) and particulate matter less than 2.5 μm in equivalent aerodynamic diameter ($PM_{2.5}$), across the modelled domain. The air dispersion model was also utilised to predict particulate deposition rates in order to determine the potential impact of particulate deposition on the surrounding environment.

The predicted results from the air dispersion modelling indicated the following:

- PM_{10} 24-hour average GLCs are predicted to exceed the guideline criteria at locations to the north-east of operations for Scenarios where elevated emissions from RDA were assessed. These exceedances were associated with dust lift off from the RDAs under elevated wind speeds;
- No exceedances of the annual average guideline are observed for either pollutant (PM_{10} and/or $PM_{2.5}$) for all scenarios across all receptor locations, in both isolation and cumulative results.

It should be noted that there is always inherent uncertainty contained in air dispersion modelling, however it is still considered an effective basis for risk assessment. It is Ramboll's understanding that if the monitored deposition results from close proximity to the RDA from the year 2021 are considered representative of Newmont's current operations, it is possible exceedances of peak (24-hour average) air quality criteria are occurring at nearby residences from activities at the RDA during periods of high winds and dry conditions.

Ramboll recommends that additional monitoring be implemented to confirm the risk and potential control measures be considered to mitigate Newmont's dust contribution to the region in the event that elevated concentrations as a result of activities from the RDA are confirmed. Specifically, it is recommended that Newmont place monitoring infrastructure (similar to dust monitor(s) 2 and 3) in an open area at the extent of their operational boundary within the region targeted mainly in the direction of the North-East Establishments and the Village and Boddington township (Figure 34).Additionally, it is also recommended that Newmont implement some dust control strategies for the dryer and hotter months to mitigate the elevated concentrations monitored and predicted under high wind speed events. Some of these include:

- Watering at source locations to reduce dust lift-off;
- Bind the surface of the tailings facility either by use of hydro-suppressants and/or hydro-mulching;
- Progressively rehabilitate unused areas of the region;

Implementation of wind fences/screens at the facility boundary in directions where high wind speeds trend (i.e. South-East and West bearings from the NBG facility as per Figure 12)

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1. INTRODUCTION

1.1 Background

Newmont Boddington Gold mine Pty Ltd (Newmont or NBG) operates the Boddington Gold Mine (BGM) located approximately 130 km southeast of Perth, Western Australia. The BGM mine is an open cut mine, targeting low grade hard rock ores which lie beneath previously mined pits. The annual gold production rate is estimated to be around 1 million ounces (Moz), with total reserves of the mine estimated at 20.1 Moz. Copper concentrate is also produced and exported at an estimated production rate of approximately 30,000 tonnes per annum (tpa).

Newmont requested that Ramboll undertake a number of tasks relating to the characterisation of impacts from dust in the region. This includes the revision of an air dispersion modelling assessment of atmospheric emissions from the BGM to assess the potential impacts on ambient air quality and deposition of dust in the region. The assessment will primarily be focused on fugitive emissions from major dust generating activities such as drilling and blasting, material handling (stockpiling, reclaiming, conveyor transfers), crushing and screening, vehicle movements on unpaved surfaces and wind erosion of unpaved surfaces and stockpiles.

BGM's mining and processing operations has air quality monitoring equipment including a tapered element oscillating microbalance (TEOM) at Communications Hill and two portable Osiris dust monitoring trailers. Ramboll proposes to review the dust monitoring data from the monitoring undertaken in the region.

1.2 Purpose of this Report

This report presents an assessment of the potential ambient air quality impacts and dust deposition rates associated with fugitive particulate emissions from Newmont's BGM operations. The approach, methodology and results of the air dispersion modelling are detailed as well as the predicted impacts.

Air dispersion modelling has been completed to predict short-term (24-hour) and long-term (annual) ambient ground level concentrations (GLCs) of Total Suspended Particulate (TSP), particulate matter less than 10 µm in equivalent aerodynamic diameter (PM_{10}) and particulate matter less than 2.5 µm in equivalent aerodynamic diameter ($PM_{2.5}$), across the modelled domain. The air dispersion model has also been utilised to predict particulate deposition rates in order to determine the potential impact of particulate deposition on the surrounding environment.

A review of ambient air quality monitoring data collected by Newmont has also been undertaken as part of this study and recommendations have been made on the ambient particulate monitoring program and dust management practices implemented at NBG Mine.

2. PROJECT INFORMATION

2.1 Project Description and Site Layout

The NBG Mine is located approximately 12 km northwest of the town of Boddington, in the southwest region of Western Australia (Figure 1). Several residences are located between the town and the mine site, the closest being approximately 7 km south of the mine. The NBG Mine accommodation village is located approximately 6.5 km southeast of the mine (Figure 1).

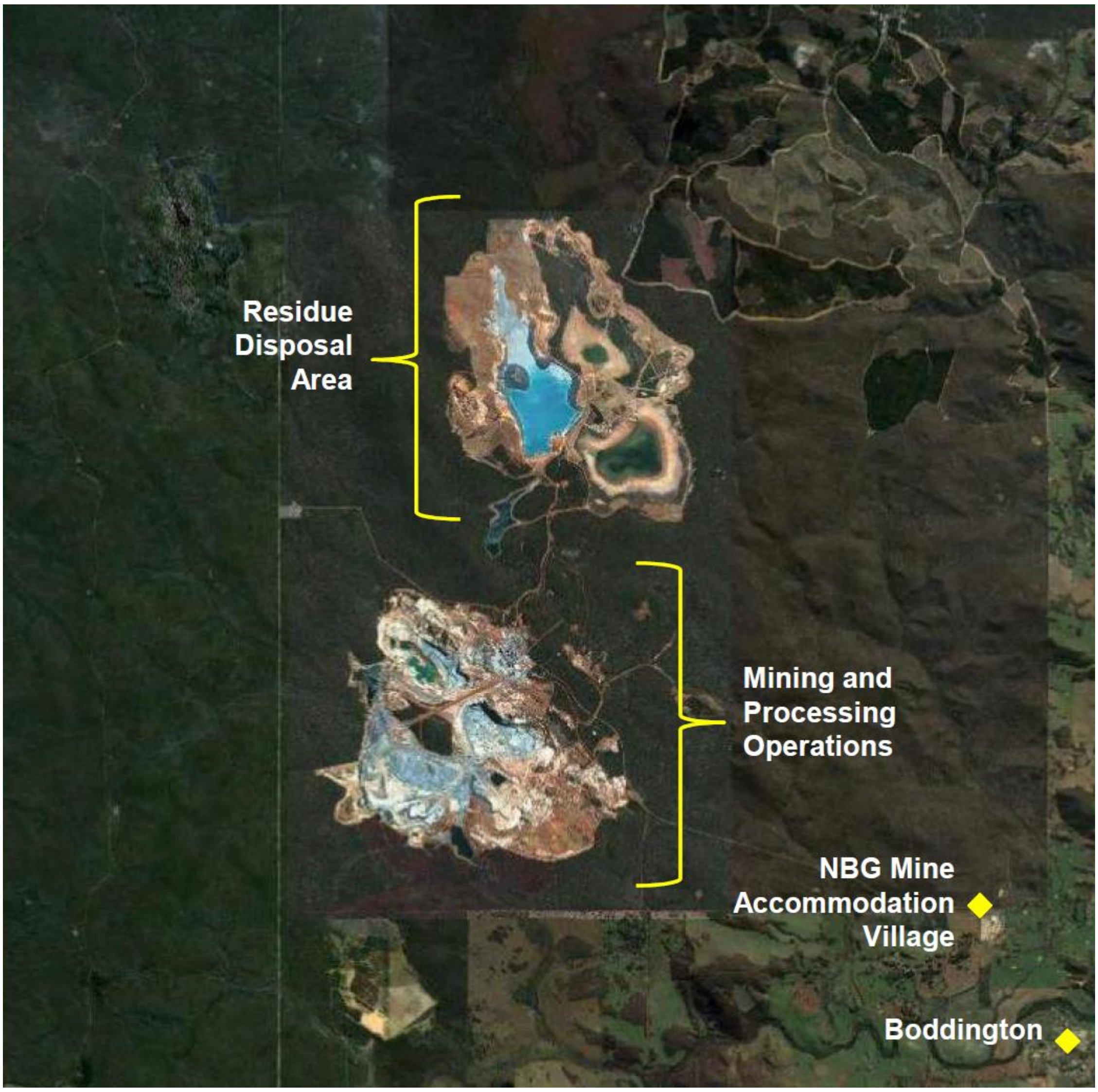

Figure 1: Newmont Boddington Gold Mine Location

An aerial image of the NBG mining operations is presented as Figure 2 and shows the Residue Disposal Areas (RDAs), north and south mining pits, ROM pad, waste rock dumps and primary crusher. An additional aerial image of the NBG mining site, RDA, nearby monitors (R1-R3) and the sensitive receptor locations (R4-R8) can be seen in Figure 3, and a summary of the locations can be seen in Table 1. A layout of the NBG process plant is presented as Figure 4 and shows the screening and crushing facilities, fine ore storage, flotation circuit, tailings storage and treatment facilities, gold furnace and carbon reactivation kilns. Additionally, an aerial image of local protection areas around the RDA can be seen in Figure 5.

Figure 2: Newmont Boddington Gold Mining Operations

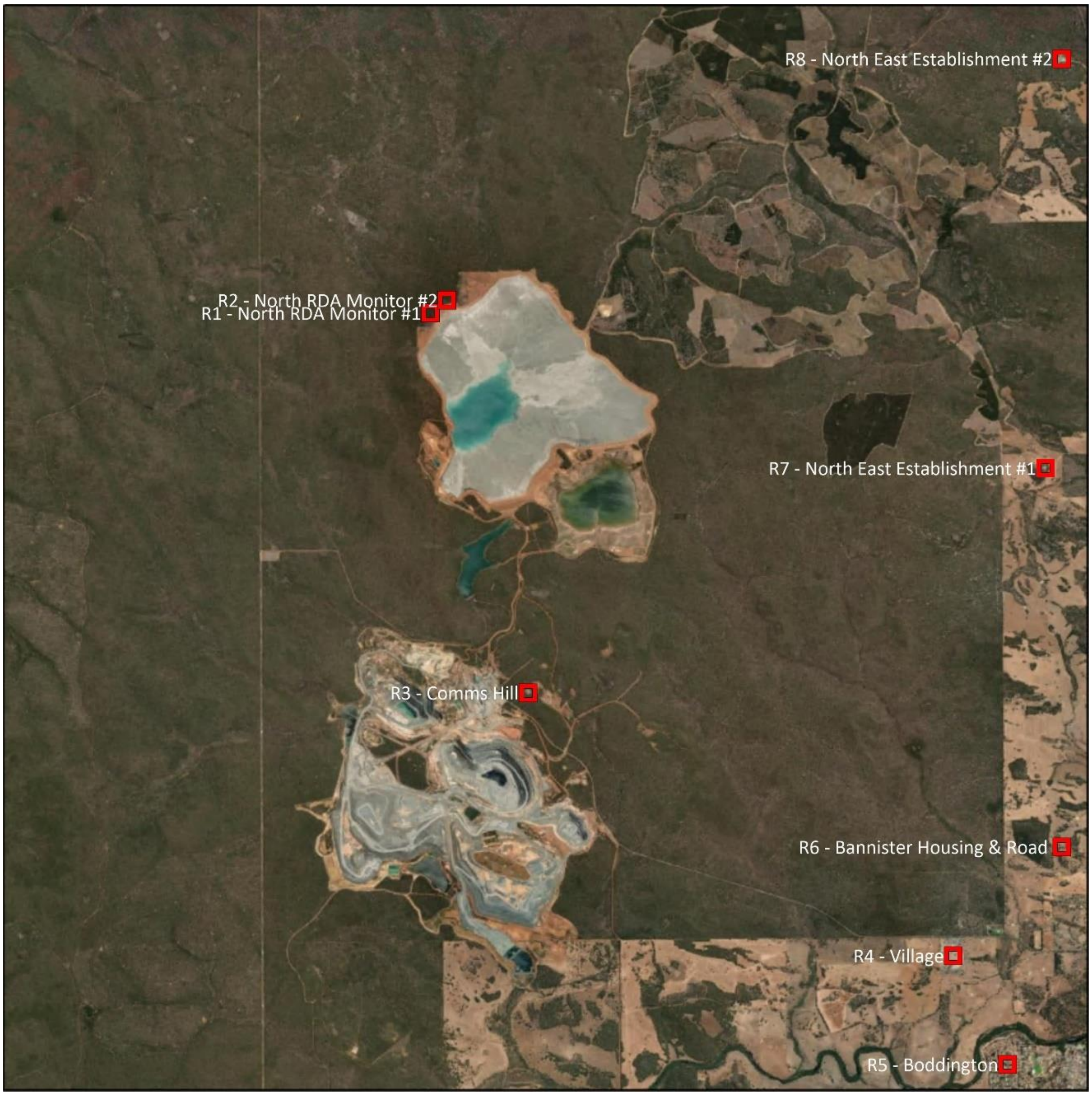

Figure 3: NBG Mine Site, RDA, Monitors (R1-R3) & Sensitive Receptor Locations (R4-R8)

Table 1: NBG Mine Site, RDA, Monitors (R1-R3) & Sensitive Receptor Locations (R4-R8)

Label	Monitor/Receptor	mE	mN
R1 – North RDA Monitor #1	Monitor	438,871	6,384,323
R2 – North RDA Monitor #2	Monitor	439,179	6,384,559
R3 – Communications Hill	Monitor	440,668	6,377,338
R4 – Village	Receptor	448,500	6,372,500
R5 – Boddington	Receptor	449,500	6,370,500
R6 – Bannister Housing & Road	Receptor	450,500	6,374,500
R7 – North East Establishment #1	Receptor	450,200	6,381,470
R8 – North East Establishment #2	Receptor	450,500	6,389,000

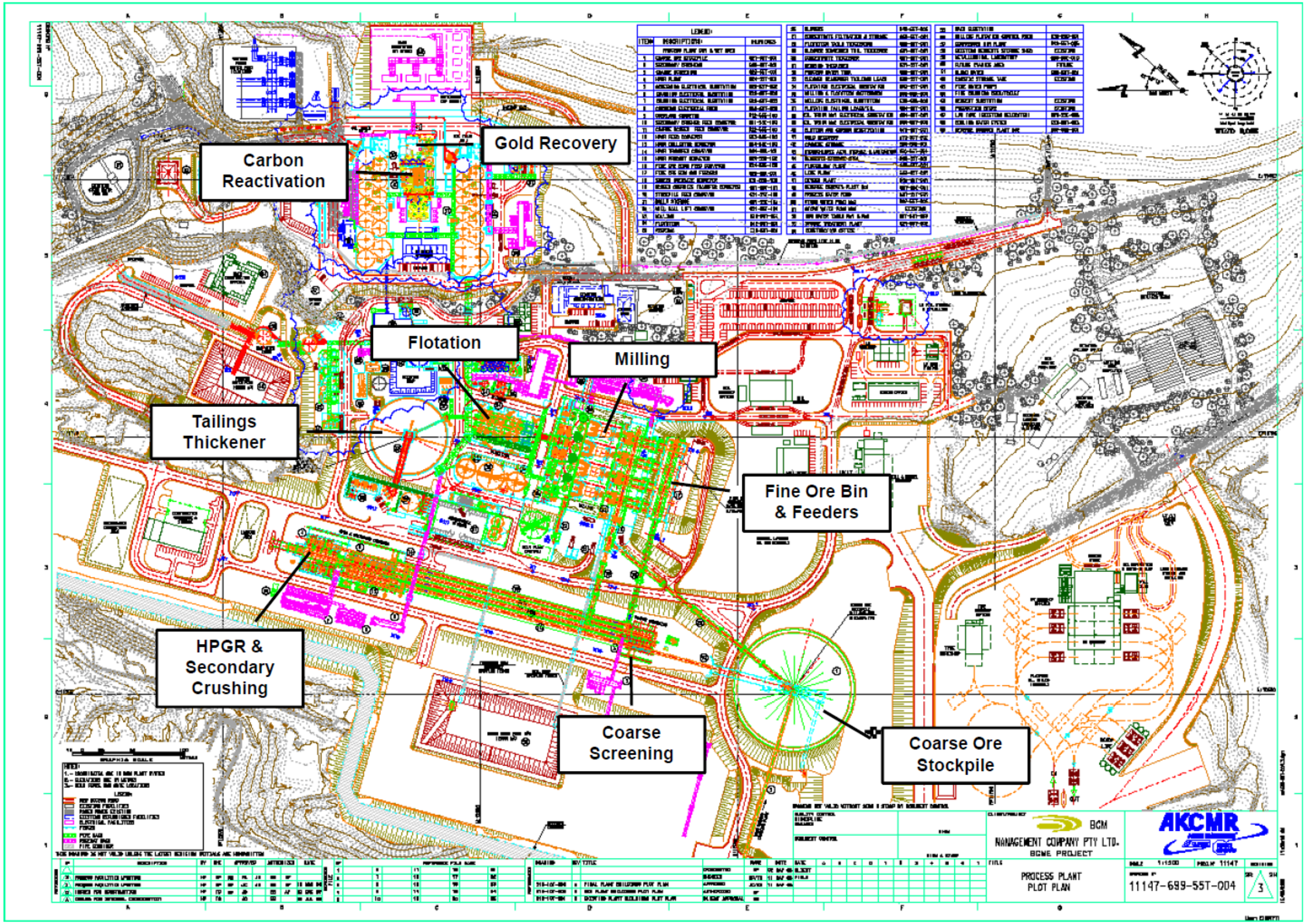

Figure 4: Newmont Boddington Gold Process Plant

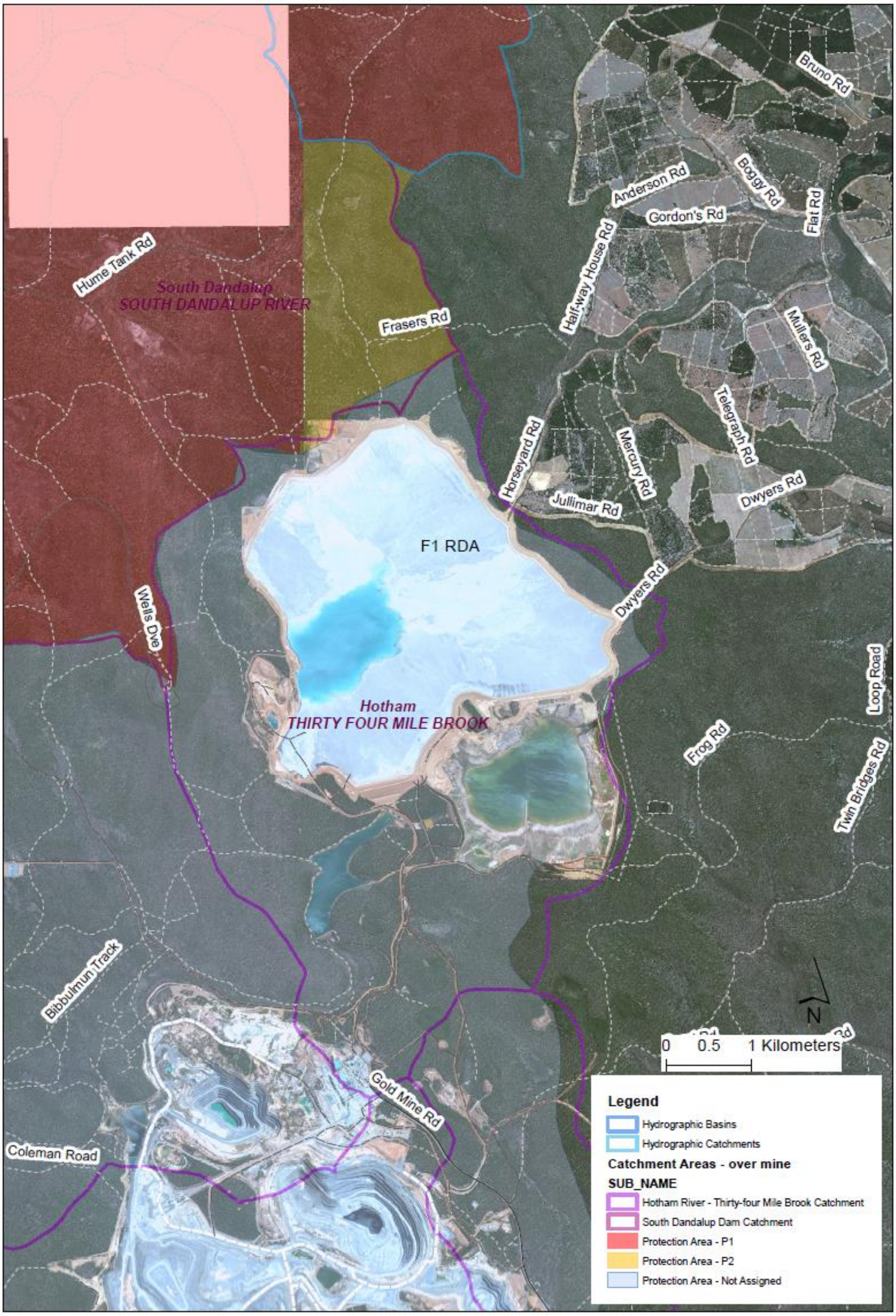

Figure 5: Newmont RDA & Surrounding Protection Areas

3. EXISTING ENVIRONMENT

3.1 Regional Climate

The climate of the region is relatively Mediterranean, with warm dry summers and mild winters. For the regional climate information, data is taken from the nearest Bureau of Meteorology (the Bureau) monitoring station to the site, Wandering, for which the data shows that during the summer months (December to February) the maximum average temperatures can go as high as 32°C and during the winter months (June to August) the minimum average temperatures can go as low as 4°C. The average maximum and minimum temperature plots can be seen below in Figure 6 and Figure 7 respectively.

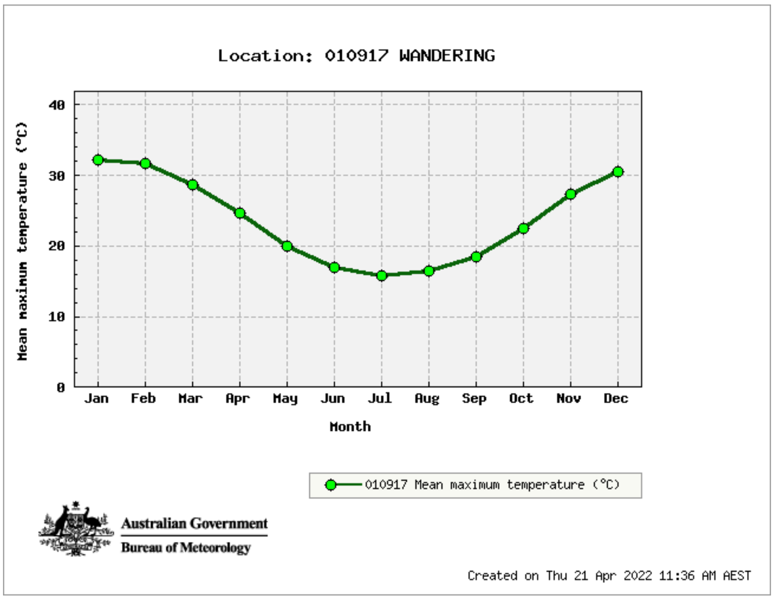

Figure 6: Mean Maximum Temperature Recorded at the Bureau Monitoring Site – Wandering (1998 - 2022)

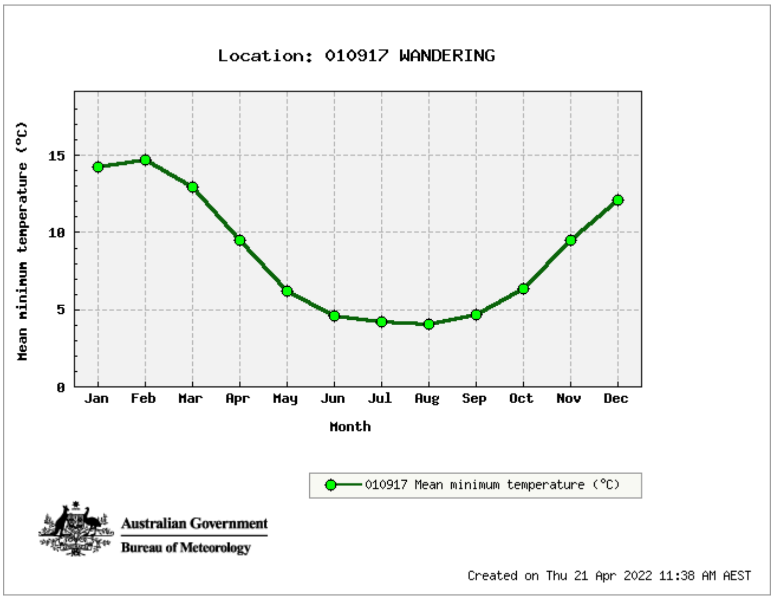

Figure 7: Mean Minimum Temperature Recorded at the Bureau Monitoring Site – Wandering (1998 - 2022)

The annual average rainfall at the nearest meteorological station (Wandering) is 522 millimetres. The majority of the rain fall within the region occurs between April to November, and the remaining period December to March is usually dry with warm to hot and sunny conditions. The plot for the mean annual rainfall can be seen in Figure 8 below.

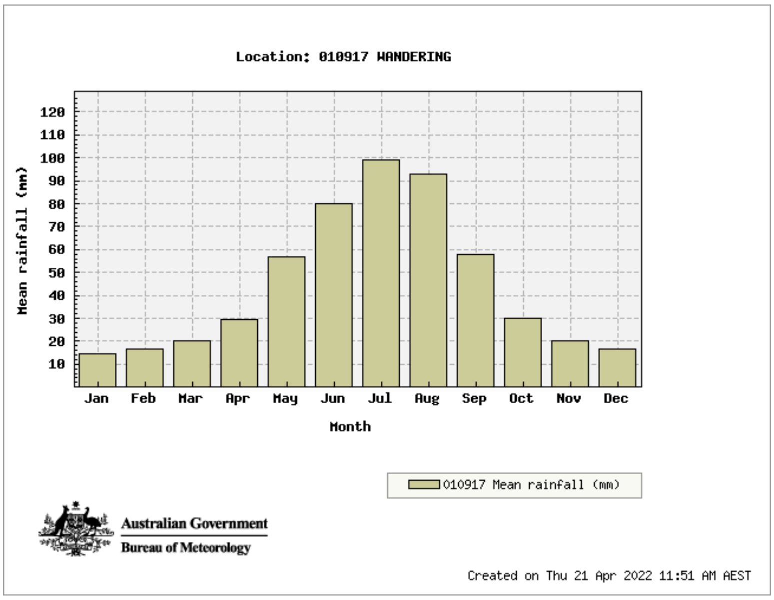

Figure 8: Mean Rainfall at the Bureau Monitoring Station – Wandering (1998 - 2022)

Figure 9 and Figure 10 present annual average wind roses for 9am and 3pm readings respectively for the period 1998-2021 at Wandering Monitoring Station. The 9am wind rose indicates that winds from a generally north and south-east direction are predominant in the region at those times, and the 3pm wind rose indicates that winds from a generally north-west and south-east direction are predominant in the region at those times.

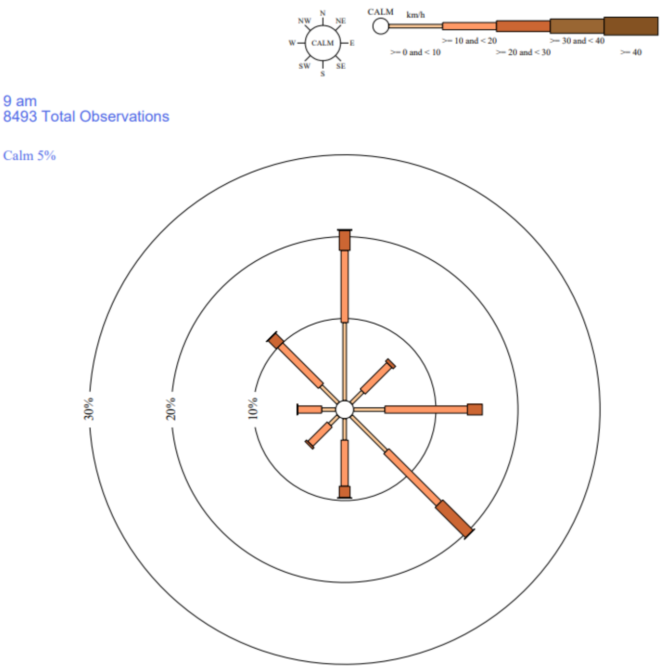

Figure 9: 9am Rose of Wind Direction VS Wind Speed in km/hr at the Bureau Wandering Monitoring Station (1994 - 2021)

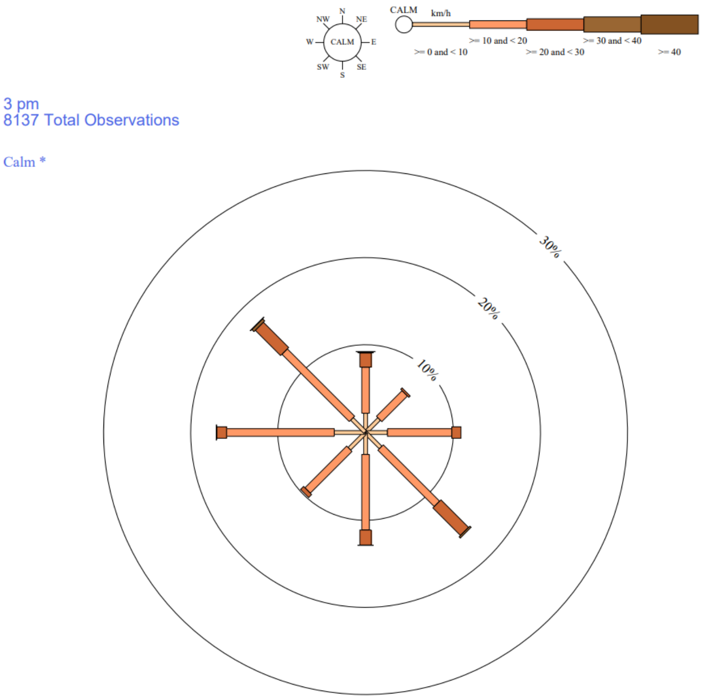

Figure 10: 3pm Rose of Wind Direction VS Wind Speed in km/hr at the Bureau Wandering Monitoring Station (1994 - 2021)

4. ASSESSMENT CRITERIA

4.1 Ambient Air Quality

Particulate matter (PM) is generally defined as particles that can remain suspended in the air by turbulence for an appreciable length of time. PM can consist of a range of matter including crustal material, pollens, sea salts and smoke from combustion products. PM is commonly defined by the size of the particles including the following:

- Total suspended particulates (TSP), which is all particulate matter with an equivalent aerodynamic particle diameter below 50 µm diameter;
- PM_{10} is particulate matter below 10 µm in equivalent aerodynamic diameter; and
- $PM_{2.5}$ is particulate matter below 2.5 µm in equivalent aerodynamic diameter.

TSP contains PM_{10} and $PM_{2.5}$ fractions and is normally associated with amenity and nuisance impacts. PM_{10} and $PM_{2.5}$ are generally associated with the potential for health impacts as particles this size and below may enter the lungs. This study has focussed on predicted PM_{10} and $PM_{2.5}$ ambient air quality concentrations and TSP deposition.

Table 2 contains the relevant criteria for particulate matter. The standards are based on the following guidelines:

- National Environment Protection Measure (NEPM) for Ambient Air Quality" by the National Environment Protection Council (NEPC, 2021);

Table 2: Relevant Air Quality Standards

Pollutant	Averaging Period	Unit[1]	Ambient Air Concentration Standard	Reference
Particles as PM_{10}	24-Hour	µg/m³	50	(NEPC 2021)
	Annual	µg/m³	25	(NEPC 2021)
Particles as $PM_{2.5}$	24-Hour	µg/m³	25	(NEPC 2021)
	Annual	µg/m³	8	(NEPC 2021)

Note:

1. Reference temperature 0°C

4.2 Particulate Deposition

4.2.1 Amenity

The Western Australian Department of Water and Environmental Regulation (DWER) has published draft guidelines for dust emissions which outlines standards for dust deposition of TSP. These guidelines are designed to take into account potential amenity impacts, such as dust depositing on fabrics and buildings. The use of these guidelines serves as a reference as to the potential magnitude of the impacts associated with dust deposition.

The DWER guidelines are based on studies undertaken on coal dust deposition in the Hunter Valley in NSW by the National Energy Research and Demonstration Council (NERDC, 1988). While the dust deposition guideline is expressed as g/m²/month, the draft DWER guidelines, has indicated that the monthly average deposition (to be compared against the guideline value) is to be determined from data spanning no less than one year, so as to account for seasonal variations.

Table 3: Amenity Dust Deposition Criteria

Pollutant	Averaging Period	Criteria (g/m²/month)
Deposited dust[1]	Annual (increase)[2]	2
	Annual (total)[3]	4

Notes

1. Dust is assessed as insoluble solids as defined by AS 3580.10.1-1991 (AM-19).
2. Maximum increase in deposited dust level.
3. Maximum total deposited dust level.

The DWER guidelines advises that the criteria for the maximum increase in deposited dust of 2 g/m^2/month is applicable when baseline data on deposited dust exists, while the total deposited dust criteria of 4 g/m^2/month criteria is applied when no baseline data exists.

4.2.2 Vegetation

There are no specific assessment guidelines available for impacts on vegetation from dust deposition, however a number of studies on impacts to vegetation from particulate deposition have been completed in Australia and globally. Most studies of the effects of mineral dusts on vegetation have focussed on dusts that have chemical effects (e.g. cement dust) or where dust loads exceed 7 g/m^2. Relatively inert mineral dusts, such as those generated in the mining process or from unsealed haul roads principally influence light and temperature relations of leaves.

A study by Doley and Rossato (2010) used published data to assess the impacts of particulate deposition on photosynthesis in cotton leaves and canopies. The study indicated that many plants species have similar ranges of values for the photosynthetic parameters used in assessing the impacts on cotton and it is possible to use the cotton estimates as a general estimate for the purpose of modelling the impacts particulate deposition and thereby the environmental risks associated with dust generating activities. The results of the study indicated that at deposition levels of approximately 9 g/m^2/month, the estimated reductions in canopy photosynthesis of cotton plants would be less than 7% with a <1% decrease in productivity (Doley & Rossato, 2010).

4.3 Background Concentration

In order to determine a background concentration to assess potential cumulative impacts for the purposes of this study, dust monitoring data from a dust monitoring station located at Communications Hill for the year 2021 was utilised.

No specific guidance for selection of an appropriate background level is provided in the Western Australian document ‘Air quality and air pollution modelling guidance notes’ (Gov. of WA DoE, 2006). Accordingly, In Victoria, the State Environment Protection Policy (Ambient Air Quality) (SEPP (AQM)) (Gov. of Vic., 2001) states that the 70th percentile concentration (concentration which is exceeded by 30% of concentrations for that averaging period) should be adopted as the background level.

The 70_{th} percentile 24-hour average and annual average PM_{10} concentration measured at the Communications Hill monitoring station for the 2021 monitoring period was used to represent the ambient background concentration for the cumulative assessment. The 70_{th} percentile 24-hour and annual average concentration of PM_{10} for the Communications Hill station was approximately 9.0 µg/m^3. Similarly, the 70th percentile 24-hour and annual average concentration of $PM_{2.5}$ for the Communications Hill station was approximately 1.26 µg/m^3. These background concentration values are taken as the indicative background dust activity for the entirety of the region and were summed to the predicted model values to attain the cumulative concentrations across each of the sensitive receptor locations.

5. EMISSIONS ESTIMATES

5.1 Introduction

The following sections outline the methodology used to quantify emissions estimates from various sources for use in the air dispersion modelling.

5.2 Emission Factors

Emission factors (EFs) and emission inventories have long been fundamental tools for air quality management. An EF is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g. kilograms of particulate emitted per tonne of iron ore mined). In most cases, these factors are simply averages of all available data of acceptable quality and are generally assumed to be representative of long-term averages for all similar facilities. However, there are inherent uncertainties associated with the use of EFs, as test data from representative sources may not always be of sufficient quantity or quality to calculate robust EFs and may not reflect the variability of actual emissions.

Data from source-specific emission tests or continuous emission monitors are typically preferred over the use of EFs to estimate source emissions as they provide the best representation of emissions from the tested source. However, in the absence of source-specific emission testing data, EFs are often the most appropriate or only method available for estimating emissions.

5.2.1 NPI Emissions Factors

The initial EFs proposed for use in this assessment are primarily based on the default EFs published in the Department of Climate Change, Energy, the Environment and Water (DCCEEW) NPI Emissions Estimation Techniques (EET) Manual for Mining (2012) (NPI mining manual) (with the exception of wind erosion). In lieu of site-specific data, it is common practice for mining operations within Australia to utilise the default EFs from the NPI mining manual in order to estimate emissions.

Many of the EFs from the NPI mining manual are derived from the United States Environment Protection Authority (USEPA) AP-42 EFs. The USEPA AP-42 represents a compilation of air pollutant EFs, published since 1972 as the primary repository for the USEPA's EFs information. The AP-42 EFs were developed and compiled from source test data, material balance studies and engineering estimates.

5.3 Emission Sources

To predict particulate deposition rates in a realistic manner, hourly estimates of particulate emissions are required from all major sources in the area. Factors which are important for particulate generation include:

- Ore type being handled - This is related to the size distribution of the material, shape and composition of the fines fraction;
- Moisture content - Increasing the moisture content decreases the dustiness of the ores with there normally being a moisture threshold above which particulate generation by material handling is negligible, known as practical extinction. This occurs as moisture acts to apply adhesive forces between particles;
- The operation occurring - Factors which are important are the drop height, the degree to which the falling ore is exposed to the wind such that winnowing can occur, and the

particulate control mechanism used. Control mechanisms may include enclosing the operation, the use of water sprays and particulate extraction to a bag filter or to a wet scrubber;

- Quantity of ore/overburden being moved and the number of movements;
- Size of stockpiles and level of activity;
- Level of vehicle traffic; and
- Ambient wind speed - For material handling operations exposed to the air, particulate emissions increase with increasing wind speed. For wind erosion, particulate emissions are negligible below a wind speed threshold, but increase rapidly above the threshold. Dust emissions from wind erosion are also dependent on the erodibility of the material which is dependent on the size distribution of the material and whether a crust has been developed.

5.3.1 Drilling

The emissions factors for drilling can be estimated using Equation 1, Equation 2 and Equation 3 as shown below.

Equation 1: Drilling (TSP)

$TSP = 0.59$ kg/hole

Equation 2: Drilling (PM_{10})

$PM_{10} = 0.31$ kg/hole

Equation 3: Drilling ($PM_{2.5}$)

$PM_{2.5} = 0.02$ kg/hole

These equations are sourced from the NPI mining manual, which in turn references the AP-42 EFs. The AP-42 provides an EF for total suspended particulates (TSP) for drilling overburden, which was assigned a factor rating of C (USEPA, 1998a).

5.3.2 Blasting

The emissions factors for blasting can be estimated using Equation 4, Equation 5 and Equation 6 as shown below.

Equation 4: Blasting (TSP)

$TSP\ (kg/blast) = 0.00022 \times A^{1.5}$

Equation 5: Blasting (PM_{10})

$PM_{10}\ (kg/blast) = 0.52 \times 0.00022 \times A^{1.5}$

Equation 6: Blasting ($PM_{2.5}$)

$PM_{2.5}\ (kg/blast) = 0.03 \times 0.00022 \times A^{1.5}$

Where:

A = blast area (m^2)

These equations are sourced from the NPI mining manual, which in turn references the AP-42 EFs for blasting overburden (USEPA, 1998a). The USEPA developed these equations for use in the crushed stone industry based on surface coal data and assigned the EF a rating of D.

5.3.3 Loading and Unloading of Ore and Waste

The emissions factors for loading and unloading of ore and waste can be estimated using Equation 7, Equation 8 and Equation 9 for use of excavators and front-end loaders on ore and overburden, and for truck dumping and general unloading, Equation 10, Equation 11 and Equation 12 can be used as shown below.

Equation 7: Loading Ore or Waste (TSP)

$TSP = 0.025$ kg/tonne

Equation 8: Loading Ore or Waste (PM_{10})

$PM_{10} = 0.012$ kg/tonne

Equation 9: Loading Ore or Waste ($PM_{2.5}$)

$PM_{2.5} = 0.003$ kg/tonne

Equation 10: Unloading Ore (TSP)

TSP = 0.012 kg/tonne

Equation 11: Unloading Ore (PM_{10})

PM_{10} = 0.0043 kg/tonne

Equation 12: Unloading Ore ($PM_{2.5}$)

$PM_{2.5}$ = 0.001 kg/tonne

These equations are sourced from the NPI mining manual and are based on the results of the NERDDC (1998) study of Australian coal mine operations. The USEPA has assigned these emission factors with a rating of A.

5.3.4 Bulldozing

The emission rate for bulldozing can be estimated using Equation 13, Equation 14 and Equation 15.

Equation 13: Bulldozing (TSP)

$TSP\ (kg/hour) = 2.6 \times (s^{1.2} / M^{1.3})$

Equation 14: Bulldozing (PM_{10})

$PM_{10}\ (kg/hour) = 0.34 \times (s^{1.5} / M^{1.4})$

Equation 15: Bulldozing ($PM_{2.5}$)

$PM_{2.5}\ (kg/hour) = 0.273 \times (s^{1.2} / M^{1.3})$

Where: S = default silt content of 10%
M = measured average moisture content of 8.22%

This equation is sourced from the NPI mining manual, which in turn references the AP-42 EFs (USEPA, 1998a). The USEPA (1998a) notes that the AP-42 dozer equation result in an emission rate (i.e. kg/hr) rather than an EF. The EF has been assigned a factor rating of D.

Figure 11 below outlines average daily soil moisture values for the Boddington region and shows and average moisture content of 45.4% for the area. This average value was utilised as the moisture content in the estimation of emissions. In the absence of site-specific emissions data for silt content, the NPI default value of 10% was considered appropriate for use.

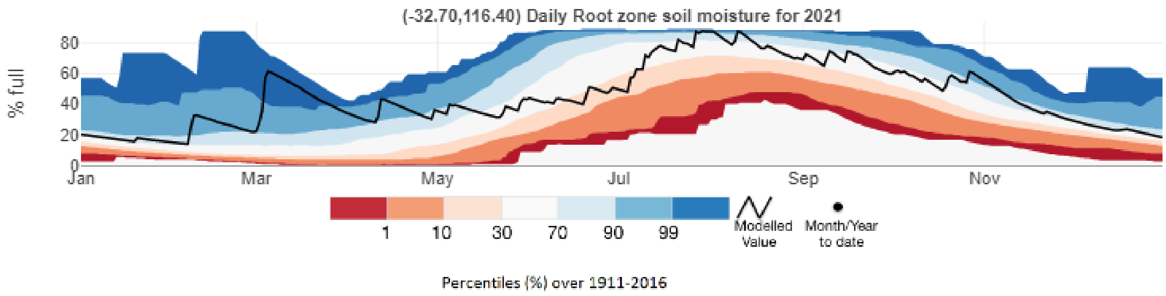

Figure 11: Average Daily Soil Moisture Content for Boddington Region, 2021 (BoM, 2021)

5.3.5 Crushing (Primary, Secondary and Tertiary)

The emission factors crushing operations of 'high' moisture ore (i.e. those with a moisture content of greater than 4%) can be estimated using Equation 16, Equation 17 and Equation 18 for primary crushing, Equation 19. Equation 20 and Equation 21 for secondary crushing, and Equation 22, Equation 23 and Equation 24 for tertiary crushing as shown below.

Equation 16: Primary Crushing (TSP)

TSP = 0.01 kg/tonne

Equation 17: Primary Crushing (PM_{10})

PM_{10} = 0.004 kg/tonne

Equation 18: Primary Crushing ($PM_{2.5}$)

$PM_{2.5}$ = 0.0015 kg/tonne

Equation 19: Secondary Crushing (TSP)

Equation 20: Secondary Crushing (PM_{10})

Equation 21: Secondary Crushing ($PM_{2.5}$)

TSP = 0.03 kg/tonne	PM_{10} = 0.012 kg/tonne	$PM_{2.5}$ = 0.0045 kg/tonne
Equation 22: Tertiary Crushing (TSP)	**Equation 23: Tertiary Crushing (PM_{10})**	**Equation 24: Tertiary Crushing ($PM_{2.5}$)**
TSP = 0.03 kg/tonne	PM_{10} = 0.01 kg/tonne	$PM_{2.5}$ = 0.0045 kg/tonne

These equations are sourced from the NPI mining manual, which in turn references the AP-42 EF for crushing of metallic minerals (USEPA, 1982). The EFs for primary, secondary and tertiary crushing represents each process as a whole (i.e. incorporating emissions from components such hoppers, surge bins and transfer points integral to the crushing unit) (USEPA, 1982). This should be taken into consideration to avoid double counting of transfers associated with each crushing unit.

5.3.6 Screening

The emission factors for screening can be estimated using Equation 25, Equation 26 and Equation 27.

Equation 25: Screening (TSP)	**Equation 26: Screening (PM_{10})**	**Equation 27: Screening ($PM_{2.5}$)**
TSP = 0.08 kg/tonne	PM_{10} = 0.06 kg/tonne	$PM_{2.5}$ = 0.0018 kg/tonne

These equations are sourced from the NPI mining manual, which does not provide reference information. However, SKM (2005) note the NPI EFs for screening most closely approach the USEPA (2004) EFs for fines screening at crushed stone processing operations (namely 0.15 kg/tonne and 0.036 kg/tonne for TSP and PM_{10} respectively), while EFs for screening associated with primary to tertiary crushing operations are 0.0125 kg/tonne for TSP and 0.0043 kg/tonne for PM_{10}.

5.3.7 Handling/Transfer

The emission factors for handling and transfer can be estimated using Equation 28, Equation 29 and Equation 30.

Equation 28: Handling/Transfers (TSP)	**Equation 29: Handling/Transfers (PM_{10})**	**Equation 30: Handling/Transfers (PM_{10})**
TSP = 0.0003 kg/tonne	PM_{10} = 0.00014 kg/tonne	$PM_{2.5}$ = 0.00002 kg/tonne

These equations are sourced from the NPI mining manual, which in turn references the AP-42 EF for the transfer and handling of metallic minerals (including conveyor transfers, ore dumps, or other points where material is allowed to fall freely) (USEPA, 1982). The selected EFs represents high moisture ores. The USEPA assigns this EF a rating of A.

5.3.8 Haul Roads

The emission factors for the haul roads can be estimated using Equation 31, Equation 32 and Equation 33.

Equation 31: Haul Roads (TSP)

$$TSP\ (kg/VKT) = (0.4536 / 1.6093) \times k \times (s/12)^{0.7} \times ((W \times 1.023)/3)^{0.45}$$

Where:

k = particle size multiplier (4.9 for TSP)

s = silt content (%) (NPI default of 10% to be applied)

W = vehicle gross mass in tonnes (262 tonnes to be adopted as the average of an empty and fully laden CAT793F haul truck)

Equation 32: Haul Roads (PM_{10})

$$PM_{10}\ (kg/VKT) = (0.4536 / 1.6093) \times k \times (s/12)^{0.9} \times ((W\times 1.023)/3)^{0.45}$$

Where:

k = particle size multiplier (1.5 for PM_{10})

s = silt content (%) (NPI default of 10% to be applied)

W = vehicle gross mass in tonnes (262 tonnes to be adopted as the average of an empty and fully laden CAT793F haul truck)

Equation 33: Haul Roads ($PM_{2.5}$)

$$PM_{2.5}\ (kg/VKT) = (0.4536 / 1.6093) \times k \times (s/12)^{0.9} \times ((W\times 1.023)/3)^{0.45}$$

Where:

k = particle size multiplier (0.15 for $PM_{2.5}$)

s = silt content (%) (NPI default of 10% to be applied)

W = vehicle gross mass in tonnes (262 tonnes to be adopted as the average of an empty and fully laden CAT793F haul truck)

This equation is sourced from the NPI mining manual, which in turn references the AP-42 EFs for miscellaneous sources (USEPA, 2006b). The USEPA (2006b) assigned this EF a factor rating of B.

5.3.9 Wind Speed Dependence for Material Handling

For all material handling processes exposed to the wind, increasing wind speed acts to increase dust emissions through winnowing of the particles from the falling ore. The USEPA batch drop equations (USEPA, 2004a) specify that the dust emission increases with the wind speed to the power of 1.3, as follows in Equation(s) 34:

Equation(s) 34: Wind Speed and Material Handling Emission Rate

$$E_{Actual} = E_{2.2}\,(WS/2.2)^{1.3}$$

Where:

WS is the wind speed at the drop height;

$E_{2.2}$ is the dust emission given for a wind speed of 2.2 m/s; and

E_{Actual} is the final emission rate.

The average source height was assumed to be 5 m above the surface, with the 10 m wind speeds used to estimate the 5 m wind speeds using the 1/7 power law given by:

$$WS_5 = WS_{10}\,(5/10)^{(1/7)}$$

Where:

WS_{10} is the wind speed at 10 m.

WS_5 is the calculated wind speed at 5 m.

5.3.10 Wind Erosion

Dust emissions generated by wind are generally negligible below a wind speed threshold but increase rapidly when wind speeds exceed the threshold. Dust emissions from wind erosion are also dependent on the erodibility of the material which in turn is dependent on the size distribution of the material and whether a crust has developed. In general, material with a large (>50%) fraction of non-erodible particles (generally particles greater than 1 mm to 2 mm) will not erode as the erodible fraction is protected by these particles. Fine ores are generally much more erodible by wind erosion, particularly if they have a large fraction of particles in the range from 100 µm to 250 µm which can be dislodged by wind and then rolled and skipped along the surface (saltation). These larger particles can then dislodge the smaller (<50 µm) dust fraction which can remain suspended in the air.

In order to predict the dust emission associated with wind erosion, Ramboll determined a series of wind speed and wind speed dependencies based on monitored wind speed, wind direction and concentration data acquired from the Communications Hill dust monitor. The custom emission factor equation for wind erosion for both the RDA and the Mining Operations respectively as follows in Equation 35 & 36.

Equation 35: Wind Erosion (RDA)

$$E_{wind} = 4.27^{-2} * e^{(0.7256*WS)}/e^{(0.7256*WST)}$$

Where:

WS_T is the threshold for wind erosion in m/s, taken to be 7 m/s;
WS is the wind speed in the region for the period of time in m/s; and
E_{wind} is the PM_{10} emissions ($g/m^2/s$).

Equation 36: Wind Erosion (Mining Operations)

$$E_{wind} = 13.484 * e^{(0.0733*WS)}/e^{(0.0733*WST)}$$

Where:

WS_T is the threshold for wind erosion in m/s, taken to be 5 m/s;
WS is the wind speed in the region for the period of time in m/s; and
E_{wind} is the PM_{10} emissions ($g/m^2/s$).

Dust emissions generated by wind erosion were considered in this assessment for all exposed surface areas. At wind speeds greater than the threshold, emission rates are scaled up based on the wind speed and the equations outlined above.

5.3.11 Rainfall Dependence

To account for the effects of rainfall in reducing dust emissions, a simple scheme was adopted. With regards to wind erosion, rainfall was assumed to not only suppress dust emissions at the time rain was occurring, but to also result in a suppression of the dust emissions that gradually decreases over time as the areas dries.

Dust emissions were taken to linearly return to a rainfall unaffected state within 400 hours of the rainfall evaporating if the rainfall event was greater than 25 mm. During the period when it was raining or if the rainfall had not evaporated, emissions were set to zero. The evaporation rate at the surface was assumed to be 1.25 times the amount from a Class A pan with a limit to the amount of water on/near the surface of 75 mm. Daily average evaporation rates for each month were obtained from the BoM for the Perth Airport monitoring station.

5.4 Summary of Estimated Emissions

A summary of emissions estimates is presented in Table 4 indicating predicted fugitive emissions for activities across mining operations.

Table 4: Source Emission Factors & Rates

Fugitive Emissions Source	Emission Factor(s)				Control		Annual Activity		TSP	PM_{10}	$PM_{2.5}$
	TSP	PM_{10}	$PM_{2.5}$	Units	Description	%	Value	Unit	g/s	g/s	g/s
Mining Operations											
Drilling	0.59	0.307	0.0177	kg/hole	Water Sprays	50%	87,120	hole/Yr	0.41	0.21	0.01
Blasting	129	67.1	3.87	kg/blast	No control	0%	264	blast/Yr	0.27	0.14	0.01
Excavating	0.025	0.012	0.00263	kg/tonne	Excavation and Truck Loading - Water Sprays and in-pit retention	53%	66,550,000	tonne/Yr	12.40	5.95	1.30
Truck Loading	0.025	0.012	0.00263	kg/tonne	Excavation and Truck Loading - Water Sprays and in-pit retention	53%	66,550,000	tonne/Yr	12.40	5.95	1.30
Stockpiling											
Wind Erosion of Stockpiles at ROM	11500	5750	863	kg/ha/yr	Watering	50%	1,307	ha	476.61	238.31	35.77
Wind Erosion of Stockpiles at WRD	11500	5750	863	kg/ha/yr	Watering	50%	215	ha	78.40	39.20	5.88
Stockpiling at ROM	0.000311	0.000147	0.0000233	kg/tonne	Water Sprays	50%	34,410,000	tonne/Yr	0.17	0.08	0.01
Stockpiling at WRD	0.000311	0.000147	0.0000233	kg/tonne	Water Sprays	50%	29,210,000	tonne/Yr	0.34	0.16	0.03
Bulldozing											
Bulldozing (Coarse Ore Stockpile)	2.76	0.568	0.29	kg/hour	Water Sprays on Stockpiles	50%	8,760	hour/Yr	0.38	0.08	0.04
Crushing											
Primary Crushing in Pit Ores	0.01	0.004	0.0012	kg/tonne	Water sprays to keep ore wet - 50%	50%	40,080,000	tonne/Yr	6.35	2.54	0.76
Secondary Crushing @ Processing Plant	0.03	0.012	0.0036	kg/tonne	Water sprays to keep ore wet - 50%	50%	40,080,000	tonne/Yr	19.06	7.63	2.29
Transfers											
Primary Crusher to Apron Feeder	0.000311	0.000147	0.0000233	kg/tonne	Water Sprays	50%	40,080,000	tonne/Yr	0.20	0.09	0.01
Apron Feeder to Acceleration Conveyor	0.000311	0.000147	0.0000233	kg/tonne	Water Sprays	50%	40,080,000	tonne/Yr	0.20	0.09	0.01
Acceleration Conveyor to Overland Conveyor	0.000311	0.000147	0.0000233	kg/tonne	Water Sprays	50%	40,080,000	tonne/Yr	0.20	0.09	0.01
Reclaim/Coarse Screen to Secondary Crushing Circuit	0.000311	0.000147	0.0000233	kg/tonne	Water Sprays	50%	40,080,000	tonne/Yr	0.29	0.14	0.02
Secondary Crushing Conveyor to Crusher Feeds	0.000311	0.000147	0.0000233	kg/tonne	Hooding with Filters - Secondary Transfer Stations	83%	40,080,000	tonne/Yr	0.10	0.05	0.01
Coarse Screen Feed Conveyor to Coarse Screen Feeders	0.000311	0.000147	0.0000233	kg/tonne	Hooding with Filters - Secondary Transfer Stations	83%	40,080,000	tonne/Yr	0.10	0.05	0.01
HPGR Feed Conveyor to HPGR Feeder	0.000311	0.000147	0.0000233	kg/tonne	Hooding with Filters - Secondary Transfer Stations	83%	40,080,000	tonne/Yr	0.10	0.05	0.01
Collection Conveyor to HPGR Transfer Conveyor	0.000311	0.000147	0.0000233	kg/tonne	Hooding with Filters - Secondary Transfer Stations	83%	40,080,000	tonne/Yr	0.10	0.05	0.01
HPGR Transfer Conveyor to Product Conveyor	0.000311	0.000147	0.0000233	kg/tonne	Hooding with Filters - Secondary Transfer Stations	83%	40,080,000	tonne/Yr	0.10	0.05	0.01
Product Conveyor to FOB Feed Conveyor	0.000311	0.000147	0.0000233	kg/tonne	Hooding with Filters - Secondary Transfer Stations	83%	40,080,000	tonne/Yr	0.10	0.05	0.01
Mill Feed to Wet Screen	0.000311	0.000147	0.0000233	kg/tonne	Mill Feeder, Wet Screen and Oversize Returns Transfer Stations (Windbreaks and water sprays)	65%	40,080,000	tonne/Yr	0.21	0.10	0.02
Wet Screen to Fine Screen Oversize Conveyor	0.000311	0.000147	0.0000233	kg/tonne	Mill Feeder, Wet Screen and Oversize Returns Transfer Stations (Windbreaks and water sprays)	65%	40,080,000	tonne/Yr	0.20	0.09	0.01
Fine Screen Oversize Conveyor to Transfer Conveyor	0.000311	0.000147	0.0000233	kg/tonne	Mill Feeder, Wet Screen and Oversize Returns Transfer Stations (Windbreaks and water sprays)	65%	40,080,000	tonne/Yr	0.20	0.09	0.01
Fine Screen Oversize Conveyor to COS Feed Conveyor	0.000311	0.000147	0.0000233	kg/tonne	Mill Feeder, Wet Screen and Oversize Returns Transfer Stations (Windbreaks and water sprays)	65%	40,080,000	tonne/Yr	0.20	0.09	0.01
Wheel Generated Dust Emissions											
Haul Trucks Travel in Pits	10.2	3.02	0.302	kg/VKT	Level 2 watering : > 2L/m2/hr - NPI - 75%	75%	10,924,110	VKT/Yr	441.66	130.77	13.08
Haul Truck Travel in Main WRD	10.2	3.02	0.302	kg/VKT	Level 2 watering : > 2L/m2/hr - NPI - 75%	75%	8,622,425	VKT/Yr	697.21	206.43	20.64
Haul Truck Travel in North WRD	10.2	3.02	0.302	kg/VKT	Level 2 watering : > 2L/m2/hr - NPI - 75%	75%	730,391	VKT/Yr	59.06	17.49	1.75
Light Vehicles	0.382	0.11	0.0287	kg/VKT	Level 2 watering : > 2L/m2/hr - NPI - 75%	75%	91,250	VKT/Yr	0.66	0.19	0.05

6. MODELLING METHODOLOGY

6.1 Model Selection

The CALPUFF dispersion model was used for this updated assessment. CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model. It utilises three-dimensional wind fields to simulate the effects of the temporal and spatial meteorological conditions on pollutant transport, transformation and removal. CALPUFF also allows for three-dimensional characterisation of land use and surface characteristics such as height and density of vegetation.

The meteorological information used in the modelling was derived from the prognostic meteorological component of The Air Pollution Modelling (TAPM) in conjunction with site specific meteorological monitoring undertaken at the site. The prognostic data from TAPM was used as input into the CALMET meteorological pre-processing program used to generate meteorological files for CALPUFF. TAPM was developed by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) and consists of coupled prognostic meteorological and air pollution dispersion model components.

6.2 Model Parameterisation

6.2.1 TAPM

The Air Pollution Model (TAPM) (Version 4) was used to generate a prognostic gridded meteorological dataset for the CALMET model domain. TAPM was developed by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) and consists of coupled prognostic meteorological and air pollution dispersion model components. The meteorological component of TAPM predicts the local-scale meteorological features, such as sea breezes and terrain-induced circulations, using the larger-scale synoptic meteorology as boundary conditions combined with other data including terrain, land use, soil and surface types. TAPM has been used extensively throughout Australia for generating site specific meteorological files for use in air dispersion modelling studies.

6.2.2 CALMET

The CALMET meteorological processor was used to develop a meteorological file for input into the CALPUFF model. CALMET is a diagnostic meteorological model that produces three-dimensional wind fields based on parameterised treatments of terrain effects such as slope flows and terrain blocking effects. Meteorological observations from the site were incorporated to determine the wind field in areas of the domain within which the observations are representative. Fine scale terrain effects were determined using the diagnostic wind module in CALMET.

6.2.3 CALPUFF

The CALPUFF modelling system was used to predict ambient concentration and deposition rates associated with fugitive particulate emissions from operations associated with the South Middleback Ranges (SMR) mines and its expansion to Cooks North. CALPUFF provides a non-steady state modelling approach which evaluates the effects of spatial changes in the meteorological and surface characteristics and has been listed by the United Stated Environmental Protection Agency (USEPA) as an alternative model for situations involving complex terrain and wind conditions, where typical steady-state plume dispersion models (such as AERMOD) have limited capability.

6.3 CALPUFF Model Parameterisation

The following model set up options within CALPUFF were used:

- Computational grid of 20 km by 20 km encompassing the Newmont mine(s) and Boddington region, associated haul road(s), the processing facility and stockpiles, with meteorological grid spacings of 1000 m;
- Multiple sampling grids was utilised with grid spacing of approximately 1000 m;
- Dry deposition;
- No chemical transformation;
- Partial Plume Penetration;
- Puff modelling method; and
- Default partial plume path adjustment.

Each emission source was individually modelled in CALPUFF using a fixed emission rate and the resultant outputs for each source were scaled against the corresponding hourly variable emissions to generate predicted concentration and deposition rates for each hour of the year, at each model grid point within the modelled region. The predicted concentrations and deposition rates for each source were then combined for each of the modelled scenarios.

An annual wind rose generated by the CALMET meteorological processor for the proposed site location is presented in Figure 12, with the annual frequency of wind speeds presented in Table 5.

Table 5: Distribution of Wind Speeds for 2021 (CALMET-Generated Data)

Wind Speed	Calms	0.0–1.0 m/s	1.0-2.0 m/s	2.0-3.0 m/s	3.0-4.0 m/s	4.0-5.0 m/s	5.0-6.0 m/s	6.0-7.0 m/s	>7.0m/s
(%)	0.0	0.1	15.3	22.2	20.2	16.0	11.5	11.5	11.6

The observations show that there are no calm wind speeds, a low frequency of low wind speeds (0-2m/s), a relatively high frequency of mid-ranges wind speeds (2-7m/s), and a low frequency of high-range wind speeds (>7m/s).

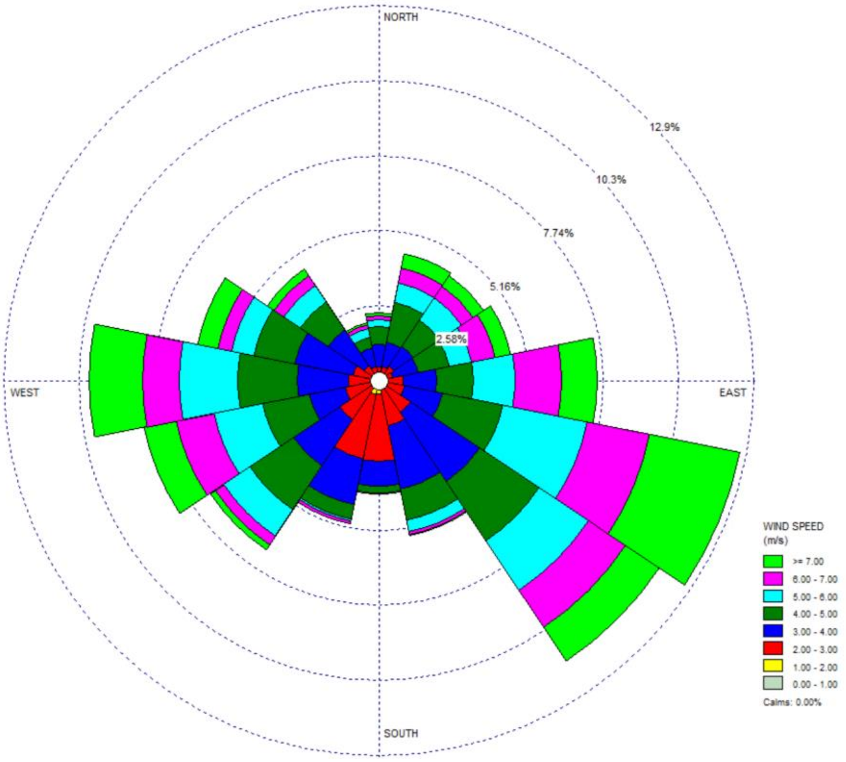

Figure 12: 2021 CALMET – Generated Annual Wind Rose

6.3.1 Particle Size Distribution

Particle size distribution data used in the model for particles in the sub-fraction of TSP emissions were based on the USEPA distributions for batch drop, wind erosion and vehicle emissions (USEPA, 2004a, b and c) as listed in Table 6. A distribution composite to all three USEPA distributions was adopted and applied for this study in the absence of actual data.

Table 6: Source Particle Size Distributions

<table>
<tr><th rowspan="2">Particle Size Range (µm)</th><th rowspan="2">Representative Particle Size (µm)</th><th colspan="4">Percentage of Particulate (%) in Various Size Ranges</th></tr>
<tr><th>USEPA Batch Drop</th><th>USEPA Wind Erosion</th><th>USEPA Unpaved Road</th><th>This Study</th></tr>
<tr><td><2.5</td><td>1.3</td><td>11</td><td>14.8</td><td>3.3</td><td>9</td></tr>
<tr><td>2.5 - 5.0</td><td>3.8</td><td>9</td><td rowspan="3">22.2</td><td rowspan="3">18.7</td><td>8</td></tr>
<tr><td>5.0 - 7.5</td><td>6.3</td><td rowspan="2">15</td><td>7</td></tr>
<tr><td>7.5 – 10</td><td>8.3</td><td>6</td></tr>
<tr><td>10 – 15</td><td>12.5</td><td>13</td><td>7</td><td rowspan="3">52</td><td>14</td></tr>
<tr><td>15 – 23</td><td>19</td><td rowspan="2">26</td><td rowspan="2">30</td><td>15</td></tr>
<tr><td>23 – 30</td><td>26</td><td>15</td></tr>
<tr><td>30 – 40</td><td>35</td><td rowspan="2">26</td><td rowspan="2">26</td><td rowspan="2">26</td><td>15</td></tr>
<tr><td>40 – 50</td><td>45</td><td>11</td></tr>
</table>

Notes

1. Particle sizes are equivalent aerodynamic size and not the physical size. The equivalent aerodynamic size relates to the aerodynamic properties of the particle as is used in dust sampling. For example, PM_{10} samplers measure the dust below 10 µm equivalent aerodynamic size and not the physical size.
2. Wind erosion and vehicle emission size distributions are given for below 30 µm only, but have been adjusted here to less than 50 µm based on assuming 74% of the particulate is less than 30 µm as per the batch drop distribution.

The particle sizes specified in Table 6 are based on the equivalent aerodynamic diameter and not the physical size. The equivalent aerodynamic diameter relates to the aerodynamic properties of the particle with a density of 1 g/cm^3 as is used in particulate matter sampling.

7. MONITORING REVIEW

7.1 Introduction

The following sections outline the review of ambient air quality monitoring data collected by Newmont, which Ramboll undertook as part of this study to observe particulate trends in the region, and for validation of the air dispersion model.

7.2 Monitoring Data from Communications Hill

A total of 5 years of monitoring data collected from the Communications Hill monitoring station was provided by NBG from 2017-2021. A trend analysis has been conducted to study the 95th, 75th and 50th percentile concentration of both PM_{10} and $PM_{2.5}$ for the 2017-2021 data set, which can be seen in Figure 13 and Figure 14 respectively.

The monitoring indicates that on average, concentrations monitored at Communications Hill have decreased over the past five years. These concentrations are probably more indicative of activities at the mining operations and less to do with activities at RDA as meteorological conditions likely to result in significant dust emissions from the RDA (dry warm conditions with high wind speeds) are less frequent from the from the direction of the RDA to the Communications Hill monitor. Monitored peak concentrations generally occur during the summer/autumn months.

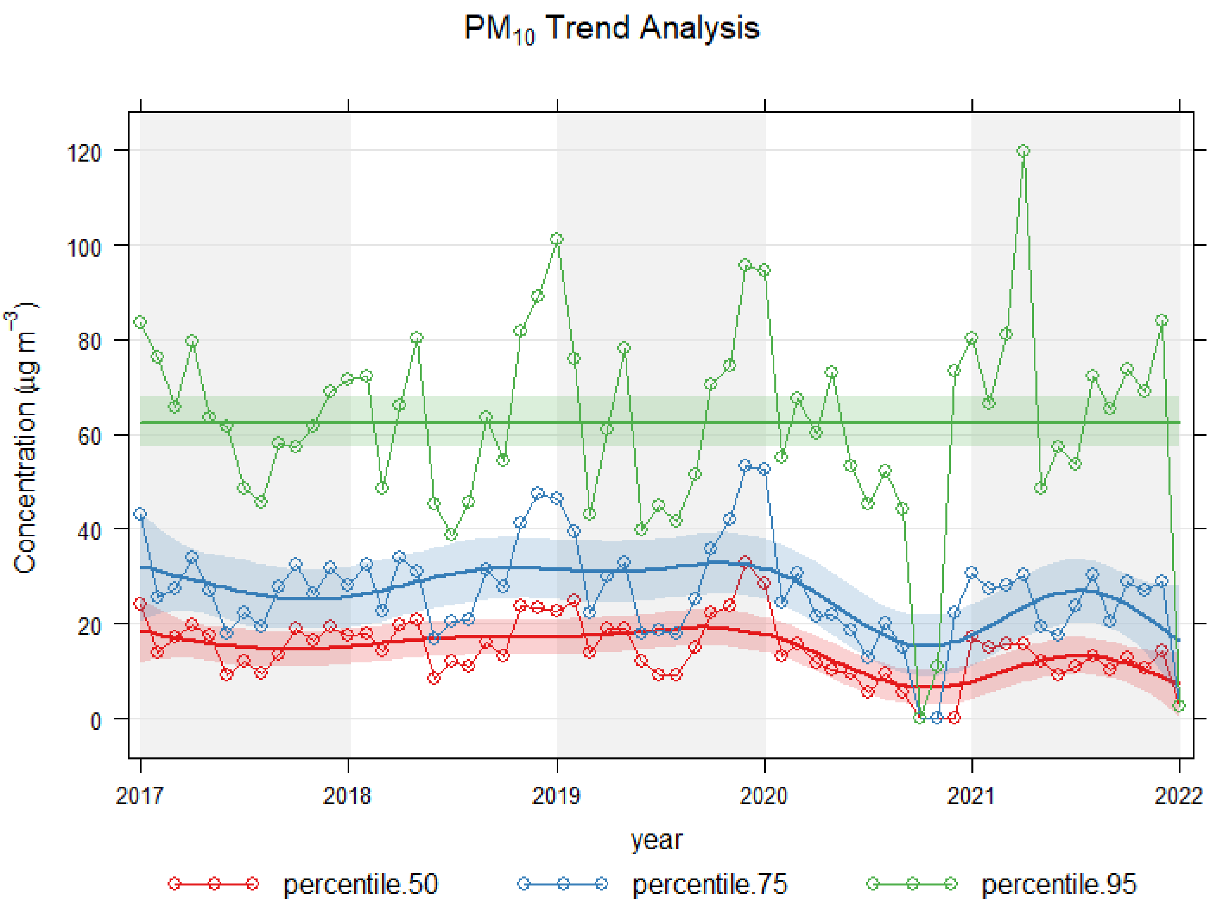

Figure 13: PM_{10} Monthly Average Trend Analysis for Communications Hill (2017-2021)

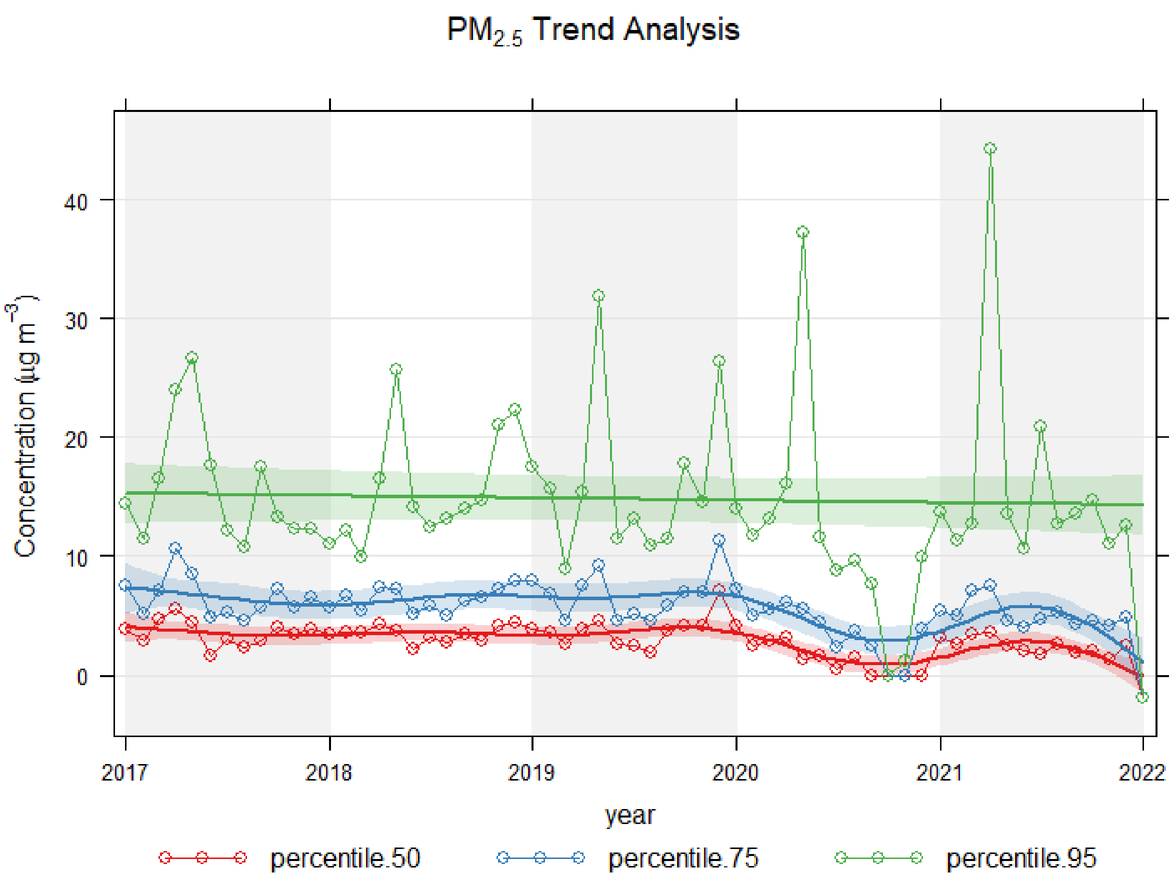

Figure 14: $PM_{2.5}$ Monthly Average Trend Analysis for Communications Hill (2017-2021)

7.3 Depositional Dust Analysis

NBG provided Ramboll dust deposition data from their six (6) deposition monitors located in the region from 2017-2021. An overview of the deposition monitor locations can be seen in Figure 15, where monitors 2 and 3 are located near the mining operations, and monitors 8, 9, 10 and 11 are located at the north-west corner of the RDA.

A summary of the deposition data provided can be seen in Table 7. The average deposition rate was calculated from each of the dust monitors excluding data from 2021, where a significant increase in deposition rates was noted. The average deposition rate observed in the region (excluding 2021 data) was approximately 2.39 g/m^2/month.

In 2021, dust monitors 8, 9, 10 and 11 recorded elevated deposition rates with an average deposition rate of 18.42 g/m^2/month. Dust control monitors (2 and 3) situated near the mining operations did not record the same increases, indicating that the elevated rates of deposition at dust monitors 8, 9, 10 and 11 were likely associated with emissions from the RDA. This is likely associated with the close proximity of the dust monitors to the RDA and the direction of the wind trajectory being almost directly upwind of the RDA towards the dust monitors 8,9,10 and 11.

Figure 15: Location of Dust Deposition Monitors

Table 7: Summary of Monitored Deposition Data (2017-2021)

Sample Point	Year	Annual Average Total Insoluble Matter (g/m²/month)	Annual Average Criteria (g/m²/month)
Deposited Dust Control Monitor 2	2017	2.21	4.0
Deposited Dust Control Monitor 3		3.13	
Deposited Dust Monitor 8		2.20	
Deposited Dust Monitor 9		2.84	
Deposited Dust Monitor 10		2.96	
Deposited Dust Monitor 11		1.60	
Deposited Dust Control Monitor 2	2018	2.42	
Deposited Dust Control Monitor 3		1.63	
Deposited Dust Monitor 8		1.52	
Deposited Dust Monitor 9		1.68	
Deposited Dust Monitor 10		3.58	
Deposited Dust Monitor 11		3.78	
Deposited Dust Control Monitor 2	2019	2.28	
Deposited Dust Control Monitor 3		1.76	
Deposited Dust Monitor 8		1.68	
Deposited Dust Monitor 9		2.89	
Deposited Dust Monitor 10		2.33	
Deposited Dust Monitor 11		3.99	
Deposited Dust Control Monitor 2	2020	2.67	
Deposited Dust Control Monitor 3		1.95	
Deposited Dust Monitor 8		1.73	
Deposited Dust Monitor 9		1.84	
Deposited Dust Monitor 10		2.63	
Deposited Dust Monitor 11		3.18	
Deposited Dust Control Monitor 2	2021	2.16	
Deposited Dust Control Monitor 3		1.56	
Deposited Dust Monitor 8		16.74	
Deposited Dust Monitor 9		18.42	
Deposited Dust Monitor 10		9.49	
Deposited Dust Monitor 11		6.28	

8. MODELLING RESULTS

8.1 Model Validation

Emission estimates utilised in the model were refined using historical ambient monitoring data from Communication Hill in 2021 and deposition monitoring data at the RDA.

Air dispersion modelling was used to predict concentrations of PM_{10} and $PM_{2.5}$ at the location of an ambient air quality monitor located at Communications Hill using default emissions estimates for all sources including operations and the RDA. The results of the modelling were plotted against the observed monitoring data for 2021 using a quantile-quantile (Q-Q) plot, as shown in Figure 16.

The emission rates from the RDA and operational sources were then iteratively adjusted and modelled to conservatively approximate monitored concentrations at the ambient monitoring location as shown in Figure 17 as well as monitored deposition rates from gauges located next to the RDA.

Due to variation in the monitored deposition gauges, two validation scenarios were assessed that looked at the highest monitored deposition rate at a gauge in 2021 as well as an average of all of the deposition gauges located near the RDA in 2021. An additional scenario was assessed looking at potential impacts if emissions from the RDA matched the historical average deposition rate before 2021 when a large increase in deposition was detected.

The three scenarios assessed included the following. All three scenarios used the refined emissions dataset for mining operations:

- **Scenario #1:** Emissions from the RDA were based on the highest monitored deposition rate recorded at the Northern RDA monitors;
- **Scenario #2:** Emissions from the RDA were based on the average deposition rates recorded at the Northern RDA monitors;
- **Scenario #3:** Emissions from the RDA were based on historical average deposition rates recorded across all the deposition monitors for the years 2017-2020.

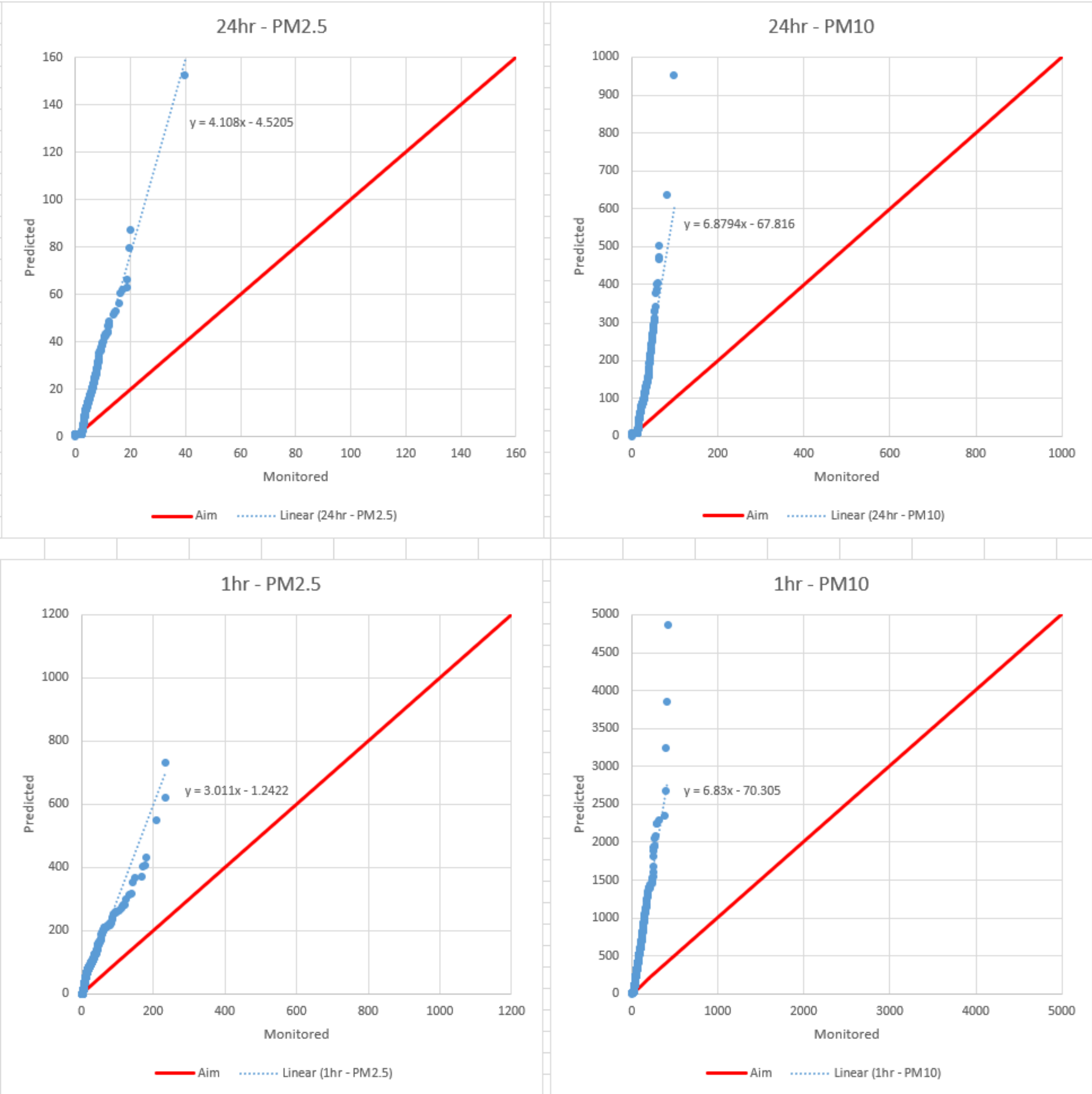

Figure 16: Quantile-Quantile (Q-Q) Predicted Modelling Results vs Monitored Data for 1-hr & 24-hr PM_{10} & $PM_{2.5}$ Average Concentrations – using Default Emission Rates (g/s)

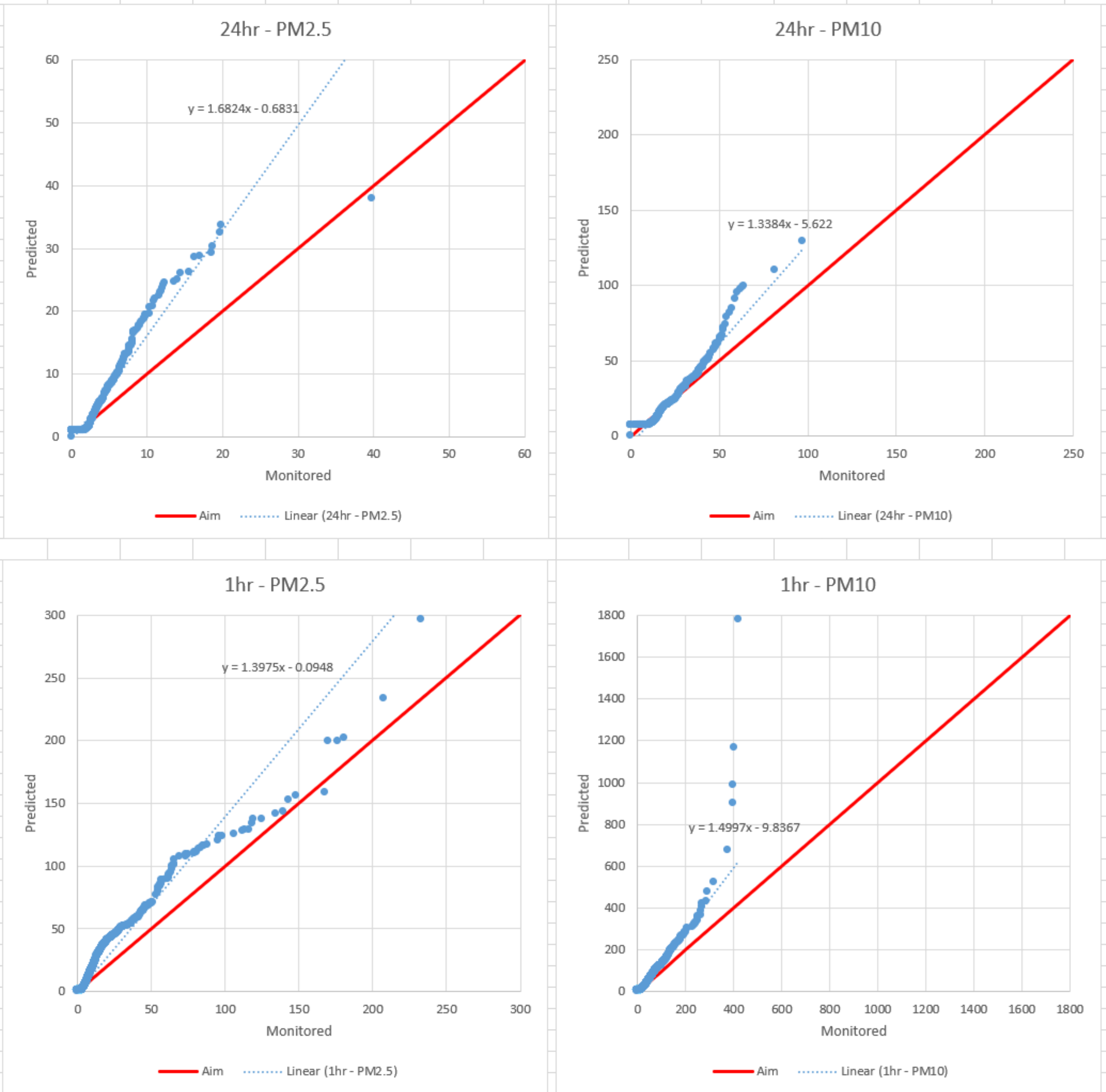

Figure 17: Quantile-Quantile (Q-Q) Predicted Modelling Results vs Monitored Data for 1-hr & 24-hr PM_{10} & $PM_{2.5}$ Average Concentrations – using Validated Emission Rates (g/s)

8.2 Results

Maximum predicted 24-hour average and annual average GLCs of PM_{10} and $PM_{2.5}$ were predicted for all three scenarios across the modelling domain and at nominated receptor locations nearest to the operations, located at Communications Hill, the Village, Boddington Town, Bannister (near eastern roads) and North-East Establishments #1 & #2 as shown in Figure 3 (Section 2.1).

The predicted GLCs in isolation and cumulatively with the assumed background at the nominated sensitive receptor location are presented in Table 8. These locations were chosen as they provide a good overview of Newmont's potential dust impacts to nearby settlements and high traffic roads. The maximum monthly deposition of TSP is presented in Table 9, which highlights that the highest levels of dust are generated during the summer months (November – April) and that the maximum recorded values in Table 8 likely correspond with the model's predictions during these months.

Both the PM_{10} and $PM_{2.5}$ 24-hour average GLCs were predicted to exceed the relevant ambient air quality criteria at the North-East Establishment #1 receptor for the scenarios with elevated emissions from the RDA for Scenarios #1 & #2 (elevated emissions from the RDA based on 2021 dust deposition rates). Exceedances of the ambient air quality guidelines were not predicted at these locations for Scenario #3 where emissions from the RDA were based on average deposition monitoring results at the RDA between 2017 and 2020.

No exceedances of the annual average guideline are observed for either pollutant (PM_{10} and/or $PM_{2.5}$) for all scenarios across all receptor locations, in both isolation and cumulatively with background concentrations.

The dust deposition guideline was not exceeded for any of the scenarios. Although the predicted deposition does not pose a risk to regional sensitive receptors, the high loading of dust monitored near the RDA in 2021 could potentially impact local vegetation and should be monitored if species of interest are located in close proximity. Ramboll recommends continual monitoring to determine if the exceedances were an isolated incidence, or part of an ongoing trend.

The PM_{10} maximum 24-hour average, PM_{10} annual average, $PM_{2.5}$ maximum 24-hour average and $PM_{2.5}$ annual average predicted GLC contour plots for operations in isolation for all scenarios are presented in Figure 18 to Figure 29 respectively. The deposition contour plots for each of the three scaling scenarios are presented in Figure 30 to Figure 32.

In accordance with the local protection areas surrounding the RDA (Figure 5), an additional contour plot for Scenario #1 with an overlay of protection area boundaries for the region can be seen in Figure 33, which shows that the placement of the RDA Monitors (R1 & R2) is appropriate, as the highest deposition levels are predicted in proximity to the monitors.

Analysis of source contributions as well meteorological conditions associated with the exceedances of the short term (24-hour average) concentrations for Scenario #1 and #2 indicates they were associated with emissions from the RDA during periods of winds exceeding the wind speed threshold for dust lift off during dry conditions.

8.3 Recommendations

Ramboll recommends that Newmont place monitors (similar to dust monitor(s) 2 and 3) in an open area at the extent of their operational boundary within the region targeted mainly in the direction of the North-East Establishments and the Village and Boddington township.

An aerial figure with the potential locations for the additional monitoring to be stationed have been identified in Figure 34. These locations for the additional monitoring were selected on the basis of the modelling, which predicted that the highest GLCs of particulates are most likely to be prevalent in these regions. The locations highlighted in Figure 34 (A,B, and C) are only an approximate guide to the placement of the monitors, and additional measures must be taken for the selection of the final location which follows below.

When positioning and placing the monitors in the recommended areas, the following criteria should be implemented as per the Australian/New Zealand Standard (Guide to siting air monitoring equipment) (AS/NZS 2016):

- No major obstruction between the major source and the sampling inlet should be present, ensuring unrestricted air flow of ~180° around the sample inlet;
- No extraneous sources nearby;
- Minimum of 2m but ideally up to 50m in distance from any road; and
- Minimum of 10m distance from any object including trees with a height exceeding 2m below the height of the sample inlet.

Upon Newmont's selection of the final locations for the additional monitoring, Ramboll can provide advice on the selected location for suitability. Additionally, for the dryer and hotter months of the year, Ramboll also recommends the implementation of greater dust control measures to mitigate the elevated concentrations of particulates which are monitored and predicted during high wind speed conditions. Examples of potential control measures are provided below:

- Watering at source locations to reduce dust lift-off;
- Bind the surface of the tailings facility either by use of hydro-suppressants and/or hydro-mulching;
- Progressively rehabilitate unused areas of the region;
- Implementation of wind fences/screens at the facility boundary in directions where high wind speeds trend (i.e. South-East and West bearings from the NBG facility as per Figure 12).

Table 8: Maximum Predicted PM_{10} & $PM_{2.5}$ GLCs for Newmont Operations Under Various Validation Scenarios

Pollutant	Averaging Period	Guideline Concentration (µg/m³)	Maximum Predicted Concentration in Isolation (µg/m³)[2]						Background Concentration (µg/m³)	Maximum Predicted Cumulative Concentration (µg/m³)[2]					
			Communications Hill[1]	Village	Boddington	Bannister	North-East Establishment #1	North-East Establishment #2		Communications Hill[1]	Village	Boddington	Bannister	North-East Establishment #1	North-East Establishment #2
Scenario #1: Emissions from the RDA were based on the highest monitored deposition rate recorded at the Northern RDA monitors															
PM_{10}	24-hour	50	122.2	20.7	9.8	29.5	125.2	42.8	9	131.2	29.7	18.8	38.5	134.2	51.8
	Annual	25	15.7	1.2	0.6	0.9	1.6	0.6	9	24.7	10.2	9.6	9.9	10.6	9.6
$PM_{2.5}$	24-hour	25	36.5	6.8	3.6	9.8	23.0	7.3	1.26	37.8	8.1	4.9	11.1	24.3	8.6
	Annual	8	5.5	0.4	0.2	0.3	0.4	0.2	1.26	6.7	1.7	1.5	1.6	1.6	1.4
Scenario #2: Emissions from the RDA were based on the average deposition rates recorded at the Northern RDA monitors															
PM_{10}	24-hour	50	101.3	20.7	9.8	29.5	65.2	22.2	9	110.3	29.7	18.8	38.5	74.2	31.2
	Annual	25	15.3	1.2	0.6	0.9	1.1	0.5	9	24.3	10.2	9.6	9.9	10.1	9.5
$PM_{2.5}$	24-hour	25	36.5	6.8	3.6	9.8	12.1	3.8	1.26	37.8	8.1	4.9	11.1	13.4	5.0
	Annual	8	5.4	0.4	0.2	0.3	0.3	0.1	1.26	6.6	1.7	1.5	1.6	1.5	1.4
Scenario #3: Emissions from the RDA were based on historical average deposition rates recorded across all the deposition monitors for the years 2017-2020															
PM_{10}	24-hour	50	101.3	20.2	9.8	29.5	15.5	8.7	9	110.3	29.2	18.8	38.5	24.5	17.7
	Annual	25	14.9	1.1	0.6	0.9	0.6	0.4	9	23.9	10.1	9.6	9.9	9.6	9.4
$PM_{2.5}$	24-hour	25	36.5	6.6	3.6	9.8	3.2	2.8	1.26	37.8	7.9	4.9	11.1	4.5	4.1
	Annual	8	5.3	0.4	0.2	0.3	0.2	0.1	1.26	6.6	1.7	1.5	1.6	1.5	1.4

Note:

1. The ambient air quality criteria is not applicable at Communications Hill as it is not a sensitive receptor location, but rather, a monitoring station location within Newmont's operational jurisdiction.
2. Highest values measured generally associated with the summer months (hotter and dryer) between November to April.

Table 9: Monthly Deposition Analysis (TSP – g/m²/month)

Pollutant	Monthly Deposition (g/m²/month)												Max (g/m²/month)	Max Month
	January	February	March	April	May	June	July	August	September	October	November	December		
TSP	171.1	148.3	159.2	146.1	84.2	60.3	42.7	59.8	68.7	76.3	142.3	146.3	171.1	January

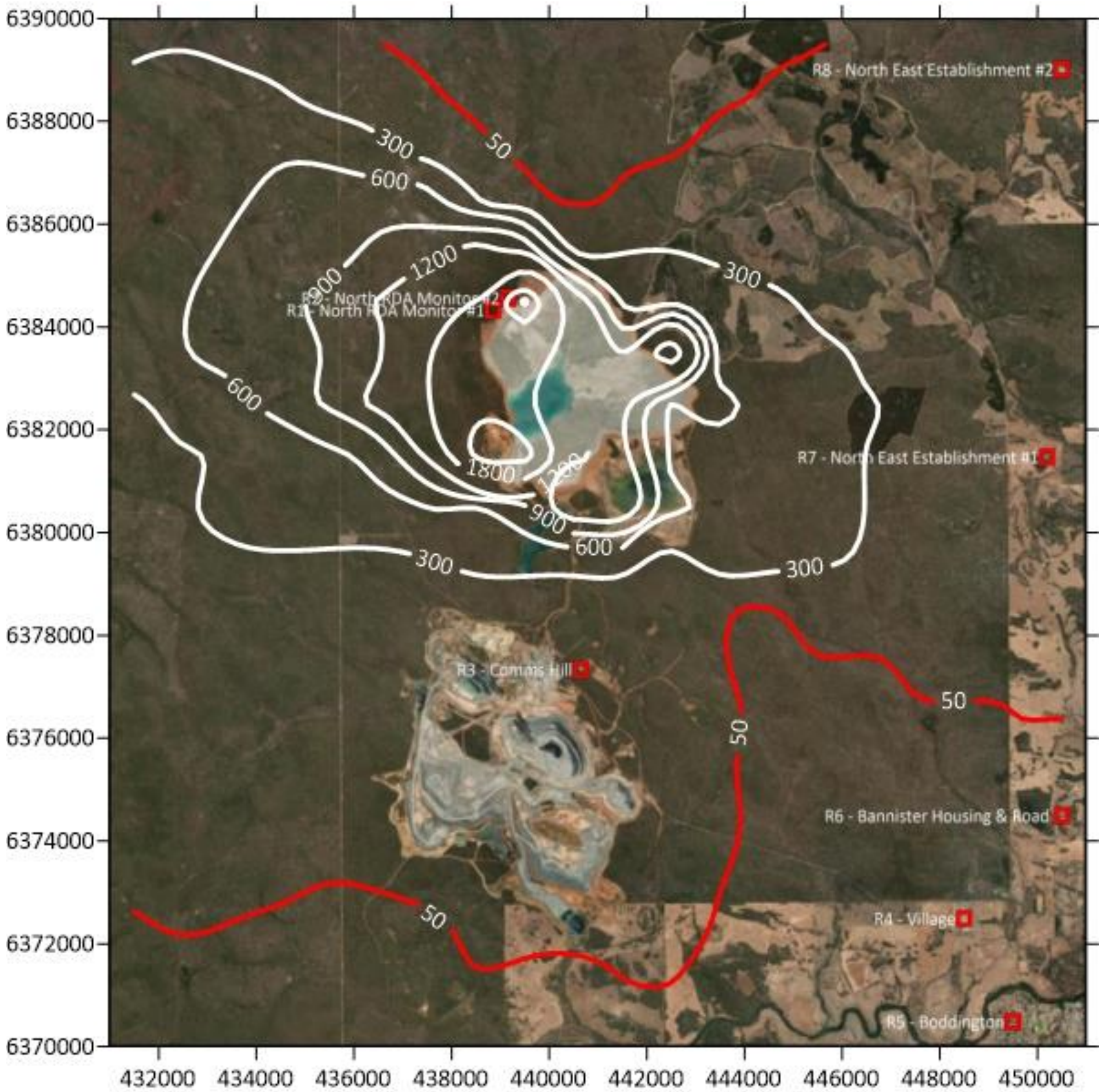

Figure 18: PM_{10} Maximum 24-hour Average GLCs (µg/m^3) Contour (Scenario #1 – Emissions from the RDA were based on the highest monitored deposition rate recorded at the Northern RDA monitors)

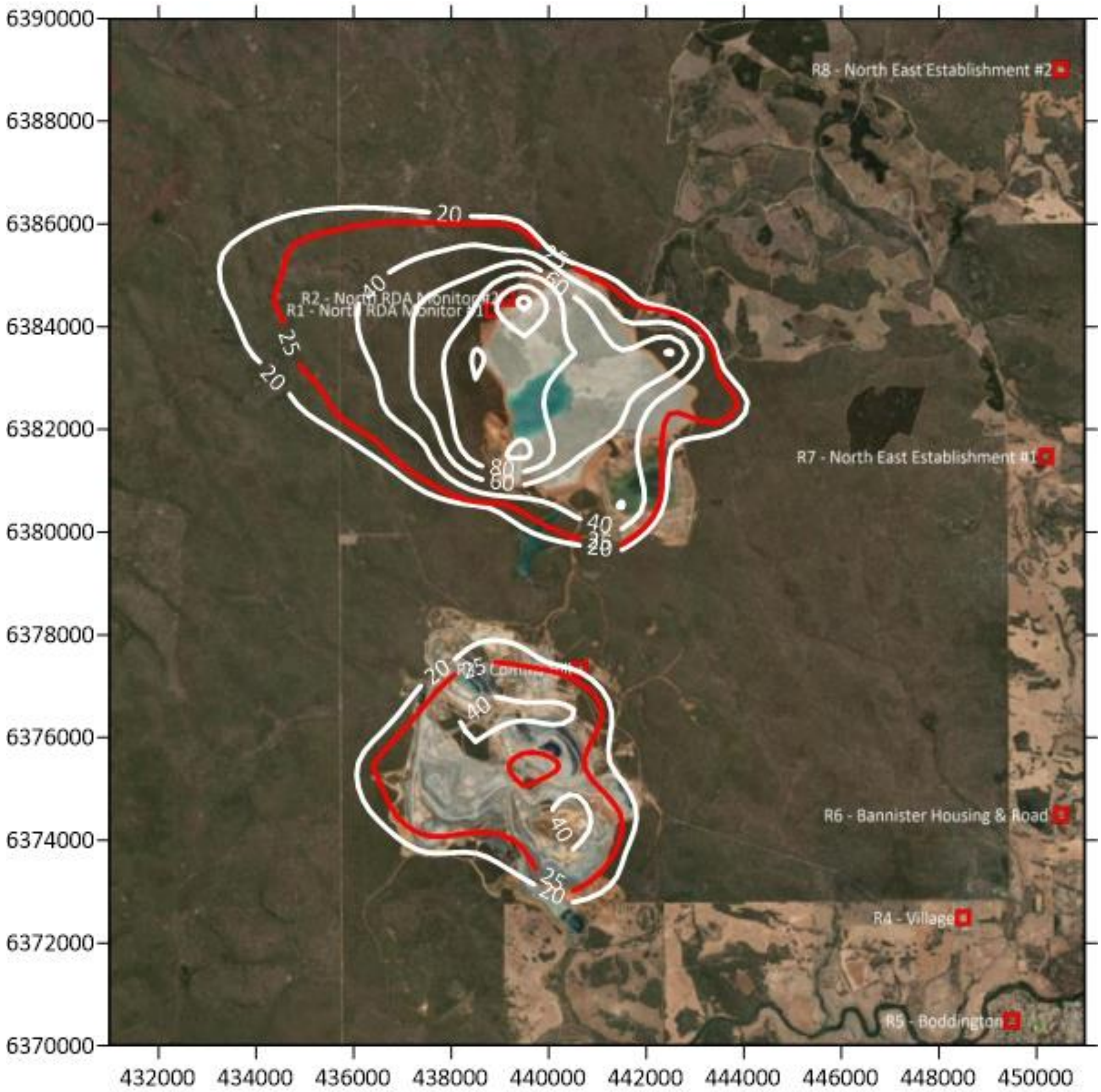

Figure 19: PM_{10} Maximum Annual Average GLCs ($\mu g/m^3$) Contour (Scenario #1 – Emissions from the RDA were based on the highest monitored deposition rate recorded at the Northern RDA monitors)

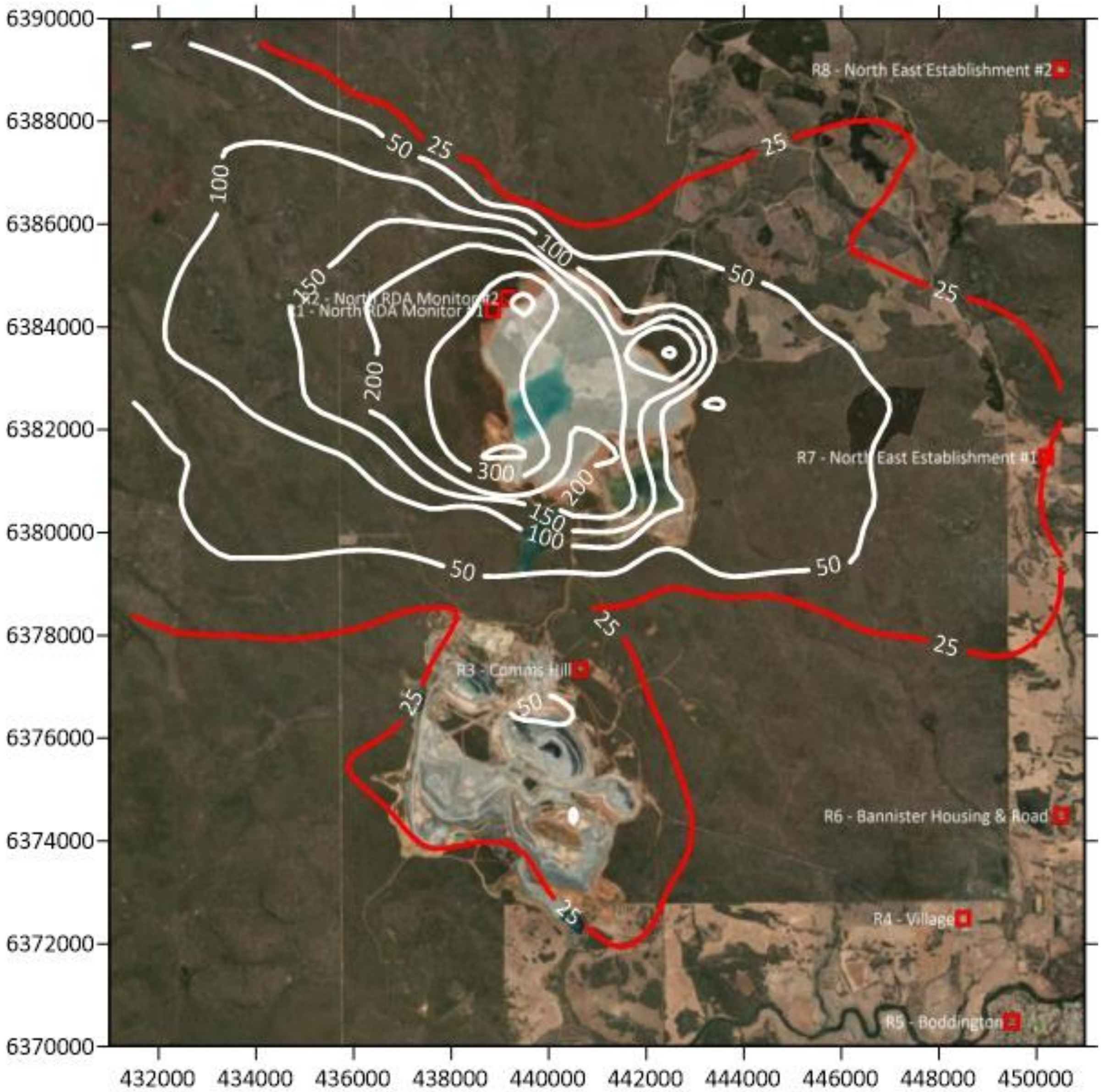

Figure 20: $PM_{2.5}$ Maximum 24-hour Average GLCs (μg/m^3) Contour (Scenario #1 – Emissions from the RDA were based on the highest monitored deposition rate recorded at the Northern RDA monitors)

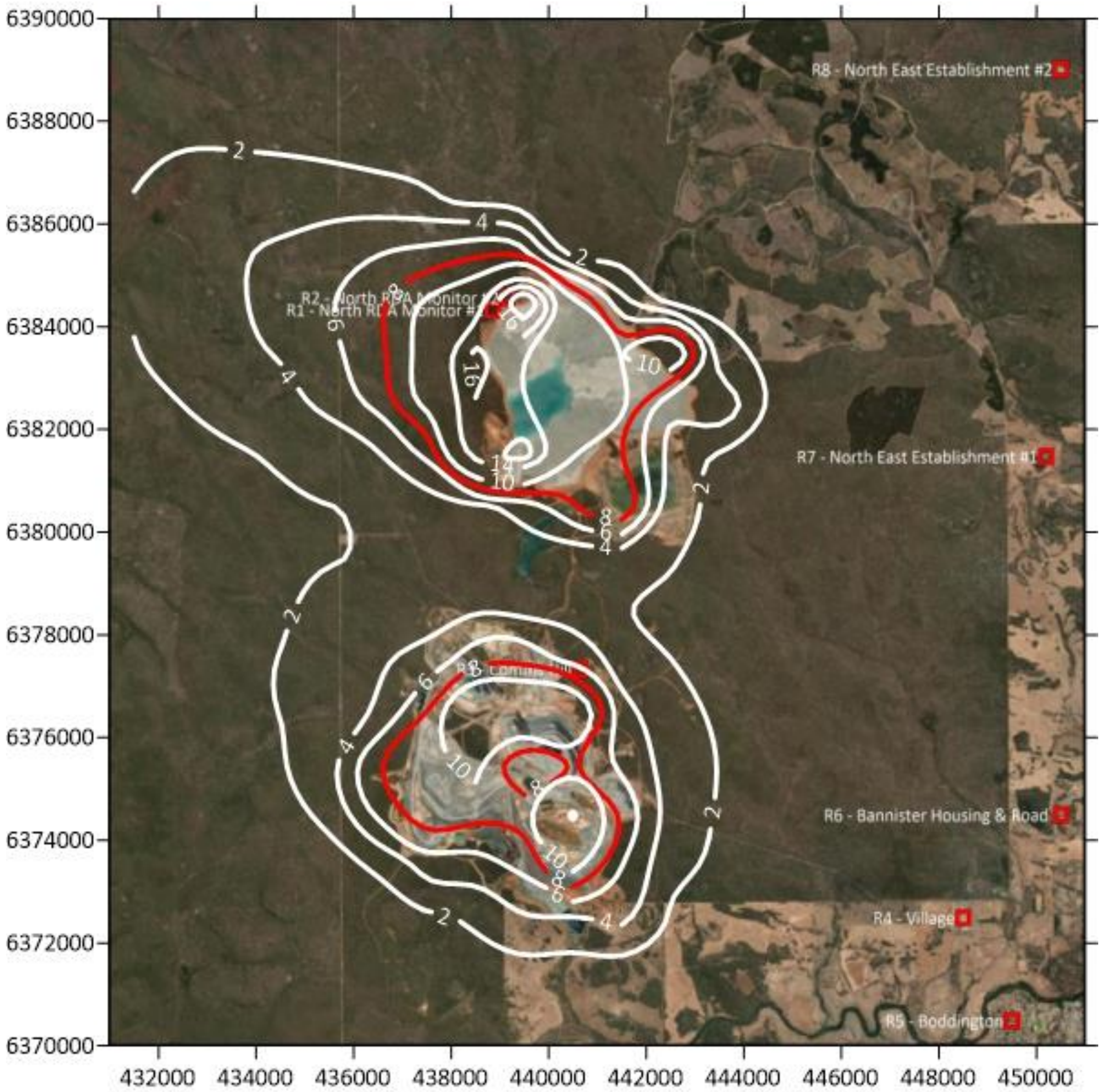

Figure 21: $PM_{2.5}$ Maximum Annual Average GLCs (µg/m³) Contour (Scenario #1 – Emissions from the RDA were based on the highest monitored deposition rate recorded at the Northern RDA monitors)

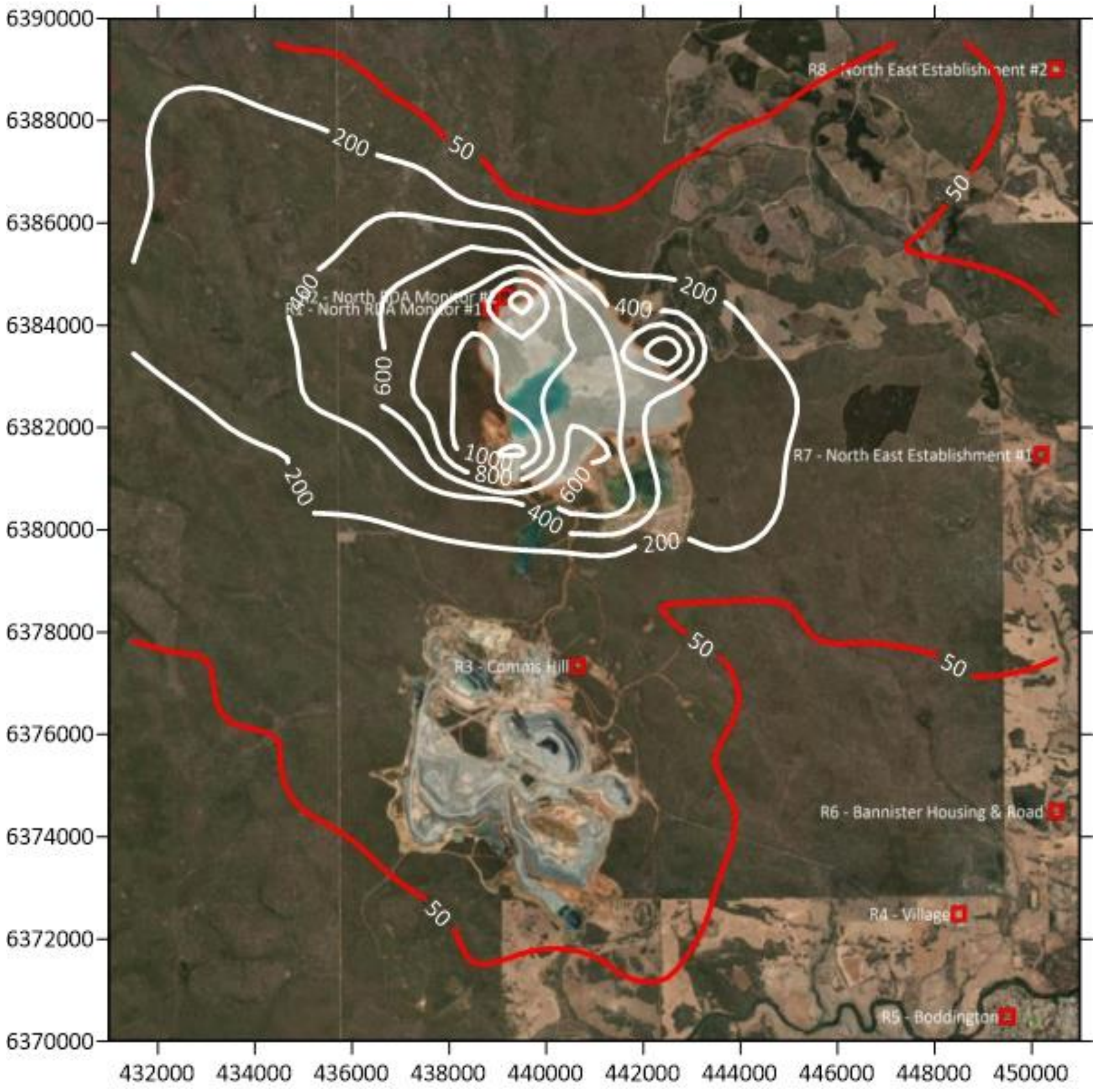

Figure 22: PM$_{10}$ Maximum 24-hour Average GLCs (µg/m^3) Contour (Scenario #2 – Emissions from the RDA were based on the average deposition rates recorded at the Northern RDA monitors)

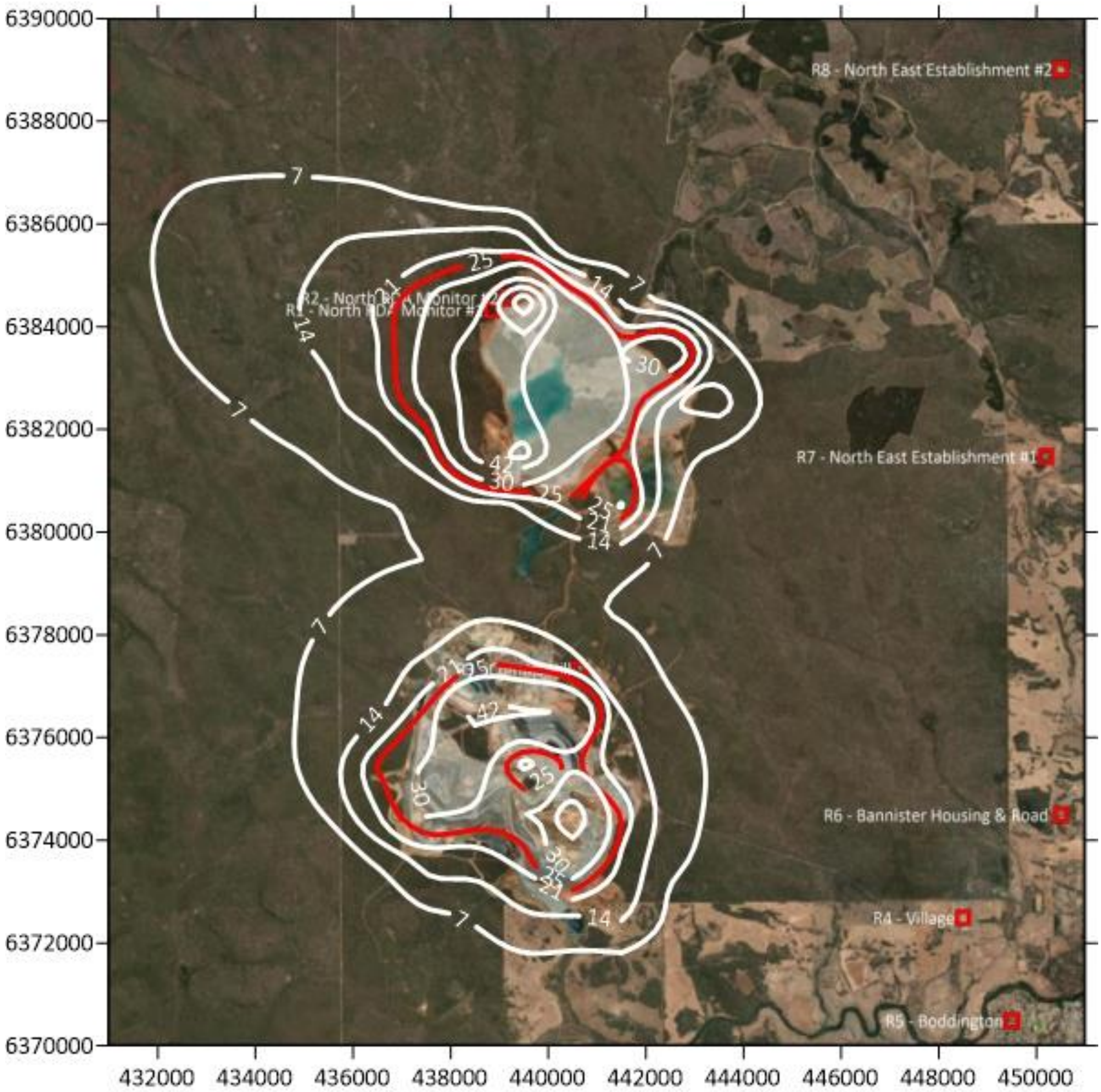

Figure 23: PM_{10} Maximum Annual Average GLCs (µg/m^3) Contour (Scenario #2 – Emissions from the RDA were based on the average deposition rates recorded at the Northern RDA monitors)

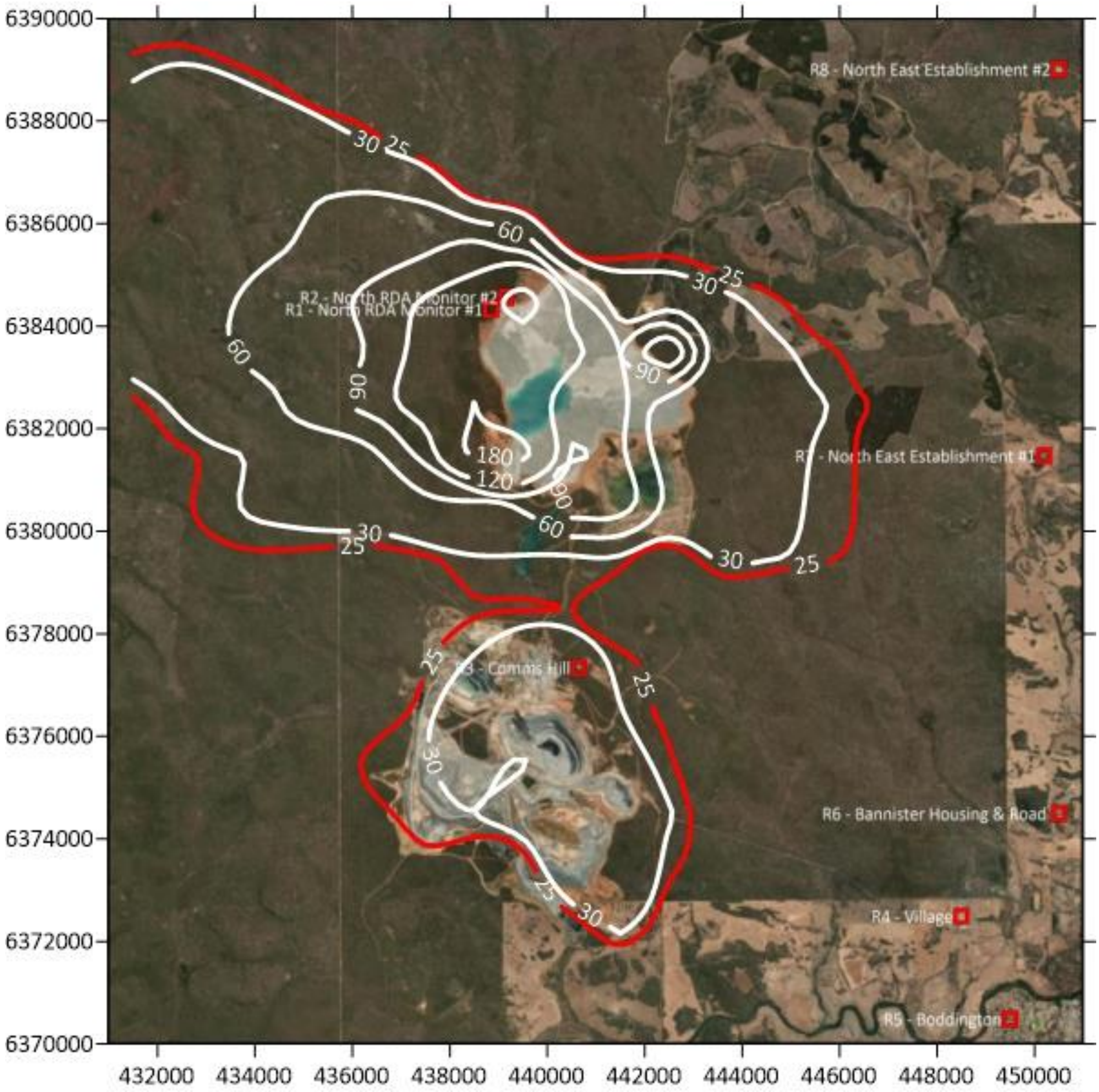

Figure 24: $PM_{2.5}$ Maximum 24-hour Average GLCs ($\mu g/m^3$) Contour (Scenario #2 – Emissions from the RDA were based on the average deposition rates recorded at the Northern RDA monitors)

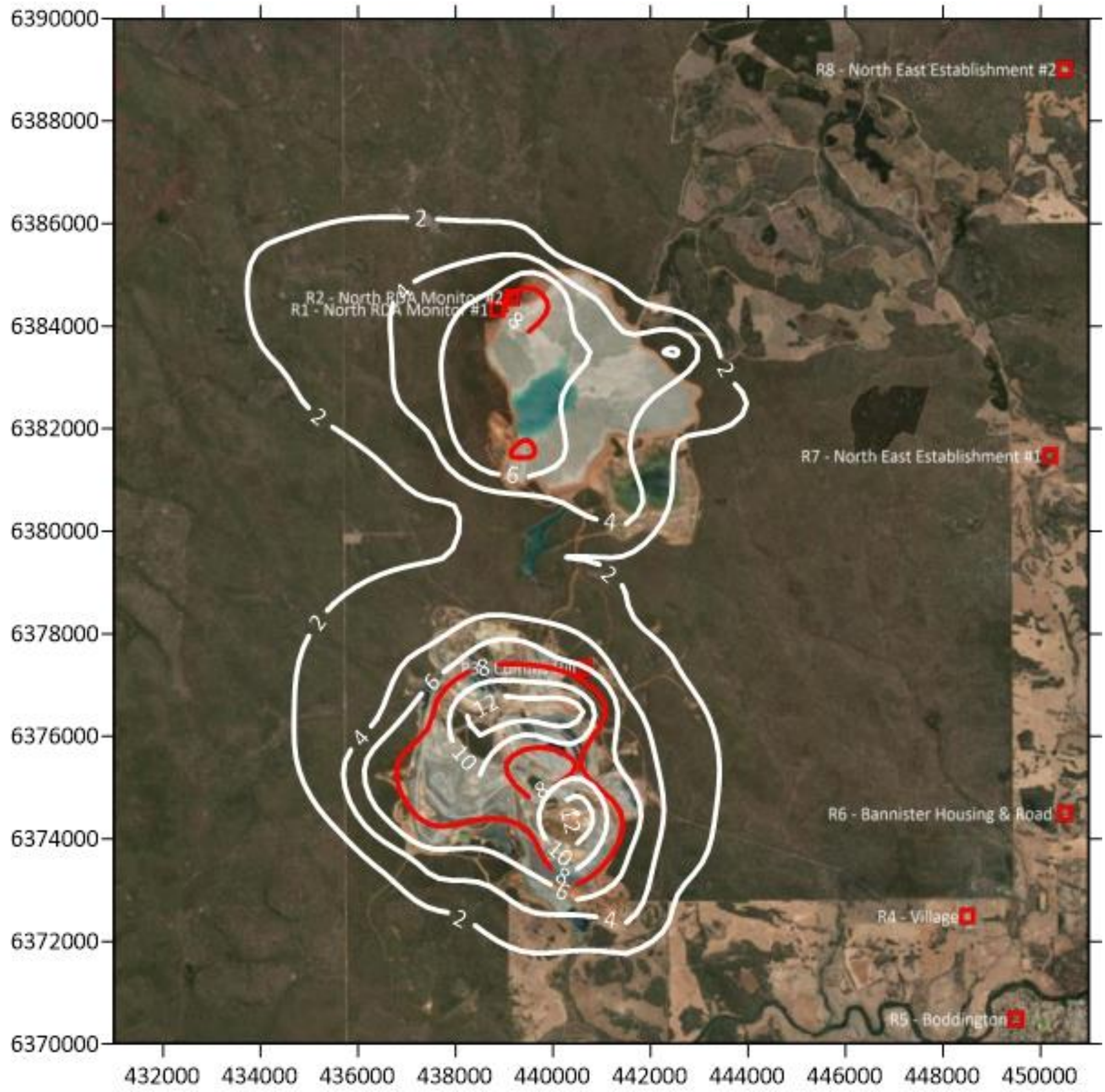

Figure 25: $PM_{2.5}$ Maximum Annual Average GLCs (µg/m^3) Contour (Scenario #2 – Emissions from the RDA were based on the average deposition rates recorded at the Northern RDA monitors)

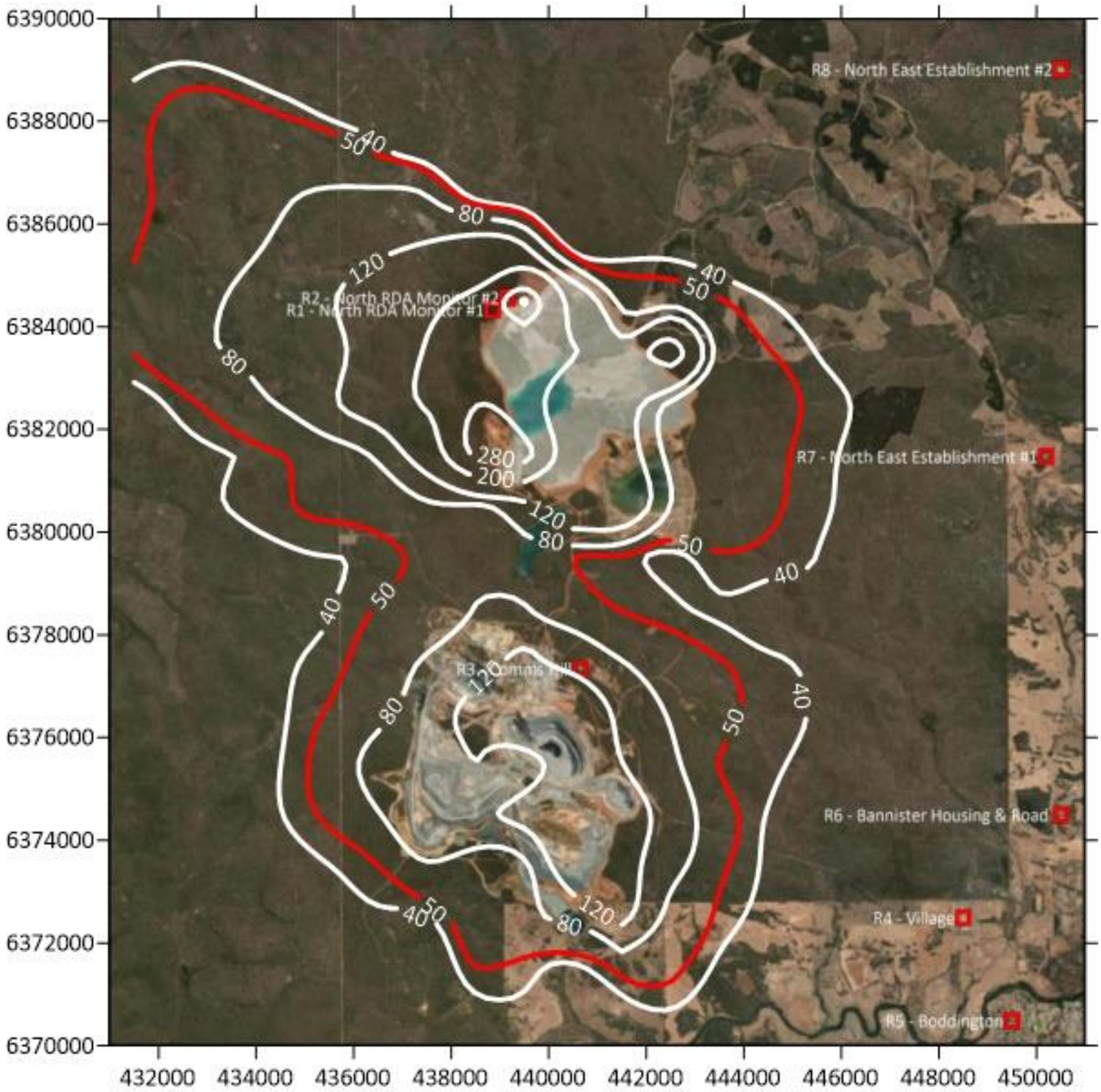

Figure 26: PM_{10} Maximum 24-hour Average GLCs (µg/m³) Contour (Scenario #3 – Emissions from the RDA were based on historical average deposition rates recorded across all the deposition monitors for the years 2017-2020)

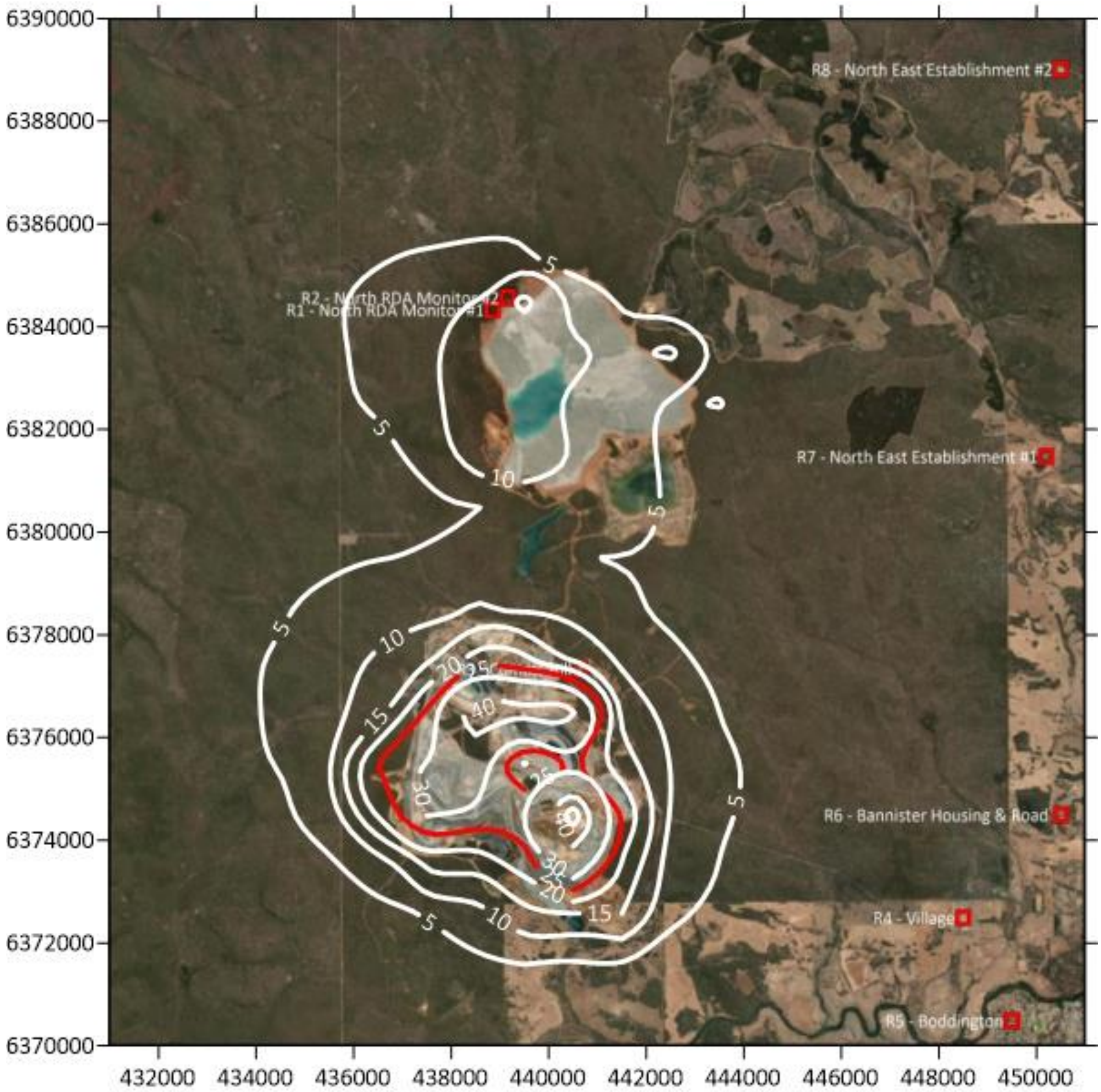

Figure 27: PM_{10} Maximum Annual Average GLCs (μg/m^3) Contour (Scenario #3 – Emissions from the RDA were based on historical average deposition rates recorded across all the deposition monitors for the years 2017-2020)

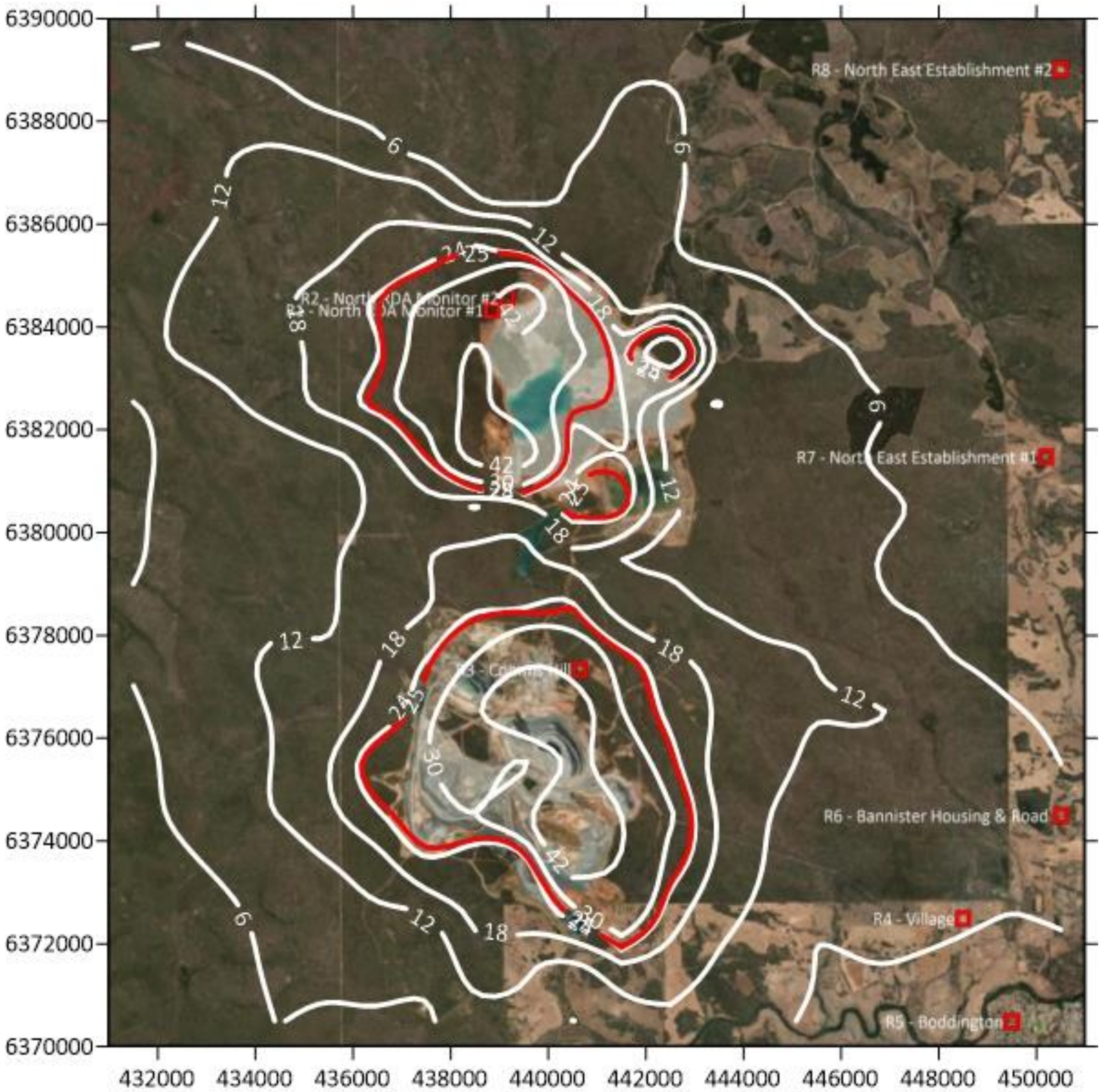

Figure 28: PM$_{2.5}$ Maximum 24-hour Average GLCs (µg/m^3) Contour (Scenario #3 – Emissions from the RDA were based on historical average deposition rates recorded across all the deposition monitors for the years 2017-2020)

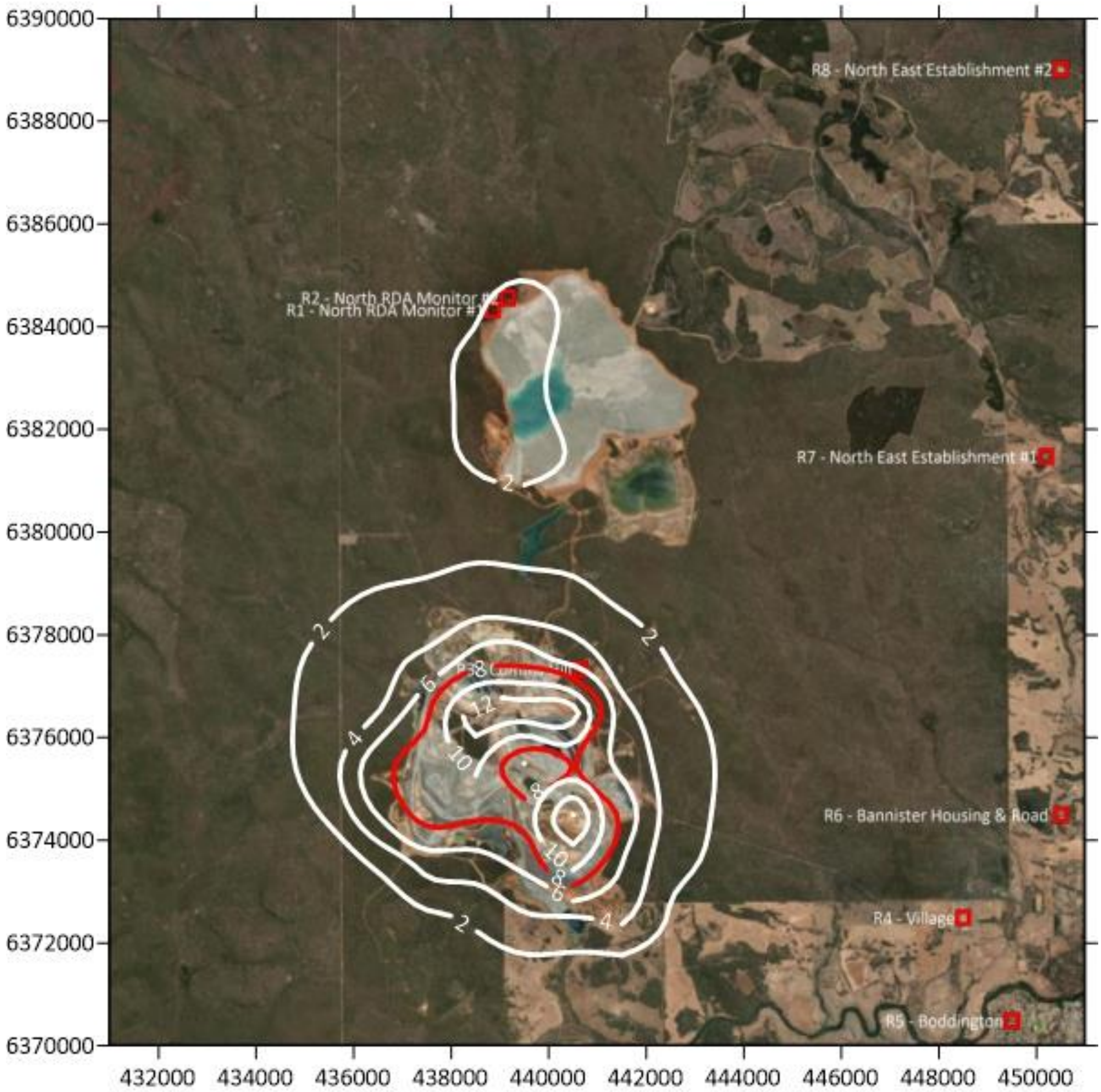

Figure 29: PM$_{2.5}$ Maximum Annual Average GLCs (μg/m^3) Contour (Scenario #3 – Emissions from the RDA were based on historical average deposition rates recorded across all the deposition monitors for the years 2017-2020)

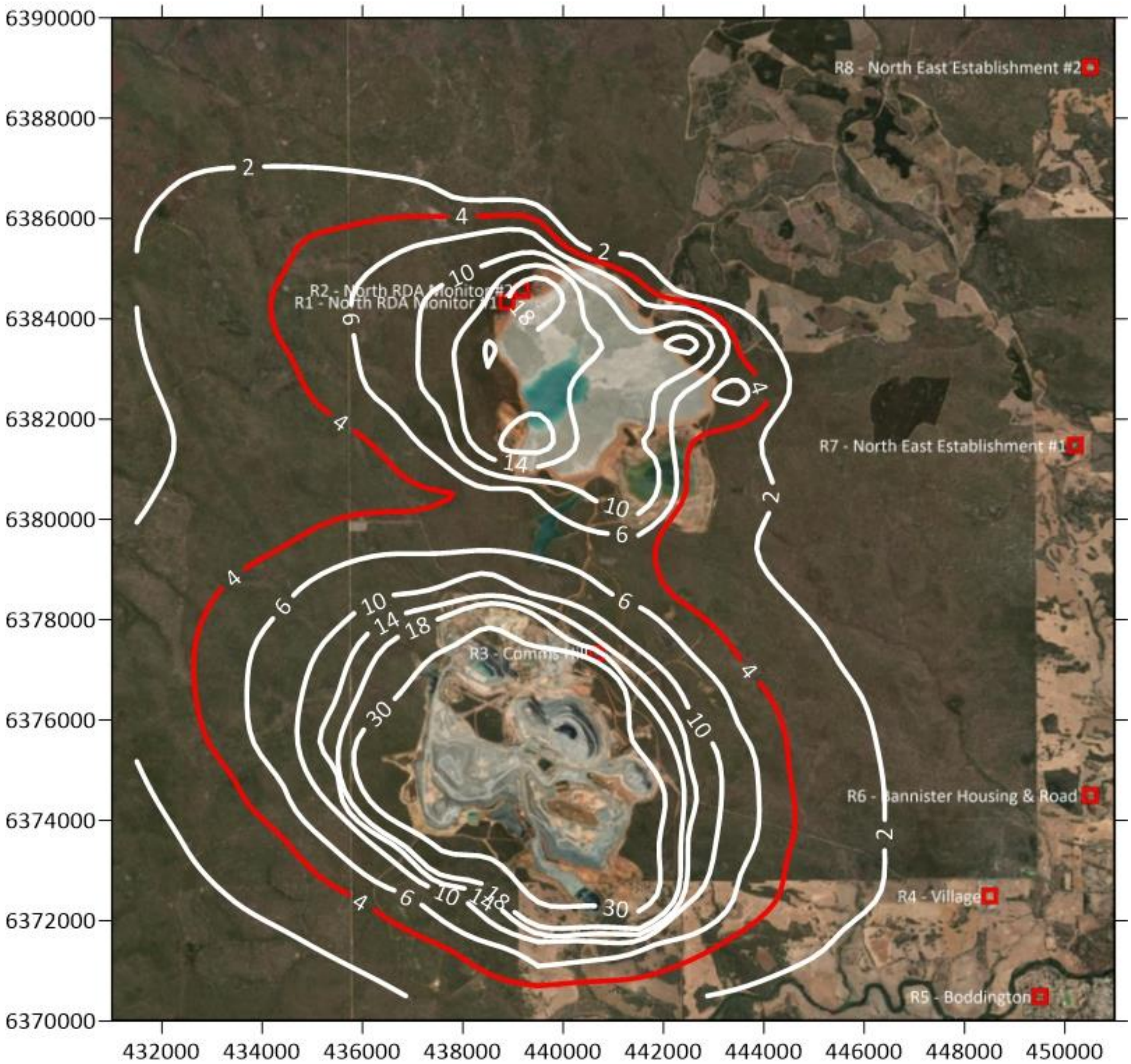

Figure 30: TSP Deposition Contour (g/m²/month) (Scenario #1 – Emissions from the RDA were based on the highest monitored deposition rate recorded at the Northern RDA monitors)

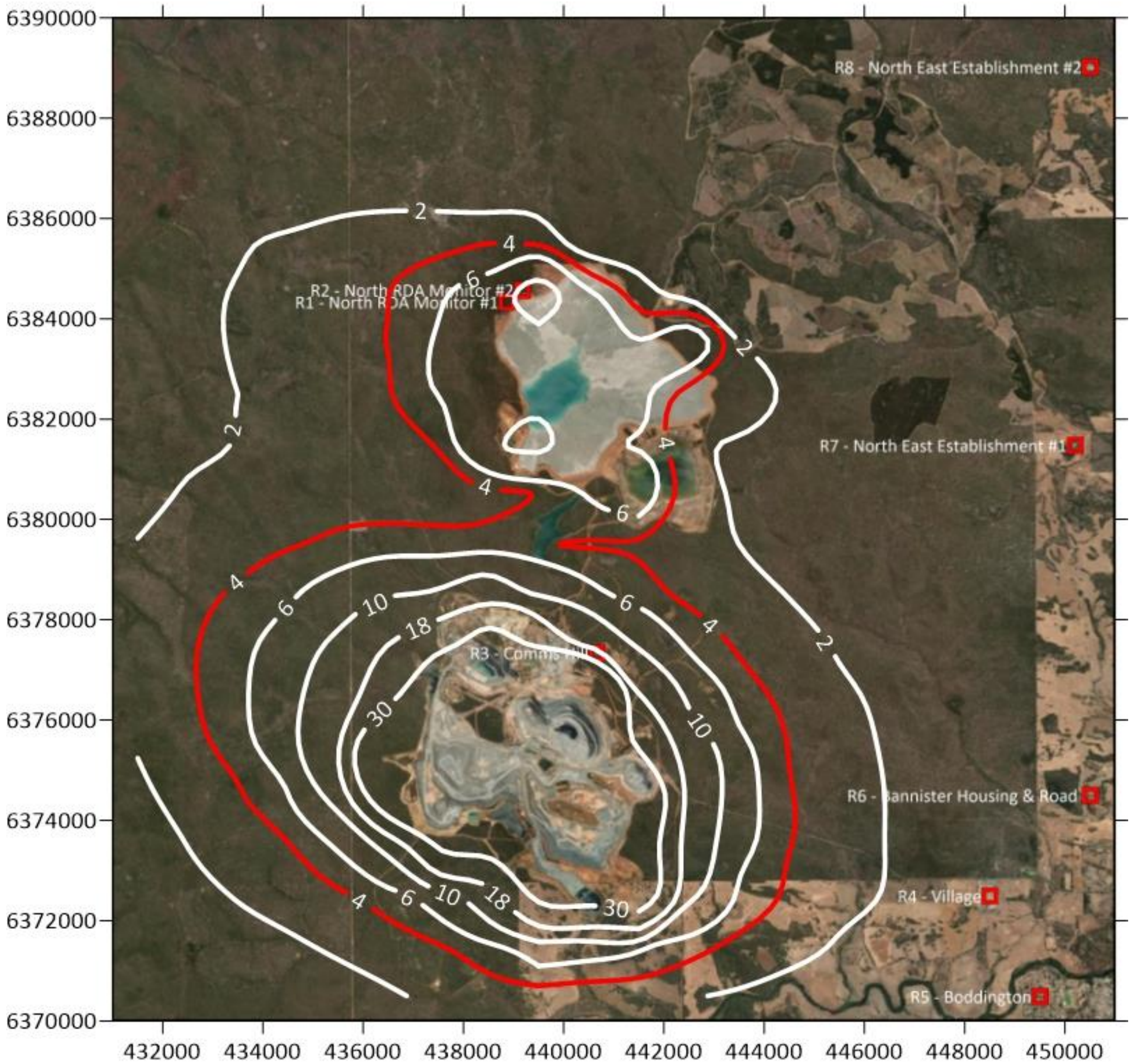

Figure 31: TSP Deposition Contour (g/m²/month) (Scenario #2 – Emissions from the RDA were based on the average deposition rates recorded at the Northern RDA monitors)

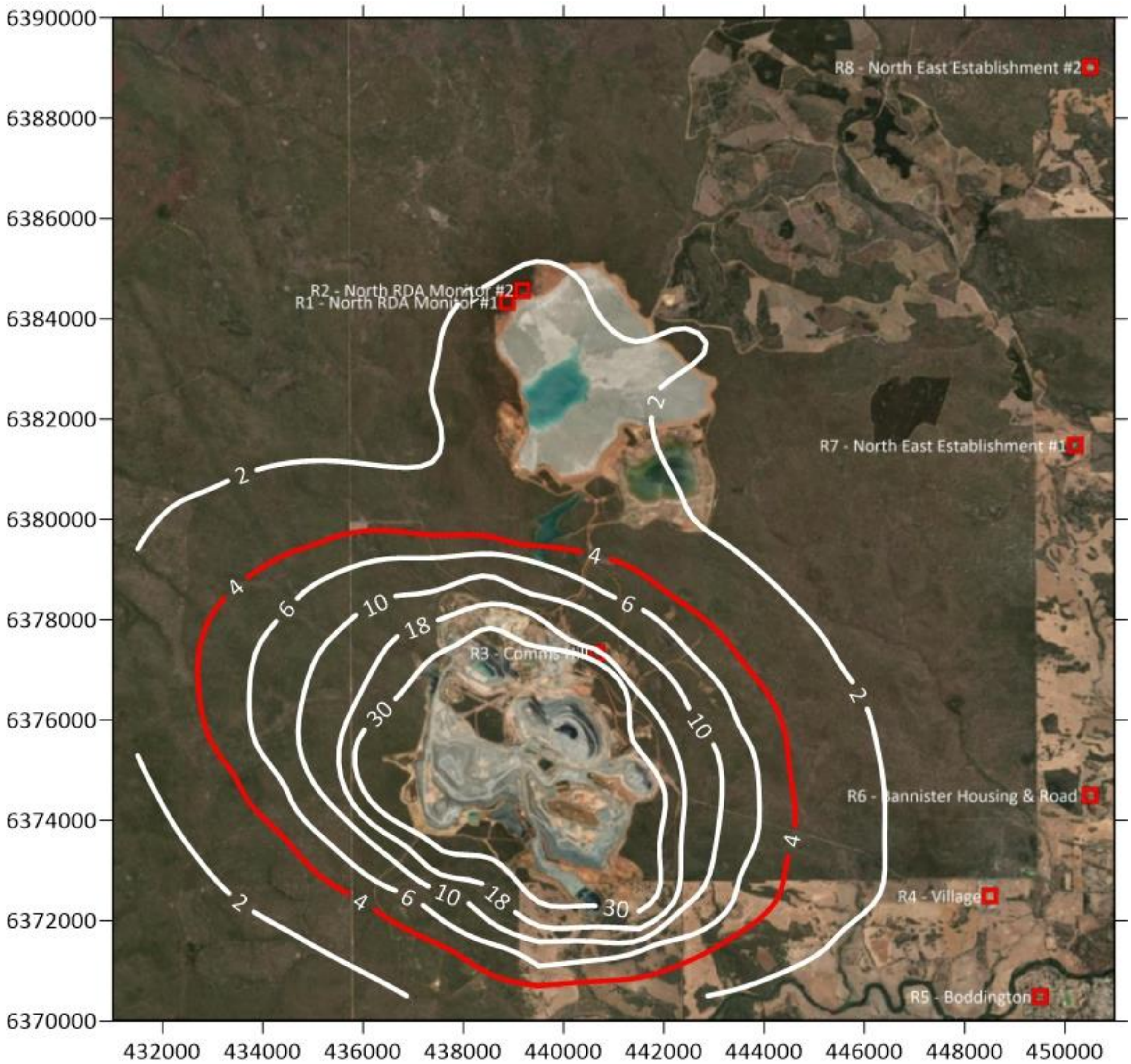

Figure 32: TSP Deposition Contour (g/m²/month) (Scenario #3 – Emissions from the RDA were based on historical average deposition rates recorded across all the deposition monitors for the years 2017-2020)

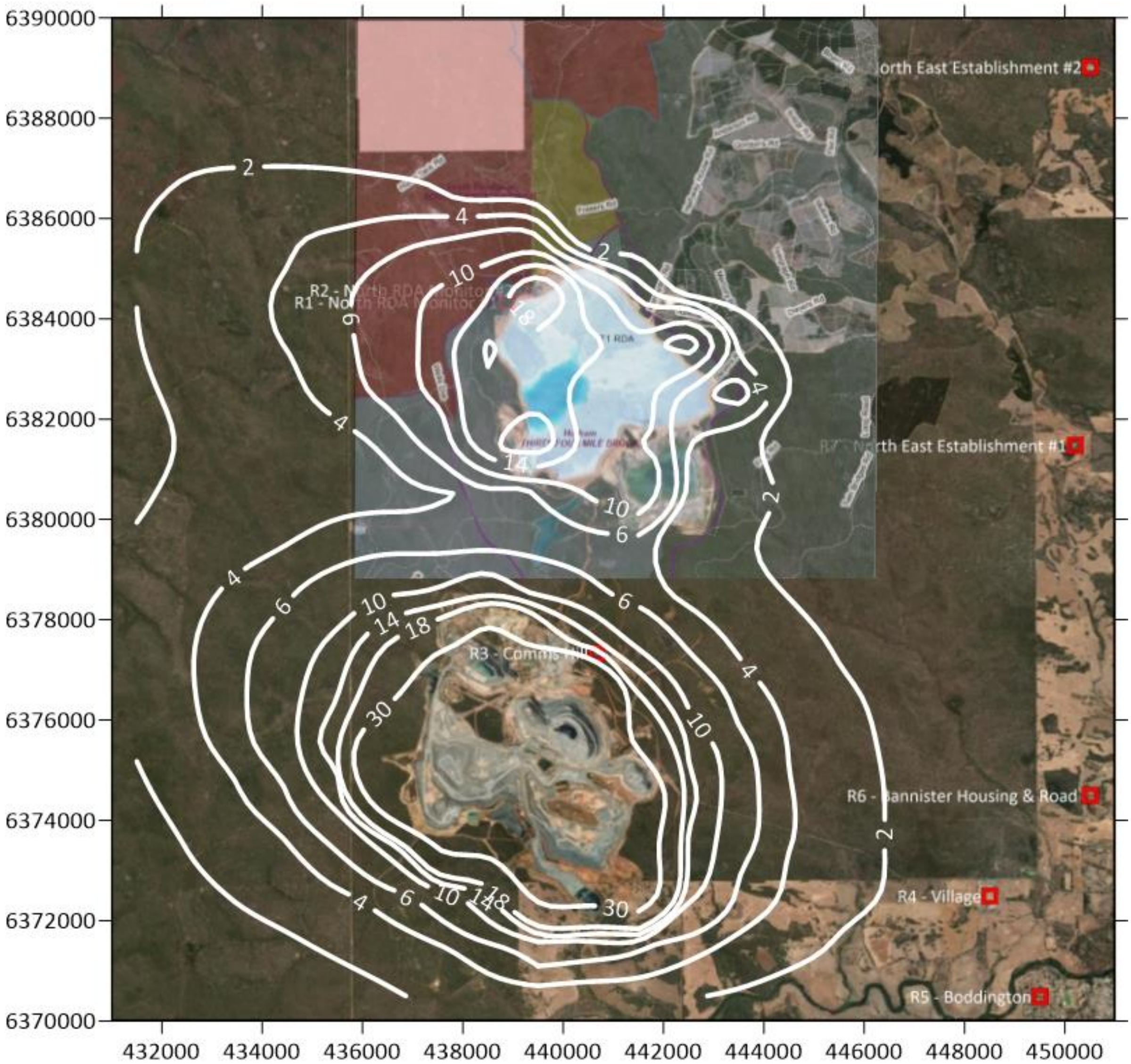

Figure 33: TSP Deposition Contour (g/m²/month) with Protection Area Overlay (Indicated by Faint Red & Yellow Overlay(s) to the North-West of the RDA) (Scenario #1 – Emissions from the RDA were based on the highest monitored deposition rate recorded at the Northern RDA monitors)

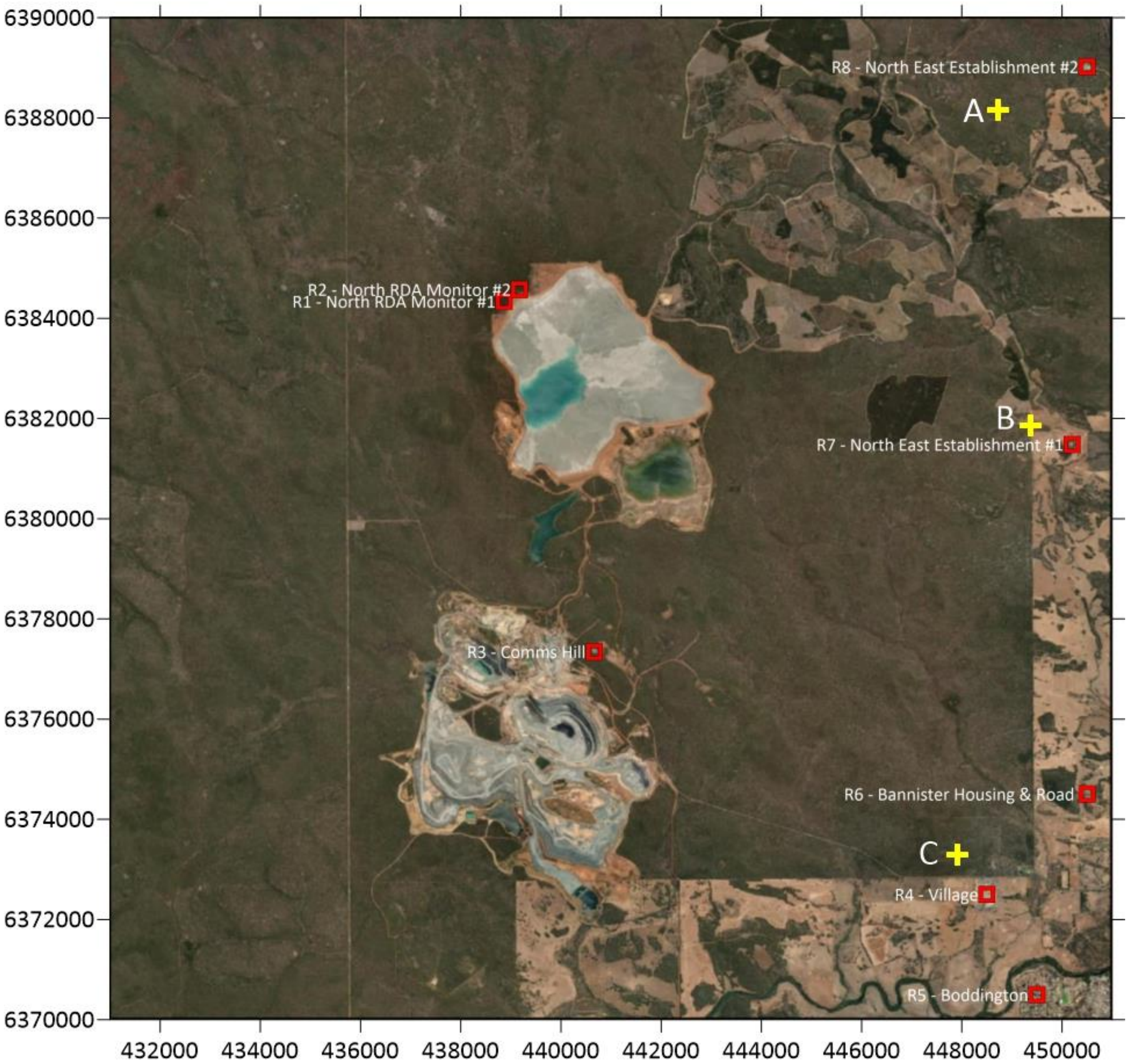

Figure 34: Potential Locations for Establishment of Additional Monitoring (A,B & C) with Reference to NBG Operations and Site Location

9. CONCLUSION

9.1 Summary of Monitoring & Modelling

A review of ambient air quality monitoring data collected by Newmont has been undertaken as part of this study. The monitoring indicates that on average, concentrations monitored at Communications Hill have decreased over the past five years. These concentrations are probably more indicative of activities at the mining operations and less to do with activities at RDA as meteorological conditions likely to result in significant dust emissions from the RDA (dry warm conditions with high wind speeds) are less frequent from the direction of the RDA to the Communications Hill monitor. Peak monitored concentrations generally occur during the summer/autumn months. A review of dust deposition monitoring data provided by BGM indicates that significantly elevated deposition of dust occurred at deposition monitors located at the RDA in 2021.

Emission estimates utilised for all modelling scenarios were refined using historical ambient monitoring data from Communication Hill and deposition monitoring data at the RDA. Three scenarios assessing variable emissions from the RDA in conjunction with mining operations were assessed.

The model results predicted:

- Both the PM_{10} and $PM_{2.5}$ 24-hour average GLCs were predicted to exceed the relevant ambient air quality criteria at the North-East Establishment #1 receptor for the scenarios with elevated emissions from the RDA for Scenarios #1 & #2 (elevated emissions from the RDA based on 2021 dust deposition rates).
- Exceedances of the ambient air quality guidelines were not predicted at these locations for Scenario #3 where emissions from the RDA were based on average deposition monitoring results at the RDA between 2017 and 2020.
- No exceedances of the annual average guideline are predicted for either pollutant (PM_{10} and/or $PM_{2.5}$) for all scenarios across all receptor locations, in both isolation and cumulatively with background concentrations.
- Analysis of source contributions as well meteorological conditions associated with the predicted exceedances of the short term (24-hour average) concentrations for Scenario #1 and #2 indicates they were associated with emissions from the RDA during periods of winds exceeding the wind speed threshold for dust lift off during dry conditions.

Although there is a level of uncertainty present with the utilisation of modelling, it is considered an effective tool to establish a basis for risk assessment. If the monitored deposition results from the year 2021 are representative of emissions from the RDA (and not as a result of errors in reporting or contamination), there is a risk that emissions from the RDA may be causing exceedances of the ambient air quality guidelines at sensitive receptor locations in the region during periods of high winds and dry conditions.

9.2 Summary of Recommendations

Ramboll recommends that additional monitoring be implemented near the RDA and in close proximity to receptors where exceedances were predicted to confirm the risk and potential control measures, particularly during periods where wind speeds above the wind speed threshold (~7 m/s) are expected, be considered to mitigate Newmont's dust contribution to the region in the event that elevated concentrations as a result of activities from the RDA are confirmed.

Specifically, Ramboll recommends that Newmont place monitoring infrastructure (similar to dust monitor(s) 2 and 3) in an open area at the extent of their operational boundary within the region targeted mainly in the direction of the North-East Establishments and the Village and Boddington township (Figure 34).

Additionally, it is also recommended that Newmont implement some dust control strategies for the dryer and hotter months to mitigate the elevated concentrations monitored and predicted under high wind speed events. Some of these include:

- Watering at source locations to reduce dust lift-off;
- Bind the surface of the tailings facility either by use of hydro-suppressants and/or hydro-mulching;
- Progressively rehabilitate unused areas of the region;
- Implementation of wind fences/screens at the facility boundary in directions where high wind speeds trend (i.e. South-East and West bearings from the NBG facility as per Figure 12)

10. LIMITATIONS

Ramboll prepared this report in accordance with the scope of work as outlined in our proposal to Newmont Australia dated 18th of March 2022 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent Ramboll's professional judgement based on information made available during the course of this assignment and are true and correct to the best of Ramboll's knowledge as at the date of the assessment.

Ramboll did not independently verify all of the written or oral information provided during the course of this investigation. While Ramboll has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

10.1 User Reliance

This report has been prepared for Newmont Australia and may not be relied upon by any other person or entity without Ramboll's express written permission.

11. REFERENCES

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APPENDIX 1
CALPUFF INPUT FILE

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---------------- Run title (3 lines) ------------------------------------------

                 CALPUFF MODEL CONTROL FILE
                 --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

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Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    * METDAT = *
   or
ISCMET.DAT    input    * ISCDAT = *
   or
PLMMET.DAT    input    * PLMDAT = *
   or
PROFILE.DAT   input    * PRFDAT = *
SURFACE.DAT   input    * SFCDAT = *
RESTARTB.DAT  input    * RSTARTB = *
--------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST = CALPUFF.LST !
CONC.DAT      output   ! CONDAT = CONC.DAT !
DFLX.DAT      output   ! DFDAT = DFLX.DAT !
WFLX.DAT      output   ! WFDAT = WFLX.DAT !

VISB.DAT      output   * VISDAT = *
TK2D.DAT      output   * T2DDAT = *
RHO2D.DAT     output   * RHODAT = *
RESTARTE.DAT  output   * RSTARTE = *
--------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    * OZDAT = *
VD.DAT        input    * VDDAT = *
CHEM.DAT      input    * CHEMDAT = *
AUX           input    * AUXEXT = *
(Extension added to METDAT filename(s) for files
 with auxiliary 2D and 3D data)
H2O2.DAT      input    * H2O2DAT = *
NH3Z.DAT      input    * NH3ZDAT = *
HILL.DAT      input    * HILDAT = *
HILLRCT.DAT   input    * RCTDAT = *
COASTLN.DAT   input    * CSTDAT = *
FLUXBDY.DAT   input    * BDYDAT = *
BCON.DAT      input    * BCNDAT = *
```

```
DEBUG.DAT     output   * DEBUG = *
MASSFLX.DAT   output   * FLXDAT = *
MASSBAL.DAT   output   * BALDAT = *
FOG.DAT       output   * FOGDAT = *
RISE.DAT      output   * RISDAT = *
PFTRAK.DAT    output   * TRKDAT = *
-------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
        T = lower case      ! LCFILES = F !
        F = UPPER CASE
NOTE: (1) file/path names can be up to 132 characters in length


Provision for multiple input files
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    Number of CALMET.DAT Domains (NMETDOM)
                              Default: 1       ! NMETDOM = 1 !

    Number of CALMET.DAT files (NMETDAT)
    (Total for ALL Domains)
                              Default: 1       ! NMETDAT = 16 !

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    Number of BAEMARB.DAT files for run (NARDAT)
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    Number of VOLEMARB.DAT files for run (NVOLDAT)
                              Default: 0       ! NVOLDAT = 0 !

    Number of FLARE source files (FLEMARB.DAT)
    with time-varying data (NFLDAT)
                              Default: 0       ! NFLDAT = 0 !

    Number of ROAD source files (RDEMARB.DAT)
    with time-varying data (NRDDAT)
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    Number of BUOYANT LINE source files (LNEMARB.DAT)
    with time-varying data (NLNDAT)
                              Default: 0       ! NLNDAT = 0 !
    Note:  Only 1 BUOYANT LINE source file is allowed
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!END!

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Subgroup (0a)
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  Provide a name for each CALMET domain if NMETDOM > 1
  Enter NMETDOM lines.
                         a,b
Default Name          Domain Name
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* DOMAINLIST = *


  The following CALMET.DAT filenames are processed in sequence
  if NMETDAT > 1

  Enter NMETDAT lines, 1 line for each file name.

                          a,c,d
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 none      input   ! METDAT=CALMET_2021-04-26-00-0000-2021-05-18-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-05-18-00-0000-2021-06-10-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-06-10-00-0000-2021-07-03-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-07-03-00-0000-2021-07-26-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-07-26-00-0000-2021-08-17-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-08-17-00-0000-2021-09-09-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-09-09-00-0000-2021-10-02-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-10-02-00-0000-2021-10-25-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-10-25-00-0000-2021-11-16-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-11-16-00-0000-2021-12-09-00-0000.DAT   !  !END!
 none      input   ! METDAT=CALMET_2021-12-09-00-0000-2021-12-31-23-0000.DAT   !  !END!

-------------
   a
    The name for each CALMET domain and each CALMET.DAT file is treated
    as a separate input subgroup and therefore must end with an input
    group terminator.
   b
    Use DOMAIN1= to assign the name for the outermost CALMET domain.
    Use DOMAIN2= to assign the name for the next inner CALMET domain.
    Use DOMAIN3= to assign the name for the next inner CALMET domain, etc.
     --------------------------------------------------------------------
     |  When inner domains with equal resolution (grid-cell size)      |
     |  overlap, the data from the FIRST such domain in the list will  |
     |  be used if all other criteria for choosing the controlling     |
     |  grid domain are inconclusive.                                  |
     --------------------------------------------------------------------
   c
    Use METDAT1= to assign the file names for the outermost CALMET domain.
```

Use METDAT2= to assign the file names for the next inner CALMET domain.
Use METDAT3= to assign the file names for the next inner CALMET domain, etc.
d
The filenames for each domain must be provided in sequential order

----
Subgroup (0b) – PTEMARB.DAT files

POINT Source File Names
The following PTEMARB.DAT filenames are processed if NPTDAT>0
A total of NPTDAT lines is expected with one file name assigned per line
Each line is treated as an input group and must terminate with END
(surrounded by delimiters)
(Each file contains emissions parameters for the entire period modeled
for 1 or more sources)

Default Name Type File Name
------------ ---- ---------
* PTDATLIST = *

Subgroup (0c) – BAEMARB.DAT files

BUOYANT AREA Source File Names
The following BAEMARB.DAT filenames are processed if NARDAT>0
A total of NARDAT lines is expected with one file name assigned per line
Each line is treated as an input group and must terminate with END
(surrounded by delimiters)
(Each file contains emissions parameters for the entire period modeled
for 1 or more sources)

Default Name Type File Name
------------ ---- ---------
* ARDATLIST = *

Subgroup (0d) – VOLEMARB.DAT files

VOLUME Source File Names
The following VOLEMARB.DAT filenames are processed if NVOLDAT>0
A total of NVOLDAT lines is expected with one file name assigned per line
Each line is treated as an input group and must terminate with END
(surrounded by delimiters)
(Each file contains emissions parameters for the entire period modeled
for 1 or more sources)

```
Default Name  Type          File Name
------------  ----          ---------
* VOLDATLIST = *

-------------
Subgroup (0e) – FLEMARB.DAT files
-------------

  FLARE Source File Names
  The following FLEMARB.DAT filenames are processed if NFLDAT>0
  A total of NFLDAT lines is expected with one file name assigned per line
  Each line is treated as an input group and must terminate with END
  (surrounded by delimiters)
  (Each file contains emissions parameters for the entire period modeled
   for 1 or more sources)

Default Name  Type          File Name
------------  ----          ---------
* FLEMARBLIST = *


-------------
Subgroup (0f) – RDEMARB.DAT files
-------------

  ROAD Source File Names
  The following RDEMARB.DAT filenames are processed if NRDDAT>0
  A total of NRDDAT lines is expected with one file name assigned per line
  Each line is treated as an input group and must terminate with END
  (surrounded by delimiters)
  (Each file contains emissions parameters for the entire period modeled
   for 1 or more sources)

Default Name  Type          File Name
------------  ----          ---------
* RDEMARBLIST = *


-------------
Subgroup (0g) – LNEMARB.DAT file
-------------

  BUOYANT LINE Source File Name  (not more than 1)
  The following LNEMARB.DAT filename is processed if NLNDAT>0
  The assignment is treated as an input group and must terminate with END
  (surrounded by delimiters)

Default Name  Type          File Name
------------  ----          ---------
* LNEMARBLIST = *
```

```
--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

   Option to run all periods found
   in the met. file     (METRUN)   Default: 0       ! METRUN = 0 !

       METRUN = 0 - Run period explicitly defined below
       METRUN = 1 - Run all periods in met. file

    Starting date:    Year   (IBYR)  --    No default   ! IBYR = 2021 !
                      Month  (IBMO)  --    No default   ! IBMO = 1 !
                      Day    (IBDY)  --    No default   ! IBDY = 1 !
    Starting time:    Hour   (IBHR)  --    No default   ! IBHR = 1 !
                      Minute (IBMIN) --    No default   ! IBMIN = 0 !
                      Second (IBSEC) --    No default   ! IBSEC = 0 !

    Ending date:      Year   (IEYR)  --    No default   ! IEYR = 2021 !
                      Month  (IEMO)  --    No default   ! IEMO = 12 !
                      Day    (IEDY)  --    No default   ! IEDY = 31 !
    Ending time:      Hour   (IEHR)  --    No default   ! IEHR = 23 !
                      Minute (IEMIN) --    No default   ! IEMIN = 0 !
                      Second (IESEC) --    No default   ! IESEC = 0 !

    (These are only used if METRUN = 0)

    Base time zone:          (ABTZ)  --    No default   ! ABTZ = UTC+0800 !
     (character*8)
    The modeling domain may span multiple time zones.  ABTZ defines the
    base time zone used for the entire simulation.  This must match the
    base time zone of the meteorological data.
    Examples:
       Greenwich Mean Time (GMT) = UTC+0000
       EST                       = UTC-0500
       CST                       = UTC-0600
       MST                       = UTC-0700
       PST                       = UTC-0800
       Los Angeles, USA          = UTC-0800
       New York, USA             = UTC-0500
       Santiago, Chile           = UTC-0400
       UK                        = UTC+0000
       Western Europe            = UTC+0100
       Rome, Italy               = UTC+0100
       Cape Town, S.Africa       = UTC+0200
       Sydney, Australia         = UTC+1000

    Length of modeling time-step (seconds)
    Equal to update period in the primary
    meteorological data files, or an
```

```
integer fraction of it (1/2, 1/3 ...)
Must be no larger than 1 hour
(NSECDT)                    Default:3600     ! NSECDT = 3600 !
                         Units: seconds

Number of chemical species (NSPEC)
                         Default: 5       ! NSPEC = 18 !

Number of chemical species
to be emitted  (NSE)          Default: 3       ! NSE = 18 !

Flag to stop run after
SETUP phase (ITEST)           Default: 2       ! ITEST = 2 !
(Used to allow checking
of the model inputs, files, etc.)
     ITEST = 1 - STOPS program after SETUP phase
     ITEST = 2 - Continues with execution of program
               after SETUP

Restart Configuration:

   Control flag (MRESTART)      Default: 0       ! MRESTART = 0 !

     0 = Do not read or write a restart file
     1 = Read a restart file at the beginning of
         the run
     2 = Write a restart file during run
     3 = Read a restart file at beginning of run
         and write a restart file during run

   Number of periods in Restart
   output cycle (NRESPD)        Default: 0       ! NRESPD = 0 !

     0 = File written only at last period
    >0 = File updated every NRESPD periods

Meteorological Data Format (METFM)
                         Default: 1       ! METFM = 1 !

     METFM = 1 - CALMET binary file (CALMET.MET)
     METFM = 2 - ISC ASCII file (ISCMET.MET)
     METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
     METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
               surface parameters file (SURFACE.DAT)
     METFM = 5 - AERMET tower file (PROFILE.DAT) and
               surface parameters file (SURFACE.DAT)

Meteorological Profile Data Format (MPRFFM)
      (used only for METFM = 1, 2, 3)
                         Default: 1       ! MPRFFM = 1 !
```

```
        MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)
        MPRFFM = 2 - AERMET tower file (PROFILE.DAT)

     Sigma-y is adjusted by the factor (AVET/PGTIME)**0.2 to either
     decrease it if the averaging time selected is less than the base
     averaging time, or increase it if the averaging time is greater.
     The base averaging time is denoted as PGTIME due to historical
     reasons as this adjustment was originally applied to the PG sigma
     option.  It is now applied to all dispersion options.
     The factor is applied to the ambient turbulence sigma-v (m/s) and
     does not alter buoyancy enhancement or far-field Heffter growth.

     Averaging Time (minutes) (AVET)
                              Default: 60.0    ! AVET = 60 !
     Base Averaging Time (minutes) (PGTIME)
                              Default: 60.0    ! PGTIME = 60 !

     Output units for binary concentration and flux files
     written in Dataset v2.2 or later formats
     (IOUTU)                     Default: 1       ! IOUTU = 1 !
        1 = mass       -  g/m3 (conc) or g/m2/s (dep)
        2 = odour      -  odour_units (conc)
        3 = radiation -  Bq/m3 (conc) or Bq/m2/s (dep)

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Technical options
--------------


     Vertical distribution used in the
     near field (MGAUSS)                Default: 1     ! MGAUSS = 1 !
       0 = uniform
       1 = Gaussian

     Terrain adjustment method
     (MCTADJ)                           Default: 3     ! MCTADJ = 3 !
       0 = no adjustment
       1 = ISC-type of terrain adjustment
       2 = simple, CALPUFF-type of terrain
           adjustment
       3 = partial plume path adjustment

     Subgrid-scale complex terrain
     flag (MCTSG)                       Default: 0     ! MCTSG = 0 !
       0 = not modeled
       1 = modeled
```

Near-field puffs modeled as
elongated slugs? (MSLUG) Default: 0 ! MSLUG = 0 !
0 = no
1 = yes (slug model used)

Transitional plume rise modeled?
(MTRANS) Default: 1 ! MTRANS = 1 !
0 = no (i.e., final rise only)
1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP) Default: 1 ! MTIP = 1 !
0 = no (i.e., no stack tip downwash)
1 = yes (i.e., use stack tip downwash)

Method used to compute plume rise for
point sources not subject to building
downwash? (MRISE) Default: 1 ! MRISE = 1 !
1 = Briggs plume rise
2 = Numerical plume rise

Apply stack-tip downwash to FLARE sources?
(MTIP_FL) Default: 0 ! MTIP_FL = 0 !
0 = no (no stack-tip downwash)
1 = yes (apply stack-tip downwash)

Plume rise module for FLARE sources
(MRISE_FL) Default: 2 ! MRISE_FL = 2 !
1 = Briggs module
2 = Numerical rise module

Method used to simulate building
downwash? (MBDW) Default: 1 ! MBDW = 1 !
1 = ISC method
2 = PRIME method

Vertical wind shear modeled above
stack top? (MSHEAR) Default: 0 ! MSHEAR = 0 !
0 = no (i.e., vertical wind shear not modeled)
1 = yes (i.e., vertical wind shear modeled)

Puff splitting allowed? (MSPLIT) Default: 0 ! MSPLIT = 0 !
0 = no (i.e., puffs not split)
1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM) Default: 1 ! MCHEM = 0 !
0 = chemical transformation not
modeled
1 = transformation rates computed
internally (MESOPUFF II scheme)
2 = user-specified transformation
rates used

3 = transformation rates computed
internally (RIVAD/ARM3 scheme)
4 = secondary organic aerosol formation
computed (MESOPUFF II scheme for OH)
5 = user-specified half-life with or
without transfer to child species
6 = transformation rates computed
internally (Updated RIVAD scheme with
ISORROPIA equilibrium)
7 = transformation rates computed
internally (Updated RIVAD scheme with
ISORROPIA equilibrium and CalTech SOA)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 6, or 7) Default: 0 ! MAQCHEM = 0 !
0 = aqueous phase transformation
not modeled
1 = transformation rates and wet
scavenging coefficients adjusted
for in-cloud aqueous phase reactions
(adapted from RADM cloud model
implementation in CMAQ/SCICHEM)

Liquid Water Content flag (MLWC)
(Used only if MAQCHEM = 1) Default: 1 ! MLWC = 1 !
0 = water content estimated from cloud cover
and presence of precipitation
1 = gridded cloud water data read from CALMET
water content output files (filenames are
the CALMET.DAT names PLUS the extension
AUXEXT provided in Input Group 0)

Wet removal modeled ? (MWET) Default: 1 ! MWET = 0 !
0 = no
1 = yes

Dry deposition modeled ? (MDRY) Default: 1 ! MDRY = 1 !
0 = no
1 = yes
(dry deposition method specified
for each species in Input Group 3)

Gravitational settling (plume tilt)
modeled ? (MTILT) Default: 0 ! MTILT = 0 !
0 = no
1 = yes
(puff center falls at the gravitational
settling velocity for 1 particle species)

Restrictions:

- MDRY = 1
- NSPEC = 1 (must be particle species as well)
- sg = 0 GEOMETRIC STANDARD DEVIATION in Group 8 is set to zero for a single particle diameter

Method used to compute dispersion
coefficients (MDISP) Default: 3 ! MDISP = 3 !

1 = dispersion coefficients computed from measured values of turbulence, sigma v, sigma w
2 = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.)
3 = PG dispersion coefficients for RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients in urban areas
4 = same as 3 except PG coefficients computed using the MESOPUFF II eqns.
5 = CTDM sigmas used for stable and neutral conditions. For unstable conditions, sigmas are computed as in MDISP = 3, described above. MDISP = 5 assumes that measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5) Default: 3 ! MTURBVW = 3 !
1 = use sigma-v or sigma-theta measurements from PROFILE.DAT to compute sigma-y (valid for METFM = 1, 2, 3, 4, 5)
2 = use sigma-w measurements from PROFILE.DAT to compute sigma-z (valid for METFM = 1, 2, 3, 4, 5)
3 = use both sigma-(v/theta) and sigma-w from PROFILE.DAT to compute sigma-y and sigma-z (valid for METFM = 1, 2, 3, 4, 5)
4 = use sigma-theta measurements from PLMMET.DAT to compute sigma-y (valid only if METFM = 3)

Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2) Default: 3 ! MDISP2 = 3 !
(used only if MDISP = 1 or 5)
2 = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.)
3 = PG dispersion coefficients for RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients in urban areas
4 = same as 3 except PG coefficients computed using the MESOPUFF II eqns.

[DIAGNOSTIC FEATURE]
Method used for Lagrangian timescale for Sigma-y
(used only if MDISP=1,2 or MDISP2=1,2)
(MTAULY) Default: 0 ! MTAULY = 0 !
0 = Draxler default 617.284 (s)
1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF
10 <Direct user input (s) -- e.g., 306.9

[DIAGNOSTIC FEATURE]
Method used for Advective-Decay timescale for Turbulence
(used only if MDISP=2 or MDISP2=2)
(MTAUADV) Default: 0 ! MTAUADV = 0 !
0 = No turbulence advection
1 = Computed (OPTION NOT IMPLEMENTED)
10 <Direct user input (s) -- e.g., 800

Method used to compute turbulence sigma-v &
sigma-w using micrometeorological variables
(Used only if MDISP = 2 or MDISP2 = 2)
(MCTURB) Default: 1 ! MCTURB = 1 !
1 = Standard CALPUFF subroutines
2 = AERMOD subroutines

PG sigma-y,z adj. for roughness? Default: 0 ! MROUGH = 0 !
(MROUGH)
0 = no
1 = yes

Partial plume penetration of Default: 1 ! MPARTL = 1 !
elevated inversion modeled for
point sources?
(MPARTL)
0 = no
1 = yes

Partial plume penetration of Default: 1 ! MPARTLBA = 0 !
elevated inversion modeled for
buoyant area sources?
(MPARTLBA)
0 = no
1 = yes

Strength of temperature inversion Default: 0 ! MTINV = 0 !
provided in PROFILE.DAT extended records?
(MTINV)
0 = no (computed from measured/default gradients)
1 = yes

PDF used for dispersion under convective conditions?

Default: 0 ! MPDF = 0 !

(MPDF)
0 = no
1 = yes

Sub-Grid TIBL module used for shore line?
Default: 0 ! MSGTIBL = 0 !

(MSGTIBL)
0 = no
1 = yes

Boundary conditions (concentration) modeled?
Default: 0 ! MBCON = 0 !

(MBCON)
0 = no
1 = yes, using formatted BCON.DAT file
2 = yes, using unformatted CONC.DAT file

Note: MBCON > 0 requires that the last species modeled be 'BCON'. Mass is placed in species BCON when generating boundary condition puffs so that clean air entering the modeling domain can be simulated in the same way as polluted air. Specify zero emission of species BCON for all regular sources.

Individual source contributions saved?
Default: 0 ! MSOURCE = 0 !

(MSOURCE)
0 = no
1 = yes

Analyses of fogging and icing impacts due to emissions from arrays of mechanically-forced cooling towers can be performed using CALPUFF in conjunction with a cooling tower emissions processor (CTEMISS) and its associated postprocessors. Hourly emissions of water vapor and temperature from each cooling tower cell are computed for the current cell configuration and ambient conditions by CTEMISS. CALPUFF models the dispersion of these emissions and provides cloud information in a specialized format for further analysis. Output to FOG.DAT is provided in either 'plume mode' or 'receptor mode' format.

Configure for FOG Model output?
Default: 0 ! MFOG = 0 !

(MFOG)
0 = no
1 = yes - report results in PLUME Mode format
2 = yes - report results in RECEPTOR Mode format

Test options specified to see if
they conform to regulatory
values? (MREG) Default: 1 ! MREG = 0 !

0 = NO checks are made
1 = Technical options must conform to USEPA
Long Range Transport (LRT) guidance
METFM 1 or 2
AVET 60. (min)
PGTIME 60. (min)
MGAUSS 1
MCTADJ 3
MTRANS 1
MTIP 1
MRISE 1
MCHEM 1 or 3 (if modeling SOx, NOx)
MWET 1
MDRY 1
MDISP 2 or 3
MPDF 0 if MDISP=3
1 if MDISP=2
MROUGH 0
MPARTL 1
MPARTLBA 0
SYTDEP 550. (m)
MHFTSZ 0
SVMIN 0.5 (m/s)

!END!

INPUT GROUP: 3a, 3b -- Species list

Subgroup (3a)

The following species are modeled:

! CSPEC = 1 ! !END!
! CSPEC = 2 ! !END!
! CSPEC = 3 ! !END!
! CSPEC = 4 ! !END!
! CSPEC = 5 ! !END!
! CSPEC = 6 ! !END!
! CSPEC = 7 ! !END!
! CSPEC = 8 ! !END!

```
! CSPEC =        9 !         !END!
! CSPEC =       10 !         !END!
! CSPEC =       11 !         !END!
! CSPEC =       12 !         !END!
! CSPEC =       13 !         !END!
! CSPEC =       14 !         !END!
! CSPEC =       15 !         !END!
! CSPEC =       16 !         !END!
! CSPEC =       17 !         !END!
! CSPEC =       18 !         !END!


                                       Dry               OUTPUT GROUP
    SPECIES        MODELED         EMITTED       DEPOSITED              NUMBER
     NAME       (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,                (0=NONE,
   (Limit: 12                                  1=COMPUTED-GAS        1=1st CGRUP,
    Characters                                  2=COMPUTED-PARTICLE   2=2nd CGRUP,
    in length)                                 3=USER-SPECIFIED)     3= etc.)

!          1  =        1,           1,         2,            0   !
!          2  =        1,           1,         2,            0   !
!          3  =        1,           1,         2,            0   !
!          4  =        1,           1,         2,            0   !
!          5  =        1,           1,         2,            0   !
!          6  =        1,           1,         2,            0   !
!          7  =        1,           1,         2,            0   !
!          8  =        1,           1,         2,            0   !
!          9  =        1,           1,         2,            0   !
!         10  =        1,           1,         2,            0   !
!         11  =        1,           1,         2,            0   !
!         12  =        1,           1,         2,            0   !
!         13  =        1,           1,         2,            0   !
!         14  =        1,           1,         2,            0   !
!         15  =        1,           1,         2,            0   !
!         16  =        1,           1,         2,            0   !
!         17  =        1,           1,         2,            0   !
!         18  =        1,           1,         2,            0   !


!END!
```

Note: The last species in (3a) must be 'BCON' when using the boundary condition option (MBCON > 0). Species BCON should typically be modeled as inert (no chem transformation or removal).

Subgroup (3b)

The following names are used for Species-Groups in which results

```
  for certain species are combined (added) prior to output.  The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.



-------------------------------------------------------------------------------


INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0     ! FEAST = 0.0 !
     (FNORTH)                   Default=0.0     ! FNORTH = 0.0 !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default      ! IUTMZN = 50 !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                   Default: N      ! UTMHEM = S !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                    No Default      ! RLAT0 = 0.00N !
     (RLON0)                    No Default      ! RLON0 = 0.00E !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
```

PS : RLON0 identifies central (grid N/S) meridian of projection
RLAT0 selected for convenience
EM : RLON0 identifies central meridian of projection
RLAT0 is REPLACED by 0.0N (Equator)
LAZA: RLON0 identifies longitude of tangent-point of mapping plane
RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(XLAT1) No Default ! XLAT1 = 30S !
(XLAT2) No Default ! XLAT2 = 60S !

LCC : Projection cone slices through Earth's surface at XLAT1 and XLAT2
PS : Projection plane slices through Earth at XLAT1
(XLAT2 is not used)

Note: Latitudes and longitudes should be positive, and include a
letter N,S,E, or W indicating north or south latitude, and
east or west longitude. For example,
35.9 N Latitude = 35.9N
118.7 E Longitude = 118.7E

Datum-region

The Datum-Region for the coordinates is identified by a character string. Many mapping products currently available use the model of the Earth known as the World Geodetic System 1984 (WGS-84). Other local models may be in use, and their selection in CALMET will make its output consistent with local mapping products. The list of Datum-Regions with official transformation parameters is provided by the National Imagery and Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)

WGS-84 WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
NAS-C NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NAR-C NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
NWS-84 NWS 6370KM Radius, Sphere
ESR-S ESRI REFERENCE 6371KM Radius, Sphere

Datum-region for output coordinates
(DATUM) Default: WGS-84 ! DATUM = WGS-84 !

METEOROLOGICAL Grid (outermost if nested CALMET grids are used):

Rectangular grid defined for projection PMAP,
with X the Easting and Y the Northing coordinate

No. X grid cells (NX) No default ! NX = 20 !
No. Y grid cells (NY) No default ! NY = 20 !
No. vertical layers (NZ) No default ! NZ = 10 !

Grid spacing (DGRIDKM) No default ! DGRIDKM = 1 !
Units: km

Cell face heights
(ZFACE(nz+1)) No defaults
Units: m
! ZFACE = 0.0, 20.0, 40.0, 80.0, 160.0, 320.0, 640.0, 1200.0, 2000.0, 3000.0, 4000.0 !

Reference Coordinates
of SOUTHWEST corner of
grid cell(1, 1):

X coordinate (XORIGKM) No default ! XORIGKM = 431 !
Y coordinate (YORIGKM) No default ! YORIGKM = 6370 !
Units: km

COMPUTATIONAL Grid:

The computational grid is identical to or a subset of the MET. grid.
The lower left (LL) corner of the computational grid is at grid point
(IBCOMP, JBCOMP) of the MET. grid. The upper right (UR) corner of the
computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
The grid spacing of the computational grid is the same as the MET. grid.

X index of LL corner (IBCOMP) No default ! IBCOMP = 1 !
(1 <= IBCOMP <= NX)

Y index of LL corner (JBCOMP) No default ! JBCOMP = 1 !
(1 <= JBCOMP <= NY)

X index of UR corner (IECOMP) No default ! IECOMP = 20 !
(1 <= IECOMP <= NX)

Y index of UR corner (JECOMP) No default ! JECOMP = 20 !
(1 <= JECOMP <= NY)

SAMPLING Grid (GRIDDED RECEPTORS):

The lower left (LL) corner of the sampling grid is at grid point
(IBSAMP, JBSAMP) of the MET. grid. The upper right (UR) corner of the
sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
The sampling grid must be identical to or a subset of the computational

```
     grid.  It may be a nested grid inside the computational grid.
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.

       Logical flag indicating if gridded
       receptors are used (LSAMP)         Default: T     ! LSAMP = T !
       (T=yes, F=no)

       X index of LL corner (IBSAMP)      No default     ! IBSAMP = 1 !
        (IBCOMP <= IBSAMP <= IECOMP)

       Y index of LL corner (JBSAMP)      No default     ! JBSAMP = 1 !
        (JBCOMP <= JBSAMP <= JECOMP)


       X index of UR corner (IESAMP)      No default     ! IESAMP = 20 !
        (IBCOMP <= IESAMP <= IECOMP)

       Y index of UR corner (JESAMP)      No default     ! JESAMP = 20 !
        (JBCOMP <= JESAMP <= JECOMP)


      Nesting factor of the sampling
       grid (MESHDN)                      Default: 1     ! MESHDN = 1 !
       (MESHDN is an integer >= 1)

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 5 -- Output Options
--------------
                                    *                    *
     FILE                    DEFAULT VALUE          VALUE THIS RUN
     ----                    -------------          --------------

   Concentrations (ICON)             1                 ! ICON = 1 !
   Dry Fluxes (IDRY)                 1                 ! IDRY = 1 !
   Wet Fluxes (IWET)                 1                 ! IWET = 0 !
   2D Temperature (IT2D)             0                 ! IT2D = 0 !
   2D Density (IRHO)                 0                 ! IRHO = 0 !
   Relative Humidity (IVIS)          1                 ! IVIS = 0 !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                         Default: T        ! LCOMPRS = T !

   *
    0 = Do not create file, 1 = create file
```

```
QA PLOT FILE OUTPUT OPTION:

   Create a standard series of output files (e.g.
   locations of sources, receptors, grids ...)
   suitable for plotting?
   (IQAPLOT)                    Default: 1        ! IQAPLOT = 1 !
     0 = no
     1 = yes

DIAGNOSTIC PUFF-TRACKING OUTPUT OPTION:

   Puff locations and properties reported to
   PFTRAK.DAT file for postprocessing?
   (IPFTRAK)                    Default: 0        ! IPFTRAK = 0 !
     0 = no
     1 = yes, update puff output at end of each timestep
     2 = yes, update puff output at end of each sampling step

DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

   Mass flux across specified boundaries
   for selected species reported?
   (IMFLX)                      Default: 0        ! IMFLX = 0 !
     0 = no
     1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
             are specified in Input Group 0)

   Mass balance for each species
   reported?
   (IMBAL)                      Default: 0        ! IMBAL = 0 !
     0 = no
     1 = yes (MASSBAL.DAT filename is
          specified in Input Group 0)


NUMERICAL RISE OUTPUT OPTION:

   Create a file with plume properties for each rise
   increment, for each model timestep?
   This applies to sources modeled with numerical rise
   and is limited to ONE source in the run.
   (INRISE)                     Default: 0        ! INRISE = 0 !
     0 = no
     1 = yes (RISE.DAT filename is
             specified in Input Group 0)


LINE PRINTER OUTPUT OPTIONS:
```

Print concentrations (ICPRT)   Default: 0   ! ICPRT = 0 !
Print dry fluxes (IDPRT)   Default: 0   ! IDPRT = 0 !
Print wet fluxes (IWPRT)   Default: 0   ! IWPRT = 0 !
(0 = Do not print, 1 = Print)

Concentration print interval
(ICFRQ) in timesteps   Default: 1   ! ICFRQ = 1 !
Dry flux print interval
(IDFRQ) in timesteps   Default: 1   ! IDFRQ = 1 !
Wet flux print interval
(IWFRQ) in timesteps   Default: 1   ! IWFRQ = 1 !

Units for Line Printer Output
(IPRTU)   Default: 1   ! IPRTU = 3 !

	for Concentration	for Deposition	
1 =	g/m**3	g/m**2/s	
2 =	mg/m**3	mg/m**2/s	
3 =	ug/m**3	ug/m**2/s	
4 =	ng/m**3	ng/m**2/s	
5 =	Odour Units		
6 =	TBq/m**3	TBq/m**2/s	TBq=terabecquerel
7 =	GBq/m**3	GBq/m**2/s	GBq=gigabecquerel
8 =	Bq/m**3	Bq/m**2/s	Bq=becquerel (disintegrations/s)

Messages tracking progress of run
written to the screen ?
(IMESG)   Default: 2   ! IMESG = 2 !
0 = no
1 = yes (advection step, puff ID)
2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)

SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

	SPECIES /GROUP	---- CONCENTRATIONS ---- PRINTED?	SAVED ON DISK?	------ DRY FLUXES ------ PRINTED?	SAVED ON DISK?	------ WET FLUXES ------ PRINTED?	SAVED ON DISK?	-- MASS FLUX -- SAVED ON DISK?	
!	1 =	1,	1,	1,	1,	1,	0,	0	!
!	2 =	1,	1,	1,	1,	1,	0,	0	!
!	3 =	1,	1,	1,	1,	1,	0,	0	!
!	4 =	1,	1,	1,	1,	1,	0,	0	!
!	5 =	1,	1,	1,	1,	1,	0,	0	!
!	6 =	1,	1,	1,	1,	1,	0,	0	!
!	7 =	1,	1,	1,	1,	1,	0,	0	!
!	8 =	1,	1,	1,	1,	1,	0,	0	!
!	9 =	1,	1,	1,	1,	1,	0,	0	!
!	10 =	1,	1,	1,	1,	1,	0,	0	!
!	11 =	1,	1,	1,	1,	1,	0,	0	!
!	12 =	1,	1,	1,	1,	1,	0,	0	!

```
!        13 =    1,       1,       1,       1,       1,       0,       0  !
!        14 =    1,       1,       1,       1,       1,       0,       0  !
!        15 =    1,       1,       1,       1,       1,       0,       0  !
!        16 =    1,       1,       1,       1,       1,       0,       0  !
!        17 =    1,       1,       1,       1,       1,       0,       0  !
!        18 =    1,       1,       1,       1,       1,       0,       0  !

  Note:  Species BCON (for MBCON > 0) does not need to be saved on disk.


     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                          Default: F     ! LDEBUG = F !

       First puff to track
       (IPFDEB)                          Default: 1     ! IPFDEB = 1 !

       Number of puffs to track
       (NPFDEB)                          Default: 1     ! NPFDEB = 1000 !

       Met. period to start output
       (NN1)                             Default: 1     ! NN1 = 1 !

       Met. period to end output
       (NN2)                             Default: 10    ! NN2 = 10 !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs
-------------------------

---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)       Default: 0     ! NHILL = 0 !

       Number of special complex terrain
       receptors  (NCTREC)                      Default: 0     ! NCTREC = 0 !

       Terrain and CTSG Receptor data for
       CTSG hills input in CTDM format ?
       (MHILL)                           No Default     ! MHILL = 2 !
       1 = Hill and Receptor data created
           by CTDM processors & read from
           HILL.DAT and HILLRCT.DAT files
```

2 = Hill data created by OPTHILL &
input below in Subgroup (6b);
Receptor data in Subgroup (6c)

Factor to convert horizontal dimensions Default: 1.0 ! XHILL2M = 1.0 !
to meters (MHILL=1)

Factor to convert vertical dimensions Default: 1.0 ! ZHILL2M = 1.0 !
to meters (MHILL=1)

X-origin of CTDM system relative to No Default ! XCTDMKM = 0.0 !
CALPUFF coordinate system, in Kilometers (MHILL=1)

Y-origin of CTDM system relative to No Default ! YCTDMKM = 0.0 !
CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

Subgroup (6b)
----

1 **
HILL information

HILL NO.	XC (km)	YC (km)	THETAH (deg.)	ZGRID (m)	RELIEF (m)	EXPO 1 (m)	EXPO 2 (m)	SCALE 1 (m)	SCALE 2 (m)	AMAX1 (m)	AMAX2 (m)
----	----	----	------	-----	------	------	------	-------	-------	-----	-----

----
Subgroup (6c)

COMPLEX TERRAIN RECEPTOR INFORMATION

XRCT (km)	YRCT (km)	ZRCT (m)	XHH
------	-----	------	----

1
Description of Complex Terrain Variables:
XC, YC = Coordinates of center of hill
THETAH = Orientation of major axis of hill (clockwise from North)
ZGRID = Height of the 0 of the grid above mean sea level
RELIEF = Height of the crest of the hill above the grid elevation

EXPO 1 = Hill-shape exponent for the major axis
EXPO 2 = Hill-shape exponent for the major axis
SCALE 1 = Horizontal length scale along the major axis
SCALE 2 = Horizontal length scale along the minor axis
AMAX = Maximum allowed axis length for the major axis
BMAX = Maximum allowed axis length for the major axis

XRCT, YRCT = Coordinates of the complex terrain receptors
ZRCT = Height of the ground (MSL) at the complex terrain
Receptor
XHH = Hill number associated with each complex terrain receptor
(NOTE: MUST BE ENTERED AS A REAL NUMBER)

**
NOTE: DATA for each hill and CTSG receptor are treated as a separate
input subgroup and therefore must end with an input group terminator.

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases
----

```
 SPECIES     DIFFUSIVITY      ALPHA STAR      REACTIVITY    MESOPHYLL RESISTANCE     HENRY'S LAW COEFFICIENT
  NAME        (cm**2/s)                                          (s/cm)                (dimensionless)
 -------     -----------      ----------      ----------    --------------------     -----------------------
* DRYGAS = *

!END!
```

INPUT GROUP: 8 -- Size parameters for dry deposition of particles
----

For SINGLE SPECIES, the mean and standard deviation are used to
compute a deposition velocity for NINT (see group 9) size-ranges,
and these are then averaged to obtain a mean deposition velocity.

For GROUPED SPECIES, the size distribution should be explicitly
specified (by the 'species' in the group), and the standard deviation
for each should be entered as 0. The model will then use the
deposition velocity for the stated mean diameter.

```
 SPECIES      GEOMETRIC MASS MEAN        GEOMETRIC STANDARD
  NAME             DIAMETER                   DEVIATION
                   (microns)                  (microns)
 -------      -------------------        ------------------
!      1 =         24.4,                    1.6   !
```

```
!       10 =      24.4,          1.6  !
!       11 =       5.6,          1.4  !
!       12 =       1.3,            2  !
!       13 =      24.4,          1.6  !
!       14 =       5.6,          1.4  !
!       15 =       1.3,            2  !
!       16 =      24.4,          1.6  !
!       17 =       5.6,          1.4  !
!       18 =       1.3,            2  !
!        2 =       5.6,          1.4  !
!        3 =       1.3,            2  !
!        4 =      24.4,          1.6  !
!        5 =       5.6,          1.4  !
!        6 =       1.3,            2  !
!        7 =      24.4,          1.6  !
!        8 =       5.6,          1.4  !
!        9 =       1.3,            2  !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------

     Reference cuticle resistance (s/cm)
     (RCUTR)                       Default: 30    ! RCUTR = 30 !
     Reference ground resistance  (s/cm)
     (RGR)                         Default: 10    ! RGR = 10 !
     Reference pollutant reactivity
     (REACTR)                      Default: 8     ! REACTR = 8 !

     Number of particle-size intervals used to
     evaluate effective particle deposition velocity
     (NINT)                        Default: 9     ! NINT = 9 !

     Vegetation state in unirrigated areas
     (IVEG)                        Default: 1     ! IVEG = 1 !
        IVEG=1 for active and unstressed vegetation
        IVEG=2 for active and stressed vegetation
        IVEG=3 for inactive vegetation

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 10 -- Wet Deposition Parameters
```

```
---------------

               Scavenging Coefficient -- Units: (sec)**(-1)

      Pollutant      Liquid Precip.       Frozen Precip.
      ---------      --------------       --------------
* WETDEPOS = *
!END!


-------------------------------------------------------------------------------


INPUT GROUP: 11a, 11b -- Chemistry Parameters
---------------------

---------------
Subgroup (11a)
---------------

    Several parameters are needed for one or more of the chemical transformation
    mechanisms.  Those used for each mechanism are:
                                                    S
                              M               B  R  O
                              A  B  R  R  R     C  H  4  B       N
                         B    V  C  N  N  N  M  K  -  -  C  O     D
                         C  M  G  K  I  I  I  H  H  I  I  K  F  V  E
                       M  K  N  N  N  T  T  T  2  2  S  S  P  R  C  C
                       O  O  H  H  H  E  E  E  O  O  R  R  M  A  N  A
    Mechanism (MCHEM)       Z  3  3  3  3  1  2  3  2  2  P  P  F  C  X  Y
    --------------------   --------------------------------------------------
    0 None                  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
    1 MESOPUFF II           X  X  .  .  X  X  X  X  .  .  .  .  .  .  .  .
    2 User Rates            .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
    3 RIVAD                 X  X  .  .  X  .  .  .  .  .  .  .  .  .  .  .
    4 SOA                   X  X  .  .  .  .  .  .  .  .  .  .  X  X  X  .
    5 Radioactive Decay     .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  X
    6 RIVAD/ISORRPIA        X  X  X  X  X  X  .  .  X  X  X  X  .  .  .  .
    7 RIVAD/ISORRPIA/SOA    X  X  X  X  X  X  .  .  X  X  X  X  X  X  .  .


    Ozone data input option (MOZ)     Default: 1            ! MOZ = 1 !
    (Used only if MCHEM = 1,3,4,6 or 7)
       0 = use a monthly background ozone value
       1 = read hourly ozone concentrations from
           the OZONE.DAT data file

    Monthly ozone concentrations in ppb (BCKO3)
    (Used only if MCHEM = 1,3,4,6, or 7 and either
       MOZ = 0, or
```

MOZ = 1 and all hourly O3 data missing)

Default: 12*80.

! BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00 !

Ammonia data option (MNH3) Default: 0 ! MNH3 = 0 !

(Used only if MCHEM = 6 or 7)

0 = use monthly background ammonia values (BCKNH3) - no vertical variation

1 = read monthly background ammonia values for each layer from
the NH3Z.DAT data file

Ammonia vertical averaging option (MAVGNH3)

(Used only if MCHEM = 6 or 7, and MNH3 = 1)

0 = use NH3 at puff center height (no averaging is done)

1 = average NH3 values over vertical extent of puff

Default: 1 ! MAVGNH3 = 1 !

Monthly ammonia concentrations in ppb (BCKNH3)

(Used only if MCHEM = 1 or 3, or
if MCHEM = 6 or 7, and MNH3 = 0)

Default: 12*10.

! BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00 !

Nighttime SO2 loss rate in %/hour (RNITE1)

(Used only if MCHEM = 1, 6 or 7)

This rate is used only at night for MCHEM=1
and is added to the computed rate both day
and night for MCHEM=6,7 (heterogeneous reactions)

Default: 0.2 ! RNITE1 = 0.2 !

Nighttime NOx loss rate in %/hour (RNITE2)

(Used only if MCHEM = 1)

Default: 2.0 ! RNITE2 = 2 !

Nighttime HNO3 formation rate in %/hour (RNITE3)

(Used only if MCHEM = 1)

Default: 2.0 ! RNITE3 = 2 !

H2O2 data input option (MH2O2) Default: 1 ! MH2O2 = 1 !

(Used only if MCHEM = 6 or 7, and MAQCHEM = 1)

0 = use a monthly background H2O2 value

1 = read hourly H2O2 concentrations from
the H2O2.DAT data file

Monthly H2O2 concentrations in ppb (BCKH2O2)

(Used only if MQACHEM = 1 and either
MH2O2 = 0 or
MH2O2 = 1 and all hourly H2O2 data missing)

Default: 12*1.

! BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !

--- Data for ISORROPIA Option

(used only if MCHEM = 6 or 7)

Minimum relative humidity used in ISORROPIA computations (RH_ISRP)
Default: 50. ! RH_ISRP = 50.0 !
Units: %

Minimum SO4 used in ISORROPIA computations (SO4_ISRP)
Default: 0.4 ! SO4_ISRP = 0.4 !
Units: ug/m3

--- Data for SECONDARY ORGANIC AEROSOL (SOA) Options
(used only if MCHEM = 4 or 7)

The MCHEM = 4 SOA module uses monthly values of:
Fine particulate concentration in ug/m^3 (BCKPMF)
Organic fraction of fine particulate (OFRAC)
VOC / NOX ratio (after reaction) (VCNX)

The MCHEM = 7 SOA module uses monthly values of:
Fine particulate concentration in ug/m^3 (BCKPMF)
Organic fraction of fine particulate (OFRAC)

These characterize the air mass when computing
the formation of SOA from VOC emissions.
Typical values for several distinct air mass types are:

Month	1	2	3	4	5	6	7	8	9	10	11	12
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Clean Continental

BCKPMF	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
OFRAC	.15	.15	.20	.20	.20	.20	.20	.20	.20	.20	.20	.15
VCNX	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.

Clean Marine (surface)

BCKPMF	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
OFRAC	.25	.25	.30	.30	.30	.30	.30	.30	.30	.30	.30	.25
VCNX	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.	50.

Urban - low biogenic (controls present)

BCKPMF	30.	30.	30.	30.	30.	30.	30.	30.	30.	30.	30.	30.
OFRAC	.20	.20	.25	.25	.25	.25	.25	.25	.20	.20	.20	.20
VCNX	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.

Urban - high biogenic (controls present)

BCKPMF	60.	60.	60.	60.	60.	60.	60.	60.	60.	60.	60.	60.
OFRAC	.25	.25	.30	.30	.30	.55	.55	.55	.35	.35	.35	.25
VCNX	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.

Regional Plume

BCKPMF	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.	20.

```
     OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30  .30  .30  .20
     VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

   Urban - no controls present
     BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.
     OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35  .35  .35  .30
     VCNX     2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.

   Default: Clean Continental
   ! BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !
   ! OFRAC = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !
   ! VCNX = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00 !

 --- End Data for SECONDARY ORGANIC AEROSOL (SOA) Options


   Number of half-life decay specification blocks provided in Subgroup 11b
   (Used only if MCHEM = 5)
   (NDECAY)                        Default: 0      ! NDECAY = 0 !

!END!


--------------
Subgroup (11b)
--------------

   Each species modeled may be assigned a decay half-life (sec), and the associated
   mass lost may be assigned to one or more other modeled species using a mass yield
   factor. This information is used only for MCHEM=5.

   Provide NDECAY blocks assigning the half-life for a parent species and mass yield
   factors for each child species (if any) produced by the decay.
   Set HALF_LIFE=0.0 for NO decay (infinite half-life).

                    a          b
     SPECIES     Half-Life   Mass Yield
      NAME         (sec)      Factor
     -------     ---------   ----------
* SPECHLLIST = *

--------
  a
   Specify a half life that is greater than or equal to zero for 1 parent species
   in each block, and set the yield factor for this species to -1
  b
   Specify a yield factor that is greater than or equal to zero for 1 or more child
   species in each block, and set the half-life for each of these species to -1

   NOTE: Assignments in each block are treated as a separate input
         subgroup and therefore must end with an input group terminator.
```

```
        If NDECAY=0, no assignments and input group terminators should appear.

-------------------------------------------------------------------------------


INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
---------------

   Horizontal size of puff (m) beyond which
   time-dependent dispersion equations (Heffter)
   are used to determine sigma-y and
   sigma-z (SYTDEP)                    Default: 550.   ! SYTDEP = 550 !

   Switch for using Heffter equation for sigma z
   as above (0 = Not use Heffter; 1 = use Heffter
   (MHFTSZ)                            Default: 0      ! MHFTSZ = 0 !

   Stability class used to determine plume
   growth rates for puffs above the boundary
   layer (JSUP)                        Default: 5      ! JSUP = 5 !

   Vertical dispersion constant for stable
   conditions (k1 in Eqn. 2.7-3)  (CONK1)     Default: 0.01   ! CONK1 = 0.01 !

   Vertical dispersion constant for neutral/
   unstable conditions (k2 in Eqn. 2.7-4)
   (CONK2)                             Default: 0.1    ! CONK2 = 0.1 !

   Factor for determining Transition-point from
   Schulman-Scire to Huber-Snyder Building Downwash
   scheme (SS used for Hs <Hb + TBD * HL)
   (TBD)                               Default: 0.5    ! TBD = 0.5 !
     TBD <0   ==> always use Huber-Snyder
     TBD = 1.5 ==> always use Schulman-Scire
     TBD = 0.5 ==> ISC Transition-point

   Range of land use categories for which
   urban dispersion is assumed
   (IURB1, IURB2)                      Default: 10     ! IURB1 = 10 !
                                                19     ! IURB2 = 19 !

   Site characterization parameters for single-point Met data files ---------
   (needed for METFM = 2,3,4,5)

     Land use category for modeling domain
     (ILANDUIN)                        Default: 20     ! ILANDUIN = 20 !

     Roughness length (m) for modeling domain
     (Z0IN)                            Default: 0.25   ! Z0IN = .25 !

     Leaf area index for modeling domain
```

(XLAIIN) Default: 3.0 ! XLAIIN = 3.0 !

Elevation above sea level (m)
(ELEVIN) Default: 0.0 ! ELEVIN = .0 !

Latitude (degrees) for met location
(XLATIN) Default: -999. ! XLATIN = -999.0 !

Longitude (degrees) for met location
(XLONIN) Default: -999. ! XLONIN = -999.0 !

Specialized information for interpreting single-point Met data files -----

Anemometer height (m) (Used only if METFM = 2,3)
(ANEMHT) Default: 10. ! ANEMHT = 10.0 !

Form of lateral turbulance data in PROFILE.DAT file
(Used only if METFM = 4,5 or MTURBVW = 1 or 3)
(ISIGMAV) Default: 1 ! ISIGMAV = 1 !
0 = read sigma-theta
1 = read sigma-v

Choice of mixing heights (Used only if METFM = 4)
(IMIXCTDM) Default: 0 ! IMIXCTDM = 0 !
0 = read PREDICTED mixing heights
1 = read OBSERVED mixing heights

Maximum length of a slug (met. grid units)
(XMXLEN) Default: 1.0 ! XMXLEN = 1 !

Maximum travel distance of a puff/slug (in
grid units) during one sampling step
(XSAMLEN) Default: 1.0 ! XSAMLEN = 1 !

Maximum Number of slugs/puffs release from
one source during one time step
(MXNEW) Default: 99 ! MXNEW = 99 !

Maximum Number of sampling steps for
one puff/slug during one time step
(MXSAM) Default: 99 ! MXSAM = 99 !

Number of iterations used when computing
the transport wind for a sampling step
that includes gradual rise (for CALMET
and PROFILE winds)
(NCOUNT) Default: 2 ! NCOUNT = 2 !

Minimum sigma y for a new puff/slug (m)
(SYMIN) Default: 1.0 ! SYMIN = 1 !

Minimum sigma z for a new puff/slug (m)
(SZMIN) Default: 1.0 ! SZMIN = 1 !

Maximum sigma z (m) allowed to avoid
numerical problem in calculating virtual
time or distance. Cap should be large
enough to have no influence on normal events.
Enter a negative cap to disable.
(SZCAP_M) Default: 5.0e06 ! SZCAP_M = 5000000 !

Default minimum turbulence velocities sigma-v and sigma-w
for each stability class over land and over water (m/s)
(SVMIN(12) and SWMIN(12))

```
             ----------  LAND  ----------       ---------  WATER  ----------
   Stab Class :  A    B    C    D    E    F        A    B    C    D    E    F
                ---  ---  ---  ---  ---  ---       ---  ---  ---  ---  ---  ---
Default SVMIN : .50, .50, .50, .50, .50, .50,      .37, .37, .37, .37, .37, .37
Default SWMIN : .20, .12, .08, .06, .03, .016,     .20, .12, .08, .06, .03, .016
```

! SVMIN = 0.5, 0.50, 0.50, 0.50, 0.50, 0.500, 0.37, 0.37, 0.37, 0.37, 0.37, 0.370 !
! SWMIN = 0.2, 0.12, 0.08, 0.06, 0.03, 0.016, 0.20, 0.12, 0.08, 0.06, 0.03, 0.016 !

Divergence criterion for dw/dz across puff
used to initiate adjustment for horizontal
convergence (1/s)
Partial adjustment starts at CDIV(1), and
full adjustment is reached at CDIV(2)
(CDIV(2)) Default: 0.0,0.0 ! CDIV = .0, .0 !

Search radius (number of cells) for nearest
land and water cells used in the subgrid
TIBL module
(NLUTIBL) Default: 4 ! NLUTIBL = 4 !

Minimum wind speed (m/s) allowed for
non-calm conditions. Also used as minimum
speed returned when using power-law
extrapolation toward surface
(WSCALM) Default: 0.5 ! WSCALM = .5 !

Maximum mixing height (m)
(XMAXZI) Default: 3000. ! XMAXZI = 3000.0 !

Minimum mixing height (m)
(XMINZI) Default: 50. ! XMINZI = 50.0 !

Temperatures (K) used for defining upper bound of
categories for emissions scale-factors
11 upper bounds (K) are entered; the 12th class has no upper limit

```
(TKCAT(11))
        Default   : 265., 270., 275., 280., 285., 290., 295., 300., 305., 310., 315.  (315.+)
                <<    <<    <<    <<    <<    <Temperature Class :  1    2    3    4    5    6    7    8    9    10
11   (12)
                ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----
        ! TKCAT = 265., 270., 275., 280., 285., 290., 295., 300., 305., 310., 315. !

Default wind speed profile power-law
exponents for stabilities 1-6
(PLX0(6))              Default   : ISC RURAL values
                ISC RURAL : .07, .07, .10, .15, .35, .55
                ISC URBAN : .15, .15, .20, .25, .30, .30

              Stability Class :  A    B    C    D    E    F
                                ---  ---  ---  ---  ---  ---
                  ! PLX0 = 0.07, 0.07, 0.10, 0.15, 0.35, 0.55 !

Default potential temperature gradient
for stable classes E, F (degK/m)
(PTG0(2))              Default: 0.020, 0.035
                  ! PTG0 = 0.020, 0.035 !

Default plume path coefficients for
each stability class (used when option
for partial plume height terrain adjustment
is selected -- MCTADJ=3)
(PPC(6))          Stability Class :  A    B    C    D    E    F
                Default  PPC : .50,  .50,  .50,  .50,  .35,  .35
                                ---  ---  ---  ---  ---  ---
                  ! PPC = 0.5, 0.5, 0.5, 0.5, 0.35, 0.35 !

Slug-to-puff transition criterion factor
equal to sigma-y/length of slug
(SL2PF)                  Default: 10.       ! SL2PF = 10 !

Receptor-specific puff/slug properties (e.g., sigmas and height above
ground at the time when the trajectory is nearest the receptor) may be
extrapolated forward or backward in time along the current step using
the current dispersion, for receptors that lie upwind of the puff/slug
position at the start of a step, or downwind at the end of a step.
Specify the upwind/downwind extrapolation zone in sigma-y units.
Using FCLIP=1.0 clips the the upwind zone at one sigma-y at the start
of the step and the downwind zone at one sigma-y at the end of the step.
This is consistent with the sampling done in CALPUFF versions through
v6.42 prior to the introduction of the FCLIP option.
The default is No Extrapolation, FCLIP=0.0.
(FCLIP)                  Default: 0.0       ! FCLIP = 0 !

Puff-splitting control variables ------------------------

  VERTICAL SPLIT
```

Number of puffs that result every time a puff
is split - nsplit=2 means that 1 puff splits
into 2
(NSPLIT) Default: 3 ! NSPLIT = 3 !

Time(s) of a day when split puffs are eligible to
be split once again; this is typically set once
per day, around sunset before nocturnal shear develops.
24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
0=do not re-split 1=eligible for re-split
(IRESPLIT(24)) Default: Hour 17 = 1
! IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 !

Split is allowed only if last hour's mixing
height (m) exceeds a minimum value
(ZISPLIT) Default: 100. ! ZISPLIT = 100.0 !

Split is allowed only if ratio of last hour's
mixing ht to the maximum mixing ht experienced
by the puff is less than a maximum value (this
postpones a split until a nocturnal layer develops)
(ROLDMAX) Default: 0.25 ! ROLDMAX = 0.25 !

HORIZONTAL SPLIT

Number of puffs that result every time a puff
is split - nsplith=5 means that 1 puff splits
into 5
(NSPLITH) Default: 5 ! NSPLITH = 5 !

Minimum sigma-y (Grid Cells Units) of puff
before it may be split
(SYSPLITH) Default: 1.0 ! SYSPLITH = 1.0 !

Minimum puff elongation rate (SYSPLITH/hr) due to
wind shear, before it may be split
(SHSPLITH) Default: 2. ! SHSPLITH = 2.0 !

Minimum concentration (g/m^3) of each
species in puff before it may be split
Enter array of NSPEC values; if a single value is
entered, it will be used for ALL species
(CNSPLITH) Default: 1.0E-07 ! CNSPLITH = 1.0E-07 !

Integration control variables ------------------------

Fractional convergence criterion for numerical SLUG

```
        sampling integration
        (EPSSLUG)                  Default:   1.0e-04  ! EPSSLUG = 0.0001 !

        Fractional convergence criterion for numerical AREA
        source integration
        (EPSAREA)                  Default:   1.0e-06  ! EPSAREA = 1E-006 !

        Trajectory step-length (m) used for numerical rise
        integration
        (DSRISE)                   Default:   1.0      ! DSRISE = 1.0 !

        Boundary Condition (BC) Puff control variables ------------------------

        Minimum height (m) to which BC puffs are mixed as they are emitted
        (MBCON=2 ONLY).  Actual height is reset to the current mixing height
        at the release point if greater than this minimum.
        (HTMINBC)                  Default:   500.     ! HTMINBC = 500 !

        Search radius (km) about a receptor for sampling nearest BC puff.
        BC puffs are typically emitted with a spacing of one grid cell
        length, so the search radius should be greater than DGRIDKM.
        (RSAMPBC)                  Default:   10.      ! RSAMPBC = 10 !

        Near-Surface depletion adjustment to concentration profile used when
        sampling BC puffs?
        (MDEPBC)                   Default:   1        ! MDEPBC = 1 !
           0 = Concentration is NOT adjusted for depletion
           1 = Adjust Concentration for depletion

!END!


-------------------------------------------------------------------------------


INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  ! NPT1 = 0 !

     Units used for point source
     emissions below           (IPTU)  Default: 1  ! IPTU = 1 !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
```

```
          5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
          6 =     Odour Unit * m**3/min
          7 =     metric tons/yr
          8 =     Bq/s  (Bq = becquerel = disintegrations/s)
          9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  ! NSPT1 = 0 !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  ! NPT2 = 0 !

     (If NPT2 > 0, these point
     source emissions are read from
     the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
                                 a
        POINT SOURCE: CONSTANT DATA
        -----------------------------
                                                              b          c
  Source       X         Y       Stack    Base     Stack    Exit  Exit    Bldg.  Emission
   No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash   Rates
              (km)      (km)       (m)      (m)       (m)  (m/s) (deg. K)
  ------   ---------- ---------- ------   ------   -------- ----- -------- ----- --------

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

     SRCNAM  is a 12-character name for a source
             (No default)
     X       is an array holding the source data listed by the column headings
             (No default)
     SIGYZI  is an array holding the initial sigma-y and sigma-z (m)
             (Default: 0.,0.)
     FMFAC   is a vertical momentum flux factor (0. or 1.0) used to represent
             the effect of rain-caps or other physical configurations that
             reduce momentum rise associated with the actual exit velocity.
             (Default: 1.0  -- full momentum used)
     ZPLTFM  is the platform height (m) for sources influenced by an isolated
             structure that has a significant open area between the surface
```

```
          and the bulk of the structure, such as an offshore oil platform.
          The Base Elevation is that of the surface (ground or ocean),
          and the Stack Height is the release height above the Base (not
          above the platform).  Building heights entered in Subgroup 13c
          must be those of the buildings on the platform, measured from
          the platform deck.  ZPLTFM is used only with MBDW=1 (ISC
          downwash method) for sources with building downwash.
          (Default: 0.0)

    b
     0. = No building downwash modeled
     1. = Downwash modeled for buildings resting on the surface
     2. = Downwash modeled for buildings raised above the surface (ZPLTFM > 0.)
     NOTE: must be entered as a REAL number (i.e., with decimal point)

    c
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IPTU
     (e.g. 1 for g/s).

---------------
Subgroup (13c)
---------------

         BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
         -------------------------------------------------------
Source                                                       a
 No.       Effective building height, width, length and X/Y offset (in meters)
         every 10 degrees.  LENGTH, XBADJ, and YBADJ are only needed for
         MBDW=2 (PRIME downwash option)
------     --------------------------------------------------------------------



--------

    a
     Building height, width, length, and X/Y offset from the source are treated
     as a separate input subgroup for each source and therefore must end with
     an input group terminator.  The X/Y offset is the position, relative to the
     stack, of the center of the upwind face of the projected building, with the
     x-axis pointing along the flow direction.

---------------
Subgroup (13d)
---------------
                                       a
        POINT SOURCE: EMISSION-RATE SCALING FACTORS
        -------------------------------------------
```

Use this subgroup to identify temporal variations in the emission
rates given in 13b. Factors assigned multiply the rates in 13b.
Skip sources here that have constant emissions. For more elaborate
variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

Sets of emission-rate scale factors are defined in Input Group 19, and
are referenced by the FACTORNAME. Provide NSPT1 lines that identify the
emission-rate scale factor table for each source-species combination that
uses the scaling option. Note that a scale-factor table can be used with
more than one source-species combination so a FACTORNAME can be repeated.

```
 Source-            Source      Species      Scale-factor table
 Species             Name   b    Name   c     Name        d
  No.               (SRCNAM)     (CSPEC)      (FACTORNAME)
 ------             ------------ ------------ ---------------------
```

----
a
Assignment for each source-specie is treated as a separate input subgroup
and therefore must end with an input group terminator.
b
Source name must match one of the SRCNAM names defined in Input Group 13b
c
Species name must match one of the CSPEC names of emitted species defined in Input Group 3
d
Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters

Subgroup (14a)

Number of polygon area sources with
parameters specified below (NAR1)   No default ! NAR1 = 123 !

Units used for area source
emissions below   (IARU)   Default: 1 ! IARU = 1 !
1 =   g/m**2/s
2 =   kg/m**2/hr
3 =   lb/m**2/hr
4 =   tons/m**2/yr
5 =   Odour Unit * m/s (vol. flux/m**2 of odour compound)
6 =   Odour Unit * m/min

```
          7 =     metric tons/m**2/yr
          8 =     Bq/m**2/s  (Bq = becquerel = disintegrations/s)
          9 =     GBq/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  ! NSAR1 = 0 !

     Number of buoyant polygon area sources
     with variable location and emission
     parameters (NAR2)                      No default  ! NAR2 = 0 !
     (If NAR2 > 0, ALL parameter data for
     these sources are read from the file: BAEMARB.DAT)

!END!

---------------
Subgroup (14b)
---------------
                              a
        AREA SOURCE: CONSTANT DATA
        ----------------------------
                                             b
Source           Effect.    Base      Initial    Emission
 No.             Height   Elevation   Sigma z     Rates
                 (m)       (m)        (m)
-------          ------    ------     --------   ---------


   1 ! SRCNAM = SRC_1_1 !
   1 ! X =       10.0,   294.97,       2.33,       1,       0,       0,       0,       0,       0,
       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0 !
!END!
   2 ! SRCNAM = SRC_1_2 !
   2 ! X =       10.0,   294.97,       2.33,       1,       0,       0,       0,       0,       0,
       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0 !
!END!
   3 ! SRCNAM = SRC_1_3 !
   3 ! X =       10.0,   294.97,       2.33,       1,       0,       0,       0,       0,       0,
       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0 !
!END!
   4 ! SRCNAM = SRC_1_4 !
   4 ! X =       10.0,   294.97,       2.33,       1,       0,       0,       0,       0,       0,
       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0 !
!END!
   5 ! SRCNAM = SRC_1_5 !
   5 ! X =       10.0,   294.97,       2.33,       1,       0,       0,       0,       0,       0,
       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0 !
!END!
   6 ! SRCNAM = SRC_1_6 !
   6 ! X =       10.0,   294.97,       2.33,       1,       0,       0,       0,       0,       0,
```

```
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
   7 ! SRCNAM = SRC_1_7 !
   7 ! X =       10.0,   294.97,       2.33,       1,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
   8 ! SRCNAM = SRC_1_8 !
   8 ! X =       10.0,   294.97,       2.33,       1,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
   9 ! SRCNAM = SRC_1_9 !
   9 ! X =       10.0,   294.97,       2.33,       1,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  10 ! SRCNAM = SRC_1_10 !
  10 ! X =       10.0,   294.97,       2.33,       1,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  11 ! SRCNAM = SRC_1_11 !
  11 ! X =       10.0,   294.97,       2.33,       1,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  12 ! SRCNAM = SRC_1_12 !
  12 ! X =       10.0,   294.97,       2.33,       1,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  13 ! SRCNAM = SRC_1_13 !
  13 ! X =       10.0,   294.97,       2.33,       1,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  14 ! SRCNAM = SRC_1_14 !
  14 ! X =       10.0,   294.97,       2.33,       1,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  15 ! SRCNAM = SRC_2_1 !
  15 ! X =       10.0,   294.97,       2.33,       0,      1,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  16 ! SRCNAM = SRC_2_2 !
  16 ! X =       10.0,   294.97,       2.33,       0,      1,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  17 ! SRCNAM = SRC_2_3 !
  17 ! X =       10.0,   294.97,       2.33,       0,      1,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  18 ! SRCNAM = SRC_2_4 !
  18 ! X =       10.0,   294.97,       2.33,       0,      1,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  19 ! SRCNAM = SRC_2_5 !
```

```
  19 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  20 ! SRCNAM = SRC_2_6 !
  20 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  21 ! SRCNAM = SRC_2_7 !
  21 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  22 ! SRCNAM = SRC_2_8 !
  22 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  23 ! SRCNAM = SRC_2_9 !
  23 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  24 ! SRCNAM = SRC_2_10 !
  24 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  25 ! SRCNAM = SRC_2_11 !
  25 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  26 ! SRCNAM = SRC_2_12 !
  26 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  27 ! SRCNAM = SRC_2_13 !
  27 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  28 ! SRCNAM = SRC_2_14 !
  28 ! X =      10.0,  294.97,      2.33,     0,     1,     0,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  29 ! SRCNAM = SRC_3_1 !
  29 ! X =      10.0,  294.97,      2.33,     0,     0,     1,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  30 ! SRCNAM = SRC_3_2 !
  30 ! X =      10.0,  294.97,      2.33,     0,     0,     1,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
  31 ! SRCNAM = SRC_3_3 !
  31 ! X =      10.0,  294.97,      2.33,     0,     0,     1,     0,     0,     0,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
```

```
 32 ! SRCNAM = SRC_3_4 !
 32 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 33 ! SRCNAM = SRC_3_5 !
 33 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 34 ! SRCNAM = SRC_3_6 !
 34 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 35 ! SRCNAM = SRC_3_7 !
 35 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 36 ! SRCNAM = SRC_3_8 !
 36 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 37 ! SRCNAM = SRC_3_9 !
 37 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 38 ! SRCNAM = SRC_3_10 !
 38 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 39 ! SRCNAM = SRC_3_11 !
 39 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 40 ! SRCNAM = SRC_3_12 !
 40 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 41 ! SRCNAM = SRC_3_13 !
 41 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 42 ! SRCNAM = SRC_3_14 !
 42 ! X =      10.0,  294.97,     2.33,     0,     0,     1,     0,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 43 ! SRCNAM = SRC_4_1 !
 43 ! X =      10.0,  251.67,     2.33,     0,     0,     0,     1,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 44 ! SRCNAM = SRC_4_2 !
 44 ! X =      10.0,  251.67,     2.33,     0,     0,     0,     1,     0,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
```

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!END!
  45 ! SRCNAM = SRC_4_3 !
  45 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  46 ! SRCNAM = SRC_4_4 !
  46 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  47 ! SRCNAM = SRC_4_5 !
  47 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  48 ! SRCNAM = SRC_4_6 !
  48 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  49 ! SRCNAM = SRC_4_7 !
  49 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  50 ! SRCNAM = SRC_4_8 !
  50 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  51 ! SRCNAM = SRC_4_9 !
  51 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  52 ! SRCNAM = SRC_4_10 !
  52 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  53 ! SRCNAM = SRC_4_11 !
  53 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  54 ! SRCNAM = SRC_4_12 !
  54 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  55 ! SRCNAM = SRC_4_13 !
  55 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      1,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  56 ! SRCNAM = SRC_5_1 !
  56 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      0,      1,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  57 ! SRCNAM = SRC_5_2 !
  57 ! X =       10.0,   251.67,       2.33,      0,      0,      0,      0,      1,      0,
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    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 58 ! SRCNAM = SRC_5_3 !
 58 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 59 ! SRCNAM = SRC_5_4 !
 59 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 60 ! SRCNAM = SRC_5_5 !
 60 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 61 ! SRCNAM = SRC_5_6 !
 61 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 62 ! SRCNAM = SRC_5_7 !
 62 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 63 ! SRCNAM = SRC_5_8 !
 63 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 64 ! SRCNAM = SRC_5_9 !
 64 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 65 ! SRCNAM = SRC_5_10 !
 65 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 66 ! SRCNAM = SRC_5_11 !
 66 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 67 ! SRCNAM = SRC_5_12 !
 67 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 68 ! SRCNAM = SRC_5_13 !
 68 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     1,     0,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 69 ! SRCNAM = SRC_6_1 !
 69 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
    0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 70 ! SRCNAM = SRC_6_2 !
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 70 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 71 ! SRCNAM = SRC_6_3 !
 71 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 72 ! SRCNAM = SRC_6_4 !
 72 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 73 ! SRCNAM = SRC_6_5 !
 73 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 74 ! SRCNAM = SRC_6_6 !
 74 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 75 ! SRCNAM = SRC_6_7 !
 75 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 76 ! SRCNAM = SRC_6_8 !
 76 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 77 ! SRCNAM = SRC_6_9 !
 77 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 78 ! SRCNAM = SRC_6_10 !
 78 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 79 ! SRCNAM = SRC_6_11 !
 79 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 80 ! SRCNAM = SRC_6_12 !
 80 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 81 ! SRCNAM = SRC_6_13 !
 81 ! X =      10.0,  251.67,      2.33,     0,     0,     0,     0,     0,     1,
     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 82 ! SRCNAM = SRC_7_1 !
 82 ! X =      10.0,  285.67,      2.33,     0,     0,     0,     0,     0,     0,
     1,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
```

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 83 ! SRCNAM = SRC_7_2 !
 83 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    1,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 84 ! SRCNAM = SRC_7_3 !
 84 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    1,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 85 ! SRCNAM = SRC_7_4 !
 85 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    1,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 86 ! SRCNAM = SRC_8_1 !
 86 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    0,     1,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 87 ! SRCNAM = SRC_8_2 !
 87 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    0,     1,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 88 ! SRCNAM = SRC_8_3 !
 88 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    0,     1,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 89 ! SRCNAM = SRC_8_4 !
 89 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    0,     1,     0,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 90 ! SRCNAM = SRC_9_1 !
 90 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    0,     0,     1,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 91 ! SRCNAM = SRC_9_2 !
 91 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    0,     0,     1,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 92 ! SRCNAM = SRC_9_3 !
 92 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    0,     0,     1,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 93 ! SRCNAM = SRC_9_4 !
 93 ! X =      10.0,  285.67,     2.33,     0,     0,     0,     0,     0,     0,
    0,     0,     1,     0,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 94 ! SRCNAM = SRC_10_1 !
 94 ! X =      10.0,  333.63,     2.33,     0,     0,     0,     0,     0,     0,
    0,     0,     0,     1,     0,     0,     0,     0,     0,     0,     0,     0 !
!END!
 95 ! SRCNAM = SRC_10_2 !
 95 ! X =      10.0,  333.63,     2.33,     0,     0,     0,     0,     0,     0,
    0,     0,     0,     1,     0,     0,     0,     0,     0,     0,     0,     0 !
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!END!
  96 ! SRCNAM = SRC_10_3 !
  96 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  97 ! SRCNAM = SRC_10_4 !
  97 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  98 ! SRCNAM = SRC_10_5 !
  98 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
  99 ! SRCNAM = SRC_10_6 !
  99 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
 100 ! SRCNAM = SRC_10_7 !
 100 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
 101 ! SRCNAM = SRC_10_8 !
 101 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
 102 ! SRCNAM = SRC_10_9 !
 102 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
 103 ! SRCNAM = SRC_10_10 !
 103 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0,      0 !
!END!
 104 ! SRCNAM = SRC_11_1 !
 104 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 105 ! SRCNAM = SRC_11_2 !
 105 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 106 ! SRCNAM = SRC_11_3 !
 106 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 107 ! SRCNAM = SRC_11_4 !
 107 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 108 ! SRCNAM = SRC_11_5 !
 108 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
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     0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 109 ! SRCNAM = SRC_11_6 !
 109 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 110 ! SRCNAM = SRC_11_7 !
 110 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 111 ! SRCNAM = SRC_11_8 !
 111 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 112 ! SRCNAM = SRC_11_9 !
 112 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 113 ! SRCNAM = SRC_11_10 !
 113 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0,      0 !
!END!
 114 ! SRCNAM = SRC_12_1 !
 114 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 115 ! SRCNAM = SRC_12_2 !
 115 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 116 ! SRCNAM = SRC_12_3 !
 116 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 117 ! SRCNAM = SRC_12_4 !
 117 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 118 ! SRCNAM = SRC_12_5 !
 118 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 119 ! SRCNAM = SRC_12_6 !
 119 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 120 ! SRCNAM = SRC_12_7 !
 120 ! X =       10.0,   333.63,      2.33,      0,      0,      0,      0,      0,      0,
     0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 121 ! SRCNAM = SRC_12_8 !
```

```
 121 ! X =        10.0,   333.63,       2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 122 ! SRCNAM = SRC_12_9 !
 122 ! X =        10.0,   333.63,       2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!
 123 ! SRCNAM = SRC_12_10 !
 123 ! X =        10.0,   333.63,       2.33,      0,      0,      0,      0,      0,      0,
      0,      0,      0,      0,      0,      1,      0,      0,      0,      0,      0,      0 !
!END!

--------
   a
    Data for each source are treated as a separate input subgroup
    and therefore must end with an input group terminator.
   b
    An emission rate must be entered for every pollutant modeled.
    Enter emission rate of zero for secondary pollutants that are
    modeled, but not emitted.  Units are specified by IARU
    (e.g. 1 for g/m**2/s).

---------------
Subgroup (14c)
---------------

         COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON
         --------------------------------------------------------
Source                                                    a
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------

   1 ! SRCNAM = SRC_1_1 !
   1 ! XVERT =   438.9389,  439.1121,  439.2853,  439.1172 !
   1 ! YVERT =   6377.052, 6376.8467, 6376.6414, 6376.8737 !
!END!
   2 ! SRCNAM = SRC_1_2 !
   2 ! XVERT =    438.399,  437.9804,  437.5618,  437.8551 !
   2 ! YVERT =  6376.5438, 6377.1348, 6377.7257, 6376.9232 !
!END!
   3 ! SRCNAM = SRC_1_3 !
   3 ! XVERT =   437.5618,   437.902,  438.2421,  437.7336 !
   3 ! YVERT =  6377.7257, 6377.6861, 6377.6464, 6377.8347 !
!END!
   4 ! SRCNAM = SRC_1_4 !
   4 ! XVERT =   441.1232,  440.0559,  438.9887,  439.2263 !
   4 ! YVERT =  6374.8252, 6375.5702, 6376.3153, 6375.5291 !
!END!
   5 ! SRCNAM = SRC_1_5 !
   5 ! XVERT =   438.2421,  438.5905,  438.9389,  438.9125 !
   5 ! YVERT =  6377.6464, 6377.3492,  6377.052, 6377.3261 !
```

```
!END!
   6 ! SRCNAM = SRC_1_6 !
   6 ! XVERT =   441.8409,  441.4821,  441.1232,  441.5803 !
   6 ! YVERT =  6374.6058, 6374.7155, 6374.8252, 6374.4367 !
!END!
   7 ! SRCNAM = SRC_1_7 !
   7 ! XVERT =   438.9887,  440.9365,  441.8409,  441.1232 !
   7 ! YVERT =  6376.3153, 6375.2107, 6374.6058, 6374.8252 !
!END!
   8 ! SRCNAM = SRC_1_8 !
   8 ! XVERT =   438.2421,  438.9389,  439.2853,  438.9887 !
   8 ! YVERT =  6377.6464,  6377.052, 6376.6414, 6376.3153 !
!END!
   9 ! SRCNAM = SRC_1_9 !
   9 ! XVERT =    440.754,  440.9323,  440.9365,  440.5522 !
   9 ! YVERT =  6376.2103, 6375.8218, 6375.2107, 6376.3316 !
!END!
  10 ! SRCNAM = SRC_1_10 !
  10 ! XVERT =   438.9887,   438.399,  437.5618,  438.2421 !
  10 ! YVERT =  6376.3153, 6376.5438, 6377.7257, 6377.6464 !
!END!
  11 ! SRCNAM = SRC_1_11 !
  11 ! XVERT =   439.9327,  440.5522,  440.9365,  438.9887 !
  11 ! YVERT =  6376.6958, 6376.3316, 6375.2107, 6376.3153 !
!END!
  12 ! SRCNAM = SRC_1_12 !
  12 ! XVERT =   441.3833,  441.7641,  441.8409,  440.9365 !
  12 ! YVERT =  6375.2574, 6375.0165, 6374.6058, 6375.2107 !
!END!
  13 ! SRCNAM = SRC_1_13 !
  13 ! XVERT =   439.9327,  438.9887,  439.2853,  439.7318 !
  13 ! YVERT =  6376.6958, 6376.3153, 6376.6414, 6376.8834 !
!END!
  14 ! SRCNAM = SRC_1_14 !
  14 ! XVERT =   440.5522,  439.9327,  440.2721,  440.5567 !
  14 ! YVERT =  6376.3316, 6376.6958, 6376.7283, 6376.6258 !
!END!
  15 ! SRCNAM = SRC_2_1 !
  15 ! XVERT =   438.9389,  439.1121,  439.2853,  439.1172 !
  15 ! YVERT =   6377.052, 6376.8467, 6376.6414, 6376.8737 !
!END!
  16 ! SRCNAM = SRC_2_2 !
  16 ! XVERT =    438.399,  437.9804,  437.5618,  437.8551 !
  16 ! YVERT =  6376.5438, 6377.1348, 6377.7257, 6376.9232 !
!END!
  17 ! SRCNAM = SRC_2_3 !
  17 ! XVERT =   437.5618,   437.902,  438.2421,  437.7336 !
  17 ! YVERT =  6377.7257, 6377.6861, 6377.6464, 6377.8347 !
!END!
  18 ! SRCNAM = SRC_2_4 !
  18 ! XVERT =   441.1232,  440.0559,  438.9887,  439.2263 !
```

```
  18 ! YVERT =  6374.8252, 6375.5702, 6376.3153, 6375.5291 !
!END!
  19 ! SRCNAM = SRC_2_5 !
  19 ! XVERT =   438.2421,  438.5905,  438.9389,  438.9125 !
  19 ! YVERT =  6377.6464, 6377.3492,  6377.052, 6377.3261 !
!END!
  20 ! SRCNAM = SRC_2_6 !
  20 ! XVERT =   441.8409,  441.4821,  441.1232,  441.5803 !
  20 ! YVERT =  6374.6058, 6374.7155, 6374.8252, 6374.4367 !
!END!
  21 ! SRCNAM = SRC_2_7 !
  21 ! XVERT =   438.9887,  440.9365,  441.8409,  441.1232 !
  21 ! YVERT =  6376.3153, 6375.2107, 6374.6058, 6374.8252 !
!END!
  22 ! SRCNAM = SRC_2_8 !
  22 ! XVERT =   438.2421,  438.9389,  439.2853,  438.9887 !
  22 ! YVERT =  6377.6464,  6377.052, 6376.6414, 6376.3153 !
!END!
  23 ! SRCNAM = SRC_2_9 !
  23 ! XVERT =    440.754,  440.9323,  440.9365,  440.5522 !
  23 ! YVERT =  6376.2103, 6375.8218, 6375.2107, 6376.3316 !
!END!
  24 ! SRCNAM = SRC_2_10 !
  24 ! XVERT =   438.9887,   438.399,  437.5618,  438.2421 !
  24 ! YVERT =  6376.3153, 6376.5438, 6377.7257, 6377.6464 !
!END!
  25 ! SRCNAM = SRC_2_11 !
  25 ! XVERT =   439.9327,  440.5522,  440.9365,  438.9887 !
  25 ! YVERT =  6376.6958, 6376.3316, 6375.2107, 6376.3153 !
!END!
  26 ! SRCNAM = SRC_2_12 !
  26 ! XVERT =   441.3833,  441.7641,  441.8409,  440.9365 !
  26 ! YVERT =  6375.2574, 6375.0165, 6374.6058, 6375.2107 !
!END!
  27 ! SRCNAM = SRC_2_13 !
  27 ! XVERT =   439.9327,  438.9887,  439.2853,  439.7318 !
  27 ! YVERT =  6376.6958, 6376.3153, 6376.6414, 6376.8834 !
!END!
  28 ! SRCNAM = SRC_2_14 !
  28 ! XVERT =   440.5522,  439.9327,  440.2721,  440.5567 !
  28 ! YVERT =  6376.3316, 6376.6958, 6376.7283, 6376.6258 !
!END!
  29 ! SRCNAM = SRC_3_1 !
  29 ! XVERT =   438.9389,  439.1121,  439.2853,  439.1172 !
  29 ! YVERT =   6377.052, 6376.8467, 6376.6414, 6376.8737 !
!END!
  30 ! SRCNAM = SRC_3_2 !
  30 ! XVERT =    438.399,  437.9804,  437.5618,  437.8551 !
  30 ! YVERT =  6376.5438, 6377.1348, 6377.7257, 6376.9232 !
!END!
  31 ! SRCNAM = SRC_3_3 !
```

```
  31 ! XVERT =   437.5618,   437.902,  438.2421,  437.7336 !
  31 ! YVERT =  6377.7257, 6377.6861, 6377.6464, 6377.8347 !
!END!
  32 ! SRCNAM = SRC_3_4 !
  32 ! XVERT =   441.1232,  440.0559,  438.9887,  439.2263 !
  32 ! YVERT =  6374.8252, 6375.5702, 6376.3153, 6375.5291 !
!END!
  33 ! SRCNAM = SRC_3_5 !
  33 ! XVERT =   438.2421,  438.5905,  438.9389,  438.9125 !
  33 ! YVERT =  6377.6464, 6377.3492,  6377.052, 6377.3261 !
!END!
  34 ! SRCNAM = SRC_3_6 !
  34 ! XVERT =   441.8409,  441.4821,  441.1232,  441.5803 !
  34 ! YVERT =  6374.6058, 6374.7155, 6374.8252, 6374.4367 !
!END!
  35 ! SRCNAM = SRC_3_7 !
  35 ! XVERT =   438.9887,  440.9365,  441.8409,  441.1232 !
  35 ! YVERT =  6376.3153, 6375.2107, 6374.6058, 6374.8252 !
!END!
  36 ! SRCNAM = SRC_3_8 !
  36 ! XVERT =   438.2421,  438.9389,  439.2853,  438.9887 !
  36 ! YVERT =  6377.6464,  6377.052, 6376.6414, 6376.3153 !
!END!
  37 ! SRCNAM = SRC_3_9 !
  37 ! XVERT =    440.754,  440.9323,  440.9365,  440.5522 !
  37 ! YVERT =  6376.2103, 6375.8218, 6375.2107, 6376.3316 !
!END!
  38 ! SRCNAM = SRC_3_10 !
  38 ! XVERT =   438.9887,   438.399,  437.5618,  438.2421 !
  38 ! YVERT =  6376.3153, 6376.5438, 6377.7257, 6377.6464 !
!END!
  39 ! SRCNAM = SRC_3_11 !
  39 ! XVERT =   439.9327,  440.5522,  440.9365,  438.9887 !
  39 ! YVERT =  6376.6958, 6376.3316, 6375.2107, 6376.3153 !
!END!
  40 ! SRCNAM = SRC_3_12 !
  40 ! XVERT =   441.3833,  441.7641,  441.8409,  440.9365 !
  40 ! YVERT =  6375.2574, 6375.0165, 6374.6058, 6375.2107 !
!END!
  41 ! SRCNAM = SRC_3_13 !
  41 ! XVERT =   439.9327,  438.9887,  439.2853,  439.7318 !
  41 ! YVERT =  6376.6958, 6376.3153, 6376.6414, 6376.8834 !
!END!
  42 ! SRCNAM = SRC_3_14 !
  42 ! XVERT =   440.5522,  439.9327,  440.2721,  440.5567 !
  42 ! YVERT =  6376.3316, 6376.6958, 6376.7283, 6376.6258 !
!END!
  43 ! SRCNAM = SRC_4_1 !
  43 ! XVERT =   440.6196,  440.4445,  440.2694,  440.3832 !
  43 ! YVERT =  6371.8747, 6372.0761, 6372.2776,  6371.936 !
!END!
```

44 ! SRCNAM = SRC_4_2 !
44 ! XVERT = 438.6931, 439.4812, 440.2694, 439.2623 !
44 ! YVERT = 6373.0307, 6372.6541, 6372.2776, 6373.5211 !
!END!
45 ! SRCNAM = SRC_4_3 !
45 ! XVERT = 439.2623, 439.2448, 439.2273, 438.4128 !
45 ! YVERT = 6373.5211, 6374.5369, 6375.5527, 6374.0115 !
!END!
46 ! SRCNAM = SRC_4_4 !
46 ! XVERT = 437.0905, 436.7577, 436.425, 436.9591 !
46 ! YVERT = 6375.4039, 6375.3294, 6375.255, 6374.9397 !
!END!
47 ! SRCNAM = SRC_4_5 !
47 ! XVERT = 440.6196, 440.2694, 439.2623, 440.8648 !
47 ! YVERT = 6371.8747, 6372.2776, 6373.5211, 6372.3389 !
!END!
48 ! SRCNAM = SRC_4_6 !
48 ! XVERT = 436.9854, 437.0905, 437.2306, 439.2273 !
48 ! YVERT = 6373.6875, 6375.4039, 6376.8225, 6375.5527 !
!END!
49 ! SRCNAM = SRC_4_7 !
49 ! XVERT = 438.4128, 437.7823, 436.9854, 439.2273 !
49 ! YVERT = 6374.0115, 6373.705, 6373.6875, 6375.5527 !
!END!
50 ! SRCNAM = SRC_4_8 !
50 ! XVERT = 437.6772, 437.2306, 437.0117, 437.0292 !
50 ! YVERT = 6377.0064, 6376.8225, 6376.8926, 6377.2779 !
!END!
51 ! SRCNAM = SRC_4_9 !
51 ! XVERT = 439.2273, 441.0838, 440.8648, 439.2623 !
51 ! YVERT = 6375.5527, 6373.3197, 6372.3389, 6373.5211 !
!END!
52 ! SRCNAM = SRC_4_10 !
52 ! XVERT = 441.1363, 441.5742, 441.0838, 439.2273 !
52 ! YVERT = 6374.7909, 6374.3793, 6373.3197, 6375.5527 !
!END!
53 ! SRCNAM = SRC_4_11 !
53 ! XVERT = 441.6004, 441.2939, 440.8648, 441.0838 !
53 ! YVERT = 6372.9431, 6372.2951, 6372.3389, 6373.3197 !
!END!
54 ! SRCNAM = SRC_4_12 !
54 ! XVERT = 436.9854, 437.0905, 436.9591, 436.749 !
54 ! YVERT = 6373.6875, 6375.4039, 6374.9397, 6374.5807 !
!END!
55 ! SRCNAM = SRC_4_13 !
55 ! XVERT = 439.2273, 437.2306, 437.6772, 438.9996 !
55 ! YVERT = 6375.5527, 6376.8225, 6377.0064, 6376.2971 !
!END!
56 ! SRCNAM = SRC_5_1 !
56 ! XVERT = 440.6196, 440.4445, 440.2694, 440.3832 !
56 ! YVERT = 6371.8747, 6372.0761, 6372.2776, 6371.936 !

```
!END!
  57 ! SRCNAM = SRC_5_2 !
  57 ! XVERT =   438.6931,  439.4812,  440.2694,  439.2623 !
  57 ! YVERT =  6373.0307, 6372.6541, 6372.2776, 6373.5211 !
!END!
  58 ! SRCNAM = SRC_5_3 !
  58 ! XVERT =   439.2623,  439.2448,  439.2273,  438.4128 !
  58 ! YVERT =  6373.5211, 6374.5369, 6375.5527, 6374.0115 !
!END!
  59 ! SRCNAM = SRC_5_4 !
  59 ! XVERT =   437.0905,  436.7577,   436.425,  436.9591 !
  59 ! YVERT =  6375.4039, 6375.3294,  6375.255, 6374.9397 !
!END!
  60 ! SRCNAM = SRC_5_5 !
  60 ! XVERT =   440.6196,  440.2694,  439.2623,  440.8648 !
  60 ! YVERT =  6371.8747, 6372.2776, 6373.5211, 6372.3389 !
!END!
  61 ! SRCNAM = SRC_5_6 !
  61 ! XVERT =   436.9854,  437.0905,  437.2306,  439.2273 !
  61 ! YVERT =  6373.6875, 6375.4039, 6376.8225, 6375.5527 !
!END!
  62 ! SRCNAM = SRC_5_7 !
  62 ! XVERT =   438.4128,  437.7823,  436.9854,  439.2273 !
  62 ! YVERT =  6374.0115,  6373.705, 6373.6875, 6375.5527 !
!END!
  63 ! SRCNAM = SRC_5_8 !
  63 ! XVERT =   437.6772,  437.2306,  437.0117,  437.0292 !
  63 ! YVERT =  6377.0064, 6376.8225, 6376.8926, 6377.2779 !
!END!
  64 ! SRCNAM = SRC_5_9 !
  64 ! XVERT =   439.2273,  441.0838,  440.8648,  439.2623 !
  64 ! YVERT =  6375.5527, 6373.3197, 6372.3389, 6373.5211 !
!END!
  65 ! SRCNAM = SRC_5_10 !
  65 ! XVERT =   441.1363,  441.5742,  441.0838,  439.2273 !
  65 ! YVERT =  6374.7909, 6374.3793, 6373.3197, 6375.5527 !
!END!
  66 ! SRCNAM = SRC_5_11 !
  66 ! XVERT =   441.6004,  441.2939,  440.8648,  441.0838 !
  66 ! YVERT =  6372.9431, 6372.2951, 6372.3389, 6373.3197 !
!END!
  67 ! SRCNAM = SRC_5_12 !
  67 ! XVERT =   436.9854,  437.0905,  436.9591,   436.749 !
  67 ! YVERT =  6373.6875, 6375.4039, 6374.9397, 6374.5807 !
!END!
  68 ! SRCNAM = SRC_5_13 !
  68 ! XVERT =   439.2273,  437.2306,  437.6772,  438.9996 !
  68 ! YVERT =  6375.5527, 6376.8225, 6377.0064, 6376.2971 !
!END!
  69 ! SRCNAM = SRC_6_1 !
  69 ! XVERT =   440.6196,  440.4445,  440.2694,  440.3832 !
```

```
  69 ! YVERT =  6371.8747, 6372.0761, 6372.2776,  6371.936 !
!END!
  70 ! SRCNAM = SRC_6_2 !
  70 ! XVERT =   438.6931,  439.4812,  440.2694,  439.2623 !
  70 ! YVERT =  6373.0307, 6372.6541, 6372.2776, 6373.5211 !
!END!
  71 ! SRCNAM = SRC_6_3 !
  71 ! XVERT =   439.2623,  439.2448,  439.2273,  438.4128 !
  71 ! YVERT =  6373.5211, 6374.5369, 6375.5527, 6374.0115 !
!END!
  72 ! SRCNAM = SRC_6_4 !
  72 ! XVERT =   437.0905,  436.7577,   436.425,  436.9591 !
  72 ! YVERT =  6375.4039, 6375.3294,  6375.255, 6374.9397 !
!END!
  73 ! SRCNAM = SRC_6_5 !
  73 ! XVERT =   440.6196,  440.2694,  439.2623,  440.8648 !
  73 ! YVERT =  6371.8747, 6372.2776, 6373.5211, 6372.3389 !
!END!
  74 ! SRCNAM = SRC_6_6 !
  74 ! XVERT =   436.9854,  437.0905,  437.2306,  439.2273 !
  74 ! YVERT =  6373.6875, 6375.4039, 6376.8225, 6375.5527 !
!END!
  75 ! SRCNAM = SRC_6_7 !
  75 ! XVERT =   438.4128,  437.7823,  436.9854,  439.2273 !
  75 ! YVERT =  6374.0115,  6373.705, 6373.6875, 6375.5527 !
!END!
  76 ! SRCNAM = SRC_6_8 !
  76 ! XVERT =   437.6772,  437.2306,  437.0117,  437.0292 !
  76 ! YVERT =  6377.0064, 6376.8225, 6376.8926, 6377.2779 !
!END!
  77 ! SRCNAM = SRC_6_9 !
  77 ! XVERT =   439.2273,  441.0838,  440.8648,  439.2623 !
  77 ! YVERT =  6375.5527, 6373.3197, 6372.3389, 6373.5211 !
!END!
  78 ! SRCNAM = SRC_6_10 !
  78 ! XVERT =   441.1363,  441.5742,  441.0838,  439.2273 !
  78 ! YVERT =  6374.7909, 6374.3793, 6373.3197, 6375.5527 !
!END!
  79 ! SRCNAM = SRC_6_11 !
  79 ! XVERT =   441.6004,  441.2939,  440.8648,  441.0838 !
  79 ! YVERT =  6372.9431, 6372.2951, 6372.3389, 6373.3197 !
!END!
  80 ! SRCNAM = SRC_6_12 !
  80 ! XVERT =   436.9854,  437.0905,  436.9591,   436.749 !
  80 ! YVERT =  6373.6875, 6375.4039, 6374.9397, 6374.5807 !
!END!
  81 ! SRCNAM = SRC_6_13 !
  81 ! XVERT =   439.2273,  437.2306,  437.6772,  438.9996 !
  81 ! YVERT =  6375.5527, 6376.8225, 6377.0064, 6376.2971 !
!END!
  82 ! SRCNAM = SRC_7_1 !
```

```
  82 ! XVERT =   439.4818,  439.0681,  438.6544,  439.2487 !
  82 ! YVERT =  6377.9422, 6377.8553, 6377.7685, 6377.5353 !
!END!
  83 ! SRCNAM = SRC_7_2 !
  83 ! XVERT =   438.6544,   438.403,  438.0007,  439.4818 !
  83 ! YVERT =  6377.7685, 6377.8462, 6378.1205, 6377.9422 !
!END!
  84 ! SRCNAM = SRC_7_3 !
  84 ! XVERT =   438.4212,  439.1481,  439.4818,  438.0007 !
  84 ! YVERT =   6378.285, 6378.2028, 6377.9422, 6378.1205 !
!END!
  85 ! SRCNAM = SRC_7_4 !
  85 ! XVERT =   438.0007,  438.0235,  438.0281,  438.4212 !
  85 ! YVERT =  6378.1205,  6378.317, 6378.3033,  6378.285 !
!END!
  86 ! SRCNAM = SRC_8_1 !
  86 ! XVERT =   439.4818,  439.0681,  438.6544,  439.2487 !
  86 ! YVERT =  6377.9422, 6377.8553, 6377.7685, 6377.5353 !
!END!
  87 ! SRCNAM = SRC_8_2 !
  87 ! XVERT =   438.6544,   438.403,  438.0007,  439.4818 !
  87 ! YVERT =  6377.7685, 6377.8462, 6378.1205, 6377.9422 !
!END!
  88 ! SRCNAM = SRC_8_3 !
  88 ! XVERT =   438.4212,  439.1481,  439.4818,  438.0007 !
  88 ! YVERT =   6378.285, 6378.2028, 6377.9422, 6378.1205 !
!END!
  89 ! SRCNAM = SRC_8_4 !
  89 ! XVERT =   438.0007,  438.0235,  438.0281,  438.4212 !
  89 ! YVERT =  6378.1205,  6378.317, 6378.3033,  6378.285 !
!END!
  90 ! SRCNAM = SRC_9_1 !
  90 ! XVERT =   439.4818,  439.0681,  438.6544,  439.2487 !
  90 ! YVERT =  6377.9422, 6377.8553, 6377.7685, 6377.5353 !
!END!
  91 ! SRCNAM = SRC_9_2 !
  91 ! XVERT =   438.6544,   438.403,  438.0007,  439.4818 !
  91 ! YVERT =  6377.7685, 6377.8462, 6378.1205, 6377.9422 !
!END!
  92 ! SRCNAM = SRC_9_3 !
  92 ! XVERT =   438.4212,  439.1481,  439.4818,  438.0007 !
  92 ! YVERT =   6378.285, 6378.2028, 6377.9422, 6378.1205 !
!END!
  93 ! SRCNAM = SRC_9_4 !
  93 ! XVERT =   438.0007,  438.0235,  438.0281,  438.4212 !
  93 ! YVERT =  6378.1205,  6378.317, 6378.3033,  6378.285 !
!END!
  94 ! SRCNAM = SRC_10_1 !
  94 ! XVERT =   438.8815,  439.1318,  439.3822,  439.0765 !
  94 ! YVERT =  6384.0625, 6384.2825, 6384.5024, 6384.4625 !
!END!
```

95 ! SRCNAM = SRC_10_2 !
95 ! XVERT = 442.8536, 441.842, 440.8304, 441.1545 !
95 ! YVERT = 6379.7624, 6380.323, 6380.8835, 6379.9113 !
!END!
96 ! SRCNAM = SRC_10_3 !
96 ! XVERT = 439.3822, 440.0581, 440.7341, 439.3941 !
96 ! YVERT = 6384.5024, 6384.7993, 6385.0962, 6385.0787 !
!END!
97 ! SRCNAM = SRC_10_4 !
97 ! XVERT = 438.6321, 438.9036, 439.1751, 438.781 !
97 ! YVERT = 6381.6104, 6381.9651, 6382.3199, 6382.3023 !
!END!
98 ! SRCNAM = SRC_10_5 !
98 ! XVERT = 440.8304, 440.7823, 440.7341, 439.1751 !
98 ! YVERT = 6380.8835, 6382.9899, 6385.0962, 6382.3199 !
!END!
99 ! SRCNAM = SRC_10_6 !
99 ! XVERT = 438.6684, 438.775, 438.8815, 438.6058 !
99 ! YVERT = 6383.6767, 6383.8696, 6384.0625, 6384.0452 !
!END!
100 ! SRCNAM = SRC_10_7 !
100 ! XVERT = 439.1751, 438.6759, 438.6684, 438.8815 !
100 ! YVERT = 6382.3199, 6383.3971, 6383.6767, 6384.0625 !
!END!
101 ! SRCNAM = SRC_10_8 !
101 ! XVERT = 438.8815, 439.3822, 440.7341, 439.1751 !
101 ! YVERT = 6384.0625, 6384.5024, 6385.0962, 6382.3199 !
!END!
102 ! SRCNAM = SRC_10_9 !
102 ! XVERT = 440.7341, 443.0813, 442.8536, 440.8304 !
102 ! YVERT = 6385.0962, 6382.7227, 6379.7624, 6380.8835 !
!END!
103 ! SRCNAM = SRC_10_10 !
103 ! XVERT = 440.8304, 439.0613, 438.6321, 439.1751 !
103 ! YVERT = 6380.8835, 6380.8485, 6381.6104, 6382.3199 !
!END!
104 ! SRCNAM = SRC_11_1 !
104 ! XVERT = 438.8815, 439.1318, 439.3822, 439.0765 !
104 ! YVERT = 6384.0625, 6384.2825, 6384.5024, 6384.4625 !
!END!
105 ! SRCNAM = SRC_11_2 !
105 ! XVERT = 442.8536, 441.842, 440.8304, 441.1545 !
105 ! YVERT = 6379.7624, 6380.323, 6380.8835, 6379.9113 !
!END!
106 ! SRCNAM = SRC_11_3 !
106 ! XVERT = 439.3822, 440.0581, 440.7341, 439.3941 !
106 ! YVERT = 6384.5024, 6384.7993, 6385.0962, 6385.0787 !
!END!
107 ! SRCNAM = SRC_11_4 !
107 ! XVERT = 438.6321, 438.9036, 439.1751, 438.781 !
107 ! YVERT = 6381.6104, 6381.9651, 6382.3199, 6382.3023 !

!END!
108 ! SRCNAM = SRC_11_5 !
108 ! XVERT = 440.8304, 440.7823, 440.7341, 439.1751 !
108 ! YVERT = 6380.8835, 6382.9899, 6385.0962, 6382.3199 !
!END!
109 ! SRCNAM = SRC_11_6 !
109 ! XVERT = 438.6684, 438.775, 438.8815, 438.6058 !
109 ! YVERT = 6383.6767, 6383.8696, 6384.0625, 6384.0452 !
!END!
110 ! SRCNAM = SRC_11_7 !
110 ! XVERT = 439.1751, 438.6759, 438.6684, 438.8815 !
110 ! YVERT = 6382.3199, 6383.3971, 6383.6767, 6384.0625 !
!END!
111 ! SRCNAM = SRC_11_8 !
111 ! XVERT = 438.8815, 439.3822, 440.7341, 439.1751 !
111 ! YVERT = 6384.0625, 6384.5024, 6385.0962, 6382.3199 !
!END!
112 ! SRCNAM = SRC_11_9 !
112 ! XVERT = 440.7341, 443.0813, 442.8536, 440.8304 !
112 ! YVERT = 6385.0962, 6382.7227, 6379.7624, 6380.8835 !
!END!
113 ! SRCNAM = SRC_11_10 !
113 ! XVERT = 440.8304, 439.0613, 438.6321, 439.1751 !
113 ! YVERT = 6380.8835, 6380.8485, 6381.6104, 6382.3199 !
!END!
114 ! SRCNAM = SRC_12_1 !
114 ! XVERT = 438.8815, 439.1318, 439.3822, 439.0765 !
114 ! YVERT = 6384.0625, 6384.2825, 6384.5024, 6384.4625 !
!END!
115 ! SRCNAM = SRC_12_2 !
115 ! XVERT = 442.8536, 441.842, 440.8304, 441.1545 !
115 ! YVERT = 6379.7624, 6380.323, 6380.8835, 6379.9113 !
!END!
116 ! SRCNAM = SRC_12_3 !
116 ! XVERT = 439.3822, 440.0581, 440.7341, 439.3941 !
116 ! YVERT = 6384.5024, 6384.7993, 6385.0962, 6385.0787 !
!END!
117 ! SRCNAM = SRC_12_4 !
117 ! XVERT = 438.6321, 438.9036, 439.1751, 438.781 !
117 ! YVERT = 6381.6104, 6381.9651, 6382.3199, 6382.3023 !
!END!
118 ! SRCNAM = SRC_12_5 !
118 ! XVERT = 440.8304, 440.7823, 440.7341, 439.1751 !
118 ! YVERT = 6380.8835, 6382.9899, 6385.0962, 6382.3199 !
!END!
119 ! SRCNAM = SRC_12_6 !
119 ! XVERT = 438.6684, 438.775, 438.8815, 438.6058 !
119 ! YVERT = 6383.6767, 6383.8696, 6384.0625, 6384.0452 !
!END!
120 ! SRCNAM = SRC_12_7 !
120 ! XVERT = 439.1751, 438.6759, 438.6684, 438.8815 !

```
 120 ! YVERT =  6382.3199, 6383.3971, 6383.6767, 6384.0625 !
!END!
 121 ! SRCNAM = SRC_12_8 !
 121 ! XVERT =   438.8815,  439.3822,  440.7341,  439.1751 !
 121 ! YVERT =  6384.0625, 6384.5024, 6385.0962, 6382.3199 !
!END!
 122 ! SRCNAM = SRC_12_9 !
 122 ! XVERT =   440.7341,  443.0813,  442.8536,  440.8304 !
 122 ! YVERT =  6385.0962, 6382.7227, 6379.7624, 6380.8835 !
!END!
 123 ! SRCNAM = SRC_12_10 !
 123 ! XVERT =   440.8304,  439.0613,  438.6321,  439.1751 !
 123 ! YVERT =  6380.8835, 6380.8485, 6381.6104, 6382.3199 !
!END!

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.


---------------
Subgroup (14d)
---------------
                                      a
          AREA SOURCE: EMISSION-RATE SCALING FACTORS
          ------------------------------------------

      Use this subgroup to identify temporal variations in the emission
      rates given in 14b.  Factors assigned multiply the rates in 14b.
      Skip sources here that have constant emissions.  For more elaborate
      variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

      Sets of emission-rate scale factors are defined in Input Group 19, and
      are referenced by the FACTORNAME.  Provide NSAR1 lines that identify the
      emission-rate scale factor table for each source-species combination that
      uses the scaling option.  Note that a scale-factor table can be used with
      more than one source-species combination so a FACTORNAME can be repeated.


  Source-          Source      Species      Scale-factor table
  Species           Name   b    Name   c     Name        d
   No.            (SRCNAM)     (CSPEC)      (FACTORNAME)
  ------          ------------ ------------ ---------------------



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
    b
```

Source name must match one of the SRCNAM names defined in Input Group 14b
c
Species name must match one of the CSPEC names of emitted species defined in Input Group 3
d
Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

```
-------------------------------------------------------------------------------

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
---------------------------

---------------
Subgroup (15a)
---------------

     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                          No default  ! NLN2 = 0 !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)        No default   ! NLINES = 0 !

     Units used for line source
     emissions below                (ILNU)          Default: 1   ! ILNU = 1 !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0  ! NSLN1 = 0 !

     Maximum number of segments used to model
     each line (MXNSEG)                         Default: 7   ! MXNSEG = 7 !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which               Default: 6   ! NLRISE = 6 !
        transitional rise is computed
```

```
     Average building length (XL)              No default   * XL = *
                                         (in meters)

     Average building height (HBL)             No default   * HBL = *
                                         (in meters)

     Average building width (WBL)              No default   * WBL = *
                                         (in meters)

     Average line source width (WML)           No default   * WML = *
                                         (in meters)

     Average separation between buildings (DXL)  No default   * DXL = *
                                         (in meters)

     Average buoyancy parameter (FPRIMEL)      No default   * FPRIMEL = *
                                         (in m**4/s**3)

!END!

---------------
Subgroup (15b)
---------------

       BUOYANT LINE SOURCE: CONSTANT DATA
       ----------------------------------
                                                                  a
Source    Beg. X     Beg. Y     End. X    End. Y    Release   Base       Emission
 No.    Coordinate  Coordinate  Coordinate Coordinate  Height    Elevation     Rates
          (km)       (km)       (km)      (km)      (m)      (m)
------  ----------  ----------  ---------  ----------  -------   ---------    ---------

--------

   a
    Data for each source are treated as a separate input subgroup
    and therefore must end with an input group terminator.

   b
    An emission rate must be entered for every pollutant modeled.
    Enter emission rate of zero for secondary pollutants that are
    modeled, but not emitted.  Units are specified by ILNTU
    (e.g. 1 for g/s).

---------------
Subgroup (15c)
---------------
                                          a
       BUOYANT LINE SOURCE: EMISSION-RATE SCALING FACTORS
       -------------------------------------------------
```

Use this subgroup to identify temporal variations in the emission
rates given in 15b. Factors assigned multiply the rates in 15b.
Skip sources here that have constant emissions. For more elaborate
variation in source parameters, use LNEMARB.DAT and NLN2 > 0.

Sets of emission-rate scale factors are defined in Input Group 19, and
are referenced by the FACTORNAME. Provide NSLN1 lines that identify the
emission-rate scale factor table for each source-species combination that
uses the scaling option. Note that a scale-factor table can be used with
more than one source-species combination so a FACTORNAME can be repeated.

```
 Source-              Source      Species      Scale-factor table
 Species              Name   b    Name   c     Name        d
  No.               (SRCNAM)     (CSPEC)      (FACTORNAME)
 ------             ------------ ------------ ---------------------
```

----
a
Data for each species are treated as a separate input subgroup
and therefore must end with an input group terminator.
b
Source name must match one of the SRCNAM names defined in Input Group 15b
c
Species name must match one of the CSPEC names of emitted species defined in Input Group 3
d
Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters

Subgroup (16a)

```
     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  ! NVL1 = 6 !

     Units used for volume source
     emissions below in 16b       (IVLU)     Default: 1  ! IVLU = 1 !
          1 =        g/s
          2 =       kg/hr
          3 =       lb/hr
          4 =     tons/yr
          5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
          6 =     Odour Unit * m**3/min
```

```
        7 =     metric tons/yr
        8 =     Bq/s  (Bq = becquerel = disintegrations/s)
        9 =     GBq/yr

    Number of source-species
    combinations with variable
    emissions scaling factors
    provided below in (16c)      (NSVL1)    Default: 0  ! NSVL1 = 0 !

    Number of volume sources with
    variable location and emission
    parameters                   (NVL2)     No default  ! NVL2 = 0 !

    (If NVL2 > 0, ALL parameter data for
     these sources are read from the VOLEMARB.DAT file(s) )

!END!

---------------
Subgroup (16b)
---------------
                                   a
          VOLUME SOURCE: CONSTANT DATA
          ------------------------------
                                                               b
Source         X           Y        Effect.    Base     Initial    Initial    Emission
 No.       Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
              (km)       (km)         (m)       (m)        (m)       (m)
------     ----------  ----------   ------    ------    --------   --------   --------

   1 ! SRCNAM = SRC_13 !
   1 ! X =  439.915, 6376.971,    10.0,   312.36,      37.5,      4.65,      0,      0,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      1,      0,      0,      0,
      0,      0 !
!END!
   2 ! SRCNAM = SRC_14 !
   2 ! X =  439.915, 6376.971,    10.0,   312.36,      37.5,      4.65,      0,      0,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      1,      0,      0,
      0,      0 !
!END!
   3 ! SRCNAM = SRC_15 !
   3 ! X =  439.915, 6376.971,    10.0,   312.36,      37.5,      4.65,      0,      0,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      1,      0,
      0,      0 !
!END!
   4 ! SRCNAM = SRC_16 !
   4 ! X =  439.859, 6377.342,    10.0,   312.96,     58.56,      4.65,      0,      0,      0,      0,
      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      0,      1,
      0,      0 !
!END!
   5 ! SRCNAM = SRC_17 !
```

```
   5 ! X =  439.859, 6377.342,    10.0,   312.96,      58.56,      4.65,       0,       0,       0,       0,
      0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,
      1,       0 !
!END!
   6 ! SRCNAM = SRC_18 !
   6 ! X =  439.859, 6377.342,    10.0,   312.96,      58.56,      4.65,       0,       0,       0,       0,
      0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,       0,
      0,       1 !
!END!

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IVLU
     (e.g. 1 for g/s).

---------------
Subgroup (16c)
---------------
                                       a
          VOLUME SOURCE: EMISSION-RATE SCALING FACTORS
          -------------------------------------------

      Use this subgroup to identify temporal variations in the emission
      rates given in 16b.  Factors assigned multiply the rates in 16b.
      Skip sources here that have constant emissions.  For more elaborate
      variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

      Sets of emission-rate scale factors are defined in Input Group 19, and
      are referenced by the FACTORNAME.  Provide NSVL1 lines that identify the
      emission-rate scale factor table for each source-species combination that
      uses the scaling option.  Note that a scale-factor table can be used with
      more than one source-species combination so a FACTORNAME can be repeated.


  Source-             Source      Species      Scale-factor table
  Species              Name   b    Name   c     Name        d
   No.               (SRCNAM)     (CSPEC)      (FACTORNAME)
  ------             ------------ ------------ ---------------------



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
```

b
Source name must match one of the SRCNAM names defined in Input Group 16b
c
Species name must match one of the CSPEC names of emitted species defined in Input Group 3
d
Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

INPUT GROUP: 17 -- FLARE source control parameters (variable emissions file)

Number of flare sources defined in FLEMARB.DAT file(s)
(NFL2) Default: 0 ! NFL2 = 0 !

(At least 1 FLEMARB.DAT file is needed if NFL2 > 0)

!END!

INPUT GROUPS: 18a, 18b, 18c -- Road Emissions parameters

Subgroup (18a)

Emissions from roads are generated from individual line segments defined by a sequence of coordinates provided for each road-link. Each link is entered as a discrete source and is defined as a section of the road for which emissions are uniform.

A long, winding isolated road might be characterized by a single link made up of many coordinate triples (x,y,z) that describe its pathway. These points should be sufficient to resolve curves, but need not have uniform spacing. For example, a straight flat segment can be defined by 2 points, regardless of the distance covered. Long line segments are automatically divided further within the model into segments that are limited by the grid-cell boundaries (no segment may extend across multiple cells). One emission rate (g/m/s) for each species is used for the entire road.

Near a congested intersection, many short links may be required to resolve the spatial and temporal distribution of emissions. Each is entered and modeled as a discrete source.

Number of road-links with emission parameters
provided in Subgroup 18b (NRD1) No default ! NRD1 = 0 !

Number of road-links with arbitrarily time-varying
emission parameters (NRD2)   No default   ! NRD2 = 0 !
(If NRD2 > 0, ALL variable road data
are read from the file: RDEMARB.DAT)

Emissions from one or more of the roads presented in Subgroup 18b
may vary over time-based cycles or by meteorology. This variability
is modeled by applying an emission-rate scale factor specified for
particular road links and species in Subgroup 18c.

Number of road links and species combinations
with variable emission-rate scale-factors
(NSFRDS)   Default: 0   ! NSFRDS = 0 !

!END!

Subgroup (18b)

DATA FOR ROADS WITH CONSTANT OR SCALED EMISSION PARAMETERS [a]

Road No.	Effect. Height (mAGL)	Initial Sigma z (m)	Initial Sigma y (m)	Emission Rates [b] (g/s/m)

[c]

----

[a] Data for each of the NRD1 roads are treated as a separate input subgroup and therefore must end with an input group terminator.

[b] NSPEC Emission rates must be entered (one for every pollutant modeled). Enter emission rate of zero for secondary pollutants.

[c] Road-source names are entered without spaces, and may be 16 characters long.

Subgroup (18c)

EMISSION-RATE SCALING FACTORS [a]

Use this subgroup to identify temporal variations in the emission

rates given in 18b. Factors assigned multiply the rates in 18b.
Skip sources here that have constant emissions. For more elaborate
variation in source parameters, use RDEMARB.DAT and NRD2 > 0.

Sets of emission-rate scale factors are defined in Input Group 19, and
are referenced by the FACTORNAME. Provide NSFRDS lines that identify the
emission-rate scale factor table for each source-species combination that
uses the scaling option. Note that a scale-factor table can be used with
more than one source-species combination so a FACTORNAME can be repeated.

Source-Species No.	Source Name b (SRCNAM)	Species Name c (CSPEC)	Scale-factor table Name d (FACTORNAME)

----

a
Assignment for each source-specie is treated as a separate input subgroup
and therefore must end with an input group terminator.

b
Source name must match one of the SRCNAM names defined in Input Group 18b

c
Species name must match one of the CSPEC names of emitted species defined in Input Group 3

d
Scale-factor name must match one of the FACTORNAME names defined in Input Group 19

Subgroup (18d)

COORDINATES FOR EACH NAMED ROAD [a]

Coordinate No.	X Coordinate (km)	Y Coordinate (km)	Ground Elevation (m)

----

a
Each line of coordinates is treated as a separate input subgroup
and therefore must end with an input group terminator.

INPUT GROUPS: 19a, 19b -- Emission rate scale-factor tables

```
---------------------

   Use this group to enter variation factors applied to emission rates for any
   source-specie combinations that use this feature.  The tables of emission-rate
   scale factors are referenced by the name assigned to FACTORNAME.  These names
   do not need to include specific source or species names used in the simulation,
   particularly if one factor table is used for many types of sources and species,
   but should be descriptive.  But if a factor table applies to just one source,
   the reference name for it should generally contain that source-name.
   FACTORNAME must NOT include spaces.

   The FACTORTYPE for each table must be one of the following:

     CONSTANT1         1   scaling factor
     MONTH12          12  scaling factors: months 1-12
     DAY7              7   scaling factors: days 1-7
                  [SUNDAY,MONDAY, ... FRIDAY,SATURDAY]
     HOUR24           24  scaling factors: hours 1-24
     HOUR24_DAY7       168 scaling factors: hours 1-24,
                   repeated  7 times: SUNDAY, MONDAY, ... SATURDAY
     HOUR24_MONTH12    288 scaling factors: hours 1-24,
                   repeated 12 times: months 1-12
     WSP6              6   scaling factors: wind speed classes 1-6
                  [speed classes (WSCAT) defined in Group 12]
     WSP6_PGCLASS6     36  scaling factors: wind speed classes 1-6
                   repeated  6 times: PG classes A,B,C,D,E,F
                  [speed classes (WSCAT) defined in Group 12]
     TEMPERATURE12     12  scaling factors: temperature classes 1-12
                  [temperature classes (TKCAT) defined in Group 12]

   The number of tables defined may exceed the number of tables referenced in the
   input groups for each source type above (for convenience), but tables for all
   FACTORNAME names referenced must be present here.

---------------
Subgroup (19a)
---------------

   Number of Emission Scale-Factor
   tables                    (NSFTAB) Default: 0  ! NSFTAB = 0 !

   !END!


---------------
Subgroup (19b)
---------------
                                          a,b,c
   Enter factors for NSFTAB Emission Scale-Factor tables
```

----

a

Assignments for each table are treated as a separate input subgroup
and therefore must end with an input group terminator.

b

FACTORNAME must be no longer than 40 characters

c

Spaces are NOT allowed in any FACTORNAME or FACTORTYPE assignment,
and the names are NOT case-sensitive

INPUT GROUPS: 20a, 20b, 20c -- Non-gridded (discrete) receptor information

----

Subgroup (20a)

Number of non-gridded receptors (NREC) No default ! NREC = 3 !

Group names can be used to assign receptor locations in
Subgroup 17c and thereby provide an identification that
can be referenced when postprocessing receptors. The
default assignment name X is used when NRGRP = 0.

Number of receptor group names (NRGRP) Default: 0 ! NRGRP = 0 !

!END!

Subgroup (20b)

Provide a name for each receptor group if NRGRP>0.
Enter NRGRP lines.

a,b

Group Name

----

* RGRPNAMLIST = *

----

a

Each group name provided is treated as a separate input subgroup
and therefore must end with an input group terminator.

b
Receptor group names must not include blanks.

```
---------------
Subgroup (20c)
---------------

                                     a
         NON-GRIDDED (DISCRETE) RECEPTOR DATA
         ------------------------------------
            c          X           Y          Ground        Height   b
Receptor Group        Coordinate   Coordinate    Elevation   Above Ground
  No.    Name           (km)         (km)          (m)           (m)
-------- -----       ----------   ----------    ---------   ------------
   1 ! X =     438.87091,   6384.32250,      349.3,          0.0 !   !END!
   2 ! X =     439.17893,   6384.55901,      345.7,          0.0 !   !END!
   3 ! X =     440.66750,   6377.33776,      342.9,          0.0 !   !END!

-------------
```

a
Data for each receptor are treated as a separate input subgroup
and therefore must end with an input group terminator.

b
Receptor height above ground is optional. If no value is entered,
the receptor is placed on the ground.

c
Receptors can be assigned using group names provided in 17b. If no
group names are used (NRGRP=0) then the default assignment name X
must be used.