advitech

Report

Air Quality Impact Assessment

Anna Bay Sand Quarry

Hay Enterprises

8 March 2018

Rev 0 (Final)

Report Details

Air Quality Impact Assessment - Anna Bay Sand Quarry

Job #: J0170316, Folder #: F15339, Revision: 0 (Final), Date: 8 March 2018

Filename: 15339-500-Air Quality Impact Assessment Rev0.docx

Prepared For

Hay Enterprises

Alan Hay c/- Julie Wells (Tattersall Lander)

Email: julie@tatland.com.au, Telephone: 02 4987 1500

PO Box 580 Raymond Terrace NSW 2324

Prepared By

Advitech Pty Limited t/a **Advitech Environmental**

ABN: 29 003 433 458

Patrick McGaw, Process Engineer

Email: Patrick.mcgaw@advitech.com.au, Telephone: 02 4924 5400

Facsimile: 02 4967 3772, Web: www.advitech.com.au, General Email: mail@advitech.com.au

7 Riverside Drive Mayfield West NSW 2304 PO Box 207 Mayfield NSW 2304

History

Date	Revision	Comments
6 March 2018	A	Draft Issue for Review
8 March 2018	0	Final Issue

Endorsements

Function	Signature	Name and Title	Date
Prepared by		Patrick McGaw Process Engineer	8 March 2018
Checked and Authorised for Release by		Dr Carl Fung Lead Consultant - Process Engineering and Sustainability, *CAQP* (*CASANZ*)	8 March 2018

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

Advitech Pty Limited was engaged by Hay Enterprises to prepare an Air Quality Impact Assessment (AQIA) for the proposed development of the sand extraction quarry at Anna Bay. This assessment considers the air quality impacts of the proposed development on sensitive receivers adjacent to the site.

It should be noted that this report was prepared by Advitech Pty Limited for Hay Enterprises ('the customer') in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

2. BACKGROUND AND OBJECTIVES

2.1 Site Location and Surrounding Land Uses

Hay Enterprises proposes to extract sand from the southern end of 4226 Nelson Bay Road, Anna Bay (**Figure 1**). The sand quarry proposes to extract up to 50,000 cubic metres of sand per year.

The land is identified as Lot 591 DP 1191380. The site has an area of 13 hectares and is located approximately 30 kilometres north-east of Newcastle. The site is zoned RU2 Rural Landscape under the Port Stephens Local Environmental Plan, 2013. The surrounding area is zoned E1 National Parks and Nature Reserves and E3 Environmental Management.

The nearest potentially affected residences are shown on **Figure 3**. The residences are located in Anna Bay, along Nelson Bay Road and small rural streets. The area surrounding the development site can be described as an established rural setting and includes recreational facilities, sand quarries and rural residents.

Figure 1: Site Location

2.2 Project Description

The proposed sand extraction operations are as follows:

1. Sand will be extracted from the dunes on the southern side of the property by a front end loader as required. Extraction will initially clear the sand dune which has encroached on the power line easement.
2. Sand will be directly unloaded into incoming truck and dog trailer combinations for immediate delivery. Stockpiling or processing operations will not be undertaken on-site.
3. Sand extraction will continue on the sand dune south of the easement within the site boundary as sand continues to encroach the site.

The facility proposes to have capacity to operate on weekdays between 7 am – 6 pm and Saturdays between 8 am – 2 pm.

The process is such that aside from the sand no other material, including water will need to be removed from the site. Vegetation removed for the purposes of the caretaker's residence, site office, machinery shed construction and site access improvements will be mulched on site and redirected to areas around the site for soil improvement purposes. The site layout and indicative sand extraction area is presented in **Figure 2**.

Figure 2: Sand Quarry Layout

2.3 Sensitive Receivers

A number of potentially affected receivers were identified in the vicinity of the project site. These are shown in **Figure 3** and **Table 1**.

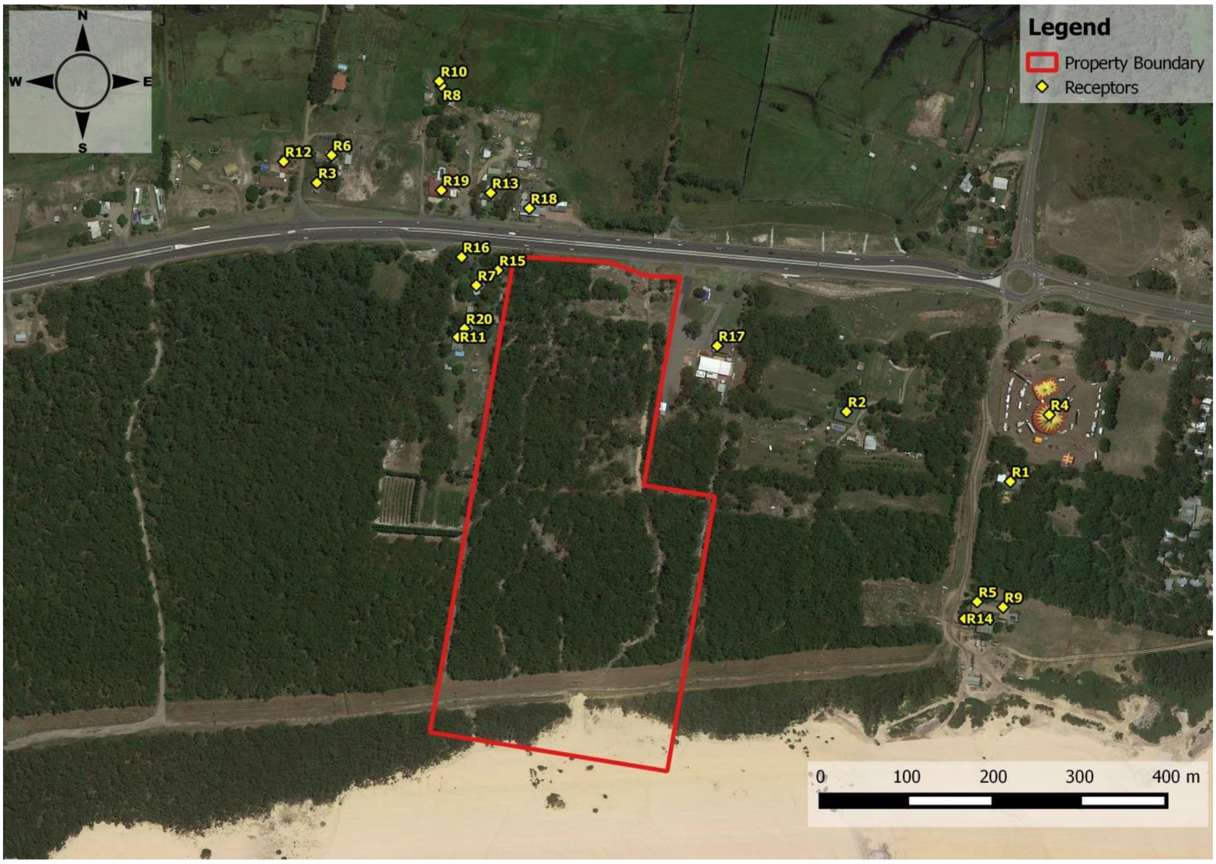


Figure 3: Sensitive Receivers

Table 1: Sensitive Receivers

Receiver ID	Easting (m)	Northing (m)	Address
R1	412483	6373710	6 Jessie Road, Anna Bay
R2	412293	6373789	5 Jessie Road, Anna Bay
R3	411678	6374047	4187 Nelson Bay Road, Anna Bay
R4	412528	6373787	2 Jessie Road, Anna Bay
R5	412446	6373571	Unit 2, 10 Jessie Road, Anna Bay
R6	411695	6374079	4199 Nelson Bay Road, Anna Bay
R7	411864	6373931	4208 Nelson Bay Road, Anna Bay
R8	411821	6374160	4199B Nelson Bay Road, Anna Bay
R9	412476	6373565	Unit 1, 10 Jessie Road, Anna Bay
R10	411819	6374165	4199A Nelson Bay Road, Anna Bay
R11	411843	6373871	Unit 2, 4206 Nelson Bay Road, Anna Bay
R12	411640	6374071	4181 Nelson Bay Road, Anna Bay

Receiver ID	Easting (m)	Northing (m)	Address
R13	411879	6374037	4205 Nelson Bay Road, Anna Bay
R14	412432	6373552	10 Jessie Road, Anna Bay
R15	411888	6373948	4210 Nelson Bay Road, Anna Bay
R16	411846	6373963	4206A Nelson Bay Road, Anna Bay
R17	412143	6373863	4236 Nelson Bay Road, Anna Bay
R18	411924	6374020	4213 Nelson Bay Road, Anna Bay
R19	411822	6374040	4201 Nelson Bay Road, Anna Bay
R20	411851	6373881	4206 Nelson Bay Road, Anna Bay

3. AIR QUALITY GUIDELINES

The NSW Environment Protection Authority (EPA) specify the impact assessment criteria in the publication *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, 2016. The relevant sections from this publication are reproduced below in **Table 2** which presents the ground level concentration (GLC) criteria for each applicable air pollutant.

Table 2: NSW EPA Impact Assessment Criteria

Pollutant	NSW EPA Design Criteria	Units	Averaging Time
TSP[a]	90	µg/m^3	Annual
PM_{10}[b]	50	µg/m^3	24 hours
	25	µg/m^3	Annual
$PM_{2.5}$[c]	25	µg/m^3	24 hours
	8	µg/m^3	Annual
Deposited Dust[d]	2[e]	g/m^2/month	Annual
	4[f]		

[a] Total suspended particulates.
[b] Particulate materials with an aerodynamic diameter less than 10 µm.
[c] Particulate materials with an aerodynamic diameter less than 2.5 µm.
[d] Dust is assessed as insoluble solids as defined by AS 3580.10.1.
[e] Maximum increase in deposited dust level.
[f] Maximum total deposited dust level.

4. METEOROLOGICAL DATA

To determine the most representative 12 month calendar period, required for modelling air emissions from the Anna Bay Sand Quarry, historical Bureau of Meteorology (BOM) climate data at the Williamtown Airport Automatic Weather Station (AWS) (061078) was reviewed in **Table 3**.

Table 3: Bureau of Meteorology (BoM) Climate Data History for Williamtown Airport (061078)

Year	Temperature (degrees Celsius)				Rainfall (mm)	
	Maximum year average	Difference from long term average	Minimum year average	Difference from long term average	Yearly total	Percentage of long term average
2008	22.8	- 0.3	12.1	- 0.3	1463.6	130%
2009	24.1	+1.0	12.6	+0.2	-	-
2010	23.8	+0.7	12.8	+0.4	956.2	85%
2011	23.7	+0.6	12.9	+0.5	1255.0	111%
2012	23.5	+0.4	12.2	- 0.2	988.8	88%
2013	24.5	+1.4	12.3	- 0.1	1299.8	115%
2014	24.1	+1.0	12.8	+0.4	868.0	77%
2015	23.9	+0.8	12.9	+0.5	1321.2	117%
2016	24.5	+1.4	13.4	+1.0	1147.1	102%

A review of BoM climate data suggests greater deviations in either the average rainfall or temperatures for the years 2008, 2009, 2013, 2014, 2015 and 2016. The years with the least deviation from long term average climate statistics are years 2010, 2011 and 2012.

The Williamtown locality has been the subject of previous proposed developments, most notably the Port Waratah Port Coal Services (PWCS) Terminal 4 Project. At present, the T4 Project has been recommended for approval by the NSW Department of Planning. The PWCS AQIA presented rigorous assessment of the local and regional climate and concluded that the year 2010 was the most representative year for modelling purposes. The PWCS AQIA quotes the following:

> *"Data from these monitoring stations (5 off) for 2010 was used to characterise the regional surface meteorology and provide input datasets for the meteorological modelling undertaken. Based on comparisons of the annual wind roses and statistical evaluation of the wind speed records for the previous five years, 2010 was concluded to be sufficiently representative of airflow patterns characteristic of each location."*

As a result of Advitech's review of climatic data (refer to **Table 3**), previous PWCS T4 Project justifications and independent peer review, this study has adopted the 2010 year for air dispersion modelling purposes.

Meteorological data representative of the Anna Bay site was obtained from the following sources:

- BoM Nobby's Head AWS data for 2010;
- BoM Williamtown Airport AWS data for 2010;
- Tomago Aluminium Company AWS data for 2010; and
- TRCMet 12 km resolution MM5 data for 2010.

4.1 CALMET

CALMET is a NSW EPA approved diagnostic meteorological model that produces three-dimensional wind fields based on parameterized treatments of terrain effects such as slope flows and terrain blocking effects. Meteorological observations are used to determine the wind field in areas of the domain within which the observations are representative.

CALMET was run in hybrid mode which combines the numerical prognostic model data in a 3D.DAT file (i.e. MM5 data from TRCMet) along with the surface observational data (i.e. Nobby's Head AWS, Williamtown Airport AWS and Tomago Aluminium Company AWS).

Figure 4 shows the frequency of wind speed and direction for each season during the 2010 calendar year extracted from the CALMET generated file.

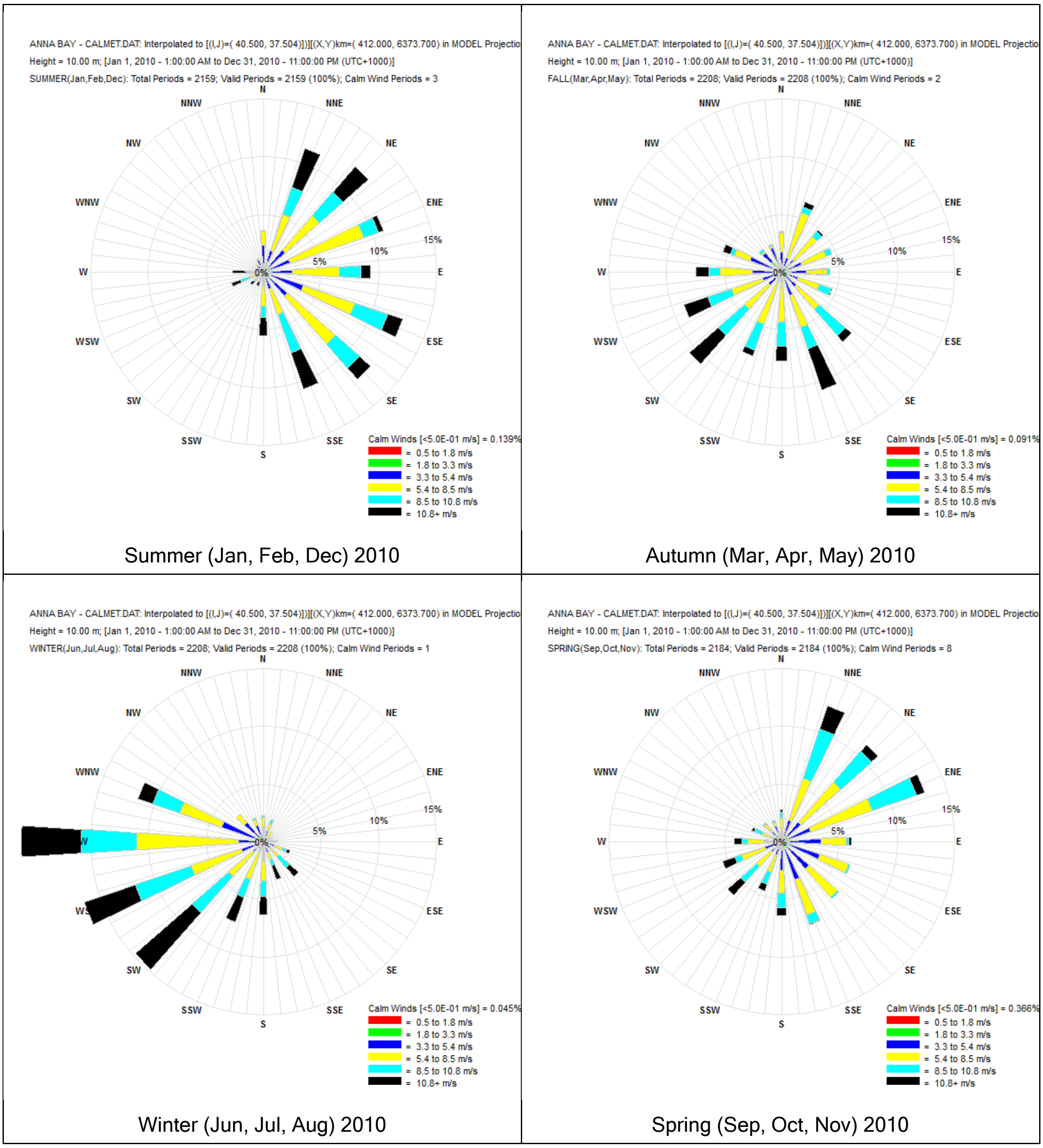


Figure 4: Seasonal Wind Roses, 2010

5. MODELLING APPROACH/METHODOLOGY

5.1 Background Air Quality

Assessment of background air quality data has been undertaken for the airshed in the vicinity of the proposed sand extraction operation.

The NSW Office of Environment and Heritage (OEH) operate an air quality monitoring program that collects accurate real-time measurements of ambient level pollutants at 28 monitoring sites within the air quality monitoring network (AQMN), located around the greater metropolitan area of Sydney, the Illawarra, the Lower Hunter and selected rural sites around NSW. The monitoring location that is considered to be representative of the Anna Bay area with data from the representative year is located at Beresfield approximately 20 kilometres to the west of the proposed development.

The Beresfield monitoring station commenced operation in 1998 and provides data on the following air quality parameters.

- Ozone;
- Particulates;
- NO, NO_2, NOx; and
- SO_2.

A Level 1 assessment of background concentrations has been prepared for the pollutants listed in **Table 4** for the 2010 monitoring year to correspond with the meteorological data. The Level 1 assessment has assumed a worst-case background concentration by using the maximum reported value.

Table 4: Background Air Quality

Pollutant	Background Concentration[a]	Units	Averaging Time
TSP	33.2	µg/m^3	Annual
Dust Deposition	na	g/m^2/month	Annual
PM_{10}	Variable (refer to **Figure 4**)	µg/m^3	24 Hours
	16.6	µg/m^3	Annual
$PM_{2.5}$	Variable (refer to **Figure 4**)	µg/m^3	24 Hours
	6.0	µg/m^3	Annual

[a] Reported value is the average 24 hour result
[b] Assumed from annual average PM_{10} background (TSP = 2 x PM_{10})
na - Not available

The maximum reported PM_{10} and $PM_{2.5}$ background concentration for the 2010 monitoring period was 50.0 and 25.9 µg/m^3 respectively, which is above the NSW OEH impact assessment criteria. As such, a Level 2 or contemporaneous assessment of the PM_{10} and $PM_{2.5}$ background concentration is required to understand the cumulative impact of the proposed development.

Figure 5 displays the PM_{10} and $PM_{2.5}$ 24 hour average background concentrations for 2010 and indicates exceedances of the NSW OEH impact assessment criteria.

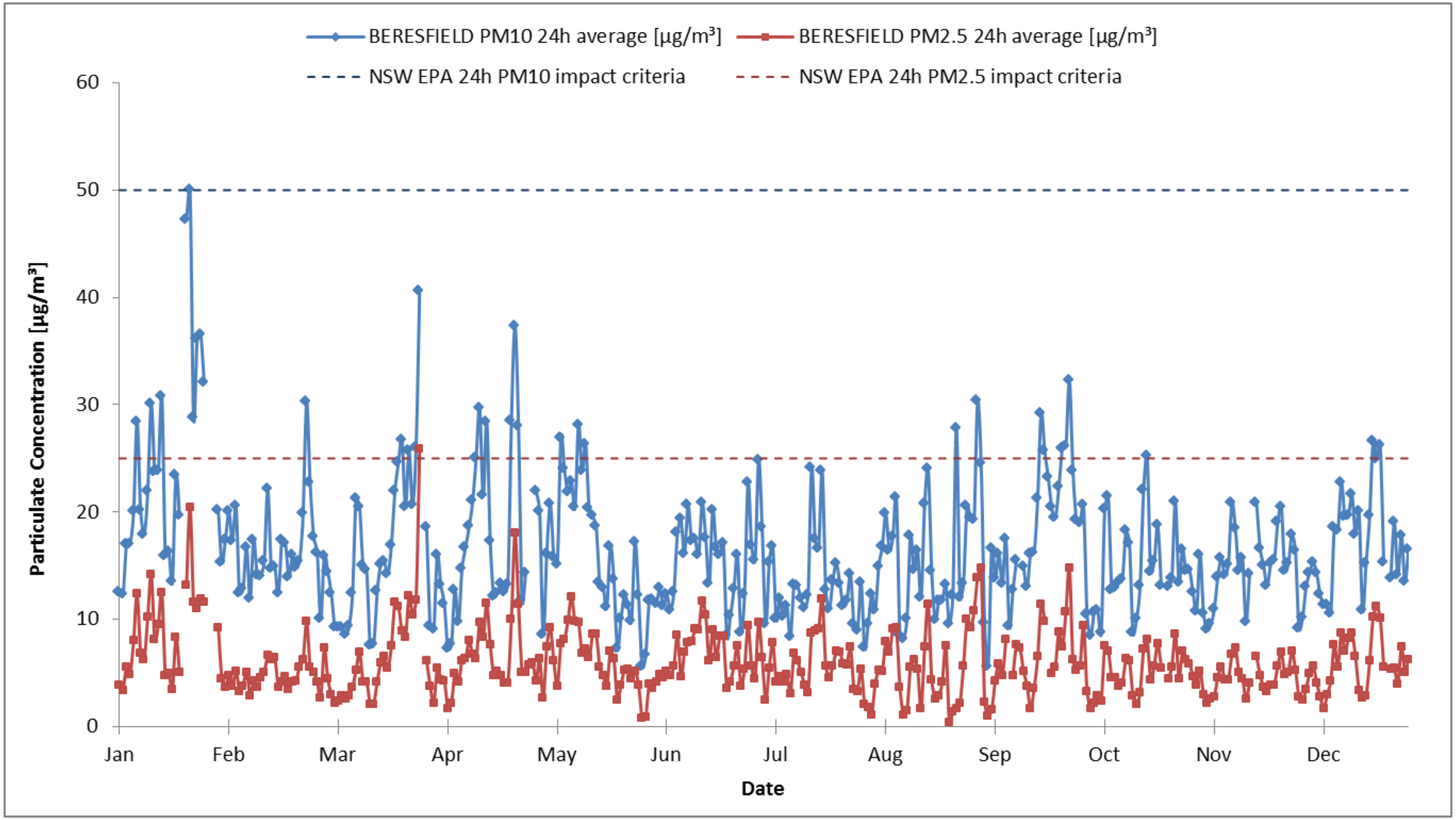


Figure 5: Daily Average Particulate Matter Concentrations for Beresfield 2010

5.2 Meteorological Model Configuration

Table 5 details the parameters used in the meteorological modelling to drive the CALMET model.

Table 5: CALMET Meteorological Parameters used in this Report

Identifier	Descriptor	Comment
MM5	Grid spacing	12 km × 12 km
	Year of analysis	2010
	Time step	hourly
CALMET (v 6.333)	Meteorological grid domain	10 km x 10 km
	Meteorological grid origin (SW corner)	408000 m, 6370000 m
	Meteorological grid resolution	0.1 km
	Surface meteorological station	Williamtown Airport AWS, Newcastle Nobbys AWS, Tomago Aluminium AWS
	TERRAD value	6 km
	Critical Parameters (R1, R2, R1Max, R2Max)	7 km, 7 km, 10 km, 10 km
	Cell Face Heights	0, 20, 40, 80, 160, 320, 700, 1300, 1700, 2300, 3000

5.3 Dispersion Modelling Configuration

CALPUFF is an advanced non-steady-state meteorological and air quality modelling system. The model advects 'puffs' of material emitted from modelled sources, simulating the dispersion and transformation processes along the way. The model has been adopted by the U.S. Environmental Protection Agency (U.S. EPA) in its guideline on air quality models. CALPUFF uses the 3D wind fields generated by CALMET with the primary output files from CALPUFF processed in CALPOST to produce time based concentration or deposition fluxes evaluated at selected receiver locations.

Particulate concentrations were simulated for a regular Cartesian receiver grid covering a 10 km by 10 km computational domain, set within the CALMET modelling domain and centred over the project area, with a grid resolution of 0.1 km. High resolution MM5 meteorological data for the year 2011 has been used in conjunction with locality specific meteorological data.

Section 5.5 outlines the assumptions made for the odour assessment. **Appendix I** contains example CALMET and CALPOST input files.

5.4 Modelling Scenarios

Sand extraction operations are to proceed as per the project description in **Section 2.2. Figure 6** below shows the sequence plan for the sand quarry operations. The sequence plan intends to control the inundation of sand onto the power line easement by continual removal from sand within the site boundary.

Dispersion modelling has been undertaken using the maximum hourly operational intensity as the emission basis for the entire 2010 calendar year, which is equivalent to approximately 260,000 cubic metres of sand per year. This assumption can be considered the worst case scenario and very conservative given the annual extraction limit of 50,000 cubic metres.

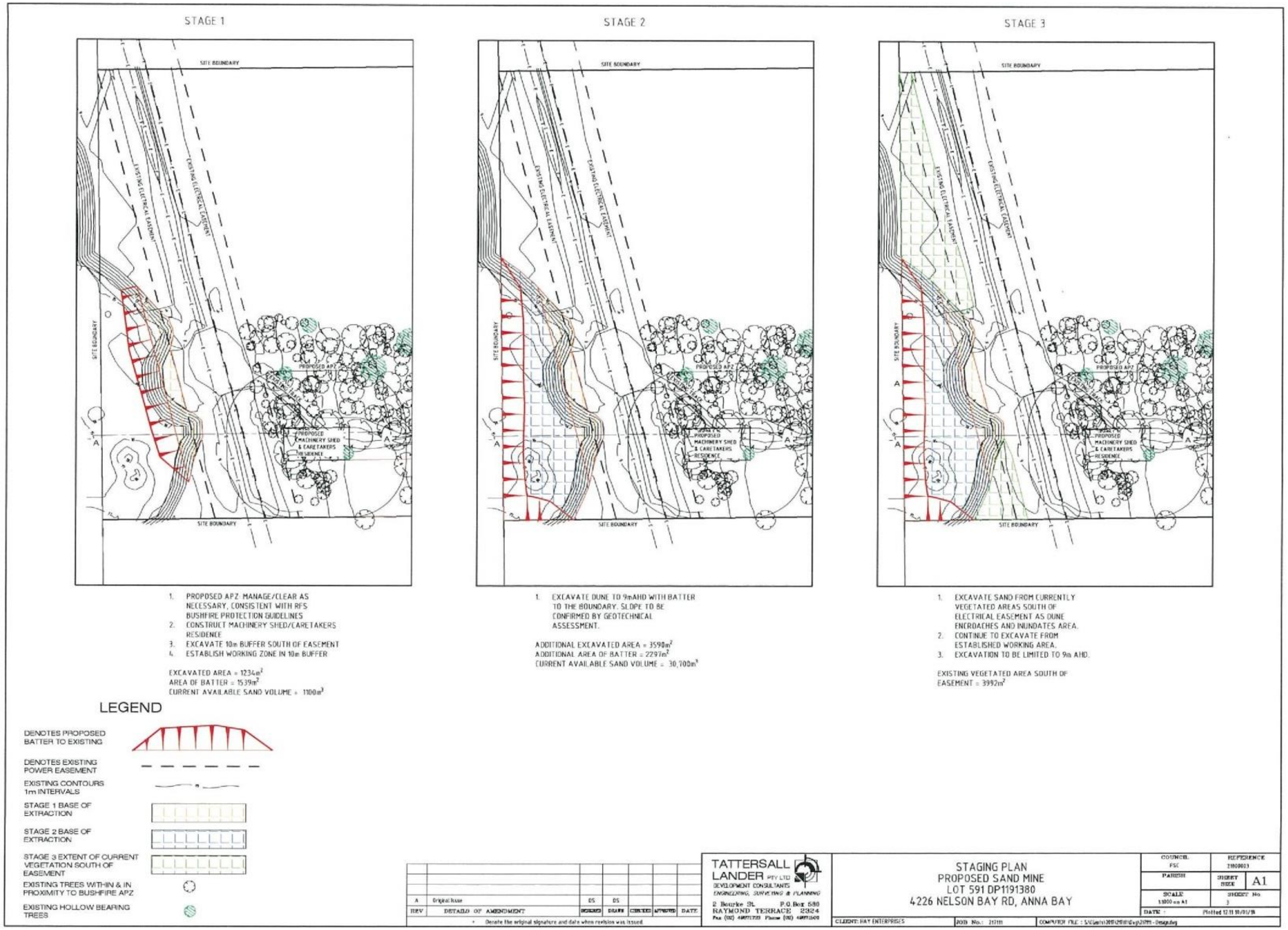


Figure 6: Proposed Sand Extraction Sequence Plan

5.5 Assumptions

Assumptions used in the computation of GLCs and deposition for particulates using the CALPUFF dispersion model are listed below:

- The topography surrounding the sand extraction quarry at Anna Bay is relatively flat. The minimum and maximum elevation within a 5 km radius of the subject site is 0 m and 60 m respectively. A digital terrain model of the site and surrounding topography is incorporated into the air dispersion model.
- Options within CALPUFF modelling reflect the *NSW OEH Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System guidelines.*
- Wet deposition has not been applied to the CALPUFF model.
- Hourly weather data from the Williamtown Airport AWS, Nobbys Newcastle AWS and Tomago Aluminium AWS was used to generate the hybrid CALMET meteorological file between 1 January 2010 and 31 December.
- Moisture content for wheel generated dust emission factor estimation assumed to be 16 per cent for dense uniform sand (*Emission Estimation Technique Manual for Fugitive Emissions* 1999).
- Silt content for wheel generated dust emission factor estimation assumed to be 6 per cent for sand soils (Estimating soil particle size distribution and percent sand, silt and clay for six texture classes using the Australian Soil Resource Information System point database CSIRO 2001).
- Hay Enterprises sand quarry has been modelled based on a maximum extraction rate of 910 cubic metres (i.e. 1,400 tonnes) of sand per day. This assumes four truckloads of sand (i.e. 35 tonnes per load) will be removed per hour for 10 hours.
- Haul trucks which transfer sand from the sand quarry site have a capacity of 35 tonnes.
- The operating times for site quarry activities are as follows:
  - Monday to Friday: 7 am to 6 pm
  - Saturday 8 am to 2 pm
  - Sundays and Public Holidays: Closed
- The sand quarry extraction area is as per overall layout drawing provided by Tattersall Lander (refer to **Figure 6**).
- A $PM_{2.5}$ to PM_{10} ratio of 0.15 and 0.1 has been applied to sand handling and wheel generated emission sources respectively (*AP 42, Fifth Edition, Volume I, Chapter 13: Miscellaneous Sources*).
- The geometric mass mean diameters assumed in the modelling were 30 µm for TSP, 10 µm for PM_{10} and 2.5 µm for $PM_{2.5}$. All pollutants were modelled with 0 µm geometric standard deviation.
- Wheel generated dust from haul trucks within the sand quarry extraction area was modelled as a volume source in CALPUFF. Each volume source has a separation distance of less than one quarter of the distance to the nearest residential receiver. Particulate emissions were equally divided between volume sources.
- The number of vehicle kilometres travelled is calculated on the unpaved haul route separating the sand extraction area and the intersection at Nelson Bay road.

5.6 Emission Sources

The activities associated with the proposed operations with the potential to generate dust are:

- Operation of front-end loaders within the extraction area;
- Loading by front-end loaders to the haul trucks; and
- Dust generated by haul truck movements within the excavation area.

Details of each emission source are given in **Table 6**. The emission factors and estimates are based on Emission Estimation Technique (EET) Manual for Mining - Version 3.1. Emissions from the manual are based on typical emission for coal and metalliferous mining operations. The emission factors have been applied to the sand quarry operation and can be considered as a conservative estimate.

Table 6: Modelled Emission Sources

Emitter Identifier	Emitter Name	Emission Factor			Modelled days (Days)	Modelled Working hours (hours/day)	Emission Rate(g/s)			Modelled Location		
		TSP	PM_{10}	Units			TSP	PM_{10}	$PM_{2.5}$	Easting (m)	Northing (m)	Ground Elevation (m)
FEL	Front end loader	0.00015	0.000071	kg/t	365	10	0.00586	0.00277	0.00042	411981	6373452	10
Load	Loading of sand into haul trucks	0.00015	0.000071	kg/t	365	10	0.00586	0.00277	0.00042	412017	6373495	11
HR1-HR21	Wheel generated dust from truck movements[1]	2.2430	0.598	kg/VKT	365	10	0.121	0.032	0.0032	Varies	Varies	Varies

Notes:

1 - Kilometres travelled by haul trucks estimated from Google Earth satellite imagery and allowing for four loads per hour. Wheel generated dust from haul trucks within the sand quarry site were modelled as a volume source in CALPUFF. Each volume source has a separation distance of 25 metres.

6. DISPERSION MODELLING RESULTS

6.1 Annual Average PM_{10}, $PM_{2.5}$, TSP

The predicted concentrations of the annual average PM_{10}, $PM_{2.5}$ and TSP for the proposed operation are presented in **Table 7**. The contour plots are presented in **Appendix I**.

Table 7: Predicted Annual Average PM_{10}, $PM_{2.5}$ and TSP at Sensitive Receivers

Receiver	Predicted Annual Average PM_{10} Increment +Background (µg/m^3)	Predicted Annual Average $PM_{2.5}$ Increment +Background (µg/m^3)	Predicted Annual Average TSP Increment +Background (µg/m^3)
Background	16.6	6.0	33.2
R1	16.8	6.0	33.9
R2	17.1	6.1	34.8
R3	16.9	6.0	34.0
R4	16.7	6.0	33.6
R5	16.9	6.1	34.2
R6	16.9	6.0	34.0
R7	17.4	6.1	35.7
R8	16.9	6.0	34.2
R9	16.9	6.0	34.0
R10	16.9	6.0	34.1
R11	17.7	6.2	36.7
R12	16.8	6.0	33.9
R13	17.2	6.1	35.0
R14	16.9	6.1	34.2
R15	17.4	6.1	35.8
R16	17.2	6.1	35.0
R17	18.4	6.2	39.4
R18	17.3	6.1	35.7
R19	17.0	6.1	34.5
R20	17.7	6.2	36.7
Impact Criteria	**25**	**8**	**90**

Table 7 presents the predicted cumulative 100th percentile annual average PM_{10}, $PM_{2.5}$ and TSP for sensitive receivers respectively. An annual average background PM_{10}, $PM_{2.5}$ and TSP concentration has been applied (refer to **Table 4**) to determine if further assessment is required.

The annual PM_{10}, $PM_{2.5}$ and TSP impact assessment criteria are not exceeded at any sensitive receivers. According to the NSW OEH guidance, no additional contemporaneous assessment of annual average PM_{10}, $PM_{2.5}$ and TSP is required.

6.2 24 Hour Average PM_{10}

The predicted concentrations of the 24-hour average PM_{10} maximum increment for the proposed operation are presented in **Figure 7**.

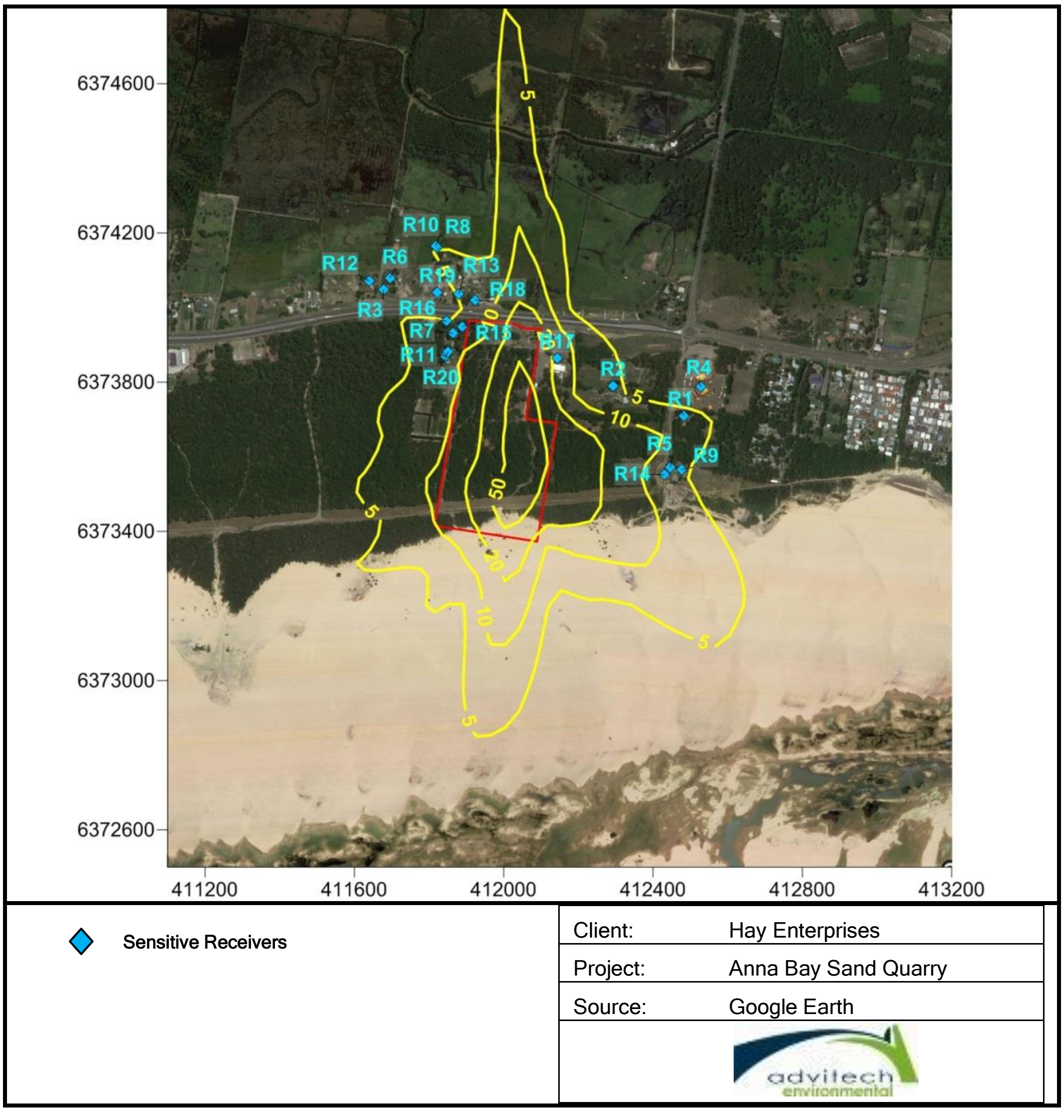


Figure 7: 100th Percentile 24 Hour Average PM_{10} Concentration

(Contour labels = 5, 10, 20, 50 µg/m³)

The predicted concentrations of the 24 hour average PM_{10} impact for the proposed operation are presented in **Table 8**.

Table 8: Maximum Impact of 24 Hour Average PM_{10}

Receiver	Maximum Predicted Increment (µg/m³)	Maximum Background Concentration	Total (µg/m³)	Impact Assessment Criteria
R1	6.1	47.2 µg/m³ (20/1/2010)	**53.3**	50 µg/m³
R2	5.5		**52.7**	
R3	4.3		**51.5**	
R4	3.0		**50.2**	
R5	5.8		**53.0**	
R6	3.6		**50.8**	
R7	6.4		**53.6**	
R8	5.2		**52.4**	
R9	5.0		**52.2**	
R10	5.1		**52.3**	
R11	8.7		**55.9**	
R12	4.0		**51.2**	
R13	5.2		**52.4**	
R14	6.3		**53.5**	
R15	5.5		**52.7**	
R16	4.9		**52.1**	
R17	14.6		**61.8**	
R18	7.0		**54.2**	
R19	3.7		**50.9**	
R20	9.3		**56.5**	

[1] The background concentration of 50.0 µg/m³ (refer to **Figure 5**) has been discounted as it is above the impact assessment criteria. Therefore the next highest value of 47.2 µg/m³ was used.

The exceedances at nearby sensitive receivers of the 24 hour average PM_{10} concentration presented in **Table 8** are a result of an elevated background PM_{10} concentration. A Level 2 contemporaneous impact and background assessment is required to determine any additional exceedances as a result of the proposed operation.

A summary of the 24 hour average PM_{10} contemporaneous impact and background assessment (Level 2 Assessment) for identified sensitive receivers are presented in **Table 9.**

Table 9: Summary of the 24 Hour Average PM_{10} Contemporaneous Impact and Background

Date	PM_{10} 24-hour average (µg/m^3)				Date	PM_{10} 24-hour average (µg/m^3)			
	Highest Background	Predicted Increment	Receiver	Total		Background	Highest Predicted Increment	Receiver	Total
21/01/2010	50.0[1]	1.7	R11	51.7[1]	16/06/2010	17.6	14.6	R17	32.2
20/01/2010	47.2	2.5	R20	49.7	5/07/2010	16.8	13.6	R17	30.4
27/03/2010	40.6	2.5	R17	43.1	24/09/2010	22.3	13.4	R17	35.7
23/04/2010	37.3	2.9	R18	40.2	20/05/2010	16.8	13.2	R17	30.0
24/01/2010	36.5	0.0[2]	R1	36.5	10/08/2010	8.5	9.3	R20	17.8
23/01/2010	36.1	1.6	R20	37.7	28/04/2010	0.0	8.8	R17	8.8
27/09/2010	32.2	2.9	R17	35.1	1/07/2010	24.8	8.6	R17	33.4
25/01/2010	32.0	4.9	R20	36.9	30/07/2010	13.4	7.9	R17	21.3
13/01/2010	30.7	0.8	R11	31.5	12/07/2010	13.1	7.5	R17	20.6
1/09/2010	30.3	2.8	R17	33.1	17/08/2010	20.7	7.2	R17	27.9
23/02/2010	30.2	1.2	R18	31.4	6/04/2010	12.7	7.1	R17	19.8
10/01/2010	30.0	0.0[2]	R1	30.0	15/09/2010	13.0	6.6	R17	19.6

[1] Predicted exceedance discounted as 24 hour average PM_{10} was already at the NSW OEH impact criteria.

[2] No predicted 24 hour average PM_{10} recorded at any sensitive receiver.

The exceedance displayed in **Table 9** has been discounted due to a background concentration greater than the impact assessment criteria. There are no additional exceedances of the 24 hour PM_{10} impact assessment criteria at nearby sensitive receivers. According to the NSW OEH guidance, mitigation measures or emission controls that reduce emissions are not required.

6.3 24 Hour Average $PM_{2.5}$

The predicted concentrations of the 24 hour average $PM_{2.5}$ for the proposed operation are presented in **Figure 8** and **Table 10**.

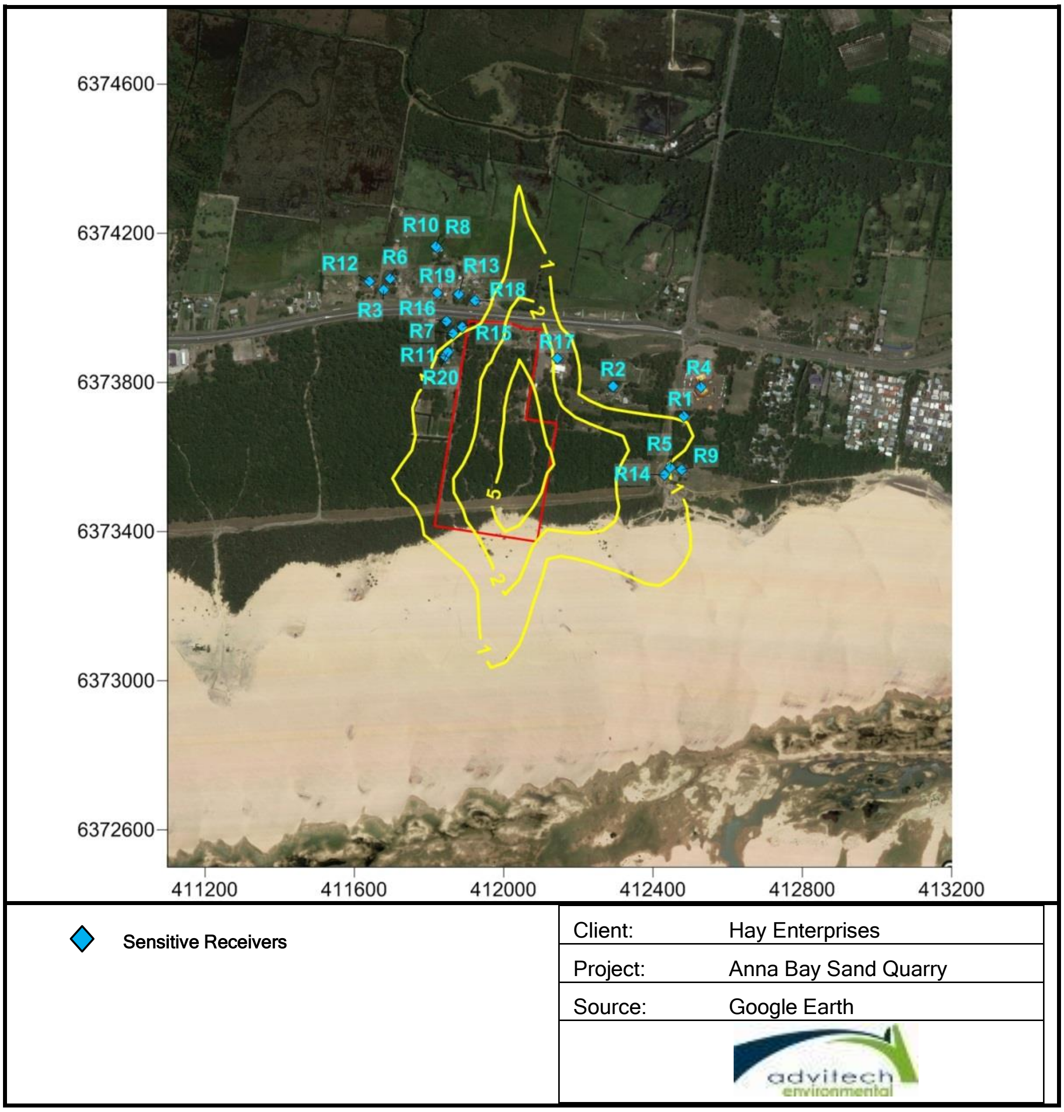


Figure 8: 100th Percentile 24 Hour Average $PM_{2.5}$ Concentration

(Contour labels = 1, 2, 5 µg/m^3)

Table 10 presents the predicted cumulative 100th percentile 24 hour average $PM_{2.5}$ for sensitive receivers respectively. A maximum 24 hour $PM_{2.5}$ background concentration of 20.4 µg/m^3 has been applied (refer to **Table 4**) to determine if further assessment is required.

Table 10: Predicted Maximum 24 Hour Average $PM_{2.5}$ at Sensitive Receivers

Receiver	Predicted Increment (µg/m^3)	Background Concentration[1]	Total (µg/m^3)	Impact Assessment Criteria
R1	0.9	20.4 µg/m^3	21.3	25 µg/m^3
R2	0.6		21.0	
R3	0.5		20.9	
R4	0.4		20.8	
R5	0.9		21.3	
R6	0.5		20.9	
R7	0.9		21.3	
R8	0.6		21.0	
R9	0.8		21.2	
R10	0.6		21.0	
R11	1.1		21.5	
R12	0.5		20.9	
R13	0.7		21.1	
R14	1.0		21.4	
R15	0.9		21.3	
R16	0.7		21.1	
R17	1.5		21.9	
R18	0.8		21.2	
R19	0.6		21.0	
R20	1.1		21.5	

[1] The background concentration of 25.9 µg/m^3 (refer to **Figure 5**) has been discounted as it is above the impact assessment criteria. Therefore the next highest value of 20.4 µg/m^3 was used.

The 24 hour average $PM_{2.5}$ impact assessment criteria are not exceeded at any sensitive receivers. According to the NSW OEH guidance, no additional contemporaneous assessment of 24 hour average $PM_{2.5}$ is required.

6.4 Dust Deposition

The predicted annual average dust deposition rates for the proposed operation are presented in **Table 11**.

Table 11: Predicted Dust Deposition at Sensitive Receivers

Receiver	Predicted Increment (g/m^2/month)	Impact Assessment Criteria
R1	0.3	2 g/m^2/month
R2	0.8	
R3	0.3	
R4	0.2	
R5	0.5	
R6	0.3	
R7	1.2	
R8	0.3	
R9	0.4	
R10	0.2	
R11	1.5	
R12	0.2	
R13	0.7	
R14	0.5	
R15	1.2	
R16	0.8	
R17	3.4	
R18	1.1	
R19	0.5	
R20	1.5	

The maximum incremental deposited dust level predicted at a sensitive receiver is 3.4 g/m^2/month at Receptor 17. This modelling is based on the proposed maximum daily intensity of the sand extraction continuously operating at maximum intensity for the entire year (i.e. 910 cubic metres per day approximately equating to 260,000 cubic metres of sand extracted per year). However the sand extraction operations will likely fluctuate with customer demand and extraction will be limited to a maximum of 50,000 cubic metres per year. The impact is not likely to exceed the maximum increase in deposited dust level criteria of 2 g/m^2/month during normal operations.

6.5 Discussion

The particulate dispersion modelling indicates that air quality impacts (i.e. airborne dust and dust deposition) from the sand quarry will be low and there will not be additional exceedances of the PM_{10}, $PM_{2.5}$ and TSP impact assessment criteria at sensitive receivers. Any exceedances that may occur will be likely attributed to elevated background concentrations rather than emissions from the sand quarry.

The maximum increase in dust deposition impact assessment criteria of 2 g/m^2/month is predicted to be exceeded at one sensitive receiver (i.e. R17). However the modelling scenario is considered to be very conservative and normal operations are unlikely to exceed the impact assessment criteria.

6.5.1 Construction Works

Potential air quality impacts may be generated from the construction of the machinery shed/caretakers residence/ site office, intersection upgrade and haul route realignment. The construction works and all related activities are expected to be completed within a 1 – 2 month period. The intensity of the activities will be highly varied depending on the schedule of construction.

It is expected the short term construction will be managed in accordance with *NSW OEH Air Quality Guidance Note for Construction Sites*. Air quality impacts from the proposed construction activities are likely to be low due to the short term construction duration, the buffer distance to sensitive receptors and the dense vegetation surrounding the site.

7. CONCLUSIONS

Advitech modelled a worst-case scenario (i.e. 910 cubic metres per day approximately equating to 260,000 cubic metres of sand extracted per year) for the proposed Anna Bay sand quarry to assess the potential particulate impacts to sensitive receivers. The results of the CALPUFF modelling indicate that operation (50,000 cubic metres of sand per year) of the sand extraction quarry will result in incremental increases in particulate matter and dust deposition at surrounding sensitive receivers.

CALPUFF dispersion modelling indicates that the Anna Bay Quarry operations will be below the NSW EPA impact assessment criteria for TSP, PM_{10} and $PM_{2.5}$ as a result of cumulative impacts. Any exceedances that may occur will be likely attributed to elevated background concentrations rather than a significant incremental contribution from the proposed development.

The maximum increase in dust deposition impact assessment criteria of 2 g/m^2/month is predicted to be exceeded at Receiver 17. However the modelling scenario is considered to be very conservative is not likely to exceed the maximum increase in deposited dust level criteria of 2 g/m^2/month during normal operations.

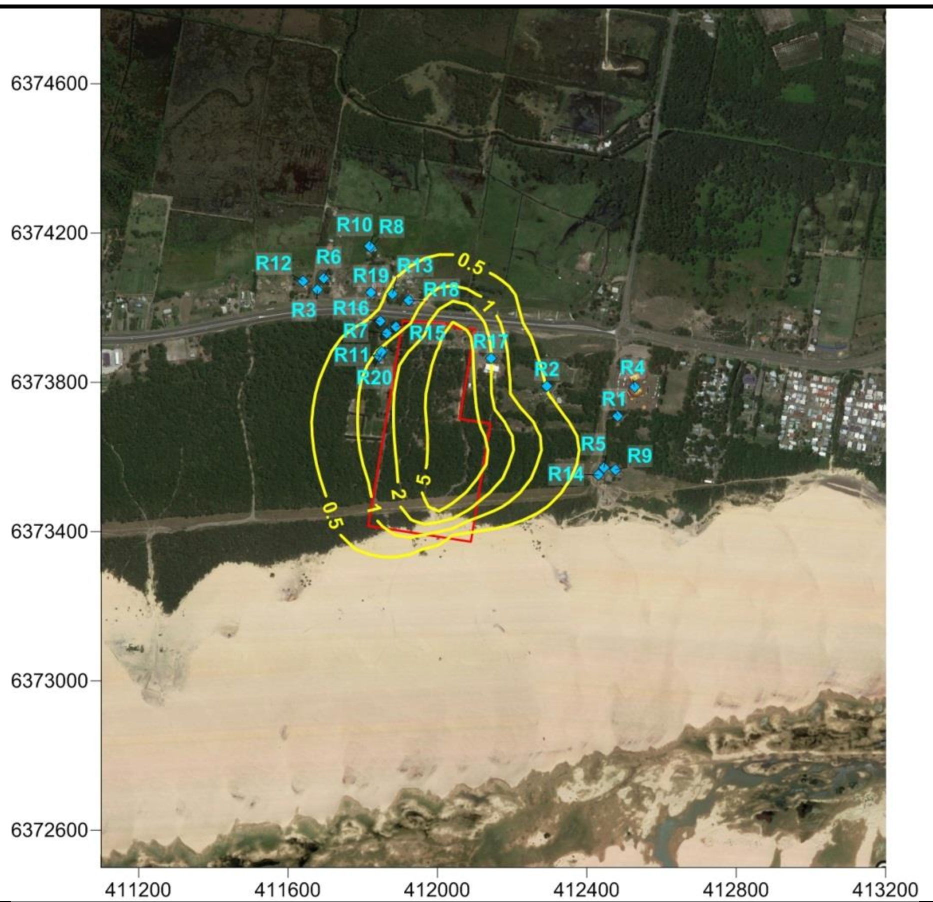
8. REFERENCES

The following information was used in the preparation of this report:

1. Bureau of Meteorology Climate Statistics accessed via http://www.bom.gov.au/climate/data/ on 22 May, 2017.
2. Department of Sustainability, Environment, Water, Population and Communities, 1999. *Emission Estimation Technique (EET) Manual for Fugitive Emissions - Version 1.0*.
3. Department of Sustainability, Environment, Water, Population and Communities, 2012. *Emission Estimation Technique (EET) Manual for Mining - Version 3.1*.
4. ENVIRON Australia, 2012. *Air Quality Assessment for the Terminal 4 Project.*
5. Midwest Research Institute, 2006. *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors*
6. NSW EPA, 2016. *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*.
7. NSW OEH, 2011. *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'*
8. NSW OEH, *Air Quality Guidance Note for Construction Sites*.
9. NSW OEH, Air Quality Monitoring Network accessed via http://www.environment.nsw.gov.au/AQMS/ on 22 May, 2017.
10. Scire, J., 2011 supplied information and personal communications.
11. Scire, J., and Barclay, J., 2011. *CALPUFF Training Course - April 4-6, 2011, Melbourne.*
12. Tattersall Lander supplied information, drawings and plans.
13. United States Enviromental Protection Agency. *AP 42, Chapter 13: Miscellaneous Sources,* Volume 1, Fifth Edition.

Appendix I

Contour Plots

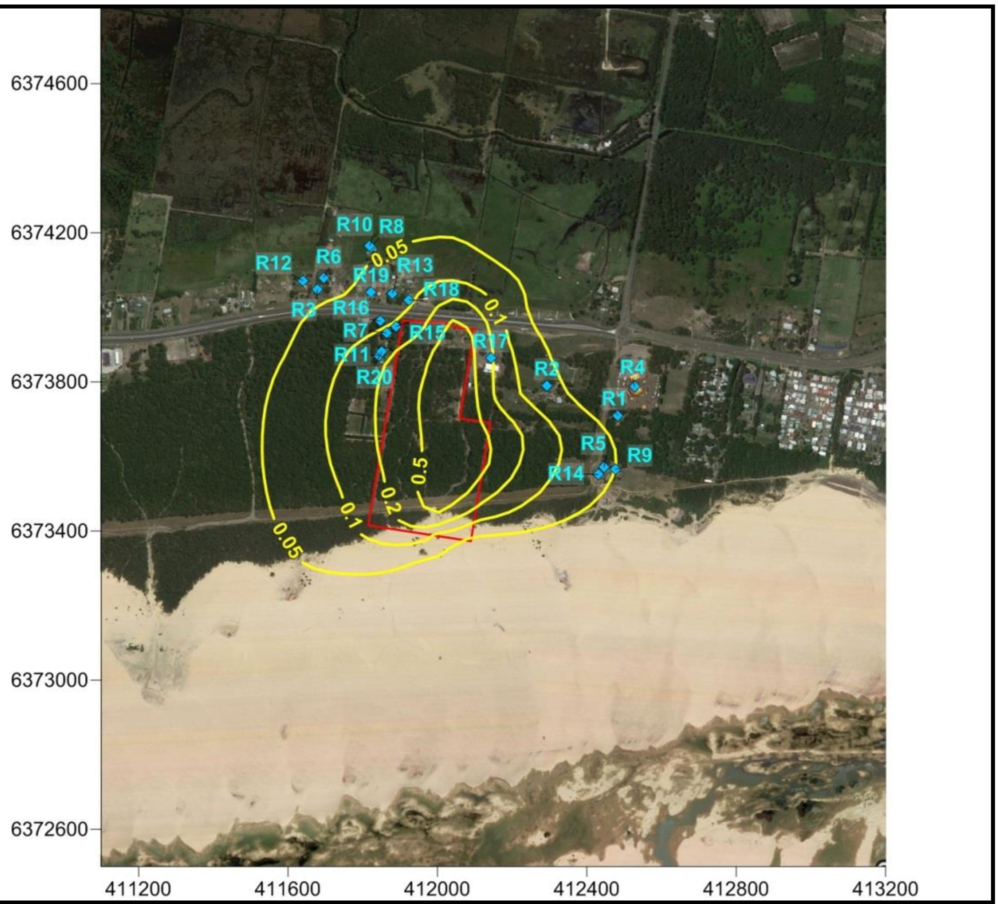


Sensitive Receivers

Client:	Hay Enterprises
Project:	Anna Bay Sand Quarry
Source:	Google Earth

Figure 9: 100th Percentile Annual Average PM_{10} Concentration

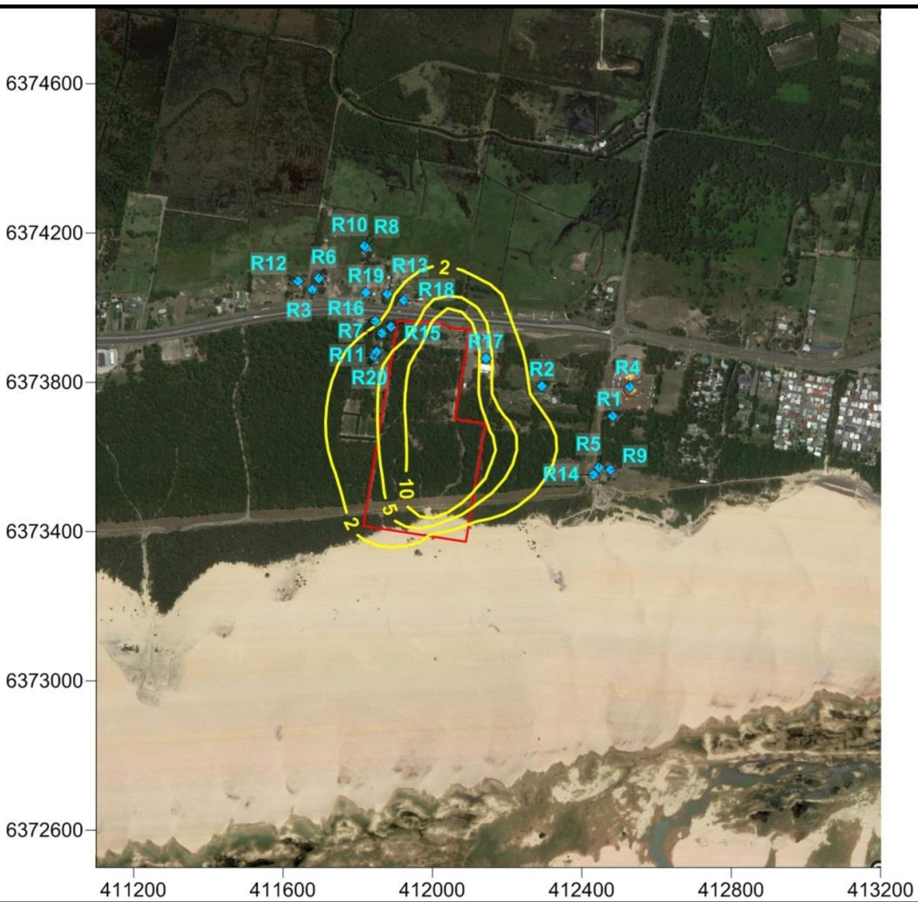
(Contour labels = 0.5, 1, 2, 5 µg/m³)



Client:	Hay Enterprises
Project:	Anna Bay Sand Quarry
Source:	Google Earth

Figure 10: 100th Percentile Annual Average $PM_{2.5}$ Concentration

(Contour labels = 0.05, 0.1, 0.2, 0.5 µg/m^3)



Client:	Hay Enterprises
Project:	Anna Bay Sand Quarry
Source:	Google Earth

Figure 11: 100th Percentile Annual Average TSP Concentration

(Contour labels = 2, 5, 10 µg/m³)

Appendix II

Example CALPUFF Input File

```
CALMET.INP      2.1            Hour Start and End Times with Seconds
Anna Bay Quarry
HYBRID
1/01/2010 00:00 - 1/01/2011 00:00
---------------- Run title (3 lines) ------------------------------------------

                    CALMET MODEL CONTROL FILE
                    --------------------------

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

INPUT GROUP: 0 -- Input and Output File Names


Subgroup (a)
------------
Default Name  Type          File Name
------------  ----          ---------
GEO.DAT       input    ! GEODAT = F:\15339 TL Anna Bay Sand
Quarry\Env\2_Analysis\Output Data\AQ\Preprocessing\anna_bay_quarry_geo.dat !
SURF.DAT      input    ! SRFDAT = F:\15339 TL Anna Bay Sand
Quarry\Env\2_Analysis\Output Data\AQ\CALMET\surf.dat !
CLOUD.DAT     input    * CLDDAT=             *
PRECIP.DAT    input    ! PRCDAT =  !
WT.DAT        input    * WTDAT=              *

CALMET.LST    output   ! METLST = Anna_Bay_Quarry_calmet.lst !
CALMET.DAT    output   ! METDAT = Anna_Bay_Quarry_calmet.dat !
PACOUT.DAT    output   * PACDAT=             *

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 = T !
         F = UPPER CASE

NUMBER OF UPPER AIR & OVERWATER STATIONS:

    Number of upper air stations (NUSTA)  No default     ! NUSTA = 0 !
    Number of overwater met stations
                                 (NOWSTA) No default     ! NOWSTA = 0 !

NUMBER OF PROGNOSTIC and IGF-CALMET FILEs:

    Number of MM4/MM5/3D.DAT files
                                 (NM3D) No default       ! NM3D = 1 !

    Number of IGF-CALMET.DAT files
                                 (NIGF)   No default     ! NIGF =   0  !

                       !END!
--------------------------------------------------------------------------------
Subgroup (b)
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
--------------------------------------------------------------------------------
Subgroup (c)
-----------------------------------------
Overwater station files (one per station)
-----------------------------------------
Default Name  Type       File Name
------------  ----       ---------
--------------------------------------------------------------------------------
Subgroup (d)
------------------------------------------------
MM4/MM5/3D.DAT files (consecutive or overlapping)
```

```
-------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
MM51.DAT       input     1  ! M3DDAT= Z:\1 ENVIRONMENT\1 Subject
Areas\MetData\MM5\Yr2010\Tile 360\Tile0360yr.m3d !    !END!
--------------------------------------------------------------------------------
Subgroup (e)
-------------------------------------------------
IGF-CALMET.DAT files (consecutive or overlapping)
-------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
IGFn.DAT       input     1  * IGFDAT=CALMET0.DAT *    *END*
--------------------------------------------------------------------------------
Subgroup (f)
----------------
Other file names
----------------

Default Name  Type       File Name
------------  ----       ---------
DIAG.DAT      input      * DIADAT=                  *
PROG.DAT      input      * PRGDAT=                  *

TEST.PRT      output     * TSTPRT=                  *
TEST.OUT      output     * TSTOUT=                  *
TEST.KIN      output     * TSTKIN=                  *
TEST.FRD      output     * TSTFRD=                  *
TEST.SLP      output     * TSTSLP=                  *
DCST.GRD      output     * DCSTGD=                  *

--------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (f) must have ONE 'END' (surrounded by
           delimiters) at the end of the group
       (3) Subgroups (b) through (e) are included ONLY if the corresponding
           number of files (NUSTA, NOWSTA, NM3D, NIGF) is not 0, and each must
have
           an 'END' (surround by delimiters) at the end of EACH LINE

                         !END!


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

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

     Starting date:    Year   (IBYR)  --    No default   ! IBYR = 2010 !
                       Month  (IBMO)  --    No default   ! IBMO = 1 !
                       Day    (IBDY)  --    No default   ! IBDY = 1 !
     Starting time:    Hour   (IBHR)  --    No default   ! IBHR = 0 !
                       Second (IBSEC) --    No default   ! IBSEC = 0 !

     Ending date:      Year   (IEYR)  --    No default   ! IEYR = 2011 !
                       Month  (IEMO)  --    No default   ! IEMO = 1 !
                       Day    (IEDY)  --    No default   ! IEDY = 1 !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR = 0 !
                       Second (IESEC) --    No default   ! IESEC = 0 !

      UTC time zone        (ABTZ) -- No default       ! ABTZ = UTC+1000 !
         (character*8)
         PST = UTC-0800, MST = UTC-0700 , GMT = UTC-0000
         CST = UTC-0600, EST = UTC-0500

     Length of modeling time-step (seconds)
     Must divide evenly into 3600 (1 hour)
     (NSECDT)                        Default:3600     ! NSECDT =  3600  !
```

```
                         Units: seconds

     Run type            (IRTYPE) -- Default: 1      ! IRTYPE=  1  !

        0 = Computes wind fields only
        1 = Computes wind fields and micrometeorological variables
            (u*, w*, L, zi, etc.)
        (IRTYPE must be 1 to run CALPUFF or CALGRID)

     Compute special data fields required
     by CALGRID (i.e., 3-D fields of W wind
     components and temperature)
     in additional to regular            Default: T    ! LCALGRD = T !
     fields ? (LCALGRD)
     (LCALGRD must be T to run CALGRID)

      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
                  COMPUTATIONAL phase after SETUP


     Test options specified to see if
     they conform to regulatory
     values? (MREG)                   No Default       ! MREG = 0 !

        0 = NO checks are made
        1 = Technical options must conform to USEPA guidance
                  IMIXH    -1       Maul-Carson convective mixing height
                                    over land; OCD mixing height overwater
                  ICOARE   0        OCD deltaT method for overwater fluxes
                  THRESHL  0.0      Threshold buoyancy flux over land needed
                                    to sustain convective mixing height growth
                  ISURFT   > 0      Pick one representative station, OR
                           -2       in NOOBS mode (ITPROG=2) average all
                                    surface prognostic temperatures to get
                                    a single representative surface temp.
                  IUPT     > 0      Pick one representative station, OR
                           -2       in NOOBS mode (ITPROG>0) average all surface
                                    prognostic temperatures to get a single
                                    representative surface temp.
                  IZICRLX  0        Do NOT use convective mixing height
                                    relaxation to equilibrium value

!END!

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

INPUT GROUP: 2 -- 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  = 0.000  !
     (FNORTH)                   Default=0.0     ! FNORTH = 0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default      ! IUTMZN = 56 !

     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 = 40N  !
     (RLON0)                    No Default      ! RLON0 = 90W  !

         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 = 30N  !
     (XLAT2)                    No Default      ! XLAT2 = 60N  !

         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 !


     Horizontal grid definition:
     ---------------------------

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

            No. X grid cells (NX)      No default     ! NX = 100 !
            No. Y grid cells (NY)      No default     ! NY = 100 !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 0.1 !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = 408 !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = 6370 !
                                       Units: km


     Vertical grid definition:
     -------------------------

        No. of vertical layers (NZ)    No default     ! NZ = 10 !

        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        ! ZFACE = 0,20,40,80,160,320,700,1300,1700,2300,3000 !

!END!

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

INPUT GROUP: 3 -- Output Options
--------------


    DISK OUTPUT OPTION

       Save met. fields in an unformatted
       output file ?            (LSAVE)  Default: T     ! LSAVE = T !
       (F = Do not save, T = Save)

       Type of unformatted output file:
       (IFORMO)                          Default: 1    ! IFORMO =  1  !

            1 = CALPUFF/CALGRID type file (CALMET.DAT)
            2 = MESOPUFF-II type file     (PACOUT.DAT)


    LINE PRINTER OUTPUT OPTIONS:

       Print met. fields ?  (LPRINT)       Default: F     ! LPRINT = F !
       (F = Do not print, T = Print)
       (NOTE: parameters below control which
              met. variables are printed)

       Print interval
       (IPRINF) in hours                 Default: 1     ! IPRINF =  1  !
       (Meteorological fields are printed
        every  1  hours)
```

```
Specify which layers of U, V wind component
to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T)        Defaults: NZ*0
! IUVOUT = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 !
-----------------------


Specify which levels of the W wind component to print
(NOTE: W defined at TOP cell face --  10  values)
(IWOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T & LCALGRD=T)
-----------------------------------
                                     Defaults: NZ*0
 ! IWOUT = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 !


Specify which levels of the 3-D temperature field to print
(ITOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T & LCALGRD=T)
-----------------------------------
                                     Defaults: NZ*0
 ! ITOUT = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 !

Specify which meteorological fields
to print
(used only if LPRINT=T)             Defaults: 0 (all variables)
-----------------------


  Variable            Print ?
                  (0 = do not print,
                   1 = print)
  --------        ------------------

!  STABILITY  =          0            ! - PGT stability class
!  USTAR      =          0            ! - Friction velocity
!  MONIN      =          0            ! - Monin-Obukhov length
!  MIXHT      =          0            ! - Mixing height
!  WSTAR      =          0            ! - Convective velocity scale
!  PRECIP     =          0            ! - Precipitation rate
!  SENSHEAT   =          0            ! - Sensible heat flux
!  CONVZI     =          0            ! - Convective mixing ht.


Testing and debug print options for micrometeorological module

   Print input meteorological data and
   internal variables (LDB)         Default: F       ! LDB = F !
   (F = Do not print, T = print)
   (NOTE: this option produces large amounts of output)

   First time step for which debug data
   are printed (NN1)                Default: 1       ! NN1 =  1  !

   Last time step for which debug data
   are printed (NN2)                Default: 1       ! NN2 =  1  !

   Print distance to land
   internal variables (LDBCST)      Default: F       ! LDBCST = F !
   (F = Do not print, T = print)
   (Output in .GRD file DCST.GRD, defined in input group 0)

Testing and debug print options for wind field module
(all of the following print options control output to
```

```
       wind field module's output files: TEST.PRT, TEST.OUT,
       TEST.KIN, TEST.FRD, and TEST.SLP)

         Control variable for writing the test/debug
         wind fields to disk files (IOUTD)
         (0=Do not write, 1=write)        Default: 0       ! IOUTD =  0  !

         Number of levels, starting at the surface,
         to print (NZPRN2)                Default: 1       ! NZPRN2 =  0  !

         Print the INTERPOLATED wind components ?
         (IPR0) (0=no, 1=yes)             Default: 0       !  IPR0 =  0  !

         Print the TERRAIN ADJUSTED surface wind
         components ?
         (IPR1) (0=no, 1=yes)             Default: 0       !  IPR1 =  0  !

         Print the SMOOTHED wind components and
         the INITIAL DIVERGENCE fields ?
         (IPR2) (0=no, 1=yes)             Default: 0       !  IPR2 =  0  !

         Print the FINAL wind speed and direction
         fields ?
         (IPR3) (0=no, 1=yes)             Default: 0       !  IPR3 =  0  !

         Print the FINAL DIVERGENCE fields ?
         (IPR4) (0=no, 1=yes)             Default: 0       !  IPR4 =  0  !

         Print the winds after KINEMATIC effects
         are added ?
         (IPR5) (0=no, 1=yes)             Default: 0       !  IPR5 =  0  !

         Print the winds after the FROUDE NUMBER
         adjustment is made ?
         (IPR6) (0=no, 1=yes)             Default: 0       !  IPR6 =  0  !

         Print the winds after SLOPE FLOWS
         are added ?
         (IPR7) (0=no, 1=yes)             Default: 0       !  IPR7 =  0  !

         Print the FINAL wind field components ?
         (IPR8) (0=no, 1=yes)             Default: 0       !  IPR8 =  0  !

!END!


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

INPUT GROUP: 4 -- Meteorological data options
--------------

    NO OBSERVATION MODE             (NOOBS)  Default: 0     ! NOOBS = 2 !
          0 = Use surface, overwater, and upper air stations
          1 = Use surface and overwater stations (no upper air observations)
              Use MM4/MM5/3D.DAT for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM4/MM5/3D.DAT for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA = 3 !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5/3D.DAT precip data)
                                    (NPSTA)  No default     ! NPSTA = -1 !

    CLOUD DATA OPTIONS
       Gridded cloud fields:
```

```
                             (ICLOUD)  Default: 0     ! ICLOUD = 4 !
      ICLOUD = 0 - Gridded clouds not used
      ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT
      ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT
      ICLOUD = 3 - Gridded cloud cover from Prognostic Rel. Humidity
                   at 850mb (Teixera)
      ICLOUD = 4 - Gridded cloud cover from Prognostic Rel. Humidity
                   at all levels (MM5toGrads algorithm)

   FILE FORMATS

      Surface meteorological data file format
                             (IFORMS)  Default: 2     ! IFORMS =  2  !
      (1 = unformatted (e.g., SMERGE output))
      (2 = formatted   (free-formatted user input))

      Precipitation data file format
                             (IFORMP)  Default: 2     ! IFORMP =  2  !
      (1 = unformatted (e.g., PMERGE output))
      (2 = formatted   (free-formatted user input))

      Cloud data file format
                             (IFORMC)  Default: 2     ! IFORMC =  2  !
      (1 = unformatted - CALMET unformatted output)
      (2 = formatted   - free-formatted CALMET output or user input)

!END!


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

INPUT GROUP: 5 -- Wind Field Options and Parameters
--------------


   WIND FIELD MODEL OPTIONS
      Model selection variable (IWFCOD)     Default: 1      ! IWFCOD =  1  !
         0 = Objective analysis only
         1 = Diagnostic wind module

      Compute Froude number adjustment
      effects ? (IFRADJ)                    Default: 1      ! IFRADJ =  1  !
      (0 = NO, 1 = YES)

      Compute kinematic effects ? (IKINE)   Default: 0      ! IKINE  =  0  !
      (0 = NO, 1 = YES)

      Use O'Brien procedure for adjustment
      of the vertical velocity ? (IOBR)     Default: 0      ! IOBR =  0  !
      (0 = NO, 1 = YES)

      Compute slope flow effects ? (ISLOPE) Default: 1      ! ISLOPE  =  1  !
      (0 = NO, 1 = YES)

      Extrapolate surface wind observations
      to upper layers ? (IEXTRP)            Default: -4     ! IEXTRP = 4 !
      (1 = no extrapolation is done,
       2 = power law extrapolation used,
       3 = user input multiplicative factors
           for layers 2 - NZ used (see FEXTRP array)
       4 = similarity theory used
       -1, -2, -3, -4 = same as above except layer 1 data
           at upper air stations are ignored

      Extrapolate surface winds even
      if calm? (ICALM)                      Default: 0      ! ICALM  =  0  !
      (0 = NO, 1 = YES)
```

```
    Layer-dependent biases modifying the weights of
    surface and upper air stations (BIAS(NZ))
      -1<=BIAS<=1
    Negative BIAS reduces the weight of upper air stations
      (e.g. BIAS=-0.1 reduces the weight of upper air stations
    by 10%; BIAS= -1, reduces their weight by 100 %)
    Positive BIAS reduces the weight of surface stations
      (e.g. BIAS= 0.2 reduces the weight of surface stations
    by 20%; BIAS=1 reduces their weight by 100%)
    Zero BIAS leaves weights unchanged (1/R**2 interpolation)
    Default: NZ*0
    ! BIAS = -1.0,-1.0,-1.0,-1.0,0.0,1.0,1.0,1.0,1.0,1.0 !

    Minimum distance from nearest upper air station
    to surface station for which extrapolation
    of surface winds at surface station will be allowed
    (RMIN2: Set to -1 for IEXTRP = 4 or other situations
     where all surface stations should be extrapolated)
                                      Default: 4.     ! RMIN2 = 4.0 !

    Use gridded prognostic wind field model
    output fields as input to the diagnostic
    wind field model (IPROG)          Default: 0      ! IPROG = 14 !
    (0 = No, [IWFCOD = 0 or 1]
     1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]
     2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]
     3 = Yes, use winds from MM4.DAT file as Step 1 field [IWFCOD = 0]
     4 = Yes, use winds from MM4.DAT file as initial guess field [IWFCOD = 1]
     5 = Yes, use winds from MM4.DAT file as observations [IWFCOD = 1]
     13 = Yes, use winds from MM5/3D.DAT file as Step 1 field [IWFCOD = 0]
     14 = Yes, use winds from MM5/3D.DAT file as initial guess field [IWFCOD
= 1]
     15 = Yes, use winds from MM5/3D.DAT file as observations [IWFCOD = 1]

    Timestep (seconds) of the prognostic
    model input data   (ISTEPPGS)     Default: 3600   ! ISTEPPGS =  3600
 !

    Use coarse CALMET fields as initial guess fields (IGFMET)
    (overwrites IGF based on prognostic wind fields if any)
                                      Default: 0      ! IGFMET =  0  !

 RADIUS OF INFLUENCE PARAMETERS

    Use varying radius of influence   Default: F      ! LVARY =  F  !
    (if no stations are found within RMAX1,RMAX2,
     or RMAX3, then the closest station will be used)

    Maximum radius of influence over land
    in the surface layer (RMAX1)      No default      ! RMAX1 = 10 !
                                      Units: km
    Maximum radius of influence over land
    aloft (RMAX2)                     No default      ! RMAX2 = 10 !
                                      Units: km
    Maximum radius of influence over water
    (RMAX3)                           No default      ! RMAX3 = 10 !
                                      Units: km


 OTHER WIND FIELD INPUT PARAMETERS

    Minimum radius of influence used in
    the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 0.1 !
                                      Units: km
    Radius of influence of terrain
    features (TERRAD)                 No default      ! TERRAD = 6 !

                                      Units: km
```

```
       Relative weighting of the first
       guess field and observations in the
       SURFACE layer (R1)                    No default      ! R1 = 7 !
       (R1 is the distance from an           Units: km
       observational station at which the
       observation and first guess field are
       equally weighted)

       Relative weighting of the first
       guess field and observations in the
       layers ALOFT (R2)                     No default      ! R2 = 7 !
       (R2 is applied in the upper layers    Units: km
       in the same manner as R1 is used in
       the surface layer).

       Relative weighting parameter of the
       prognostic wind field data (RPROG)    No default      ! RPROG = 0. !
       (Used only if IPROG = 1)              Units: km
       ------------------------

       Maximum acceptable divergence in the
       divergence minimization procedure
       (DIVLIM)                              Default: 5.E-6  ! DIVLIM= 5.0E-06 !

       Maximum number of iterations in the
       divergence min. procedure (NITER)     Default: 50     ! NITER =  50  !

       Number of passes in the smoothing
       procedure (NSMTH(NZ))
       NOTE: NZ values must be entered
            Default: 2,(mxnz-1)*4 ! NSMTH =
 2, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4 !

       Maximum number of stations used in
       each layer for the interpolation of
       data to a grid point (NINTR2(NZ))
       NOTE: NZ values must be entered       Default: 99.    ! NINTR2 =
 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5 !

       Critical Froude number (CRITFN)       Default: 1.0    ! CRITFN = 1. !

       Empirical factor controlling the
       influence of kinematic effects
       (ALPHA)                               Default: 0.1    ! ALPHA = 0.1 !

       Multiplicative scaling factor for
       extrapolation of surface observations
       to upper layers (FEXTR2(NZ))          Default: NZ*0.0
       ! FEXTR2 = 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
0., 0., 0., 0., 0. !
       (Used only if IEXTRP = 3 or -3)


    BARRIER INFORMATION

       Number of barriers to interpolation
       of the wind fields (NBAR)             Default: 0      ! NBAR =  0  !

       Level (1 to NZ) up to which barriers
       apply (KBAR)                          Default: NZ     ! KBAR =  10  !

       THE FOLLOWING 4 VARIABLES ARE INCLUDED
       ONLY IF NBAR > 0
       NOTE: NBAR values must be entered     No defaults
             for each variable               Units: km

          X coordinate of BEGINNING
          of each barrier (XBBAR(NBAR))      ! XBBAR = 0. !
```

```
   Y coordinate of BEGINNING
   of each barrier (YBBAR(NBAR))      ! YBBAR = 0. !

   X coordinate of ENDING
   of each barrier (XEBAR(NBAR))      ! XEBAR = 0. !
   Y coordinate of ENDING
   of each barrier (YEBAR(NBAR))      ! YEBAR = 0. !


DIAGNOSTIC MODULE DATA INPUT OPTIONS

  Surface temperature (IDIOPT1)         Default: 0      ! IDIOPT1 =  0  !
     0 = Compute internally from
         hourly surface observations or prognostic fields
     1 = Read preprocessed values from
         a data file (DIAG.DAT)

     Surface met. station to use for
     the surface temperature (ISURFT)   Default: -1    ! ISURFT =  -1  !
     (Must be a value from 1 to NSSTA,
      or -1 to use 2-D spatially varying
         surface temperatures,
      or -2 to use a domain-average prognostic
         surface temperatures (only with ITPROG=2))
     (Used only if IDIOPT1 = 0)
     --------------------------

  Temperature lapse rate used in the    Default: 0     ! IDIOPT2 =  0  !
     computation of terrain-induced
     circulations (IDIOPT2)
     0 = Compute internally from (at least) twice-daily
         upper air observations or prognostic fields
     1 = Read hourly preprocessed values
         from a data file (DIAG.DAT)

     Upper air station to use for
     the domain-scale lapse rate (IUPT) Default: -1    ! IUPT   =  -1  !
     (Must be a value from 1 to NUSTA,
      or -1 to use 2-D spatially varying lapse rate,
      or -2 to use a domain-average prognostic
         lapse rate (only with ITPROG>0))
     (Used only if IDIOPT2 = 0)
     --------------------------

     Depth through which the domain-scale
     lapse rate is computed (ZUPT)      Default: 200.  ! ZUPT = 200. !
     (Used only if IDIOPT2 = 0)         Units: meters
     --------------------------

  Initial Guess Field Winds
  (IDIOPT3)                             Default: 0     ! IDIOPT3 =  0  !
     0 = Compute internally from
         observations or prognostic wind fields
     1 = Read hourly preprocessed domain-average wind values
         from a data file (DIAG.DAT)

     Upper air station to use for
     the initial guess winds (IUPWND)   Default: -1    ! IUPWND = -1  !
     (Must be a value from -1 to NUSTA, with
     -1 indicating 3-D initial guess fields,
     and IUPWND>1 domain-scaled (i.e. constant) IGF)
     (Used only if IDIOPT3 = 0 and noobs=0)
     --------------------------------------

     Bottom and top of layer through
     which the domain-scale winds
     are computed
     (ZUPWND(1), ZUPWND(2))        Defaults: 1., 1000. ! ZUPWND= 1., 1000.
```

```
!
          (Used only if IDIOPT3 = 0, NOOBS>0 and IUPWND>0)    Units: meters
          --------------------------

       Observed surface wind components
       for wind field module (IDIOPT4)  Default: 0     ! IDIOPT4 =  0  !
          0 = Read WS, WD from a surface
              data file (SURF.DAT)
          1 = Read hourly preprocessed U, V from
              a data file (DIAG.DAT)

       Observed upper air wind components
       for wind field module (IDIOPT5)  Default: 0     ! IDIOPT5 =  0  !
          0 = Read WS, WD from an upper
              air data file (UP1.DAT, UP2.DAT, etc.)
          1 = Read hourly preprocessed U, V from
              a data file (DIAG.DAT)

       LAKE BREEZE INFORMATION

          Use Lake Breeze Module  (LLBREZE)
                                         Default: F      ! LLBREZE = F !

           Number of lake breeze regions (NBOX)          ! NBOX =  0  !

        X Grid line 1 defining the region of interest
                                                      ! XG1 = 0. !
        X Grid line 2 defining the region of interest
                                                      ! XG2 = 0. !
        Y Grid line 1 defining the region of interest
                                                      ! YG1 = 0. !
        Y Grid line 2 defining the region of interest
                                                      ! YG2 = 0. !

         X Point defining the coastline (Straight line)
                   (XBCST)  (KM)   Default: none    ! XBCST = 0. !

         Y Point defining the coastline (Straight line)
                   (YBCST)  (KM)   Default: none    ! YBCST = 0. !

         X Point defining the coastline (Straight line)
                   (XECST)  (KM)   Default: none    ! XECST = 0. !

         Y Point defining the coastline (Straight line)
                   (YECST)  (KM)   Default: none    ! YECST = 0. !


       Number of stations in the region     Default: none ! NLB =  0 !
       (Surface stations + upper air stations)

       Station ID's  in the region   (METBXID(NLB))
       (Surface stations first, then upper air stations)
         ! METBXID =  0 !

!END!


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

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters
--------------

    EMPIRICAL MIXING HEIGHT CONSTANTS

       Neutral, mechanical equation
       (CONSTB)                            Default: 1.41   ! CONSTB = 1.41 !
       Convective mixing ht. equation
       (CONSTE)                            Default: 0.15   ! CONSTE = 0.15 !
```

```
      Stable mixing ht. equation
      (CONSTN)                          Default: 2400.  ! CONSTN = 2400.!
      Overwater mixing ht. equation
      (CONSTW)                          Default: 0.16   ! CONSTW = 0.16 !
      Absolute value of Coriolis
      parameter (FCORIOL)               Default: 1.E-4  ! FCORIOL =
1.0E-04!
                                        Units: (1/s)

   SPATIAL AVERAGING OF MIXING HEIGHTS

      Conduct spatial averaging
      (IAVEZI)  (0=no, 1=yes)           Default: 1      ! IAVEZI =  1  !

      Max. search radius in averaging
      process (MNMDAV)                  Default: 1      ! MNMDAV =  1  !
                                        Units: Grid
                                               cells
      Half-angle of upwind looking cone
      for averaging (HAFANG)            Default: 30.    ! HAFANG = 30. !
                                        Units: deg.
      Layer of winds used in upwind
      averaging (ILEVZI)                Default: 1      ! ILEVZI =  1  !
      (must be between 1 and NZ)


   CONVECTIVE MIXING HEIGHT OPTIONS:
      Method to compute the convective
      mixing height(IMIHXH)             Default: 1      ! IMIXH =  1  !
          1: Maul-Carson for land and water cells
         -1: Maul-Carson for land cells only -
             OCD mixing height overwater
          2: Batchvarova and Gryning for land and water cells
         -2: Batchvarova and Gryning for land cells only
             OCD mixing height overwater

      Threshold buoyancy flux required to
      sustain convective mixing height growth
      overland (THRESHL)                Default: 0.0    ! THRESHL = 0. !
      (expressed as a heat flux         units: W/m3
       per meter of boundary layer)


      Threshold buoyancy flux required to
      sustain convective mixing height growth
      overwater (THRESHW)               Default: 0.05   ! THRESHW = 0.05 !
      (expressed as a heat flux         units: W/m3
       per meter of boundary layer)


      Flag to allow relaxation of convective mixing height
      to equilibrium value when  0<QH<THRESHL (overland)
                             or  0<QH<THRESHW (overwater)
      (IZICRLX)                         Default: 1      ! IZICRLX =  1  !
         0 : do NOT use convective mixing height relaxation
             to equilibrium value (treatment identical to CALMET v5.8)
         1 : use convective mixing height relaxation
             to equilibrium value


      Relaxation time of convective mixing height to
      equilibrium value when  0<QH<THRESHL (overland)
                          or  0<QH<THRESHW (overwater)
      (Used only if IZICRLX = 1 and  TZICRLX must be >= 1.)
      (TZICRLX)                         Default: 800.   ! TZICRLX = 800. !
                                        Units: seconds
```

```
   Option for overwater lapse rates used
   in convective mixing height growth
   (ITWPROG)                             Default: 0      ! ITWPROG =  0  !
   0 : use SEA.DAT lapse rates and deltaT (or assume neutral
       conditions if missing)
   1 : use prognostic lapse rates (only if IPROG>2)
       and SEA.DAT deltaT (or neutral if missing)
   2 : use prognostic lapse rates and prognostic delta T
       (only if iprog>12 and 3D.DAT version# 2.0 or higher)

   Land Use category ocean in 3D.DAT datasets
   (ILUOC3D)                             Default: 16     ! ILUOC3D =  16  !
   Note: if 3D.DAT from MM5 version 3.0, iluoc3d = 16
         if MM4.DAT,          typically iluoc3d = 7


OTHER MIXING HEIGHT VARIABLES

   Minimum potential temperature lapse
   rate in the stable layer above the
   current convective mixing ht.         Default: 0.001  ! DPTMIN = 0.001 !
   (DPTMIN)                              Units: deg. K/m
   Depth of layer above current conv.
   mixing height through which lapse     Default: 200.   ! DZZI = 200. !
   rate is computed (DZZI)               Units: meters

   Minimum overland mixing height        Default:  50.   ! ZIMIN = 50. !
   (ZIMIN)                               Units: meters
   Maximum overland mixing height        Default: 3000.  ! ZIMAX = 3000. !
   (ZIMAX)                               Units: meters
   Minimum overwater mixing height       Default:   50.  ! ZIMINW = 50. !
   (ZIMINW) -- (Not used if observed     Units: meters
   overwater mixing hts. are used)
   Maximum overwater mixing height       Default: 3000.  ! ZIMAXW = 3000. !
   (ZIMAXW) -- (Not used if observed     Units: meters
   overwater mixing hts. are used)


OVERWATER SURFACE FLUXES METHOD and PARAMETERS
      (ICOARE)                           Default: 10      ! ICOARE =  10   !
       0: original deltaT method (OCD)
      10: COARE with no wave parameterization (jwave=0, Charnock)
      11: COARE with wave option jwave=1 (Oost et al.)
          and default wave properties
     -11: COARE with wave option jwave=1 (Oost et al.)
          and observed wave properties (must be in SEA.DAT files)
      12: COARE with wave option 2 (Taylor and Yelland)
           and default wave properties
     -12: COARE with wave option 2 (Taylor and Yelland)
          and observed wave properties (must be in SEA.DAT files)

      Note:  When ICOARE=0, similarity wind profile stability PSI functions
             based on Van Ulden and Holtslag (1985) are substituted for
             later formulations used with the COARE module, and temperatures
             used for surface layer parameters are obtained from either the
             nearest surface station temperature or prognostic model 2D
             temperatures (if ITPROG=2).


      Coastal/Shallow water length scale (DSHELF)
      (for modified z0 in shallow water)
      ( COARE fluxes only)
                                      Default : 0.        ! DSHELF = 0. !
                                      units: km

       COARE warm layer computation (IWARM)               ! IWARM =  0   !
       1: on - 0: off (must be off if SST measured with
       IR radiometer)                 Default: 0
```

```
        COARE cool skin layer computation (ICOOL)          ! ICOOL =  0   !
        1: on - 0: off (must be off if SST measured with
        IR radiometer)                  Default: 0

 RELATIVE HUMIDITY PARAMETERS

      3D relative humidity from observations or
      from prognostic data? (IRHPROG)       Default:0        ! IRHPROG = 0 !

         0 = Use RH from SURF.DAT file
             (only if NOOBS = 0,1)
         1 = Use prognostic RH
             (only if NOOBS = 0,1,2)

 TEMPERATURE PARAMETERS

      3D temperature from observations or
      from prognostic data? (ITPROG)        Default:0        ! ITPROG = 2 !

         0 = Use Surface and upper air stations
             (only if NOOBS = 0)
         1 = Use Surface stations (no upper air observations)
             Use MM5/3D.DAT for upper air data
             (only if NOOBS = 0,1)
         2 = No surface or upper air observations
             Use MM5/3D.DAT for surface and upper air data
             (only if NOOBS = 0,1,2)

      Interpolation type
      (1 = 1/R ; 2 = 1/R**2)                Default:1         ! IRAD =  1  !

      Radius of influence for temperature
      interpolation (TRADKM)                Default: 500.     ! TRADKM = 500. !
                                            Units: km

      Maximum Number of stations to include
      in temperature interpolation (NUMTS)  Default: 5        ! NUMTS = 5  !

      Conduct spatial averaging of temp-
      eratures (IAVET)  (0=no, 1=yes)       Default: 1        ! IAVET =  1  !
      (will use mixing ht MNMDAV,HAFANG
       so make sure they are correct)

      Default temperature gradient          Default: -.0098   ! TGDEFB =
-0.0098 !
      below the mixing height over          Units: K/m
      water (TGDEFB)

      Default temperature gradient          Default: -.0045   ! TGDEFA =
-0.0045 !
      above the mixing height over          Units: K/m
      water (TGDEFA)

      Beginning (JWAT1) and ending (JWAT2)
      land use categories for temperature                    ! JWAT1 =  55  !
      interpolation over water -- Make                       ! JWAT2 =  55  !
      bigger than largest land use to disable

    PRECIP INTERPOLATION PARAMETERS

      Method of interpolation (NFLAGP)      Default: 2       ! NFLAGP =  2  !
       (1=1/R,2=1/R**2,3=EXP/R**2)
      Radius of Influence  (SIGMAP)         Default: 100.0   ! SIGMAP = 100. !
       (0.0 => use half dist. btwn          Units: km
        nearest stns w & w/out
        precip when NFLAGP = 3)
      Minimum Precip. Rate Cutoff (CUTP)    Default: 0.01    ! CUTP = 0.01 !
```

```
        (values < CUTP = 0.0 mm/hr)          Units: mm/hr
!END!

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

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station -- 3 records in all)


             1     2
          Name   ID            X coord.   Y coord.   Time   Anem.
                                (km)       (km)      zone   Ht.(m)
        ----------------------------------------------------------
! SS1  ='WILL'    61078       390.994      6371.05  -10    10  !
! SS2  =' NOB'    61055       387.653     6357.113  -10    10  !
! SS3  =' TAC'    10001       381.193      6368.23  -10    10  !
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Six digit integer for station ID

!END!

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

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station -- 0 records in all)

             1     2
          Name    ID      X coord.   Y coord.  Time zone
                            (km)       (km)
         -----------------------------------------------
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!

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

INPUT GROUP: 9 -- Precipitation station parameters
--------------

     PRECIPITATION STATION VARIABLES
     (One record per station -- -1 records in all)
     (NOT INCLUDED IF NPSTA = 0)

            1         2
          Name   Station    X coord.  Y coord.
                 Code(km)(km)
          ------------------------------------
-------------------
      1
        Four character string for station name
```

```
        (MUST START IN COLUMN 9)

      2
        Six digit station code composed of state
        code (first 2 digits) and station ID (last
        4 digits)

!END!
```

Anna_Bay_Quarry_calpuff_FEL.inp

```
CALPUFF.INP     2.0            File version record
Anna Bay Quarry - Front End Loader Emissions


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

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

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

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    ! METDAT = C:\15339\anna_bay_quarry_calmet.DAT !
    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 = Anna_Bay_Quarry_calpuff_FEL.lst !
CONC.DAT      output   ! CONDAT = Anna_Bay_Quarry_calpuff_FEL.con !
DFLX.DAT      output   ! DFDAT = Anna_Bay_Quarry_calpuff_FEL.dry !
WFLX.DAT      output   * WFDAT = *

VISB.DAT      output   * VISDAT = *
TK2D.DAT      output   * T2DDAT = *
RHO2D.DAT     output   * RHODAT = *
RESTARTE.DAT  output   * RSTARTE=             *
--------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT  =             *
VOLEMARB.DAT  input    ! VOLDAT = AnnaBay_FEL_VOLEMARB_Rev4.DAT     !
BAEMARB.DAT   input    * ARDAT  =             *
LNEMARB.DAT   input    * LNDAT  =             *
--------------------------------------------------------------------------------
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=             *
--------------------------------------------------------------------------------
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 = T !
         F = UPPER CASE
```

```
NOTE: (1) file/path names can be up to 132 characters in length


Provision for multiple input files
----------------------------------

     Number of Modeling Domains (NMETDOM)
                                Default: 1       ! NMETDOM =   1   !

     Number of CALMET.DAT files for run (NMETDAT)
                                Default: 1       ! NMETDAT = 1 !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                Default: 0       ! NPTDAT =   0   !

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

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

!END!

-------------
Subgroup (0a)
-------------

  Provide a name for each CALMET domain if NMETDOM > 1
  Enter NMETDOM lines.
                                           a,b
Default Name             Domain Name
------------             ------------
 none                  * DOMAIN=     *   *END*


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

  Enter NMETDAT lines, 1 line for each file name.

                                            a,c,d
Default Name  Type          File Name
------------  ----          ---------
 none         input    * METDAT=  *    *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)
-------------

  The following PTEMARB.DAT filenames are processed if NPTDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * PTDAT=     *   *END*


-------------
Subgroup (0c)
-------------

  The following BAEMARB.DAT filenames are processed if NARDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * ARDAT=     *   *END*


-------------
Subgroup (0d)
-------------

  The following VOLEMARB.DAT filenames are processed if NVOLDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input       * VOLDAT=     *   *END*

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

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 = 2010 !
                       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 = 2011 !
                       Month  (IEMO)  --    No default   ! IEMO = 1 !
                       Day    (IEDY)  --    No default   ! IEDY = 1 !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR = 0 !
                       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+1000 !
      (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:
```

```
    Los Angeles, USA          = UTC-0800
    New York, USA             = UTC-0500
    Santiago, Chile           = UTC-0400
    Greenwich Mean Time (GMT) = UTC+0000
    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 = 3 !

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

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)

PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
Averaging Time (minutes) (AVET)
                                Default: 60.0    ! AVET = 60. !
```

```
     PG 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)


     Output Dataset format for binary concentration
     and flux files (e.g., CONC.DAT)
     (IOVERS)                     Default: 2       ! IOVERS =  2   !
         1 = Dataset Version 2.1
         2 = Dataset Version 2.2


!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

     Method used to simulate building
     downwash? (MBDW)                   Default: 1     ! MBDW = 1 !
```

```
   1 = ISC method
   2 = PRIME method

Vertical wind shear modeled above
stack top (modified Briggs plume rise)?
(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 =  1  !
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 = PM10 !         !END!
! CSPEC = TSP !         !END!
! CSPEC = PM2.5 !         !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.)
!        PM10=       1,               1,           2,                  0   !
!         TSP=       1,               1,           2,                  0   !
!       PM2.5=       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  = 0.000  !
     (FNORTH)                   Default=0.0     ! FNORTH = 0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default      ! IUTMZN = 56 !

     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 = 0N  !
     (RLON0)                    No Default      ! RLON0 = 0E  !

         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 = 0N  !
     (XLAT2)                    No Default      ! XLAT2 = 0N  !

         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:

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

            No. X grid cells (NX)      No default     ! NX = 100 !
            No. Y grid cells (NY)      No default     ! NY = 100 !
        No. vertical layers (NZ)       No default     ! NZ = 10 !

          Grid spacing (DGRIDKM)       No default     ! DGRIDKM = 0.1 !
```

```
                                      Units: km

              Cell face heights
                  (ZFACE(nz+1))       No defaults
                                      Units: m
   ! ZFACE = 0,20,40,80,160,320,700,1300,1700,2300,3000 !

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

           X coordinate (XORIGKM)     No default     ! XORIGKM = 408 !
           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 = 100 !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP = 100 !
                  (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 = F !
        (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 = 100 !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP = 100 !
         (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 =  1   !
       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            for
                   Concentration    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

       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

                 ---- CONCENTRATIONS ----   ------ DRY FLUXES ------   ------
WET FLUXES ------   -- MASS FLUX --
   SPECIES
   /GROUP        PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?
SAVED ON DISK?   SAVED ON DISK?
   -------       ------------------------   ------------------------
------------------------   ---------------
!        PM10=   0,           1,           0,           1,           0,
  0,          0   !
!         TSP=   0,           1,           0,           1,           0,
  0,          0   !
!       PM2.5=   0,           1,           0,           1,           0,
  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 =  1  !

       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 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

       Y-origin of CTDM system relative to      No Default     ! YCTDMKM = 0 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

---------------
Subgroup (6b)
---------------

                      1 **
     HILL information


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

---------------
Subgroup (6c)
---------------
```

```
    COMPLEX TERRAIN RECEPTOR INFORMATION

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


-------------------
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)
     -------     -----------      ----------      ----------
--------------------     -----------------------



!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)
      -------      -------------------        ------------------

!        PM10 =           10,           0 !
!         TSP =           30,           0 !
!       PM2.5 =          2.5,           0 !

!END!


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


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

     Reference cuticle resistance (s/cm)
     (RCUTR)                           Default: 30    !  RCUTR = 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                             Default: 10    !    RGR = 10.0 !
     Reference pollutant reactivity
     (REACTR)                          Default: 8     ! REACTR = 8.0 !

     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.
       ---------      --------------       --------------


!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:
                                       M                 B
                                       A  B  R  R  R     C  B        N
                                 B     V  C  N  N  N  M  K  C  O     D
```

```
                              C  M  G  K  I  I  I  H  H  K  F  V  E
                           M  K  N  N  N  T  T  T  2  2  P  R  C  C
                           O  O  H  H  H  E  E  E  O  O  M  A  N  A
     Mechanism (MCHEM)     Z  3  3  3  3  1  2  3  2  2  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  .  .  .  .
     7 RIVAD/ISORRPIA/SOA  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 = .2 !

     Nighttime NOx loss rate in %/hour (RNITE2)
     (Used only if MCHEM = 1)
                                       Default: 2.0         ! RNITE2 = 2.0 !

     Nighttime HNO3 formation rate in %/hour (RNITE3)
     (Used only if MCHEM = 1)
                                       Default: 2.0         ! RNITE3 = 2.0 !

     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 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) Option


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

     *   SPEC1   =    3600.,        -1.0   *    (Parent)
     *   SPEC2   =     -1.0,         0.0   *    (Child)
   *END*

--------
    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 =
5.5E02 !

     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 = .01 !

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

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

     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 = 1.0 !

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

     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 = 1.0  !

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

     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 =
5.0E06 !

     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 = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500, 0.370, 0.370,
0.370, 0.370, 0.370, 0.370!
          ! SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030, 0.016, 0.200, 0.120,
0.080, 0.060, 0.030, 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 = 20.0
!

     Default wind speed classes --
     5 upper bounds (m/s) are entered;
     the 6th class has no upper limit
     (WSCAT(5))                      Default   :
                                     ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8
(10.8+)

                              Wind Speed Class :  1     2     3     4     5
                                                 ---   ---   ---   ---   ---
                                        ! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

     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 = 0.50, 0.50, 0.50, 0.50, 0.35,
0.35 !

     Slug-to-puff transition criterion factor
     equal to sigma-y/length of slug
     (SL2PF)                               Default: 10.       ! SL2PF = 10.0 !

     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 = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

       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 =
1.0E-04 !

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

       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 = 500.0
!

       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 = 10.0
!

       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)
---------------
```

```
        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)
---------------
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: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 13b.  Factors entered 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.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)


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


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


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

---------------
Subgroup (14a)
---------------

     Number of polygon area sources with
```

```
     parameters specified below (NAR1)       No default  ! NAR1 = 0 !

     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)
-------          ------    ------     --------   ---------

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

--------
    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: VARIABLE EMISSIONS DATA
          --------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 14b.  Factors entered 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.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                               Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



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


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

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: VARIABLE EMISSIONS DATA
          ----------------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 15b.  Factors entered multiply the rates in 15b.
     Skip sources here that have constant emissions.
```

```
     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



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


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


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

---------------
Subgroup (16a)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  ! NVL1 = 0 !

     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 =   2   !

     (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
         X           Y         Effect.    Base      Initial    Initial    Emission
     Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
        (km)        (km)         (m)       (m)        (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 IVLU
     (e.g. 1 for g/s).

---------------
Subgroup (16c)
---------------
                                                      a
         VOLUME SOURCE: VARIABLE EMISSIONS DATA
         ----------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 16b.  Factors entered 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.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



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


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

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information
-----------------------

---------------
Subgroup (17a)
---------------

     Number of non-gridded receptors (NREC)  No default  ! NREC = 4253 !

!END!
```

```
---------------
Subgroup (17b)
---------------
                                               a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           ------------------------------------

                      X            Y          Ground         Height   b
Receptor         Coordinate   Coordinate    Elevation    Above Ground
  No.               (km)         (km)          (m)           (m)
--------         ----------   ----------    ---------    ------------
     1 ! X =      410.16,6375.175,1,0!   !END!
     2 ! X =     410.207,6375.176,0,0!   !END!
     3 ! X =     410.254,6375.176,1,0!   !END!
     4 ! X =       410.3,6375.177,2,0!   !END!
     5 ! X =     410.347,6375.177,2,0!   !END!
     6 ! X =     410.394,6375.178,2,0!   !END!
     7 ! X =     410.441,6375.178,2,0!   !END!
     8 ! X =     410.488,6375.178,2,0!   !END!
     9 ! X =     410.535,6375.179,2,0!   !END!
    10 ! X =     410.582,6375.179,2,0!   !END!
    11 ! X =     410.628,6375.18,2,0!   !END!
    12 ! X =     410.675,6375.18,2,0!   !END!
    13 ! X =     410.722,6375.181,1,0!   !END!
    14 ! X =     410.769,6375.181,0,0!   !END!
    15 ! X =     410.816,6375.181,0,0!   !END!
    16 ! X =     410.863,6375.182,1,0!   !END!
    17 ! X =     410.909,6375.182,1,0!   !END!
    18 ! X =     410.956,6375.183,2,0!   !END!
    19 ! X =     411.003,6375.183,3,0!   !END!
    20 ! X =      411.05,6375.183,3,0!   !END!
    21 ! X =     411.097,6375.184,3,0!   !END!
    22 ! X =     411.144,6375.184,2,0!   !END!
    23 ! X =      411.19,6375.185,2,0!   !END!
    24 ! X =     411.237,6375.185,2,0!   !END!
    25 ! X =     411.284,6375.186,2,0!   !END!
    26 ! X =     411.331,6375.186,2,0!   !END!
    27 ! X =     411.378,6375.186,2,0!   !END!
    28 ! X =     411.425,6375.187,2,0!   !END!
    29 ! X =     411.471,6375.187,1,0!   !END!
    30 ! X =     411.518,6375.188,2,0!   !END!
    31 ! X =     411.565,6375.188,2,0!   !END!
    32 ! X =     411.612,6375.189,2,0!   !END!
    33 ! X =     411.659,6375.189,2,0!   !END!
    34 ! X =     411.706,6375.189,2,0!   !END!
    35 ! X =     411.752,6375.19,3,0!   !END!
    36 ! X =     411.799,6375.19,2,0!   !END!
    37 ! X =     411.846,6375.191,-1,0!   !END!
    38 ! X =     411.893,6375.191,3,0!   !END!
    39 ! X =      411.94,6375.191,3,0!   !END!
    40 ! X =     411.987,6375.192,3,0!   !END!
    41 ! X =     412.033,6375.192,3,0!   !END!
    42 ! X =      412.08,6375.193,2,0!   !END!
    43 ! X =     412.127,6375.193,2,0!   !END!
    44 ! X =     412.174,6375.194,2,0!   !END!
    45 ! X =     412.221,6375.194,2,0!   !END!
    46 ! X =     412.268,6375.194,2,0!   !END!
    47 ! X =     412.315,6375.195,2,0!   !END!
    48 ! X =     412.361,6375.195,2,0!   !END!
    49 ! X =     412.408,6375.196,2,0!   !END!
    50 ! X =     412.455,6375.196,2,0!   !END!
    51 ! X =     412.502,6375.196,3,0!   !END!
    52 ! X =     412.549,6375.197,3,0!   !END!
    53 ! X =     412.596,6375.197,3,0!   !END!
    54 ! X =     412.642,6375.198,4,0!   !END!
    55 ! X =     412.689,6375.198,4,0!   !END!
    56 ! X =     412.736,6375.198,5,0!   !END!
    57 ! X =     412.783,6375.199,6,0!   !END!
```

```
  4206 ! X =     412.293,6372.312,5,0!   !END!
  4207 ! X =      412.34,6372.312,5,0!   !END!
  4208 ! X =     412.387,6372.313,5,0!   !END!
  4209 ! X =     412.434,6372.313,5,0!   !END!
  4210 ! X =      412.48,6372.314,5,0!   !END!
  4211 ! X =     412.527,6372.314,5,0!   !END!
  4212 ! X =     412.574,6372.314,5,0!   !END!
  4213 ! X =     412.621,6372.315,5,0!   !END!
  4214 ! X =     412.668,6372.315,5,0!   !END!
  4215 ! X =     412.715,6372.316,5,0!   !END!
  4216 ! X =     412.761,6372.316,5,0!   !END!
  4217 ! X =     412.808,6372.316,4,0!   !END!
  4218 ! X =     412.855,6372.317,4,0!   !END!
  4219 ! X =     412.902,6372.317,5,0!   !END!
  4220 ! X =     412.949,6372.318,4,0!   !END!
  4221 ! X =     412.996,6372.318,4,0!   !END!
  4222 ! X =      413.37,6372.321,6,0!   !END!
  4223 ! X =     413.417,6372.322,6,0!   !END!
  4224 ! X =     413.464,6372.322,6,0!   !END!
  4225 ! X =     413.511,6372.323,6,0!   !END!
  4226 ! X =     413.557,6372.323,6,0!   !END!
  4227 ! X =     413.604,6372.323,6,0!   !END!
  4228 ! X =     413.651,6372.324,6,0!   !END!
  4229 ! X =     413.698,6372.324,6,0!   !END!
  4230 ! X =     413.745,6372.325,7,0!   !END!
  4231 ! X =     413.792,6372.325,8,0!   !END!
  4232 ! X =     413.838,6372.325,9,0!   !END!
  4233 ! X =     413.885,6372.326,9,0!   !END!
  4234 ! X =     412.483,6373.71,12,1.5!   !END!
  4235 ! X =     412.293,6373.789,12,1.5!   !END!
  4236 ! X =     411.678,6374.047,5,1.5!   !END!
  4237 ! X =     412.528,6373.787,11,1.5!   !END!
  4238 ! X =     412.446,6373.571,11,1.5!   !END!
  4239 ! X =     411.695,6374.079,4,1.5!   !END!
  4240 ! X =     411.864,6373.931,7,1.5!   !END!
  4241 ! X =     411.821,6374.16,3,1.5!   !END!
  4242 ! X =     412.476,6373.565,11,1.5!   !END!
  4243 ! X =     411.819,6374.165,3,1.5!   !END!
  4244 ! X =     411.843,6373.871,9,1.5!   !END!
  4245 ! X =      411.64,6374.071,4,1.5!   !END!
  4246 ! X =     411.879,6374.037,5,1.5!   !END!
  4247 ! X =     412.432,6373.552,11,1.5!   !END!
  4248 ! X =     411.888,6373.948,6,1.5!   !END!
  4249 ! X =     411.846,6373.963,7,1.5!   !END!
  4250 ! X =     412.143,6373.863,10,1.5!   !END!
  4251 ! X =     411.924,6374.02,4,1.5!   !END!
  4252 ! X =     411.822,6374.04,5,1.5!   !END!
  4253 ! X =     411.851,6373.881,9,1.5!   !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.
```

7 Riverside Drive, Mayfield West NSW 2304 AUSTRALIA
Email mail@advitech.com.au Web www.advitech.com.au PO Box 207 Mayfield NSW 2304
Advitech Pty Limited t/a Advitech Environmental ABN 29 003 433 458 P 02 4924 5400 F 02 4967 3772

17 Dec 2019

Tattersall Lander
2 Bourke Street / PO Box 580
Raymond Terrace NSW 2324
AUSTRALIA

Attention: **Julie Wells**

Subject: **Anna Bay: Request for Clarification/Further Information**

Dear Julie,

I have reviewed the EPA responses in relation to the Anna Bay air quality report. While Advitech Environmental demonstrated the proposed development would not exceed NSW regulatory dust guidelines levels, it appears the EPA are still seeking some assurances that the sand mine will be operating in a manner that will be considerate of potential dust impacts on neighbours.

An area of possible concern is the potential for short term (that is, less than 24 hour) impacts. These impacts may appear to be several times greater than the 24 hour guideline value but may not trigger an exceedance due to the short term nature of each event. To that end, the proponent should implement an Air Quality Management Plan to ensure any potential air impacts are minimised. Any AQMP may include:

- A commitment to building vegetative screens (or tarped fencing) to minimise possible windblown erosion from the site and to provide a visual buffer from the neighbouring receivers;
- Enforcement of 40 km/h speed limits on internal roads. The lower speed limit will help minimise wheel generated dust from haul trucks;
- Consideration of utilising a water cart on site to wet down the unsealed haul road during periods of peak export from the site (although this is likely to impose additional costs on the proponent);
- Monitoring local wind conditions and minimising extraction during adverse conditions. For example, as most of the receivers are located to the NNW, during strong NNW winds the proponent could decrease the extraction rate to prevent potential impacts; and
- Monitoring local air quality conditions and minimising extraction when air quality is poor. The NSW DPIE publish an hourly air quality index values, monitoring this and limiting extraction when the air quality is ‘poor’, for example, could also help minimise impacts.

This should ensure that the emissions of air pollutants will be minimised during the construction and operation of the development.

Moreover, the modelling was conducted using a very conservative value for the extraction rates. To account for fluctuations in demand, the values used in the model were based on a maximum extraction rate of 260,000 cubic metres per year. However, the maximum extraction under normal operations would be 50,000 cubic metres of sand per year, meaning that the modelled values presented in the report represent a worst case scenario, and not the day to day operations.

Yours faithfully,

Grant Brown

Environmental Scientist (Air Quality)
Advitech Pty Limited

Job No.: J0191250
Folder No.: F20981
Our Ref: 20981 Anna Bay Advitech Response to Air Quality Rev0.docx