



**AIR DISPERSION MODELLING
OF MERCURY EMISSIONS**
for
Kalgoorlie Consolidated Gold Mines

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Ref: Report KCGM Mercury Modelling (Rev0)
5 July 2006

5 July 2006

Kalgoorlie Consolidated Gold Mines
PMB 27
Kalgoorlie, Western Australia 6433

Attention: Dr Jim Bawden

Dear Jim

**Air Dispersion Modelling of Mercury Emissions
Kalgoorlie Consolidated Gold Mines**

ENVIRON is please to present its draft report for the air dispersion modelling of mercury emissions from Kalgoorlie Consolidated Gold Mines' (KCGM) Kalgoorlie operations. We will finalise this report upon receipt of comments from KCGM.

If you have any queries, please do not hesitate to contact the undersigned directly.

Yours sincerely
ENVIRON Australia Pty Ltd

Brian Bell
Manager WA

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REPORT
AIR DISPERSION MODELLING
OF MERCURY EMISSIONS
For Kalgoorlie Consolidated Gold Mines

1. INTRODUCTION

Kalgoorlie Consolidated Gold Mines (KCGM) engaged ENVIRON Australia Pty Ltd (ENVIRON) to undertake air dispersion modelling of the atmospheric mercury emissions from its Gidji Roaster and Fimiston Carbon Regeneration Plant in order to assess the potential air quality impacts in the Kalgoorlie-Boulder residential area.

This report provides details on the modelling methodology and an analysis of the model results.

2. MODELLING INFORMATION

2.1 AIR DISPERSION MODEL

The air dispersion modelling was completed using CALMET and CALPUFF, a non-steady-state meteorological and air quality modelling system. CALMET is a diagnostic three-dimensional meteorological model that assimilates observations from multiple meteorological sites to create hourly meteorological data within the modelling domain. CALPUFF is a non-steady-state Lagrangian puff model that generally uses the three-dimensional meteorological fields developed by the CALMET model. Temporal and spatial variations in the meteorological data throughout the model domain are therefore explicitly treated which makes CALPUFF well suited for modelling long-range transport of atmospheric emissions. The United States Environmental Protection Agency (USEPA) has adopted CALPUFF in its *Guideline on Air Quality Models* (2005) as the preferred model for assessing long-range transport of pollutants.

As the Gidji Roaster is located over 15 km from the Kalgoorlie-Boulder residential area, long-range plume transport is an important consideration for modelling of emissions from the Gidji Roaster. As such, CALPUFF was selected for use in this assessment rather than the conventional steady-state Gaussian-based regulatory models such as Ausplume and ISCST3 (Industrial Source Complex Short-term Version 3) for which the steady state assumptions implicit in the models are not met for long plume travel distances.

2.2 METEOROLOGICAL DATA

CALMET can be used to assimilate meteorological parameters from surface and upper air observation stations. As upper air meteorological data files suitable for use in CALMET are not readily available for Kalgoorlie (e.g. the Bureau of Meteorology release only one radiosonde per day and CALMET requires a minimum of two flights per day), the prognostic meteorological component of TAPM (The Air Pollution Model) has been used to produce surface and upper air meteorological files.

TAPM was developed by the CSIRO, and includes a prognostic meteorological (i.e. using the larger-scale meteorology provided by synoptic analyses) modelling component. TAPM does not require site-specific meteorological observations, and rather predicts gridded three-dimensional local wind fields (and other meteorological parameters) based on synoptic meteorology, local topography and land surface characteristics (i.e. soil type, vegetation cover, land use).

The CSIRO has a global data set of synoptic meteorological data that is required as input to the TAPM model. It is derived from LAPS (Limited Area Prediction System) (within Australia only) analysis data used by Bureau of Meteorology (BoM) for weather forecasting. The synoptic meteorological data used in the modelling has been obtained from the CSIRO for the Australian region for the year 2004. TAPM allows the use of site-specific meteorological observations to be included as input into the model, however for this study TAPM was run in a purely prognostic mode (i.e. no site-specific meteorological observations were used).

The TAPM meteorological simulation was setup as follows:

- Three nested grids (each 70 x 70) with horizontal grid spacings of 15 km (grid 1), 4 km (grid 2), and 1 km (grid 3);
- 20 vertical grid levels, using TAPM default setting to define the vertical grid levels; and
- All grids were centred around Latitude 30° 42' S Longitude 121° 28' W (353,519 mE and 6,602,861 mN [GDA94]).

Terrain elevations and land surface characteristics over the TAPM modeled domain were obtained from the CSIRO for the Australian region. The optional finer resolution 9-second Digital Elevation Model (DEM) terrain data developed by Geoscience Australia was used to define terrain elevations across the TAPM modelled domain. The TAPM default Deep Soil Volumetric Moisture Content was adjusted to 0.05 to account for the semi-arid climate of the Kalgoorlie region.

A sample TAPM model configuration file is presented as Appendix A. When viewing the sample configuration file it should be noted that due to a Microsoft file size restriction it was necessary to separate the model run into two parts (i.e. January to June 2004, and July to December 2004) to run the model.

The surface and upper air meteorological data predicted by TAPM were extracted for the locations listed in Table 1, in a format suitable for use as meteorological observation data required as input to the CALMET model.

Table 1: Location of Surface and Upper Air Meteorological Sites

Description	TAPM Inner Grid Reference ¹		Local Coordinates (GDA94)	
	Grid No. East	Grid No. North	kmE	kmN
Gidji Satellite Station	32	49	350.0	6616.4
Metals Exploration	37	28	355.0	6595.4
Southwest of TAPM modelled domain	12	14	330.0	6581.4
Kalgoorlie Nickel Smelter	38	16	356.0	6583.4
North of Gidji Roaster	34	54	352.0	6621.4

Notes:

1. Grid reference for south west corner of TAPM modelled domain is 0,0.

The surface and upper air meteorological data derived for the locations listed in Table 1, along with the geophysical data (terrain heights, soil types, land use, etc) for the model domain were then used with the CALMET model to derive the three dimensional wind fields across the model domain.

2.3 MODEL SETUP AND EMISSIONS INFORMATION

Using the three-dimensional gridded meteorological data produced by the CALMET model, the air dispersion model CALPUFF was used to predict the ground level concentrations of mercury arising from atmospheric emissions from the Gidji Roaster and the Fimiston Carbon Regeneration Plant across the CALPUFF model domain.

This section provides information on the CALMET and CALPUFF model setup, and the emissions information used in the modelling for the Gidji Roaster and the Carbon Regeneration Plant.

2.3.1 CALMET Model Setup

The CALMET model was setup with the following input configuration:

- model domain covering an area of 2,500 km² (50 km x 50 km) with horizontal grid spacing of 1 km with the origin of the model domain (i.e. southwest corner of model domain) 339,019 mE; 6588,361 mN (GDA94);
- 12 vertical levels with cell face heights (m): 0, 20, 30, 50, 100, 200, 350, 500, 750, 1000, 1250, 1500, 2000;
- map projection UTM zone 51S and datum WGS-G;
- surface and upper air meteorological data obtained from TAPM (refer to Section 2.2); and
- terrain elevation and landuse characterisation data were obtained from the datasets accompanying the TAPM modelling package (refer to Section 2.2).

The CALMET default input parameters were applied to the modelling, where applicable.

A sample input file used for the CALMET modelling is presented as Appendix B. When viewing the sample input file it should be noted that due to a Microsoft file size restriction it was necessary to separate the model run into four parts (i.e. January to March, April to June, July to September, and October to December 2004) to run the model.

2.3.2 CALPUFF Model Setup

The CALPUFF model was setup with the following input configuration:

- the model computational domain grid was set-up as per CALMET;
- model output domain covering an area of 693 km² (21 km x 33 km) with horizontal grid spacing of 500 m with the origin of the output domain (i.e. southwest corner) 345,019 mE; 6588,361 mN (GDA94);
- terrain effects were considered using the “partial plume path adjustment” method, which is the default method used by CALPUFF;
- dry and wet deposition, and chemical transformations were not modelled;
- the effect of building wakes upon plume dispersion has been included for the Fimiston Carbon Regeneration Plant using the Prime algorithm; and
- Pasquill-Gifford (rural ISC curves) and McElroy-Pooler (urban) dispersion coefficients were selected in accordance with the CALPUFF default selection.

The CALPUFF default input parameters were applied to the modelling, where applicable.

The input file used for the CALPUFF modelling is presented as Appendix C.

2.3.3 Emissions Information

The air dispersion modelling has included mercury emissions from the Gidji Roaster and the Carbon Regeneration Plant.

The Fimiston Open Pit mining operation is also a potential source of mercury (entrained in the dust emissions), however it has not been considered in this modelling as it is expected to be a very minor contributor to ambient mercury levels in the Kalgoorlie-Boulder area. This is based on a very limited dataset of mercury analysis on Total Suspended Particulate (TSP) dust samples collected at sites located on the border of the Kalgoorlie residential area and in close proximity to the Fimiston Open Pit (Geotechnical Services, 2006), and the results of dust modelling for the Fimiston Operations Extension (ENVIRON, 2006). The results of the analysis of the dust samples indicate that the mercury composition of dust from the Fimiston Operations is in the order of 0.008 % w/w to 0.01% w/w. Based on the annual average ground level concentration of TSP predicted for the proposed extension to the Fimiston Operations, this equates to an annual mercury contribution of less than 0.002 $\mu\text{g}/\text{m}^3$ within the Kalgoorlie-Boulder residential area, which is not considered significant when compared to the relevant ambient air quality guidelines for mercury (refer to Section 3).

In deriving the mercury emission estimate for the Gidji Roaster, the following assumptions were made:

- Both roasters are operated continuously;
- The concentrate feed to the roasters has a mercury content of 80 ppm, and all of the mercury present in the concentrate is emitted via the main stack; and
- The concentrate feed rate for two roasters (combined) is 1,200 tpd.

The emission rate used in the modelling was calculated assuming 80 ppm of mercury in concentrate and the maximum feed rate to the two roasters operating continuously. Recent concentrate assays indicate an average concentration of around 23 ppm. Further, the Gidji Air Quality Control Strategy results in either one or both of the Gidji roasters being shut down when the winds are in the arc between 315° and 45° (i.e. blowing towards Kalgoorlie-Boulder). Ground level concentrations predicted by the modelling for the Gidji Roaster are therefore likely to be conservative.

In deriving the mercury emission estimate for the Carbon Regeneration Plant, the following assumptions were made:

- Both Carbon Regeneration Kilns are operated continuously with the emissions discharged via a common stack after passing through a scrubber; and
- The total mercury emission rate from the kilns is 0.067 g/s which assumes a loading of 195 ppm mercury at a total carbon feed rate of 42 tpd and a mercury removal efficiency of 30% by the Carbon Regeneration Kilns scrubber.

Recent carbon assays indicate an average concentration of mercury on carbon of 85 ppm. The modelling also assumes that 100% of the mercury is released from the carbon, however, the carbon assays indicate about 5% of the mercury is typically retained within the carbon. As the mercury scrubber on the Carbon Regeneration Plant is relatively new, there is currently insufficient data to accurately define its efficiency, and therefore a low removal rate of 30% has been assumed in the modelling. Ground level concentrations predicted by the modelling for the Carbon Regeneration Plant are therefore likely to be conservative.

The stack release parameters, including mercury emissions information, used in the modelling are presented in Table 2.

Table 2: Emissions Information and Release Parameters used in the Modelling

Parameter	Units	Gidji Roaster ¹	Carbon Regeneration Plant ²
Stack location (GDA94)	mE	352,074	357,373
	mN	6,614,834	6,595,211
Stack height	m	180	28
Stack internal diameter	m	2	0.315
Release temperature	°C	320	300
Stack gas exit velocity	m/s	24.4	22.8
Mercury emissions	g/s	1.11 ³	0.067 ⁴

Notes:

1. Stack release parameters provided by KCGM (ENVIRON 2005).
2. Stack release parameters provided by KCGM, using scrubber design parameters associated with the burner operating (Email from M Goodz, 11 May 2006).
3. Mercury emissions for the Gidji Roaster calculated by ENVIRON, based on assumption of 80 ppm mercury in concentrate and a concentrate throughput of 1,200 tpd.
4. Mercury emissions for the Carbon Regeneration Plant calculated by ENVIRON based on a mercury content of 195 ppm in the carbon, a carbon throughput rate of 42 tpd, and assuming all mercury present in carbon is evolved, and assuming a scrubber efficiency of 30%.

3. AMBIENT AIR QUALITY GUIDELINES

There are no Western Australian or nationally recognised ambient air quality guidelines for mercury, therefore a review of various other Australian and international guidelines was undertaken. The guidelines applied have been taken from the USEPA's Integrated Risk Information System (IRIS), World Health Organisation (WHO) and California's Office of Environmental Health Hazard Assessment (OEHHA), and are summarised in Table 3.

Table 3: Ambient Air Quality Guidelines for Mercury

Guideline Type	Guideline	Averaging Time	Concentration ($\mu\text{g}/\text{m}^3$)
Chronic Inhalation Exposure ¹	IRIS (USEPA)	annual	0.3
Chronic Inhalation Exposure ²	WHO	annual	1.0
Acute Inhalation Exposure ²	OEHHA	1-hour	1.8

Notes:

1. Based on exposure to elemental mercury.
2. Based on exposure to inorganic mercury.

While the WHO annual average ambient guideline for inorganic mercury vapour is $1 \mu\text{g}/\text{m}^3$ (WHO 2000), the IRIS guideline ($0.3 \mu\text{g}/\text{m}^3$) has been applied in this assessment for chronic exposure as it is more stringent.

4. AIR DISPERSION MODEL RESULTS

CALPUFF was used to predict the annual average and maximum 1-hour average ground level concentrations of mercury resulting from the Gidji Roaster and Fimiston Carbon Regeneration Plant emissions for the city of Kalgoorlie-Boulder.

The maximum predicted ground level concentrations of mercury within the Kalgoorlie-Boulder residential area are presented in Table 4. The predicted annual average and maximum 1-hour average ground level concentrations of mercury resulting from the cumulative impacts of the Fimiston Carbon Regeneration Plant and the Gidji Roaster emissions, and the Fimiston Carbon Regeneration Plant in isolation, are presented as Figures 1 and 2.

Table 4: Predicted Ground Level Concentrations of Mercury in the Kalgoorlie-Boulder Residential Area

Averaging Period	Predicted Maximum Ground Level Concentration ($\mu\text{g}/\text{m}^3$)		
	Gidji Roaster in Isolation	Fimiston Carbon Regeneration Plant in Isolation	Combined Gidji Roaster and Fimiston Carbon Regeneration Plant
Annual	<0.001	0.02	0.02
1-Hour	<0.2	1.8	1.8

The results presented in Table 4 and Figures 1 and 2 indicate that:

- the annual average ground level concentration of mercury predicted in the Kalgoorlie-Boulder residential area comfortably complies with the IRIS ambient air quality guideline;
- the maximum 1-hour average ground level concentrations predicted in the Kalgoorlie-Boulder residential area are generally well below the Californian OEHAA guideline, although this guideline is approached to on the edge of Kalgoorlie to the west of the Fimiston Carbon Regeneration Plant;
- the emissions from the Fimiston Carbon Regeneration Plant are predicted to result in higher ground level concentrations in the Kalgoorlie-Boulder residential area than those from the Gidji Roaster due to its closer proximity to the residential area.

It should also be noted that the modelling results are likely to be very conservative as:

- the mercury emission estimates derived for the Gidji Roaster and the Fimiston Carbon Regeneration Plant have used the upper range of the mercury content in the concentrate and carbon respectively and therefore overstate the typical emission rates. In reality, the average mercury content is less than 30% of this value for the Gidji concentrate and less than 50% for the Fimiston Carbon Kiln;
- the modelling has assumed that the Gidji Roaster operates continuously at maximum capacity. However, the Gidji Air Quality Control Strategy, used by KCGM to manage the air quality impacts arising from its sulphur dioxide emission, results in either one or both of the Gidji roasters being shutdown when the winds are blowing towards Kalgoorlie-Boulder; and
- the modelling has assumed that the Fimiston Carbon Regeneration Plant is operating continuously at full load over the year and this is unlikely to occur.

Based on the results of the modelling it can be concluded that the emissions of mercury from the Gidji Roaster and the Fimiston Carbon Regeneration Plant are not expected to result in any acute (i.e short-term) or chronic (i.e long-term) health affects in the Kalgoorlie-Boulder residential area.

These results are consistent with the initial screening assessment conducted by ENVIRON (2005).

5. SUMMARY

The air dispersion model CALPUFF has been used to predict the annual average ground level concentrations of mercury resulting from the Gidji Roaster and the Fimiston Carbon Regeneration Plan in the Kalgoorlie-Boulder residential area.

The results of the modelling are likely to be very conservative, and indicate the following:

- the annual average ground level concentrations of mercury predicted in the Kalgoorlie-Boulder residential area comfortably comply with the USEPA's IRIS and the WHO guidelines;
- while the Californian OEHAA 1-hour (or acute exposure) guideline is predicted to be approached on the edge of Kalgoorlie, to the west of the Fimiston Carbon Regeneration Plant, the conservative assumptions used in deriving the emissions means this is unlikely to occur; and
- emissions from the Fimiston Carbon Regeneration Plant are predicted to result in higher ground level concentrations in the Kalgoorlie-Boulder residential area than the Gidji Roaster due to its closer proximity to the residences.

Based on the results of the modelling it can be concluded that the emissions of mercury from the Gidji Roaster and the Fimiston Carbon Regeneration Plant are not expected to result in any acute (i.e short-term) or chronic (i.e long-term) health affects in the Kalgoorlie-Boulder residential area.

6. REFERENCES

WHO, 2000. *Air Quality Guidelines for Europe* (Second Edition). World Health Organisation, 2000.

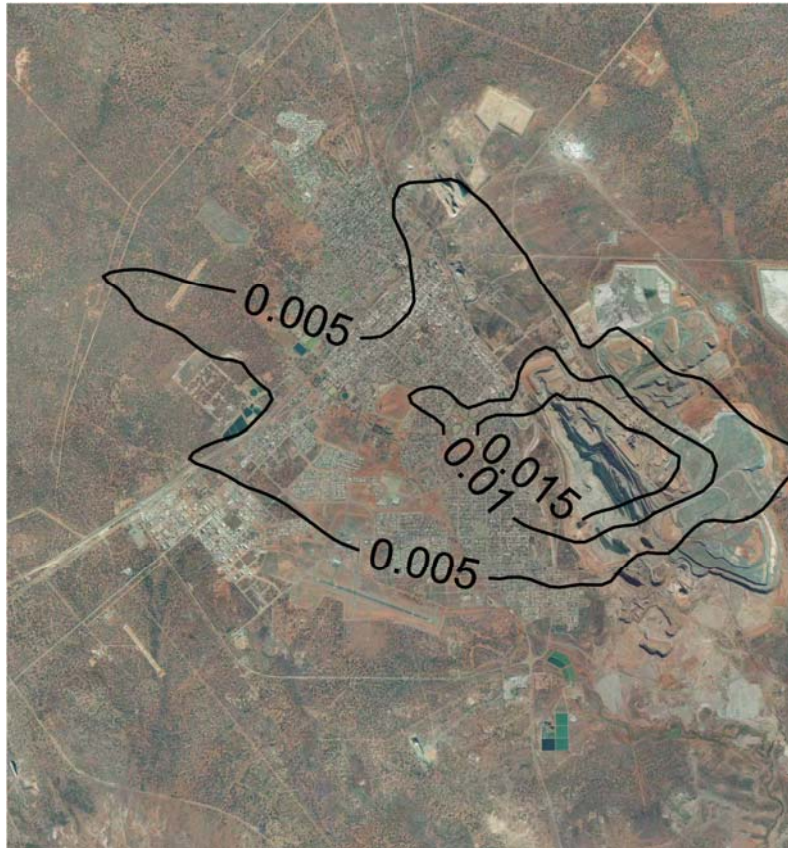
USEPA, 2005. *Guideline on Air Quality Models*, Appendix W to Part 51, Federal Register, 40 CFR Ch. I (2005 Edition).

ENVIRON, 2005. *Memorandum: Air Dispersion Modelling Assessment of Mercury Emissions from Gidji Roasters and Fimiston Carbon Regeneration Kilns*. ENVIRON, 21 July 2005.

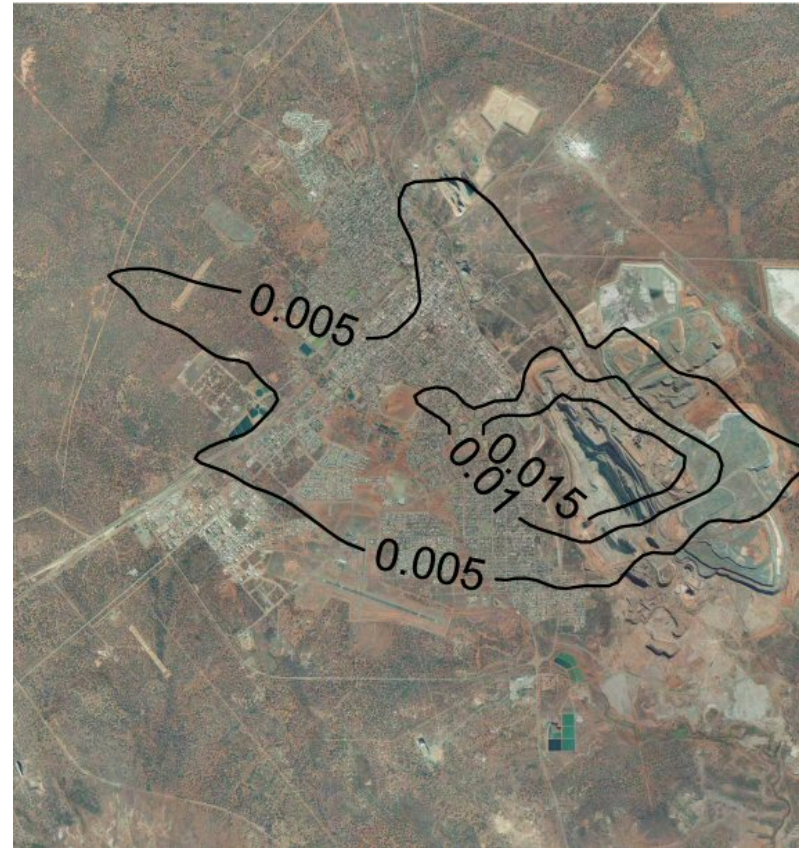
ENVIRON, 2006. *Dust Modelling Study – Fimiston Operations Extension for Kalgoorlie Consolidated Gold Mines. Draft Report*. ENVIRON, June 2006.

Geotechnical Services, 2006. *Report on Analysis of Filters*. Geotechnical Services, 10 January 2006.

FIGURES



a) Cumulative Impacts (Gidji Roaster and Fimiston Carbon Kiln)



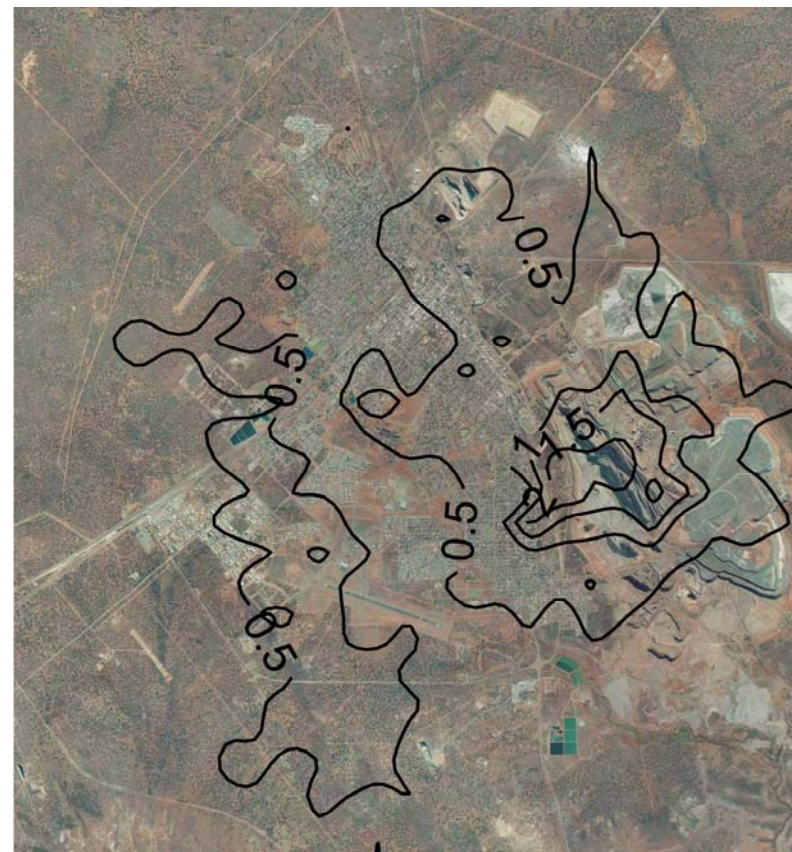
b) Fimiston Carbon Kiln in Isolation

Figure 1: Predicted Annual Average Ground Level Concentrations of Mercury ($\mu\text{g}/\text{m}^3$)

Client: KCGM	ENVIRON	
Project: Mercury Emissions Modelling	Drawing Ref: BPB	Date: 30 Jun 2006



a) Cumulative Impacts (Gidji Roaster and Fimiston Carbon Kiln)



b) Fimiston Carbon Kiln in Isolation

Figure 2: Predicted Maximum 1-Hour Average Ground Level Concentrations of Mercury ($\mu\text{g}/\text{m}^3$)

Client: KCGM

ENVIRON

Project: Mercury Emissions Modelling

Drawing Ref: BPB

Date: 30 Jun 2006

APPENDIX A

Sample TAPM Model Configuration File

"TAPM.DEF"
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APPENDIX B

Sample CALMET Input File

Kalgoorlie 2004
Meteorological Data Derived from TAPM Prognostic Predictions
Merged Surface File (KALSURF04.SUR)

CALMET MODEL CONTROL FILE

INPUT GROUP: 0 -- Input and output file names

Subgroup (a)

! GEODAT = C:\Clients\KCGM\CALPUFF\KAL200~1\KalT04.geo ! Geophysical dat...
! SRFDAT = C:\CLIENTS\KCGM\CALPUFF\KAL200~1\KALSUR~1.SUR ! Hourly surfac...
* CLDDAT = * Gridded cloud file
* PRCDAT = * Precipitation data file
* MM4DAT = * MM4/MM5 data file
* WTDAT = * Gridded weighting obs. vs. MM4 data file
! METLST = C:\CLIENTS\KCGM\CALPUFF\KAL200~1\KALT04a.CML ! CALMET output ...
! METDAT = C:\CLIENTS\KCGM\CALPUFF\KAL200~1\KALT04a.MET ! Output meteoro...
* PACDAT = * Output meteorological data file (MESOPAC/MESOPUFF)
! NUSTA = 5 ! Number of upper air stations
! NOWSTA = 0 ! Number of overwater stations
! LCFILES = T ! Convert file names to lower case
! END !

Subgroup (b)

Upper air files

! UPDAT = C:\CLIENTS\KCGM\CALPUFF\KAL200~1\TSAT04.UP ! !END!
! UPDAT = C:\CLIENTS\KCGM\CALPUFF\KAL200~1\TMEX04.UP ! !END!
! UPDAT = C:\CLIENTS\KCGM\CALPUFF\KAL200~1\TKNS04.UP ! !END!
! UPDAT = C:\CLIENTS\KCGM\CALPUFF\KAL200~1\TNEC04.UP ! !END!
! UPDAT = C:\CLIENTS\KCGM\CALPUFF\KAL200~1\TNG04.UP ! !END!

Subgroup (c)

Overwater station files

Subgroup (d)

Other file names

* DIADAT = * Preprocessed input met data
* PRGDAT = * Gridded prognostic wind data file (CSUMM)
* TSTPRT = * Debug variables test file
* TSTOUT = * Final wind fields test file
* TSTKIN = * Winds after kinematic effects test file
* TSTFRD = * Winds after Froude number effects test file
* TSTSLP = * Winds after slope flow effects test file
! END !

INPUT GROUP: 1 -- General run control parameters

! IBYR = 2004 ! Starting year of the run
! IBMO = 1 ! Starting month of the run
! IBDY = 2 ! Starting day of the run
! IBHR = 1 ! Starting hour of the run

```
! IBTZ   = -8      ! Base time zone
! IRLG   = 2159    ! Length of the run
! IRTYPE = 1       ! Run type
! LCALGRD = T      ! Store extra data fields
! ITEST  = 2       ! Stop run after setup phase
! END !
```

INPUT GROUP: 2 -- Map Projection and grid control paramaters

Projection

```
-----
! PMAP   = UTM      ! Map projection for all XY coordinates
! FEAST  = 0        ! False Easting
! FNORTH = 0        ! False Northing
! IUTMZN = 51       ! UTM zone
! UTMHEM = S        ! Hemisphere for UTM projection
* RLAT0  =          * Reference latitude
* RLOK0  =          * Reference longitude
* XLAT1  =          * Latitude of 1st standard parallel
* XLAT2  =          * Latitude of 2nd standard parallel
```

Datum

```
-----
! DATUM  = WGS-G    ! Datum-region for output coordinates
```

Grid

```
-----
! NX     = 50       ! Number of grid cells in the X direction
! NY     = 50       ! Number of grid cells in the Y direction
! NZ     = 12       ! Number of vertical layers
! DGRIDKM = 1       ! Horizontal grid spacing
! ZFACE  = 0, 20, 30, 50, 100, 200, 350, 500, 750, 1000, 1250, 1500, 2000 !
! XORIGKM = 339.019 ! Reference X coordinate of grid
! YORIGKM = 6588.361 ! Reference Y coordinate of grid
```

! END !

INPUT GROUP: 3 -- Output options

```
! LSAVE  = T        ! Generate output file
! IFORMO = 1        ! Output file type
! LPRINT = T        ! Generate list file
! IPRINF = 2000     ! List file interval
! IUVOU  = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 ! Levels of U and V to print
! IWOU   = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 ! Levels of W to print
! ITOUT  = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 ! Levels of temperature to...
! STABILITY = 1     ! Stability classes printed
! USTAR  = 0        ! Surface friction velocities printed
! MONIN  = 0        ! Monin-Obukhov lengths printed
! MIXHT  = 1        ! Mixing heights printed
! WSTAR  = 0        ! Convective velocity scales printed
! PRECIP = 0        ! Hourly precipitation rates printed
! SENSHEAT = 1     ! Sensible heat fluxes printed
! CONVZI = 1        ! Convective mixing heights printed
! LDB    = F        ! Generate micrometeorological debug file
! NN1    = 0        ! First time step
```

```
! NN2   = 0    ! Last time step
! IOUTD = 0    ! Generate wind field debug file
! NZPRN2 = 1   ! Number of levels
! IPR0   = 0    ! Interpolated wind components printed
! IPR1   = 0    ! Terrain adjusted surface wind components printed
! IPR2   = 0    ! Smoothed wind components and initial divergence...
! IPR3   = 0    ! Final wind speed and direction printed
! IPR4   = 0    ! Final divergence printed
! IPR5   = 0    ! Wind fields after kinematic effects printed
! IPR6   = 0    ! Wind fields after Froude number printed
! IPR7   = 0    ! Wind fields after slope flows printed
! IPR8   = 0    ! Final wind component printed
! END !
```

INPUT GROUP: 4 -- Meteorological data options

```
! NOOBS = 0    ! No observation mode
! NSSTA = 5    ! Number of surface meteorological stations
! NPSTA = 0    ! Number of precipitation stations
! ICLD   = 0    ! Cloud data file options
! IFORMS = 2    ! Surface meteorological data file format
! IFORMP = 2    ! Precipitation data file format
! IFORMC = 2    ! Gridded cloud data file format
! END !
```

INPUT GROUP: 5 -- Wind field options and parameters

Wind field model options

```
! IWFCOD = 1    ! Wind field module
! IFRADJ = 1    ! Froude number adjustment effects
! IKINE   = 0    ! Kinematic effects
! IOBR    = 0    ! O'Brien vertical velocity adjustment procedure
! ISLOPE  = 1    ! Slope flow effects
! IEXTRP  = -4   ! Vertical extrapolation
! ICALM   = 0    ! Extrapolation of calm surface winds to layers a...
! BIAS    = -1, 1, 1, 1, 1, 1, 1, 1, 1, 1 ! Layer-dependent biases ...
! RMIN2   = 4    ! Distance from an upper air station
! IPRG    = 0    ! Gridded prognostic model field winds option
! ISTEPPG = 1    ! Timestep of the prognostic model input data
```

Radius of influence parameters

```
! LVARY   = F    ! Varying radius of influence
! RMAX1   = 100  ! Maximum radius of influence over land in the su...
! RMAX2   = 100  ! Maximum radius of influence over land in layers...
! RMAX3   = 100  ! Maximum radius of influence overwater
```

Other wind field input parameters

```
! RMIN    = 0.1  ! Minimum radius of influence used in the wind fi...
! TERRAD  = 40   ! Radius of influence of terrain features
! R1      = 100  ! Weighting parameter for the diagnostic wind fie...
! R2      = 500  ! Weighting parameter for the diagnostic wind fie...
* RPROG   =      * Weighting parameter for the prognostic wind fie...
! DIVLIM  = 5.0E6 ! Convergence criterion for the divergence minimi...
! NITER   = 50   ! Maximum number of iterations for the divergence...
! NSMTH   = 2, 4, 4, 4, 4, 4, 4, 4, 4, 4 ! Number of smoothing pass...
! NINTR2  = 99, 99, 99, 99, 99, 99, 99, 99, 99, 99, 99 ! Maximum numb...
```

! CRITFN = 1 ! Critical Froude number used in the evaluation o...
! ALPHA = 0.1 ! Empirical parameter controlling the influence o...
! FEXTR2 = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0 ! Extrapolation values for...

Barrier information

! NBAR = 0 ! Number of wind field interpolation barriers
* XBBAR = * X coordinate of the beginning of each barrier
* YBBAR = * Y coordinate of the beginning of each barrier
* XEBAR = * X coordinate of the end of each barrier
* YEBAR = * Y coordinate of the end of each barrier

Diagnostic module data input options

! IDIOPT1 = 0 ! Surface temperature input to diagnostic wind fi...
! ISURFT = 5 ! Surface station number used for the surface tem...
! IDIOPT2 = 0 ! Domain-averaged temperature lapse rate
! IUPT = 5 ! Upper air station number used to compute the do...
! ZUPT = 200 ! Depth through which the domain-scale TLR is com...
! IDIOPT3 = 0 ! Initial-guess wind components
! IUPWND = -1 ! Upper air station number used to compute the in...
! ZUPWND = 1, 1000 ! Bottom and top layer through which the initial-...
! IDIOPT4 = 0 ! Surface wind components
! IDIOPT5 = 0 ! Upper air wind components

Lake breeze information

! LLBREZE = F ! Lake breeze region option
! NBOX = 0 ! Number of boxes defining region
* XG1 = * 1st x-grid line to define box
* XG2 = * 2nd x-grid line to define box
* YG1 = * 1st y-grid line to define box
* YG2 = * 2nd y-grid line to define box
* XBCST = * Beginning x coordinate of user defined coastline
* YBCST = * Beginning y coordinate of user defined coastline
* XECST = * Ending x coordinate of user defined coastline
* YECST = * Ending y coordinate of user defined coastline
* NLB = * Number of meteorological stations (surface and ...
* METBXID = * Station IDs of the meteorological stations with...

! END !

INPUT GROUP: 6 -- Mixing height, temperature, and precipitation parameters

! CONSTB = 1.41 ! Neutral, mechanical mixing height constant
! CONSTE = 0.15 ! Convective mixing height constant
! CONSTN = 2400 ! Stable mixing height constant
! CONSTW = 0.16 ! Overwater mixing height constant
! FCORIOI = 1.E-4 ! Absolute value of Coriolis parameter
! DPTMIN = 0.001 ! Minimum potential temperature lapse rate
! DZZI = 200 ! Depth of layer above current mixing height
! ZIMAX = 3000 ! Maximum overland mixing height
! ZIMIN = 50 ! Minimum overland mixing height
! ZIMAXW = 3000 ! Maximum overwater mixing height
! ZIMINW = 50 ! Minimum overwater mixing height
! IAVEZI = 1 ! Spatial averaging of mixing heights
! MNMDAV = 1 ! Maximum search distance (grid cells)
! HAFANG = 30 ! Half-angle of upwind looking cone
! ILEVZI = 1 ! Upwind averaging layer
! ITPROG = 0 ! 3D temperature from observations or from progno...
! IRAD = 1 ! Temperature interpolation method

! IAVET = 1 ! Spatial averaging of temperatures
! TRADKM = 500 ! Radius of influence for temperature
! NUMTS = 5 ! Maximum number of stations
! TGDEFB = -0.0098 ! Temperature lapse rate - below
! TGDEFA = -0.0045 ! Temperature lapse rate - above
! JWAT1 = 999 ! Beginning land use category
! JWAT2 = 999 ! Ending land use category
! NFLAGP = 2 ! Precipitation interpolation method
! SIGMAP = 100 ! Radius of influence for precipitation
! CUTP = 0.01 ! Cutoff precipitation rate
! END !

INPUT GROUP: 7 -- Surface meteorological station parameters

Name	ID	X coord. (km)	Y coord. (km)	Time zone	Anem. ht. (m)
! SS1	'TKNS'	54323	356.019	6583.361	-8 10 !
! SS2	'TMEX'	54322	355.019	6595.361	-8 10 !
! SS3	'TNEC'	54324	330.019	6581.361	-8 10 !
! SS4	'TNG'	54325	352.019	6621.361	-8 10 !
! SS5	'TSAT'	54321	350.019	6616.361	-8 10 !

! END !

INPUT GROUP: 8 -- Upper air meteorological station parameters

Name	ID	X coord. (km)	Y coord. (km)	Time zone
! US1	'TSAT'	54321	350.019	6616.361 -8 !
! US2	'TMEX'	54322	355.019	6595.361 -8 !
! US3	'TKNS'	54323	356.019	6583.361 -8 !
! US4	'TNEC'	54324	330.019	6581.361 -8 !
! US5	'TNG'	54325	352.019	6621.361 -8 !

! END !

INPUT GROUP: 9 -- Precipitation station parameters

Name	ID	X coord. (km)	Y coord. (km)
------	----	------------------	------------------

! END !

APPENDIX C

CALPUFF Input File

KCGM Mercury Modelling
Cumulative Impact of Roasting and Carbon Regeneration

----- 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 = *

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 =C:\ENVIRON\KCGM\CALPUF\TAPM2004\HG.CPL !
CONC.DAT output ! CONDAT =C:\ENVIRON\KCGM\CALPUF\TAPM2004\HG.CON !
DFLX.DAT output * DFDAT = *
WFLX.DAT output * WFDAT = *

VISB.DAT output * VISDAT = *

RESTARTE.DAT output * RSTARTE= *

Emission Files

PTEMARB.DAT input * PTDAT = *

VOLEMARB.DAT input * VOLDAT = *

BAEMARB.DAT input * ARDAT = *

LNEMARB.DAT input * LNDAT = *

Other Files

OZONE.DAT input * OZDAT = *

VD.DAT input * VDDAT = *

CHEM.DAT input * CHEMDAT= *

H2O2.DAT input * H2O2DAT= *

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= *

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 70 characters in length

Provision for multiple input files

Number of CALMET.DAT files for run (NMETDAT)
Default: 1 ! NMETDAT = 4 !

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)

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

Default Name	Type	File Name
none	input	! METDAT=C:\ENVIRON\KCGM\CALPUF\TAPM2004\KALT04A.MET ! !END!
none	input	! METDAT=C:\ENVIRON\KCGM\CALPUF\TAPM2004\KALT04B.MET ! !END!
none	input	! METDAT=C:\ENVIRON\KCGM\CALPUF\TAPM2004\KALT04C.MET ! !END!
none	input	! METDAT=C:\ENVIRON\KCGM\CALPUF\TAPM2004\KALT04D.MET ! !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 = 2004 !
(used only if Month (IBMO) -- No default ! IBMO = 1 !
METRUN = 0) Day (IBDY) -- No default ! IBDY = 2 !
Hour (IBHR) -- No default ! IBHR = 1 !

Base time zone (XBTZ) -- No default ! XBTZ = -8.0 !
PST = 8., MST = 7.
CST = 6., EST = 5.

Length of run (hours) (IRLG) -- No default ! IRLG = 8759 !

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)

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. !

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

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

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

Chemical mechanism flag (MCHEM) Default: 1 ! MCHEM = 0 !
0 = chemical transformation not modeled
1 = transformation rates computed internally (MESOPUFF II scheme)
2 = user-specified transformation rates used
3 = transformation rates computed internally (RIVAD/ARM3 scheme)
4 = secondary organic aerosol formation computed (MESOPUFF II scheme for OH)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 1, or 3) Default: 0 ! MAQCHEM = 0 !
0 = aqueous phase transformation not modeled
1 = transformation rates adjusted for aqueous phase reactions

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

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

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)
- 2 = use sigma-w measurements
from PROFILE.DAT to compute sigma-z
(valid for METFM = 1, 2, 3, 4)
- 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)
- 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.

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?

(MPARTL)

- 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

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
MCHEM 1 or 3 (if modeling SO_x, NO_x)
MWET 1
MDRY 1
MDISP 2 or 3
MPDF 0 if MDISP=3
1 if MDISP=2
MROUGH 0
MPARTL 1
SYTDEP 550. (m)
MHFTSZ 0

!END!

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

Subgroup (3a)

The following species are modeled:

! CSPEC = HG1 ! !END!
! CSPEC = HG2 ! !END!
! CSPEC = HG3 ! !END!

SPECIES NAME (Limit: 12 Characters in length)	MODELED (0=NO, 1=YES)	Dry		OUTPUT GROUP	
		EMITTED (0=NO, 1=YES)	DEPOSITED (0=NO, 1=YES)	NUMBER (0=NONE, 1=1st CGRUP, 2=2nd CGRUP, 3=etc.)	
! HG1 =	1,	1,	0,	0	!
! HG2 =	1,	1,	0,	0	!
! HG3 =	1,	1,	0,	0	!

!END!

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 = 51 !

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-G !

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 = 50 !
No. Y grid cells (NY) No default ! NY = 50 !
No. vertical layers (NZ) No default ! NZ = 12 !

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

Cell face heights
(ZFACE(nz+1)) No defaults
Units: m

! ZFACE = 0., 20., 30., 50., 100., 200., 350., 500., 750., 1000.,
1250., 1500., 2000. !

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

X coordinate (XORIGKM) No default ! XORIGKM = 339.019 !
Y coordinate (YORIGKM) No default ! YORIGKM = 6588.361 !
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 = 50 !
(1 <= IECOMP <= NX)

Y index of UR corner (JECOMP) No default ! JECOMP = 50 !
(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/MESH DN.

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

X index of LL corner (IBSAMP) No default ! IBSAMP = 7 !
(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 = 28 !
(IBCOMP <= IESAMP <= IECOMP)

Y index of UR corner (JESAMP) No default ! JESAMP = 33 !
(JBCOMP <= JESAMP <= JECOMP)

Nesting factor of the sampling
grid (MESH DN) Default: 1 ! MESH DN = 2 !
(MESH DN 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 = 0 !
Wet Fluxes (IWET) 1 ! IWET = 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

DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

Mass flux across specified boundaries
for selected species reported hourly?
(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 hourly?
(IMBAL) Default: 0 ! IMBAL = 0 !
0 = no
1 = yes (MASSBAL.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 hours Default: 1 ! ICFRQ = 1 !
Dry flux print interval
(IDFRQ) in hours Default: 1 ! IDFRQ = 2000 !
Wet flux print interval
(IWFRQ) in hours Default: 1 ! IWFRQ = 2000 !

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?
-----  -----
!   HG1 =  0,    1,    0,    0,    0,    0,    0  !
!   HG2 =  0,    1,    0,    0,    0,    0,    0  !
!   HG3 =  0,    1,    0,    0,    0,    0,    0  !

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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. !
to meters (MHILL=1)

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

X-origin of CTDM system relative to No Default ! XCTDMKM = 0.0E00 !
CALPUFF coordinate system, in Kilometers (MHILL=1)

Y-origin of CTDM system relative to No Default ! YCTDMKM = 0.0E00 !
CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

Subgroup (6b)

1 **
HILL information

HILL AMAX1 NO.	XC AMAX2 (km)	YC (km)	THETAH (deg.)	ZGRID (m)	RELIEF (m)	EXPO 1 (m)	EXPO 2 (m)	SCALE 1 (m)	SCALE 2
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Subgroup (6c)

COMPLEX TERRAIN RECEPTOR INFORMATION

XRCT (km)	YRCT (km)	ZRCT (m)	XHH
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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 HENRY'S LAW COEFFICIENT NAME	DIFFUSIVITY (cm**2/s)	ALPHA STAR (s/cm)	REACTIVITY (dimensionless)	MESOPHYLL RESISTANCE
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!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 NAME	GEOMETRIC MASS MEAN DIAMETER (microns)	GEOMETRIC STANDARD DEVIATION (microns)
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!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.
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!END!

INPUT GROUP: 11 -- Chemistry Parameters

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

Monthly ozone concentrations
(Used only if MCHM = 1, 3, or 4 and
MOZ = 0 or MOZ = 1 and all hourly O3 data missing)
(BCKO3) in ppb 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 !

Monthly ammonia concentrations
(Used only if MCHM = 1, or 3)
(BCKNH3) in ppb 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 (RNITE1)
in percent/hour Default: 0.2 ! RNITE1 = .2 !

Nighttime NOx loss rate (RNITE2)
in percent/hour Default: 2.0 ! RNITE2 = 2.0 !

Nighttime HNO3 formation rate (RNITE3)
in percent/hour Default: 2.0 ! RNITE3 = 2.0 !

H2O2 data input option (MH2O2) Default: 1 ! MH2O2 = 1 !
(Used only if MAQCHEM = 1)
0 = use a monthly background H2O2 value
1 = read hourly H2O2 concentrations from
the H2O2.DAT data file

Monthly H2O2 concentrations
(Used only if MQACHEM = 1 and
MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)
(BCKH2O2) in ppb 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) Option
(used only if MCHEM = 4)

The SOA module uses monthly values of:
Fine particulate concentration in ug/m³ (BCKPMF)
Organic fraction of fine particulate (OFRAC)
VOC / NOX ratio (after reaction) (VCNX)
to 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!

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 turbulence data in PROFILE.DAT file
(Used only if METFM = 4 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 !

Default minimum turbulence velocities
sigma-v and sigma-w for each
stability class (m/s)
(SVMIN(6) and SWMIN(6)) Default SVMIN : .50, .50, .50, .50, .50, .50
Default SWMIN : .20, .12, .08, .06, .03, .016

Stability Class : A B C D E F
--- --- --- --- --- ---
! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500!
! SWMIN = 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 !

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

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

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

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 !

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/m³) 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 (in BC segment lengths) about a receptor for sampling nearest BC puff. BC puffs are emitted with a spacing of one segment length, so the search radius should be greater than 1.

(RSAMPBC) Default: 4. ! 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 = 4 !

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

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

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

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

!END!

Subgroup (13b)

a

POINT SOURCE: CONSTANT DATA

```

-----
                b      c
Source   X     Y   Stack Base Stack Exit Exit Bldg. Emission
No.     Coordinate Coordinate Height Elevation Diameter Vel. Temp. Dwash Rates
        (km)   (km)   (m)   (m)   (m) (m/s) (deg. K)
-----
1 ! SRCNAM = GIDJI !
1 ! X = 352.074, 6614.834, 180.0, 345.0,   2.0, 24.4, 593.0, .0,1.11E00, 0.0E00, 0.0E00 !
1 ! FMFAC = 1.0 ! !END!
2 ! SRCNAM = SCRUB !
2 ! X = 357.373, 6595.211, 28.0, 375.0,   .315, 22.8, 573.0, 1.0, 0.0E00, 6.7E-02, 0.0E00 !
2 ! FMFAC = 1.0 ! !END!
3 ! SRCNAM = OLD1 !
3 ! X = 357.238, 6595.065, 25.0, 375.0,   .45, 15.7, 552.0, 1.0, 0.0E00, 0.0E00, 4.8E-02 !
3 ! FMFAC = 1.0 ! !END!
4 ! SRCNAM = OLD2 !
4 ! X = 357.245, 6595.057, 30.0, 375.0,   .45, 15.7, 552.0, 1.0, 0.0E00, 0.0E00, 4.8E-02 !
4 ! FMFAC = 1.0 ! !END!
-----

```

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)

b

0. = No building downwash modeled, 1. = downwash modeled
NOTE: must be entered as a REAL number (i.e., with decimal point)

c

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

Subgroup (13c)

BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH

```

-----
                a
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)
-----

```

2 ! SRCNAM = SCRUB !


```
2 !HEIGHT = 15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6!
2 !WIDTH = 9.63, 10.0, 10.0, 9.75, 9.5, 10.0,
10.0, 10.5, 10.0, 9.5, 9.0, 8.0,
6.5, 5.0, 5.5, 7.0, 8.13, 9.0,
9.63, 10.0, 10.0, 9.75, 9.5, 9.5,
10.0, 10.5, 10.0, 9.5, 9.0, 7.5,
6.5, 5.0, 5.5, 7.0, 8.0, 9.0!
2 !LENGTH = 9.5, 8.5, 7.5, 6.5, 5.0, 5.75,
7.0, 8.13, 9.0, 9.69, 10.0, 10.0,
9.75, 9.0, 9.5, 10.0, 10.0, 10.0,
9.5, 8.5, 8.0, 6.5, 5.0, 5.5,
7.0, 8.13, 9.0, 9.63, 10.0, 10.0,
9.75, 9.0, 9.5, 10.0, 10.0, 10.0!
2 !XBADJ = -9.5, -8.5, -7.0, -5.5, -4.0, -3.5,
-3.0, -2.63, -2.28, -1.88, -1.25, -0.75,
.0, 1.0, .5, .5, .0, .0,
.0, .0, -1.0, -.5, -1.0, -2.25,
-4.0, -5.5, -6.72, -7.81, -8.75, -9.5,
-9.75, -10.0, -10.0, -10.5, -10.0, -10.0!
2 !YBADJ = -3.05, -3.69, -4.23, -4.77, -5.2, -5.57,
-5.41, -5.32, -5.06, -4.65, -3.91, -3.38,
-2.59, -1.77, -.27, .49, 1.34, 2.212,
3.71, 4.43, 4.65, 5.23, 5.13, 5.34,
5.33, 5.17, 4.37, 4.09, 3.28, 2.22,
1.25, .48, -.41, -1.32, -2.2, .0!
!END!
3 !SRCNAM = OLD1 !
3 !HEIGHT = 15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6!
3 !WIDTH = 9.63, 10.0, 10.0, 9.75, 9.5, 10.0,
10.0, 10.5, 10.0, 9.5, 9.0, 8.0,
6.5, 5.0, 5.5, 7.0, 8.13, 9.0,
9.63, 10.0, 10.0, 9.75, 9.5, 9.5,
10.0, 10.5, 10.0, 9.5, 9.0, 7.5,
6.5, 5.0, 5.5, 7.0, 8.0, 9.0!
3 !LENGTH = 9.5, 8.5, 7.5, 6.5, 5.0, 5.75,
7.0, 8.13, 9.0, 9.69, 10.0, 10.0,
9.75, 9.0, 9.5, 10.0, 10.0, 10.0,
9.5, 8.5, 8.0, 6.5, 5.0, 5.5,
7.0, 8.13, 9.0, 9.63, 10.0, 10.0,
9.75, 9.0, 9.5, 10.0, 10.0, 10.0!
3 !XBADJ = -9.5, -8.5, -7.0, -5.5, -4.0, -3.5,
-3.0, -2.63, -2.28, -1.88, -1.25, -0.75,
.0, 1.0, .5, .5, .0, .0,
.0, .0, -1.0, -.5, -1.0, -2.25,
-4.0, -5.5, -6.72, -7.81, -8.75, -9.5,
-9.75, -10.0, -10.0, -10.5, -10.0, -10.0!
3 !YBADJ = -3.05, -3.69, -4.23, -4.77, -5.2, -5.57,
-5.41, -5.32, -5.06, -4.65, -3.91, -3.38,
-2.59, -1.77, -.27, .49, 1.34, 2.212,
3.71, 4.43, 4.65, 5.23, 5.13, 5.34,
```

```

5.33, 5.17, 4.37, 4.09, 3.28, 2.22,
1.25, .48, -.41, -1.32, -2.2, .0!
!END!
4 !SRCNAM = OLD2 !
4 !HEIGHT = 15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6,
15.6, 15.6, 15.6, 15.6, 15.6, 15.6!
4 !WIDTH = 9.63, 10.0, 10.0, 9.75, 9.5, 10.0,
10.0, 10.5, 10.0, 9.5, 9.0, 8.0,
6.5, 5.0, 5.5, 7.0, 8.13, 9.0,
9.63, 10.0, 10.0, 9.75, 9.5, 9.5,
10.0, 10.5, 10.0, 9.5, 9.0, 7.5,
6.5, 5.0, 5.5, 7.0, 8.0, 9.0!
4 !LENGTH = 9.5, 8.5, 7.5, 6.5, 5.0, 5.75,
7.0, 8.13, 9.0, 9.69, 10.0, 10.0,
9.75, 9.0, 9.5, 10.0, 10.0, 10.0,
9.5, 8.5, 8.0, 6.5, 5.0, 5.5,
7.0, 8.13, 9.0, 9.63, 10.0, 10.0,
9.75, 9.0, 9.5, 10.0, 10.0, 10.0!
4 !XBADJ = -9.5, -8.5, -7.0, -5.5, -4.0, -3.5,
-3.0, -2.63, -2.28, -1.88, -1.25, -.75,
.0, 1.0, .5, .5, .0, .0,
.0, .0, -1.0, -.5, -1.0, -2.25,
-4.0, -5.5, -6.72, -7.81, -8.75, -9.5,
-9.75, -10.0, -10.0, -10.5, -10.0, -10.0!
4 !YBADJ = -3.05, -3.69, -4.23, -4.77, -5.2, -5.57,
-5.41, -5.32, -5.06, -4.65, -3.91, -3.38,
-2.59, -1.77, -.27, .49, 1.34, 2.212,
3.71, 4.43, 4.65, 5.23, 5.13, 5.34,
5.33, 5.17, 4.37, 4.09, 3.28, 2.22,
1.25, .48, -.41, -1.32, -2.2, .0!
!END!

```

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

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

Source No.	Effect. Height (m)	Base Elevation (m)	Initial Sigma z (m)	Emission Rates
---------------	--------------------------	--------------------------	---------------------------	-------------------

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 No.	a 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

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 = .0 !
(in meters)

Average building height (HBL) No default ! HBL = .0 !
(in meters)

Average building width (WBL) No default ! WBL = .0 !
(in meters)

Average line source width (WML) No default ! WML = .0 !
(in meters)

Average separation between buildings (DXL) No default ! DXL = .0 !
(in meters)

Average buoyancy parameter (FPRIMEL) No default ! FPRIMEL = .0 !
(in m^4/s^3)

!END!

Subgroup (15b)

BUOYANT LINE SOURCE: CONSTANT DATA

Source No.	Beg. X Coordinate (km)	Beg. Y Coordinate (km)	End. X Coordinate (km)	End. Y Coordinate (m)	Release Height (m)	Base Elevation	Emission Rates
------------	------------------------	------------------------	------------------------	-----------------------	--------------------	----------------	----------------

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

5 = bounds (m/s) defined in Group 12
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

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

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

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

!END!

Subgroup (16b)

a
VOLUME SOURCE: CONSTANT DATA

b
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 = 0 !

!END!

Subgroup (17b)

a
NON-GRIDDED (DISCRETE) RECEPTOR DATA

Receptor No.	X Coordinate (km)	Y Coordinate (km)	Ground Coordinate (m)	Height b Elevation Above Ground (m)
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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.