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9.11 Air Quality & Greenhouse Gas Impact Assessment

Development of a data management centre at 273 Pyrmont Street, Ultimo, Sydney

Air Quality and Greenhouse Gas Impact Assessment

February, 2010

Global Switch

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Glossary

Term	Definition
MW	Megawatt.
$\mu g/m^3$	Micrograms per cubic metre.
mg/m^3	Milligrams per cubic metre.
ppm	Parts per million.
AMG	Australian Metric Grid
BOM	Bureau of Meteorology.
CO	Carbon monoxide.
CSIRO	Commonwealth Scientific and Industrial Research Organisation.
DA	Development Application
DEC	Department of Environment and Conservation
DECCW	Department of the Environment, Climate Change and Water
GS	Global Switch
US EPA	United States Environmental Protection Agency
Fugitive dust	Dust derived from a mixture of sources (non-point source) or not easily defined sources. Examples of fugitive dust include dust from vehicular traffic on unpaved roads, materials transport and handling, and un-vegetated soils and surfaces.
MW	Megawatt
NEPM	National Environment Protection (Ambient Air Quality) Measure. National Environment Protection Measures are broad framework-setting statutory instruments defined under the *National Environment Protection Council (New South Wales) Act 1995*. They outline agreed national objectives for protecting or managing particular aspects of the environment. NEPMs are similar to environmental protection policies and may consist of any combination of goals, standards, protocols, and guidelines.
NHMRC	National Health and Medical Research Council
GHG	Greenhouse gases
NO_X	Oxides of nitrogen.
NO	Nitrogen monoxide.
NO_2	Nitrogen dioxide.
PM_{10}	Particulate matter less than or equal to 10 µm in aerodynamic diameter.
PAH	Polyaromatic hydrocarbons.
$PM_{2.5}$	Particulate matter less than or equal to 2.5 µm in aerodynamic diameter.
SO_2	Sulfur dioxide
O_3	Ozone
TSP	Total Suspended Particulates.
TAPM	The Air Pollution Model.
US EPA	United States Environmental Protection Agency
HGVs	Heavy Goods Vehicles.

Executive summary

This Technical Paper assesses the potential emissions from construction and operation of a proposed data centre at 273 Pyrmont Street, Ultimo, Sydney comprising of nine gas reciprocating engines (trigeneration units) and 27 diesel fired engines (the 'Project').

The assessment has been undertaken in accordance with the guidelines presented in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*, DEC 2005.

Construction phase

The main impacts during this phase of the Project would arise from dust and combustion emissions during the construction of the Project. These potential impacts have been assessed qualitatively. This Technical Paper proposes comprehensive mitigation measures to minimise impact on the receiving environment. Implementation and adherence to these measures would ensure that potential impacts would not be significant.

Operational phase

Site-specific background data was not recorded at the project site. Hourly ambient air quality data (NO_2, O_3, CO and PM_{10}) for 2006 at the air monitoring station in Rozelle was provided by DECCW. With the exception of one 24 hour PM_{10} and one 4-hour maximum O_3 exceedance, all parameters were below the relevant air quality goals. Ambient air quality data recorded at Tumbalong Park at Mary Ann Street in Darling Harbour were also presented for comparison purposes.

A dispersion modelling assessment was undertaken to predict the impact of emissions from the Project on the receiving environment. Maximum predicted levels were modelled for NO_x (as NO_2) from the Project during continuous operation. Using the OLM approach, the results indicated that the estimated NO_2 concentrations will comply with the adopted 1-hour average DECCW goal of 246 µg/m^3 and annual average NEPM goal of 62 µg/m^3 respectively at all sensitive receptors assessed.

Sensitive receptors were assessed at ground level and at varying heights above ground level (agl) to a maximum height of 40 metres above ground level (mAGL) at the Goldsbrough apartments. The highest predicted hourly NO_x concentration of 189.6 µg/m^3 occurs at Receptor 7 (Goldsbrough Apartments) at a receptor height of 40 metres (m). The apartments are located approximately 50 m north of the Project.

Emissions from the diesel engines were not assessed quantitatively in this Technical Paper. They will only be in operation for up to 1 hour per month for testing purposes and in the unlikely event of gas and electrical network failure.

A quantitative assessment of the likely greenhouse gas emissions during operation of the Project was undertaken to determine the carbon intensity of gas and diesel fuel usage at the proposed site.

Mitigation measures for the operational phase have been proposed to ensure air quality impacts are minimised.

In summary, predicted emissions from the project are not expected to result in adverse impacts on the receiving environment during continuous operation of the gas reciprocating engines, including all considered sensitive receptors within the receiving environment.

1. Introduction

Global Switch (GS) has commissioned Parsons Brinckerhoff (PB) to assess the potential air quality impacts during the construction and operation of a proposed secondary data management centre comprising nine gas reciprocating engines (the 'Project').

Required under Part 3A of the NSW *Environmental Planning and Assessment Act* 1979 (EP&A Act), an Environmental Assessment is to be prepared for the Project.

The Project will be located adjacent to its existing facility on Harris Street in Ultimo. The two sites will have linked building services as well as access walkways and will operate as a single facility spread across two buildings. This Technical Paper has been compiled as part of a Development Application (DA) being prepared by GS.

1.1 Background

The air quality assessment has been completed in accordance with the guidelines presented in the *Approved Methods and Guidance for the Modelling of Air Pollutants in New South Wales* (DEC 2005a). Consideration has also been given to the *Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2005*, the Director General's Requirements for Global Switch Site Redevelopment (MP 08_0222) and the *Interim DECC Nitrogen Oxide Policy for Cogeneration in Sydney and the Illawarra* (2009).

The report considers the potential for off-site air quality impacts from the Project based on predictive air quality modelling. The air quality assessment focuses on the impact of potential pollutant generation during operation of the Project.

Meteorological data and model outputs are included within the appendices of this report.

1.2 Scope

The scope of work for this study was to prepare an air quality and Greenhouse Gas (GHG) impact assessment for the construction and operation of the project. The following tasks were carried out:

- All relevant existing information was collated and reviewed including site layout, boundary area, topography, location of sensitive receptors, modelling input information.
- Relevant meteorological information was obtained from the nearest Bureau of Meteorology (BoM) monitoring station and assessed with respect to its potential impact on dispersion of pollutants from the Project.
- Using the most relevant published data from the DECCW and Cross City Tunnel Project, the local air environment was characterised.
- Location and type of sensitive receptor that may be potentially affected by the Project was identified.
- Potential air emission sources for both the construction and operational phases of the Project was identified.
- Impacts (primarily dust) during the construction phase of the development were assessed qualitatively.
- NO_x (as NO_2) impacts during the operational phase were assessed quantitatively using the CALPUFF dispersion model and Ozone Limiting Method (OLM) approach.

- The predicted hourly and annual concentrations were assessed at various heights above ground level and compared to relevant air quality goals.
- Isopleths were prepared to illustrate the extent of dispersion.
- A concise statement of potential air quality impact(s) was compiled.
- Recommendations for mitigation and management of air quality impact(s) (if required) were developed.

Limitations to the scope and use of this assessment are addressed in Section 13.

2. Project description

2.1 Overview

Global Switch (GS) is proposing to develop a 6-storey above ground secondary data management centre (the Project) with three basement levels adjacent to its existing facility at 273 Pyrmont Street, Ultimo, NSW in a mixed-use zone. The Project will include the on-site electricity generation provided by nine gas reciprocating engines each producing 4.3 Megawatts (MW) of power. The proposed system is known as tri-generation which simultaneously produces electrical / mechanical energy, heat and cooling from a single heat source. This system is also known as combined heat, cooling and power (CHCP). Twenty seven 1,500kW diesel fired engines will provide emergency back-up in the event of gas and electrical network failure.

The Project will operate 24 hours per day, 365 days per year, and will also supply electricity to the adjacent Global Switch Sydney 1 facility.

2.2 Location and topographical setting

The Project site is located in the Sydney City Council jurisdiction and borders Pyrmont Street (East), Quarry Street (South), the Western Distributor / Goldsborough apartments to the north and the existing adjacent Global Switch data centre to the west respectively. Darling Harbour and the Sydney Convention and Exhibition Centre (SCEC) is situated to the east of the site and is separated by the Central to Lilyfield light rail corridor.

The site slopes at a gradient of approximately 9 per cent in a west to east direction with a fall of approximately 117 m to 107.5 m. The site is currently vacant with fencing erected along three sides.

2.3 Sensitive receptors

There are residential and commercial properties located within the vicinity of the proposed Project. The nearest sensitive land use (dwelling) is located within 50 m north and south of the proposed site.

The nearest potentially affected receptors are listed in Table 2-1 and are shown in Figure 2-1. Many of the sensitive receptors in the vicinity of the Project site are above ground level. This assessment has included receptors heights of up to 40 mAGL.

Table 2-1 Nearest potentially affected sensitive receptors to the Project site

Receptor No	Receptor heights (m)	Location	Approximate distance & vector from site boundary (m)	Co-ordinates (AMG)
1	1.5 & 3	Bristol Arms hotel on Quarry Street	40, south-west	333345, 6250089
2	1.5 & 3	4 storey apartments on Quarry Street	40, south	333362, 6250097
3	1.5, 3 & 4.5	6 storey apartments on Quarry Street	40, south	333387, 6250111

Receptor No	Receptor heights (m)	Location	Approximate distance & vector from site boundary (m)	Co-ordinates (AMG)
4	1.5 & 3	3 storey commercial building on Quarry Street	60, south-west	333314, 6250072
5	1.5 & 3	3 storey commercial building on Quarry Street	110, south-west	333273, 6250052
6	1.5	2 storey commercial on Harris Street	60, west	333301, 6250100
7	1.5, 3, 10, 15, 20, 25, 30, 35, 40	10 storey Goldsborough apartments across from Western Distributor	40, north	333284, 6250285
8	1.5, 3, 10, 15,	6 storey Goldsbrough apartments	40, north	333243, 6250264
9	1.5, 3 & 4.5	5 storey commercial / residential	90, north-west	333205, 6250274
10	1.5 & 3	2 storey residential on Harris Street	60, west	333300, 6250102

3. Adopted standards and guidelines

Relevant National and NSW ambient air quality goals are applicable to this project. Air quality reporting standards and regional goals are established to protect the health of local communities and minimise potential annoyance.

The identified national goals are based on the recommendations of the National Health and Medical Research Council (NHMRC, 1995) and the National Environmental Protection (Ambient Air Quality) Measure (NEPM, 1998) prepared by the National Environment Protection Council (NEPC). The NEPM goals are long-term reporting descriptors.

NSW ambient air quality goals are provided in the Department of the Environment and Conservation (DEC, now the Department of Environment and Climate Change and Water (DECCW)) document *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NS*W (DEC 2005a). The adopted standards/goals for this air quality assessment are presented in Table 3-1.

Table 3-1 Adopted ambient air quality goals

Pollutant	Averaging period	Goal[1]	Source[2]
Nitrogen dioxide	1 hour maximum	246 µg/m^3	NEPC, NEPM, DECCW
	annual mean	62 µg/m^3	NEPC, DECCW
Photochemical oxidants (as ozone)	1 hour maximum	214 µg/m^3	DECC, NEPM
	4 hour maximum	171 µg/m^3	DECC, NEPM

Notes:

1 ug/m^3 = micrograms per cubic metre

2 NEPM allows for no more than one exceedance in a given year

The above values are ambient air quality goals. Wherever possible, cumulative assessment of air quality impacts is required.

4. Existing air quality, meteorology and topography

4.1 Referenced data

Air quality data and meteorological conditions have been referenced from a combination of Bureau of Meteorology (BoM), and DECCW measured and synthetically compiled (CSIROs (The Commonwealth Scientific and Industrial Research Organisation) The Air Pollution Model (TAPM)) data. The following data sets have been adopted within this Technical Paper:

- BoM Sydney (Observatory Hill) Station (066062), -33.86S, 151.21E: meteorological conditions (1858-2010).
- CSIRO TAPM compiled meteorological conditions for Ultimo (2006), coordinates of 333219 mE, 6249998 mN: four nesting grids of 30 kilometres (km), 10 km, 3 km and 1 km.
- DECCW (33deg 51 min 57sec S and 151deg 09min 45sec E) Rozelle air monitoring station: carbon monoxide (CO), nitrogen dioxide (NO_2), PM_{10} and ozone (O_3) concentrations for 2006.
- Tumbalong Park and Mary Ann Street Park air monitoring stations (Darling Harbour) as part Cross City Tunnel project: carbon monoxide (CO), nitrogen dioxide (NO_2) and $PM_{10.}$

The data set compiled is considered suitable for the purposes of this assessment.

4.2 Existing ambient air quality

Based on a review of existing land-uses in the vicinity of the Project area, the existing air quality is considered characteristic of an urban environment. There are several sources that may be contributing to the Project region as discussed below.

4.2.1 Regional sources

A search of the National Pollution Inventory database (NPI) 2007 – 2008 indicated seven industrial sources reporting emissions to the Sydney Local Government Area (LGA). Reporting was carried out for a total of 24 substances from seven sources. No diffuse data was collected for this region. It was noted that the industrial facilities that reported to the NPI were located in the suburbs of Alexandria, Mascot and Rosebery only. Based on the information provided in the NPI report, ambient air quality levels for the local or regional air sheds are not expected to be adversely influenced by existing industrial sources.

4.2.2 Local sources

There are no industrial air emission sources in the immediate vicinity of the Project area. A number of non-industrial air emission sources in the Project area have the potential to influence the local air shed to varying degrees. These include but are not limited to:

- Emissions from vehicles on the surrounding road network e.g. Western Distributor, Harris Street and Pyrmont Street
- Ferries in nearby Darling Harbour
- Emissions from other combustion sources.

Depending on the management of air emissions, these sources are likely to give rise to emissions of particulate matter (Total Suspended Particulates (TSP), PM_{10} and $PM_{2.5}$), oxides of nitrogen, sulphur dioxide, carbon monoxide, Volatile Organic Compounds (VOCs) including air toxics, heavy metals and Polyaromatic Hydrocarbons (PAHs).

4.2.3 Referenced background air quality

The existing air quality for the study area is considered to be characteristic of an urban environment. With the exception of traffic, no known major pollutant generating facilities are located within the immediate locality.

Sufficiently detailed background air quality data is not currently available (PM_{10}, NO_2, or CO levels) for the study area. No historical information was available and no site-specific monitoring was undertaken. Air quality monitoring data provided by DECCW (Rozelle air monitoring station) was therefore adopted to estimate existing background levels at the study area. Air quality monitoring data for the Cross City Tunnel Project was also included for comparison purposes.

Rozelle Air Monitoring Station

The Rozelle air quality monitoring station is located in the grounds of Rozelle Hospital, off Balmain Road, Rozelle. It is situated in a residential area in the Parramatta River valley at an elevation of 22 m. It is situated within the DECCW's Sydney region.

Table 4-1 Background levels at Rozelle air monitoring stations for 2006

	Pollutant – Rozelle Air Monitoring Station (2006)								
	CO (ppm) [1]		**NO_2 (pphm)** [1]		**PM_{10} ($\mu g/m^3$)** [1]		**O_3 (pphm)** [1]		
Month	**Max 1 Hr**	**Max 8 Hr**	**Hourly Average**	**Maximum 1-hour**	**Hourly Average**	**Maximum 24-hour**	**Hourly Average**	**Maximum 1-hour**	**Maximum 4-hour**
Jan	0.7	0.5	1.4	2.3	23	50	1.5	6.8	5.8
Feb	0.9	0.5	1.9	3.9	24	38	1.7	9.3	8.2
Mar	1.5	0.8	2.0	3.3	21	36	1.5	4.8	4.6
April	2.0	1.4	1.6	4.2	21	33	1.3	4.9	4.3
May	3.1	1.7	1.8	4.4	20	31	1.0	3.6	2.9
June	2.9	2.1	1.8	5.2	20	39	1.1	3.7	3.5
July	2.2	1.6	1.7	3.7	16	32	0.9	2.9	2.9
Aug	2.3	1.5	1.8	4.4	19	28	1.2	3.6	3.5
Sept	1.6	0.9	1.5	5.0	21	50	1.8	4.4	4.1
Oct	1.0	0.6	1.2	4.4	23	31	2.1	6.9	6.3
Nov	1.0	0.8	1.1	5.7	25	52	2.1	8.6	7.6
Dec	0.8	0.6	0.9	4.3	21	32	1.7	6.6	5.6
NSW Goal	***25***	***9***		***12***		***50***		***10***	***8***
Peak	3.1	2.1		5.7		52		9.3	8.2

Note 1: Carbon monoxide (CO), nitrogen dioxide (NO_2), PM_{10}: particulate matter with an aerodynamic diameter of less the
10 microns, ozone (O_3)
$\mu g/m^3$ = micro grams per cubic metre, ppm = parts per million, pphm = parts per hundred million
Note 2: Blue indicates an exceedance of the DECCW air quality goals

- CO

At the Rozelle location (2006), maximum eight hour averages were within the range of 0.5 – 2.1 ppm. The maximum 1 hour (3.1 ppm in May) and 8 hour (2.4 ppm in June) CO levels recorded are below their respective air quality goals.

- NO_2

NO_2 was recorded at the Rozelle location during 2006. The maximum 1-hour NO_2 concentration (5.7 pphm) recorded in November was below its DECCW air quality goal.

- PM_{10}

PM_{10} was recorded at the Rozelle location during 2006. The maximum 24-hour results indicate an exceedance of the 50 µg/m^3 limit value during November (52 µg/m^3). Elevated PM_{10} levels were also recorded in January and September (50 µg/m^3). These exceedances may have been due to windblown dust.

- O_3

At the Rozelle location (2006), the maximum 4-hour ozone goal of 8 pphm was exceeded during February (8.2 pphm). The highest maximum 1-hour level of 9.3 pphm also occurred in February. In general, the highest ozone levels were recorded in the summer months as expected. This indicates that photochemical oxidants such as ozone are being formed via a complex photochemical reaction involving the oxides of nitrogen, Volatile Organic Compounds (VOCs) and sunlight.

Cross City Tunnel Project

Ambient air monitoring has been conducted from September 2005 to date in the Darling Harbour area as part of the Cross City Tunnel Project at two locations. Air monitoring stations are located at Tumbalong Park situated approximately 250 m east of the proposed Project and the Mary Ann Street Park (MASP) situated 600 m south of the Project. The stations are located in an urban environment and emissions from traffic travelling through the Cross city Tunnel and the surrounding road network are considered to be the main sources of air pollution.

The pollutant levels recorded at the two air monitoring station are expected to be of similar magnitude to those at the Project site.

Ambient air quality data for the Darling Harbour air monitoring stations is presented in Table 4-2.

Table 4-2 Background levels at Tumbalang Park and Mary Ann Street park monitoring stations for 2006

	CO (ppm)			NO_2 (pphm)[2]	PM_{10} (µg/m³)[2]	
	Average 8 hour	Maximum 8-hour	Hourly Average	Maximum 1-hour	Average 24 hour	Maximum 24-hour
	TP / MASP[1]	TP / MASP	TP / MASP	TP / MASP	TP / MASP	TP / MASP
Jan 06	0.16 / 0.12	0.37 / 0.36	2.0 / 1.7	3.3 / 2.8	25.5 / 21.0	118.0 / 38.3
Feb 06	0.25 / 0.22	0.51 / 0.50	2.6 / 2.3	7.5 / 5.5	21.5 / 21.5	33.1 / 31.8
Mar 06	0.47 / 0.27	0.96 / 1.01	2.5 / 2.5	4.6 / 4.5	22.4 / 21.3	37.3 / 37.8
Apr 06	0.66 / 0.44	1.09 / 1.20	3.3 / 3.2	5.3 / 5.7	19.7 / 19.3	35.1 / 37.6
May 06	0.85 / 0.82	1.61 / 1.83	3.1 / 3.1	4.4 / 4.1	16.8 / 17.2	27.9 / 27.9
June 06	1.20 / 1.44	2.46 / 3.88	3.1 / 3.2	4.2 / 4.7	16.2 / 16.2	25.4 / 26.5
July 06	1.09 / 1.27	2.18 / 2.63	3.2 / 3.2	4.1 / 4.0	15.9 / 16.2	29.6 / 31.5
Aug 06	1.11 / 1.29	2.54 / 3.17	3.6 / 3.6	4.6 / 4.6	18.8 / 18.5	27.9 / 27.3
Sep 06	0.71 / 0.57	1.24 / 1.66	3.4 / 3.2	5.4 / 5.2	21.4 / 23.2	43.0 / 42.1
Oct 06	0.55 / 0.28	1.03 / 1.04	3.0 / 2.9	4.5 / 4.8	23.7 / 23.5	33.0 / 34.7
Nov 06	0.59 / 0.27	1.51 / 1.29	3.0 / 2.5	8.4 / 4.4	24.8 / 22.9	60.3 / 37.8
Dec 06	0.50 / 0.18	0.91 / 0.59	2.3 / 2.1	4.8 / 4.9	23.5 / 23.6	51.9 / 51.2
DECCW /NEPM Goal **(µg/m³)**	**-**	**9**		**12**	**-**	**50**
Peak		3.88		8.4		118.0

Note 1 TP: Tumbalong Park, MA SP: Mary Ann Street Park
Note 2 Carbon monoxide (CO), Nitrogen dioxide (NO_2), PM_{10}: particulate matter with an aerodynamic diameter of less the 10 microns
µg/m³ = micro grams per cubic metre, ppm – parts per million, pphm = parts per hundred
Note 3 Blue indicates an exceedance above air quality goals

Some general comments on the results in Tables 4-2 are presented below:

- CO

At the Tumbalong Park and MASP locations (2006), maximum eight hour averages were within the range of 0.36 – 3.88 ppm and are well below the air quality goal of 9 ppm.

- NO_2

NO_2 was recorded at Tumbalong Park and MASP locations during 2006. The maximum 1-hour NO_2 concentrations recorded were below the DECCW air quality goals.

- PM_{10}

PM_{10} was recorded at Tumbalong Park and MASP locations during 2006. The maximum 24-hour results indicate exceedances of the 50 µg/m³ limit value in January, November and December at Tumbalong Park and in December at MASP. The maximum exceedance was at 118.0 µg/m³ recorded at Tumbalong Park in January. These exceedances may have been due to windblown dust.

Ozone was not measured at the Tumbalong Park and MASP locations in 2006.

Comparison of results

Analysis of the air monitoring results from the Rozelle and Darling Harbour air monitoring stations indicates that the levels at Darling Harbour are on average higher. The maximum 8-hour CO concentrations at Rozelle range from 0.5 – 2.1 ppm. At the TA / MASP stations levels range from 0.36 – 3.88 ppm. The maximum 1 hour NO_2 levels range from 2.6 – 5.7 pphm and 2.8 – 8.4 pphm at the TP / MASP stations. The highest 24 hour PM10 concentrations ranged from 28 – 52 µg/m³ at Rozelle and 25.4 – 118 µg/m³ at TA / MASP stations.

Ambient air quality concentrations at the Darling Harbour stations may be higher due their location in an urban environment and concentrations due to a combination of emissions from the Cross City Tunnel and a busy surrounding road network such as the Western Distributor. Rozelle is located in the grounds of Rozelle Hospital which is removed from the direct impact of emissions along Balmain Road. It's also located in a suburban environment where traffic levels are not expected to be as concentrated as in the Darling Harbour area.

The air monitoring results at the Rozelle air monitoring station have been adopted for this assessment due to the availability of hourly NO_2 and O_3 data for 2006.

4.3 Meteorology

Air quality impacts are influenced by regional meteorological conditions, primarily in the form of gradient wind flow regimes, and by local conditions, generally driven by topographical features in the form of drainage flows. Topography, wind speed and wind direction all affect the potential dispersion and transport of plumes. Regional and local dispersion meteorology at the project site has therefore been defined.

4.3.1 BoM Sydney (Observatory Hill) Meteorological data

Historical meteorological data from the BoM station at Sydney (Observatory Hill) is presented in Table 4-3. This station is currently operational and is located approximately 2 km east of the Project. With the exception of local meteorological variations, the presented data is considered to be representative of the Project site.

Table 4-3 Historical meteorological data at Sydney (Observatory Hill) BoM Station

Parameter	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Ann.
Sydney (Observatory Hill) – Lat: 33.86S, Long: 151.21E													
Mean max temp (°C)[1]	25.9	25.7	24.7	22.4	19.4	16.9	16.3	17.8	20.0	22.1	23.6	25.2	21.7
Mean min temp.[1]	18.7	18.8	17.5	14.7	11.5	9.3	8.0	8.9	11.1	13.5	15.6	17.5	13.8
Mean rainfall (mm)[2]	102.0	117.9	129.4	126.4	120.7	130.6	97.3	81.2	69.1	77.6	83.1	77.8	1212.3
Highest daily rainfall (mm)[3]	191.0	243.6	280.7	191.0	212.3	150.6	198.1	327.6	144.5	161.8	234.6	126.0	327.6
Mean 9 am rel. hum.[4] (%)	71	74	74	72	73	74	71	66	62	61	66	67	69
Mean 3 pm rel. hum.[4] (%)	62	64	62	59	57	57	51	49	51	56	58	59	57
Mean 9 am wind speed[5](km/hr)	8.6	8.2	7.9	8.8	10.5	11.9	13.1	13.3	12.4	12.2	11.0	9.8	10.6
Mean 3 pm wind speed[6] (km/hr)	17.9	16.8	15.2	13.8	12.7	13.6	15.3	17.6	18.3	19.1	19.4	19.5	16.6

Note 1: Data from 1859–2009, Note 2: Data from 1858-2009, Note 3: Data from 1858–2010, Note 4: Data from 1955–2009, Note 5: Data from 1955-1992, Note 6: Data from 1955-1991

Rainfall

The majority of rainfall at Sydney (Observatory Hill) falls in the months of midsummer, autumn and early winter (i.e. January to June), with June being the wettest month. Mean monthly rainfall levels ranged from 69.1 millimetres (mm) in September to 130.6 mm in June.

Average annual rainfall is 1212.3 mm, which falls over approximately 143.4 days throughout the year. Highest daily rainfall over the period of operation is also recorded. Analysis of the results has indicated that the highest daily rainfall amounts occurred across all four seasons. Highest daily rainfall from data presented in Table 4-3 range from 126.0 mm (December) to 327.6 mm (August) at the Sydney (Observatory Hill) meteorological station.

Temperature

Mean maximum monthly temperatures for the region range from between 16.3^{o}C in July to 25.9^{o}C in January. Mean minimum monthly regional temperatures range between 8.0^{o}C in July to 18.8^{o}C in February.

Humidity

The relative humidity (RH) levels are consistently higher at 9 am than at 3 pm. Generally, relative humidity is lowest in late winter and spring (i.e. August to November), and highest during midsummer to early autumn (January to March). Maximum RH levels (74%) occurred in February, March and June (9 am data set) and the lowest in August (49%).

Wind speed

Reference to wind speed data collected by the Bureau of Meteorology listed in Appendix A indicates that the lowest morning wind speeds occur in the months of summer to mid autumn (i.e. December to April) and are highest in the months of winter and spring. The lowest afternoon wind speeds occur in mid-autumn and early winter (i.e. April to June) and are highest in the months of mid-spring and early summer (i.e. October to December). The data also shows that 3 pm mean wind speeds are stronger than 9 am wind speeds.

The lowest mean 9 am and 3 pm wind speed recorded was 7.9 km/hr during March, and the highest mean 9 am and 3 pm wind speed being 19.5 km/hr during the month of December.

Wind direction

Regional wind flow gradients from 01 January 1955 to 01 May 1992 is provided in Appendix A. Annual wind flow patterns indicate predominant wind flows from the west for the 9 am data set and the east for the 3pm data set. The noted flow regimes were present throughout autumn, winter and late spring for the 9am data set and mid spring, summer, and mid autumn for the 3pm data set. Review of the annual wind rose data indicates that for the 9 pm data sets the wind direction changes to a southerly/easterly and for the 3 pm data set the wind direction changes to a westerly/southerly direction. Of 13,502 annual observations, the 9 am data set showed 13 per cent calm conditions and of the 13,347 observations, 3 per cent calm conditions were observed for the 3 pm data set.

4.3.2 TAPM generated meteorological data

TAPM is a three dimensional prognostic meteorological model developed by the CSIRO and uses databases of terrain, vegetation, soil type, sea surface temperature and synoptic scale meteorological analyses for Australia as derived by the Bureau of Meteorology.

A site-representative regional meteorological data file was configured for the project site. The data was based on 2006 conditions for temperature, wind speed and wind direction. Eight thousand seven hundred and sixty valid hours were present in the configured data.

Wind roses have been generated for 2006 using the site representative TAPM derived data, presented in Appendix B. The prevailing wind direction varied from easterly to north-easterly and westerly to south-westerly. This is generally consistent with a predominantly easterly and westerly wind flow for the 9am and 3pm Sydney (Observatory Road) data set. For the spring months and some of the autumn months (March), south-easterly directions were also prevalent. Of the 8760 observations for 2006, calm conditions were recorded for less than 1 per cent of the time. Calm conditions based on the Beaufort scale can be defined as wind speed of less than 0.5 metres per second and where smoke rises vertically (Beaufort Number 0).

Worst case dispersion conditions from the site (least dispersion) would normally be associated with F-class stability conditions — still/light winds and clear skies during the early morning period (less than 3/8 cloud cover at night).

Analysis of the referenced site-specific meteorological data indicates that F-class dispersion conditions were present for less than 1 per cent of the time for 2006.

The meteorological CALMET input file is considered representative of the wind climate and wind direction events at the proposed Project site and in the study region in general. Over 8,760 wind speed and wind direction data were obtained ensuring that worse case conditions were adequately represented in the model predictions. With the exception of local meteorological variations, the presented data is considered to be representative of the Project site and the study region in general.

4.4 Topography

When assessing the impact potential from a ground level source of air pollutants, it is important to consider local drainage flows. The movement of cold air down a slope (generally under stable atmospheric conditions) is referred to as katabatic drift and can result in plume entrapment and poor dispersion of air borne pollutants and the potential to cause greater off-site impacts. Katabatic drift would follow the topography of the site.

The site slopes at a gradient of approximately 9 per cent in a west to east direction with a fall of approximately 117 m to 107.5 m. Due to both the heights of the adjacent buildings (Global Switch building 1 and the Goldsbrough Apartments) and the location of the emission points (approximately 35 mAGL), topography is not expected to influence the dispersion of emissions from the proposed Global Switch 2 building.

5. Air emission sources

There are two phases of the Project that have the potential to affect air quality:

- Construction phase
- Operation phase.

5.1 Construction phase

5.1.1 Dust emissions

The impact of a fugitive dust source on air quality primarily depends on the quantity and drift potential of the dust particles injected into the atmosphere. In addition to the larger dust particles that settle out near the source (often creating a local nuisance problem), fine particles are also emitted and dispersed over much greater distances.

Dust emission sources that could result during project construction have been identified as:

- Vehicle movements on paved and unpaved roads
- erosion of stockpiles and freshly exposed areas on-site
- handling, transfer and storage of materials
- heavy earthwork operations such as excavation and earth moving activities
- re-contouring of land and soil exposure for reseeding.

The types and numbers of machinery used during the construction phase will be detailed in the Construction Environmental Management Plan (CEMP).

It has been assumed that construction work will be undertaken during the daytime only, with dust generating potential limited to short-term periods of greater intensity activity.

5.1.2 Vehicle emissions

Emissions are likely to be associated with the combustion of diesel fuel and petrol. The operation of on-site machinery during construction and general site operations would generate CO, carbon dioxide (CO_2), NO_X, SO_2 and trace amounts of non-combustible hydrocarbons. Emission rates and impact potential depend on the number and power output of the combustion engines, the quality of the fuel and the condition of the combustion engines.

Slight odours may be detectable close to the emission source(s). However, based on the setting of the project site, the likely ambient air quality characteristics, low population density, limited number of emission sources and transient nature of odorous emissions, adverse impacts are not expected. Exhaust emissions from mobile sources have not therefore been considered further with regard to air impact predictions.

5.2 Operation phase

The main air emission sources during operation phase of the project include:

- Emissions from the nine tri-generation units
- Emissions during the testing of the 27 emergency diesel fired engines
- Emissions during the operation of the 27 emergency diesel fired engines. They will only run in the unlikely event of gas and electrical network failure
- Miscellaneous sources such as traffic emissions.

5.2.1 Gas reciprocating engine emissions

Emissions from the 9 gas reciprocating engines will be released to atmosphere during continuous operation. The primary emissions from the gas reciprocating engines are expected to include the oxides of nitrogen and to a lesser extent carbon monoxide. Trace levels of sulphur dioxide, particulate matter (PM_{10}) and air toxics (benzene, toluene, xylenes, formaldehyde and polyaromatic hydrocarbons (PAHs)) are also expected to be emitted during normal operation.

Emissions of NO_X (as NO_2) only have been assessed quantitatively as part of this technical assessment.

5.2.2 Diesel fired engine emissions

Ancillary sources, such as emergency diesel engines will also be installed to provide emergency power in the event of gas or electrical network failure and during periodic generator testing. Twenty-seven 1500kW diesel engines are proposed and will be tested over a period of one hour each month. Approximately 400,000 litres of diesel will be stored on-site equivalent to 48 hours of consumption.

Emissions from the engines are expected to include oxides of nitrogen, particulate matter, sulphur dioxide, carbon monoxide and air toxics (benzene, toluene, xylenes and formaldehyde).

5.2.3 Miscellaneous emissions

Emissions are anticipated to arise from the combustion of diesel and petrol fuel from employee and visitor cars, delivery trucks and HGVs entering and leaving the Project. The number of vehicles entering and leaving the site is expected to be low and emissions are not considered to be of significance and have not been considered any further in this Technical Paper.

In addition, low levels of Volatile Organic Compounds (VOCs) are anticipated through breathing losses from the diesel storage tanks.

6. Air dispersion modelling characteristics & inputs

6.1 CALPUFF model

CALPUFF (Version 6.4.5_27_2008) is a multi-layer, multi-species, non-steady state Gaussian puff dispersion model that simulates the effects of time and space-varying meteorological conditions on pollutant transport. Puff models represent a continuous plume as a number of discrete packets of pollutant material. CALPUFF is a transport and dispersion model that advects 'puffs' of material emitted from modelled sources, simulating dispersion and transformation processes along the way.

CALPUFF has been listed in the DECCW *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC 2005) as an advanced dispersion model for specialist applications. It can also be used in situations involving complex flow and non-steady state cases.

For the purposes of this assessment, the CALPUFF model has predicted the one-hour and annual average pollutant NO_x (as NO_2) concentration at each receptor specified, for each hour of the year's (2006) meteorological data.

6.2 Model justification

CALPUFF has the capability of computing ground level and above ground level concentrations at discrete and grid receptor locations in the following applications:

Complex terrain, non-steady state conditions. CALPUFF is a non-steady state Gaussian puff dispersion model that simulates the effect of terrain on ground-level concentrations in the following ways:

1. adjustment of the wind field to large scale terrain features (using CALMET)
2. simulation of puff terrain iteration for distinct features too small to influence the large scale wind field
3. 'simplified' treatment for puff-terrain interaction with both large and small scale features.

This allows CALPUFF to respond to the presence of terrain on two scales. Complex terrain is not a feature of the proposed site.

Coastal effects such as fumigation - There are important differences in the structure of land and water boundary layers which can have significant effects on plume dispersion in costal environments and over water. The CALMET model uses techniques based on air-sea temperature difference, wind speed and specific humidity to determine overwater mixing height, stability and surface layer parameters to the parts of the modelling domain over water. The puff model formulation is well-suited to accommodate rapid changes in the dispersion characteristics in the coastal transition zone which can significantly affect the ground level concentrations from coastal sources. In this instance, the subject site may be influenced by coastal effects on a regular basis. Coastline data and coastal weather effects are included in the CALMET model.

High frequency of stable and calm night-time conditions - CALMET can handle meteorological conditions of wind speeds less than 1 m/s whereby a default calm threshold speed is identified during periods when transport distances are minimal but not zero. Under these conditions, several adjustments are made to the normal algorithms and alter the way gradual rise is addressed, how near-source effects are simulated and the way puff size changes during each sampling step. These adjustments are consistent with the conceptual model in which fresh releases rise virtually straight up from a source and disperse as a function of time due to wind fluctuations about a mean of zero, while existing emissions stagnate and disperse as a function of time due to wind fluctuations about a mean of zero. Calm and light wind conditions are not a significant feature of the meteorological conditions at the proposed site.

Inversion break-up fumigation conditions - This process occurs when pollutants emitted above the inversion layer during the night are fumigated down to the ground. Inversion break-up fumigation is often associated with very high pollutant concentrations at some distance from the source. This process is fairly transient, taking place over tens of minutes and typically during mid-morning. The CALPUFF model incorporates algorithms to enable it to predict maximum concentrations during inversion break-up.

6.3 Model characteristics

6.3.1 Meteorological input data

The CALPUFF model utilises CALMET a three dimension meteorological model for the prediction of pollutant transport from source to receptor. Terrain, land use and surface and upper air meteorological data are input into the CALMET model. This data is then used to create a model of air movement within the modelling grid domain at surface and upper air levels over a calendar year period.

The CALMET data file is considered representative of the wind climate and wind direction events at the Project site and in the study region in general. Over 8,000 wind speed and wind direction events were obtained, ensuring worst case conditions were adequately represented in the model predictions.

6.3.2 Terrain effects

When assessing the impact potential from a ground level source of air pollutants, it is important to consider local drainage flows. The movement of cold air down a slope (generally under stable atmospheric conditions) is referred to as katabatic drift and can result in plume entrapment and poor dispersion of air borne pollutants and the potential to cause greater off-site impacts. Katabatic drift would follow the topography of the site.

Terrain effects have been included as part of this assessment utilising GTOPO30 data. GTOPO30 is a global digital elevation model (DEM) with a horizontal grid spacing of 30 arc-seconds (approximately 1 kilometre). It was derived from several raster and vector sources of topographic information.

6.3.3 Building downwash

Building downwash occurs when the aerodynamic turbulence, induced by the presence of nearby buildings, cause pollutants emitted from an elevated source to be mixed rapidly toward the ground (downwash). This often results in higher ground-level concentrations.

Due to the nature and location of the buildings with respect to the nine gas turbine emission points, the potential for building downwash following pollutant emission was evaluated using the Prime Plume Rise and Building Downwash Model. The position and dimension of each building relative to each source was identified for every 10^o wind flow. Buildings within an area of 5L from the source, where L is the lesser of the building height or projected building width were considered for downwash affects.

The model was constructed and processed, the output of which was included in the CALPUFF model. 19 buildings in the surrounding locality were included in the model including:

- Global Switch 1 building
- Goldsbrough apartments
- Buildings on Harris Street
- Buildings on Quarry Street.

6.3.4 Cartesian grid and site plan

A grid size of 14 kilometres square was utilised for the initial CALMET model established for the region. The larger scale meteorological model is established to take into account regional terrain and coastal effects. The south western corner of the CALMET model domain was located approximately 10 kilometres to the south west of the site at 323200m, 6240000m.

A CALPUFF modelling domain of 14 km by 14 km was established for the subject site with 1 km grid spacing and a nesting factor of 1. The grid was used to assess the extent of dispersion of emissions during operation. A site layout map provided by the client was used as the template for the source locations. The south western corner of the model domain was set at 323200 m, 6240000 m.

Fifty-seven discrete (sensitive) receptors were also included in the grid. These receptors represented locations to which people may be exposed to emissions from the Project and the heights ranged from ground level (1.5 m) to a maximum height of 40 m (at the Goldsbrough apartments).

6.3.5 Modelling scenarios

Based on information supplied by GS, the following scenarios were assessed.

Table 6-1 Modelling scenarios and pollutant modelled

Scenario	Pollutants	Averaging period
1	NO_x (as NO_2)	1 hour
2	As above	Annual

The model runs for NO_x (as NO_2) are consistent with air quality goals presented in Section 3 of this report (Table 3-1).

6.3.6 Model input parameters

Table 6-2 presents the input data for the turbine emission stacks.

Table 6-2 Modelling input data for turbine emission points

Parameter	Turbine emission point[1]	
Stack diameter (m)	0.9	
Release height above roof (m)	2.4	
Number of emission points[3]	7[2]	2[2]
Emission temperature (k)	433	710
Efflux velocity (m/s)	11.6	19.0
Volume flow rate (m3/s) at stack gas conditions	7.38	12.10
NOx (as NO2) mass emission (g/s)	0.37	0.60
Periods of operation	Continuous (24 hours a day)	

Notes:

1 Based on data provided by Global Switch

2 7 of the turbine units operate at a temperature of 433K and 2 units operate at a temperature of 710K and higher velocity and mass emission rate.

3 Stack locations include: 333319, 6250244; 333321, 6250238; 333324, 6250231; 333327, 6250225; 333329, 6250218; 333355, 6250158; 333357, 6250151; 333360, 6250145; 333363, 6250137

6.3.7 Modelling assumptions

The following general assumptions were made for this study:

- the gas reciprocating engines are assumed to be operating continuously
- location of gas reciprocating engines provided by the client
- stack and building heights supplied by the client
- all other modelling input information provided by the client.

6.3.8 NO_X to NO_2 conversion

There are various methods for estimating NO_2 concentrations from model predictions of NO_x as the plume is emitted from the turbine emission points. The simplest is to assume that all of the NO_X emitted from the gas reciprocating engines is present as NO_2. This is an extremely conservative approach and not likely to occur in reality. A more refined approach is therefore necessary and one of the more common methods, the Ozone Limiting Method (OLM) is described below.

Ozone Limiting Method

The USEPA has developed the Ozone Limiting Method (OLM) in the determination of NO_2 in the NO_x mix. This method assumes that all of the available ozone in the atmosphere will react with NO instantly to produce NO_2. In reality this reaction takes place over a number of hours. Based on this assumption when there is a low concentration of ozone, only small amounts of NO_2 will be produced and conversely when there are high levels of ozone, high concentrations of NO_2 will be formed. While this method will over-estimate the production of NO_2, it provides a useful yet simple means of estimating a more realistic upper bound on the NO_2 concentration.

The NSW *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DEC, 2005)* provides guidance in the determination of NO_2 using the OLM method. The DECC provides two levels of assessment using this method — Level 1 and Level 2. A Level 1 assessment uses maximum predicted NO_x and maximum background NO_2 and O_3 data to estimate the NO_2 concentration. This is considered to be a conservative estimate and has not been developed further in this report. A Level 2 assessment requires contemporaneous hourly NO_2 and O_3 data for every hour of the modelling period and uses the predicted NO_X concentration with background O_3 and NO_2 data.

The ozone limiting method has the form of the equation shown below:

$$[NO_2]_{total} = \{0.1x[NO_X]_{pred}\} + MIN\left\{(0.9)x[NO_X]_{pred}\ or \left(\frac{46}{48}\right)x[O_3]_{bkgd}\right\} + [NO_2]_{bkgd}$$

Source: DEC (2005a).

The Level 2 method has been used to estimate the NO_2 concentrations for all sensitive receptors considered in this assessment.

6.3.9 Emission limits

Emissions from the gas reciprocating engines

The main emissions from the nine gas reciprocating engines will be NO_x (as NO_2). DECCW have published an *Interim DECC Nitrogen Oxide Policy for Cogeneration in Sydney and the Illawarra, 2009* which provides guidance on emission limits from proposed cogeneration and trigeneration plants. The purpose of this document is to assist proponents in demonstrating there will be no adverse impact on human health or the environment from these proposals.

NO_x emission limits for gas reciprocating engines in the Sydney Metropolitan area have not been set out in this document. However, further to a meeting on 16 December 2009 with DECCW representatives (Andrew Mattes and Janelle Pickup), it was established that the preferred NO_x limit for Sydney is 50mg/m^3 throughout the year. This emission limit was adopted for this assessment to demonstrate compliance with the NO_x (as NO_2) ambient air quality goal.

An emission limit of 250mg/m^3 was originally proposed for the gas reciprocating engines. However, dispersion modelling results indicated exceedances at some of the elevated sensitive receptors e.g. Goldsbrough apartments.

Emissions from the diesel engines

The 27 diesel engines will be tested once a month and are not subject to emission limits during the testing program. In the event of gas and electrical network failure, operation of the diesel engines will be required to comply with a NO_x emission limit of 90mg/m^3 in accordance with the *Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2005*. This emission limit applies to '*any turbine operating on a fuel other than gas, being a turbine used in connection with an electricity generating system with a capacity of 30MW or more*'.

7. Potential air quality impacts

7.1 Prediction method

Air quality impacts from the proposed Project have been quantitatively assessed using the CALPUFF modelling software package. Indicative background data presented in Section 4.2.3 was adopted for the purposes of this assessment. This data was used to determine the cumulative impact of NO_x concentrations at the nearest sensitive receptors and compare the results to air quality goals. This approach is considered to be consistent with the approach of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, DEC 2005.*

7.2 Construction phase

Conservative estimates of dust generating potential have been primarily based on guidance provided in the US EPA document *AP-42 Compilation of Air Pollutant Emission Factors* (1995). Emission factors applied relate to the dust generating potential for varying sources and modes of operation.

Predicted dust impacts

An indicative breakdown of anticipated sources and dust generating activities follows:

- Dust from loading aggregate material onto trucks may result in emission rates of 0.04 kilograms per tonne Total Suspended Particulates (TSP) and 0.01 kilograms per tonne (PM_{10}). The loading of 10 by 15 cubic metre capacity trucks over a 10 hour working day would result in a total of 150 cubic metres, or approximately 300 tonnes, of material per day. Dust generation from truck loading would therefore be expected in the range of 12.0 kilograms (TSP) to 3.0 kilograms (PM_{10}) per day.
- Operation of a bulldozer may result in emission rates of 2.3 kilograms per hour (TSP) and 0.5 kilograms per hour (PM_{10}). During a typical 10 hour working day, dust generation from bulldozer operation would be expected in the range of 23.0 kilograms (TSP) to 5.0 kilograms (PM_{10}) per day.
- Emissions of dust from movement of vehicles on unsealed roads have been calculated at values of 1.4 kilograms per vehicle per kilometre (TSP) and 0.5 kilograms per vehicle per kilometre (PM_{10}). Two vehicle movements per hour, at an average of 500 m per movement, may be expected to result in dust generation of 14 kilograms per day (TSP) to 5 kilograms per day (PM_{10}) over a 10 hour working day.
- Wind erosion from exposed surfaces may occur from disturbed areas of 200 by 200 m. Dust entrainment rates from exposed surfaces vary with (among other things) wind gusts, threshold wind speeds, friction velocities, precipitation events, silt loadings and the number of disturbances that restore the erosion potential. Assuming a silt content of 11 per cent, 50 days of precipitation and 30 per cent of hourly wind events above 5.4 m/s, dust emissions from exposed surfaces could be expected to range between 0.04 kilograms per hectare per hour (TSP) to 0.02 kilograms per hectare per hour (PM_{10}) (NSW Minerals Council *Particulate Matter and Mining Interim Report* 2000). Over a 10 hour working day, dust generation from exposed surfaces may be expected between 0.8 kilograms (TSP) to 0.4 kilograms (PM_{10}).

From the above, the worse-case total dust levels generated over a 10 hour construction day have been predicted between 50 kilograms (TSP) to 14 kilograms (PM_{10}). Although the qualitative assessment cannot confirm compliance with current air quality goals, anticipated levels of particulate matter impact potential are not considered excessive. Received impact levels would be expected to decrease significantly with distance from the source. Negligible dust impacts from construction activities are anticipated beyond 200 m from the dust generating activity.

Mobile vehicular emissions

The operation of on-site machinery, Heavy Goods Vehicles (HGVs), cars and delivery vehicles during the construction works and general site operations would generate CO, CO_2, NO_x, oxides of sulphur and trace amounts of non-combustible hydrocarbons.

Emission rates and impact potential depend on the power output of the combustion engines, the quality of the fuel and the condition of the combustion engines. The construction contractor and site management would ensure that all equipment does not release smoke in contravention of Section 124 of the *Protection of the Environment Operations Act 1997*.

On this basis, emissions from construction vehicles and plant are unlikely to result in air quality impacts, and are not considered further.

7.3 Operation phase

Predicted emissions from the gas turbine units have been assessed using the OLM method. A sample CALPOST output file is presented in Appendix C.

7.3.1 Assessment of nitrogen dioxide using the ozone limiting method

A Level 2 OLM assessment has been undertaken in accordance with DECCW (Department of Environment, Climate Change and Water) guidelines (DEC 2005). Two scenarios were assessed to estimate the hourly and annual NO_2 levels:

- Maximum predicted hourly NO_x concentration with measured hourly NO_2 and O_3 levels for that hour (Scenario 1). This is known as a contemporaneous assessment.
- Annual average NO_x concentrations with annual average NO_2 and O_3 levels (Scenario 2).

The results of NO_2 predictions using the OLM approach are outlined in Table 7-1. Measured background NO_2 and O_3 concentrations from the nearest and most suitable air monitoring station (Rozelle) were adopted. Using this data, the maximum NO_2 and O_3 concentrations and the highest estimated NO_2 levels were using to determine the impact at each sensitive receptor assessed. It should be noted that all sensitive receptors have been assessed at a range of heights above ground level (AGL). Table 7-1 represents the maximum concentration for each receptor at a specific AGL height. The AGL heights are presented in Table 2-1. The OLM spreadsheet calculations are presented in Appendix D.

Table 7-1 NO^2 predictions using OLM approach

	Scenario 1 – OLM predictions of 1 hourly maximum NO_2 concentrations ($\mu g/m^3$)				
Location	**Maximum Receptor Height (m)[1]**	**Predicted maximum 1-hour average NO_x**	**Adopted maximum 1-hour average NO_2**	**Adopted maximum 1-hour average O_3**	**Estimate of maximum 1-hour NO_2 by OLM**
Receptor 1	3	301.9	34.9[2]	15.0[2]	79.4
Receptor 2	3	294.5	34.9[2]	15.0[2]	78.7
Receptor 3	4.5	289.2	34.9[2]	15.0[2]	78.1
Receptor 4	3	292.3	34.9[2]	15.0[2]	78.4
Receptor 5	3	311.5	20.5[3]	38.5[3]	88.6
Receptor 6	1.5	302.2	34.9[2]	15.0[2]	79.4
Receptor 7	40	1483.2	32.8[4]	8.56[4]	189.3
Receptor 8	15	355.5	67.7[5]	6.42[5]	108.4
Receptor 9	4.5	358.4	45.1[6]	10.7[6]	91.2
Receptor 10	3	301.1	34.9[2]	15.0[2]	79.3

	Scenario 2 – OLM predictions of 1 maximum annual NO_2 concentrations				
Location	**Receptor Height (m)[1]**	**Predicted annual average NO_x**	**Adopted annual average NO_2**	**Adopted annual average O_3**	**Estimate of annual NO_2 by OLM**
Receptor 1	3	3.97	26.9[7]	31.3[7]	30.9
Receptor 2	3	4.14			31.0
Receptor 3	4.5	5.40			32.3
Receptor 4	3	3.86			30.8
Receptor 5	3	4.27			31.1
Receptor 6	1.5	4.94			31.8
Receptor 7	40	20.5			47.4
Receptor 8	15	7.56			34.5
Receptor 9	4.5	5.26			32.2
Receptor 10	3	9.32			36.2

Note 1: Receptor height represents the height at which the maximum NO_x (as NO_2) concentration was predicted.

Note 2: Adopted from measured NO_2 and O_3 background levels at DECCW monitoring station located at Rozelle (2006) at time of maximum predicted hourly NO_X levels for 2006 (on 2/7/2006 at 10 am).

Note 3: As per note 2 and maximum predicted hourly NO_X levels for 2006 occurred on 1/710/2006 at 9 am.

Note 4: As per note 2 and maximum predicted hourly NO_X levels for 2006 occurred on 21/510/2006 at 7 am.

Note 5: As per note 2 and maximum predicted hourly NO_X levels for 2006 occurred on 28/310/2006 at 9 am.

Note 6: As per note 2 and maximum predicted hourly NO_X levels for 2006 occurred on 16/510/2006 at 10 am.

Note 7: Average annual background concentration for 2006 at Rozelle air monitoring station.

7.3.2 Diesel fired engines

As previously discussed, the main emissions from the diesel engines will include oxides of nitrogen, sulphur dioxide, carbon monoxide, particulate matter and air toxics. They will only be used during a major power outage and for monthly testing over a maximum 1 hour period and have not been considered further in this assessment.

7.3.3 Miscellaneous emissions

Other emissions may arise during the operation of the Project. These are likely to include:

- emissions from cars, delivery vans, HGVs entering/exiting the site
- minor fugitive emissions from fuel and chemicals stored on-site (e.g. diesel, lubricant oils, cleaning chemicals).

Emissions from these sources are expected to be low and of minimal significance.

The results of the air dispersion modelling assessment of NO_x (as NO_2) emissions (ground level only) from the gas reciprocating engines are illustrated in Figures 7-1 and 7-2.

8. Discussion of air quality impacts

Using the OLM approach, the results show that the estimated NO_2 concentrations will comply with the adopted 1-hour average DECCW goal of 246 µg/m^3 and annual average NEPM goal of 62 µg/m^3 respectively at all sensitive receptors assessed.

Sensitive receptors were assessed at ground level and at varying heights above ground level (agl) to a maximum height of 40 mAGL (Goldsbrough apartments). Table 7-1 represents the maximum receptor height at which the highest NO_x concentration is predicted to occur.

The highest predicted hourly NO_x concentration of 189.6 µg/m^3 occurs at Receptor 7 (Goldsbrough Apartments) at a receptor height of 40 m. The apartments are located approximately 50 m north of the Project.

Figures 7-1 and 7-2 illustrate the extent of dispersion for the hourly and annual cumulative ground level NO_x (as NO_2) concentrations using the OLM method. These figures do not represent dispersion patterns but rather the extent of NO_x impacts.

9. Greenhouse gas assessment

9.1 Prediction method

A quantitative assessment of the likely greenhouse gas emissions during operation of the project was undertaken in accordance with the *National Greenhouse Accounts (NGA) Factors* (NGA Factors, June 2009). Greenhouse gas emissions generated by the project were estimated as tonnes of carbon dioxide equivalent (t CO_2-e).

The sources of greenhouse gas emissions related to the project are classified as:

- Scope 1 emissions — emissions directly caused by operation of the project, such as the combustion of fuel in plant / vehicles (World Resources Institute (WRI) and World Business Council for Sustainable Development (WBSCD) 2005).
- Scope 2 emissions - emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated. (WRI and WBCSD 2005).
- Scope 3 emissions — indirect emissions, such as those to produce materials used for operation of the project (WRI and WBCSD 2005).

It is understood that there will be no Scope 2 (electricity generation) emissions produced during the operation of this project. However, we have calculated emissions that would result if electricity were used instead of fuels (natural gas and diesel) for power demand.

9.2 Operation phase

Energy consuming activities during operation of the project would be limited to:

- The use of natural gas to power 9 x 4.3 MW gas reciprocating engines. Maintenance for the gas reciprocating engines is estimated at approximately 3 days per year for each engine, which is equivalent to 72 hours per gas reciprocating engine per year of non-operation.
- The use of diesel fuel in the case of both gas and electrical network failure. It is estimated that the diesel engines will be operational for a cumulative maximum of 90 hours per year.

9.2.1 Calculations for natural gas consumption

- Calculations are based on the assumption that all 9 gas reciprocating engines continuously operate at 100% capacity (365.25x24 hours – maintenance time (3 days x 24 hours)), which equates to 8,694 hours per year per turbine.
- According to the MWM GmbH Technical specifications for gas reciprocating engines, each turbine uses 9,691 kW (+/-5%) fuel (assuming per hour), which equates to a worst case (+5%) usage of 10,176KW of fuel per hour.
- 10,176KW x 8,694 hours = 88,470,144 kWh per year per turbine.
- 1 kWh = 0.0036 GJ (NGA Factors, 2009), so 88,470,144 kWh multiplied by 0.0036 = 318,493 GJ/year per turbine.
- This confirms that the client is a large user (>100,000GJ/year), according to the NGA Factors (2009).
- The NGA Factors provide a value of 67.03 kg CO_2-e/GJ (Scope 1 and Scope 3), which is equivalent to 0.06703 tonnes CO_2-e/GJ.

- 318,493 GJ/year per turbine multiplied by 0.06703 t CO_2/GJ = 21,348.5 t CO_2-e/year per gas reciprocating engines.
- 21,348.5 t CO_2-e/year per machine multiplied by 9 gas reciprocating engines equates to a total of **192,137 t CO_2-e/year**.

9.2.2 Calculations for diesel consumption

- Calculations are based on the assumption that there are 27 engines in total, all of which consume 300L/hour of diesel.
- It has been assumed that the diesel engines would be operational for a cumulative total of 90 hours per year for all engines combined.
- 90 hours operations multiplied by 300L/hour of diesel consumption is equivalent to 27,000 litres/year of diesel consumption.
- Fuel diesel oil is 38.6 MJ/litre. With 27,000 litres this equates to 1,042,200 MJ or 1,042 GJ total consumption of diesel energy.
- Carbon intensity is currently rated at 74.8 kg CO_2-e/GJ (Scope 1 and Scope 3).
- 1,042 GJ multiplied by 74.8 kg CO_2-e/GJ, equates to 77,957 kg CO_2-e/year, which is approximately a total of **78 t CO_2-e/year**.

9.2.3 Calculations for standard electrical grid connection

- Calculations are based on the assumption that the facility load is calculated at 30 MW, the electric chiller is calculated at 4 MW and the offset load from Sydney 1 is calculated at 8 MW, which equates to a total of 42 MW
- Carbon intensity for the consumption of purchased electricity from the grid is currently rated at 0.89 kg CO_2-e/kWh (NGA Factors, 2009)
- 42 MW x 24 hours X 365 days x 0.89 = 327,448 t CO2-e

9.3 Discussion of GHG results

- The natural gas (energy stationary) use would result in the emission of greenhouse gases. The total greenhouse gases that would be emitted as a result of this natural gas fuel usage are estimated to be 192,137 t CO_2-e per year (Scope 1 and 3).
- This diesel (energy stationary) use would result in the emission of greenhouse gases. The total greenhouse gases that would be emitted as a result of this diesel fuel usage is estimated to be 78 t CO_2-e per year (Scope 1 and 3).
- The carbon intensity of using gas for this project is calculated as 0.24 kg CO_2-e/kWh, whereas diesel has a carbon intensity of 0.27 kg CO_2-e/kWh. As a result, it is recommended that the diesel engines usage is minimised.
- If electricity purchased from the grid were to be used, the Scope 2 total greenhouse gas emissions is calculated at 327,448 t CO2-e, whereas the total emissions from using natural gas and diesel is significantly less at 192,215 t CO_2-e.

Table 9-1 Operational quantity estimates and associated greenhouse gas emissions

Source	Quantity (GJ)	Greenhouse gas emissions (t CO_2-e)				Assumptions
		Scope 1	Scope 2	Scope 3	Total	
Operation						
Natural Gas	2,866,437	147,134	–	45,003	192,137	Maintenance for the gas reciprocating engines is

Source	Quantity (GJ)	Greenhouse gas emissions (t CO_2-e)				Assumptions
		Scope 1	Scope 2	Scope 3	Total	
						estimated at approximately 3 days per year for each turbine, which is equivalent to 72 hours per turbine per year of inoperation.
Diesel fuel	1042	72.5	–	5.5	78	It is estimated that the diesel generators will be operational for a cumulative maximum of 90 hours per year.
Operation with standard conventional grid electricity						
Electricity from grid	2867479	–	327,448	–	327,448	Calculations are based on the assumption that the facility load is calculated at 30MW, The electric chiller is calculated at 4MW and the offset load from Sydney 1 is calculated at 8MW, which equates to a total of 42MW

10. Mitigation and management measures

To ensure that any impacts arising from the Project would not have an adverse impact on the receiving environment, mitigation measures are proposed for the construction and operation of the project as outlined in the following sections.

10.1 Construction phase

During unfavourable meteorological conditions, such as dry and windy, dust emissions may be higher, requiring specific corrective measures. The construction environmental management plan (CEMP) would identify triggers and procedures for dealing with these conditions.

Dust and vehicle emissions represent the greatest potential for air quality impacts during the construction works. Dust suppression would be implemented during all construction work to reduce impacts throughout the local air shed. The implementation of effective management practices would minimise the potential for impact. The following mitigation measures and safeguards, which would be detailed in the project CEMP, would be implemented during the construction phase of the project:

- Develop dust minimisation measures will be developed in consultation with/with agreement of all parties prior to commencement of construction.
- Dust monitoring (dust deposition/PM_{10}) will be undertaken at selected locations to determine compliance with ambient air quality standards.
- A mechanism for generating complaints will be put in place for the duration of the construction phase.
- Water will be applied to aggregate storage piles, internal unsealed access roadways and work areas, application rates should be related to atmospheric conditions and the intensity of construction operations.
- Where applicable, sealed roads will be swept to remove deposited material that could generate dust.
- Revegetation activities will proceed as soon as construction activities are completed within a disturbed area.
- Disturbed areas will be stabilised as soon as possible to prevent or minimise wind blown dust.
- Dust generating activities (particularly clearing and excavating) will be avoided or minimised during dry and windy conditions.
- Site speed limits will be imposed on all construction vehicles at the site.
- Vehicle and machinery movements during construction will be restricted to designated areas.
- Rumble grids and wheel wash facilities may be provided at the site exit to remove mud and dust from vehicles.
- Vehicles transporting material to and from the site will be covered immediately after loading to prevent wind blown dust emissions and spillages; tailgates of road transport trucks will be securely fixed prior to loading and immediately after unloading.
- Construction plant and equipment will be well maintained and regularly serviced so that vehicular emissions remain within relevant air quality guidelines and standards.

- Adherence to good site engineering practices will assist in reducing the potential for dust generation.
- All site vehicles and machinery will be switched off or throttled down to a minimum when not in use.
- Excess or unnecessary revving of engines will not be permitted.
- All contractors will be required to ensure that vehicles and machinery is maintained in good order.
- On-site speed limits will be enforced for all vehicles.

10.2 Operation phase

10.2.1 Gas reciprocating engines

An Operational Environmental Management Plan (OEMP) will be prepared to ensure emissions from the Project will be minimised. They will include but not limited to the following measures:

- The gas-fired gas reciprocating engines will use low NO_x technology.
- Emissions from the gas reciprocating engines will be regulated by the operating in-stack limit of 50mg/m^3 NO_x (as NO_2).
- Annual extractive monitoring will be undertaken by both the operator and the regulatory authority to demonstrate compliance with in-stack limits.
- A continuous on-line monitoring system will be installed to monitor oxides of nitrogen emission to atmosphere.
- A regular and documented maintenance and inspection program will be implemented for all plant items.
- On-site good housekeeping and raw material handling practices will be stringently controlled through agreed protocols.
- An ambient air monitoring program will be established to ensure all pollutants comply with ambient air quality limit values. The details will be provided in the OEMP.
- Gas detectors will be installed to detect fugitive gas emissions.
- All pumps will be rubber sealed to prevent release of natural gas.

10.2.2 Diesel fired engines

The following mitigation measures would be put in place to ensure emissions from the generators are kept to a minimum and comply with in-stack limits:

- Emissions from the engines will be regulated by the operating in-stack limits, this may include periodic monitoring by both the operator and the regulator to demonstrate compliance with in stack limits.
- A regular and documented maintenance and inspection program will be implemented for all plant items.
- A regular and documented testing program will be implemented at regular intervals.
- On-site good housekeeping and raw material handling practices will be stringently controlled through agreed protocols.

10.2.3 Miscellaneous emissions

All other on-site sources are considered minor and of minimal significance. Notwithstanding this, mitigation measures would be implemented as follows:

- adherence to site speed limits
- switching off idling engines or limiting throttling down
- excess or unnecessary revving of engines will not be permitted
- all chemicals and fuels will be stored in sealed containers or sealed buildings
- unloading of diesel will be vented via return hoses that recirculate vapours from delivery to receiver.

11. Conclusions

This Technical Paper has assessed the potential air quality and GHG impacts (operational only) associated with the construction and operation of the proposed data centre at Pyrmont in Sydney, NSW. The data centre will be powered by 9 continuously operating gas reciprocating engines (trigeneration units) and 27 back-up diesel engines. The main findings of the assessment are summarised as follows:

- The main impacts during the construction phase are anticipated to arise from dust generated during on-site activities. Comprehensive mitigation measures detailed in a CEMP would ensure that sensitive receptors would not be adversely affected during this phase.
- During the operation phase, the maximum predicted levels using the OLM approach for NO_x (as NO_2) are predicted to be below their respective air quality goals.
- GHG calculations have been undertaken for both gas and diesel usage for the operation phase only to determine the carbon intensity of the proposed fuel usage.
- Mitigation measures for the operational phase have been proposed to minimise and control emissions to atmosphere.

In conclusion, air emissions from the Project will not result in exceedances of the relevant air quality goals at all sensitive receptor locations and heights assessed. Furthermore, emissions from the Project would result in acceptable air quality impacts within the study area and will not adversely affect any sensitive receptor in the vicinity of the proposed data centre.

12. References

Australian Government Department of Environment, Water, Heritage and the Arts – National Pollution Inventory

Department of Environment and Conservation, 2005, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*

Department of the Environment, Climate Change and Water, *Interim DECC Nitrogen Oxide Policy for Cogeneration in Sydney and the Illawarra, February 2009*

Enviro Risk Management, November 2008, Assessment of Potential Air Quality Barriers to Development, Global Switch Sydney 2.

National Environment Protection Council 1998, *National Environmental Protection (Ambient Air Quality) Measure*

National Environment Protection Council 2004*, National Environmental Protection (Air Toxics) Measure*

National Environment Protection Authority Council 1998, *National Environmental Protection (Ambient Air Quality) Measure* (1998)

National Health and Medical Research Council 1995, *Interim National Indoor Air Quality Goals Recommended by the National Health and Medical Research Council*

NSW Minerals Council *Particulate Matter and Mining Interim Report* [2000]

The Air Pollution Model (TAPM) Version 3. User Manual, April 2005

TRC, A Users Guide for the CALPUFF Dispersion Model

TRC, A User's Guide for the CALMET Meteorological Model

US EPA, Office of Air Quality Planning and Standards, User's Guide to the Building Profile Input Program, October 2003

United Stated Environment Protection Authority 1995, *AP-42 Compilation of Air Pollutant Emission Factors*

www.bom.gov.au

www.src.com

World Resources Institute's (WRI's)/World Business Council for Sustainable Development's (WBCSD's) 2004 Greenhouse Gas Protocol; A Corporate Accounting and Reporting Standard

Sustainable Energy (2008):Beyond Hot Air, David JC MacKay

http://en.wikipedia.org/wiki/Energy_density

MWM GmbH TechGen 632-3-240(02) Technical specifications for gas reciprocating engines

13. Limitations

Scope of services and reliance of data

This air impact study ('the study') has been prepared in accordance with the scope of work/services set out in the contract, or as otherwise agreed, between Parsons Brinckerhoff (PB) and the Client. In preparing this air impact study, PB has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the air impact study ('the data'). Except as otherwise stated in the air impact study, PB has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this air impact study ('conclusions') are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. PB will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to PB.

Study for benefit of client

This air impact study has been prepared for the exclusive benefit of the Client and no other party. PB assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt within this air impact study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this air impact study (including without limitation matters arising from any negligent act or omission of PB or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this air impact study). Other parties should not rely upon the air impact study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

Other limitations

To the best of PB's knowledge, the project presented and the facts and matters described in this air impact study reasonably represent the Client's intentions at the time of printing of the air impact study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the project and of its possible air impact.

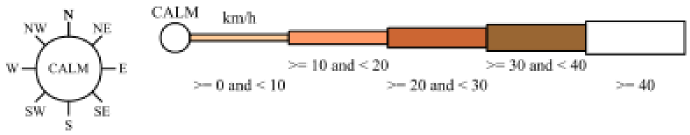
PB will not be liable to update or revise the air impact study to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the air impact study.

Appendix A

Annual and monthly TAPM wind rose plots for proposed site

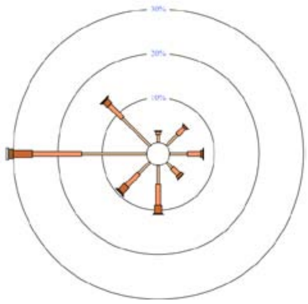
Windrose Plot
Sydney (Observatory Hill) - 1 January 1955 to 1 May 1992

Annual (9am)



13502 Total Observations

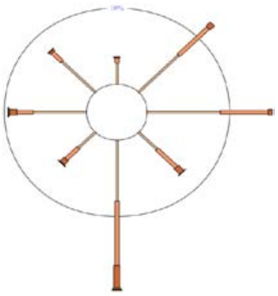
Calm 13%



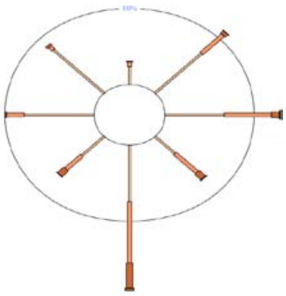
Windrose Plots
Sydney (Observatory Hill) - 1 January 1955 to 1 May 1992

Monthly (9am)

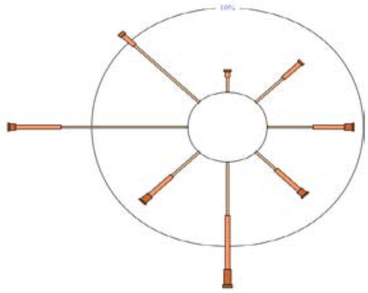
January
1146 Total Observations
Calm 19%



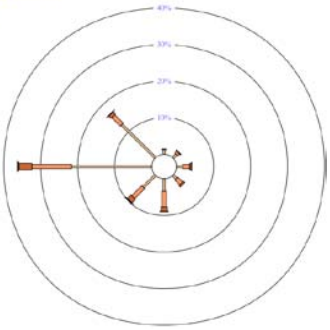
February
1045 Total Observations
Calm 20%



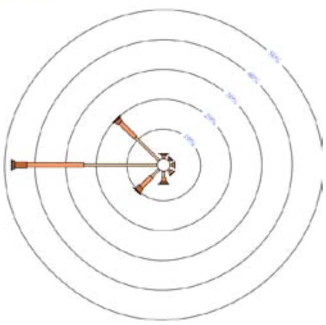
March
1175 Total Observations
Calm 21%



April
1139 Total Observations
Calm 17%

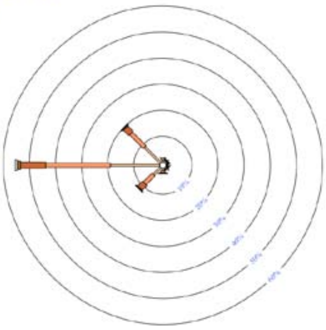


May
1146 Total Observations
Calm 11%

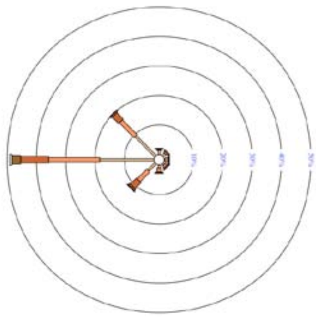


June
1109 Total Observations
Calm 7%

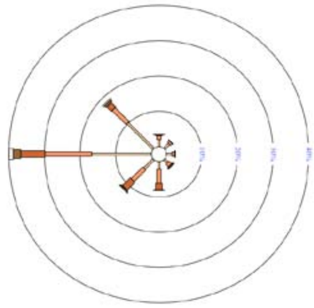
July
1146 Total Observations
Calm 6%



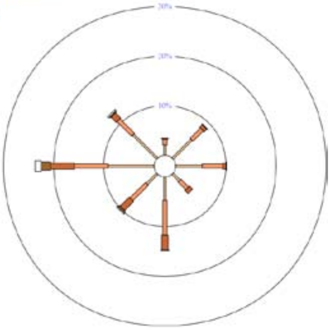
August
1146 Total Observations
Calm 9%



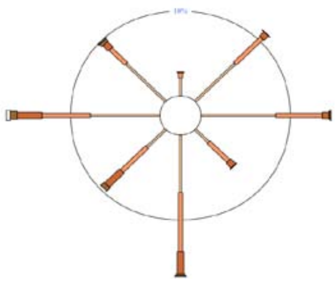
September
1109 Total Observations
Calm 10%



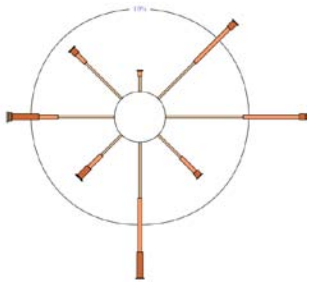
October
1145 Total Observations
Calm 11%



November
1079 Total Observations
Calm 13%

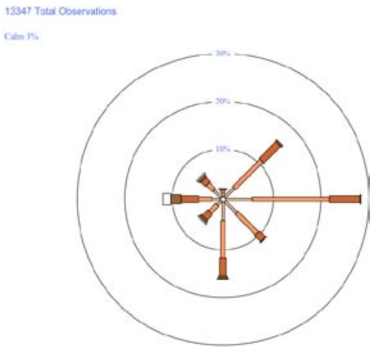


December
1115 Total Observations
Calm 15%



Windrose Plot
Sydney (Observatory Hill) - 1 January 1955 to 1 May 1992

Annual (3pm)

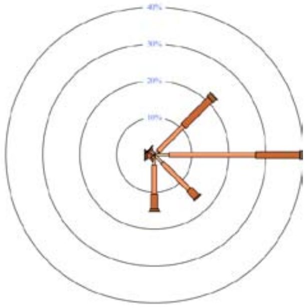


Windrose Plot
Sydney (Observatory Hill) - 1 January 1955 to 1 May 1992

Monthly (3pm)

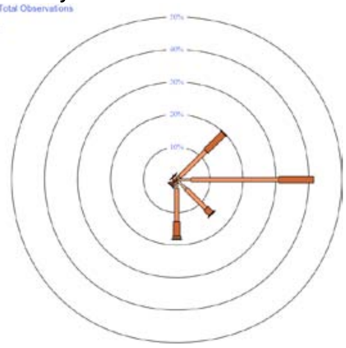
January
1113 Total Observations

Calm 1%



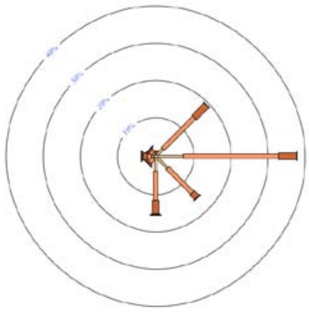
February
1016 Total Observations

Calm *



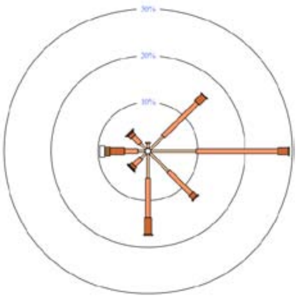
March
1147 Total Observations

Calm 2%



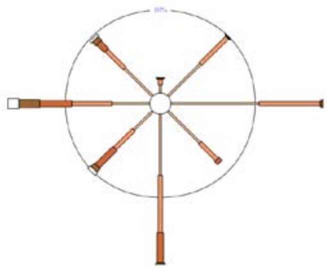
April
1108 Total Observations

Calm 3%



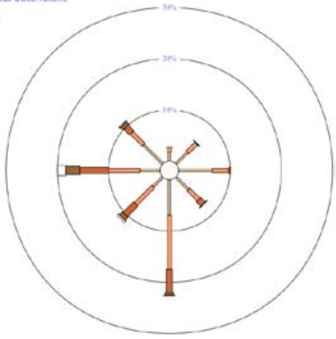
May
1147 Total Observations

Calm 5%



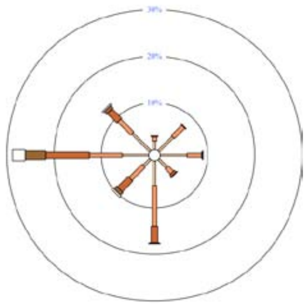
June
1110 Total Observations

Calm 9%



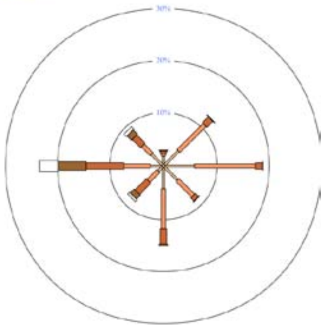
July
1145 Total Observations

Calm 6%



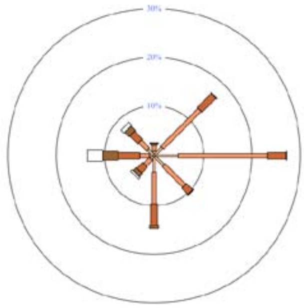
August
1147 Total Observations

Calm 1%



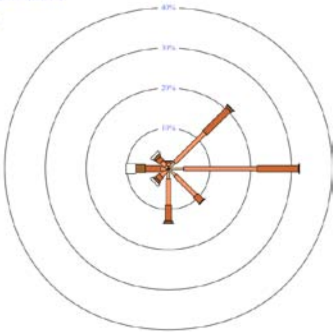
September
1099 Total Observations

Calm 1%



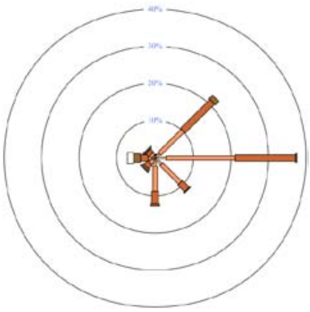
October
1146 Total Observations

Calm 1%



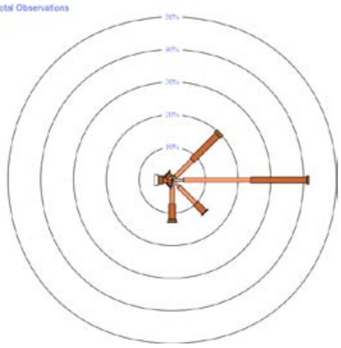
November
1080 Total Observations

Calm 1%



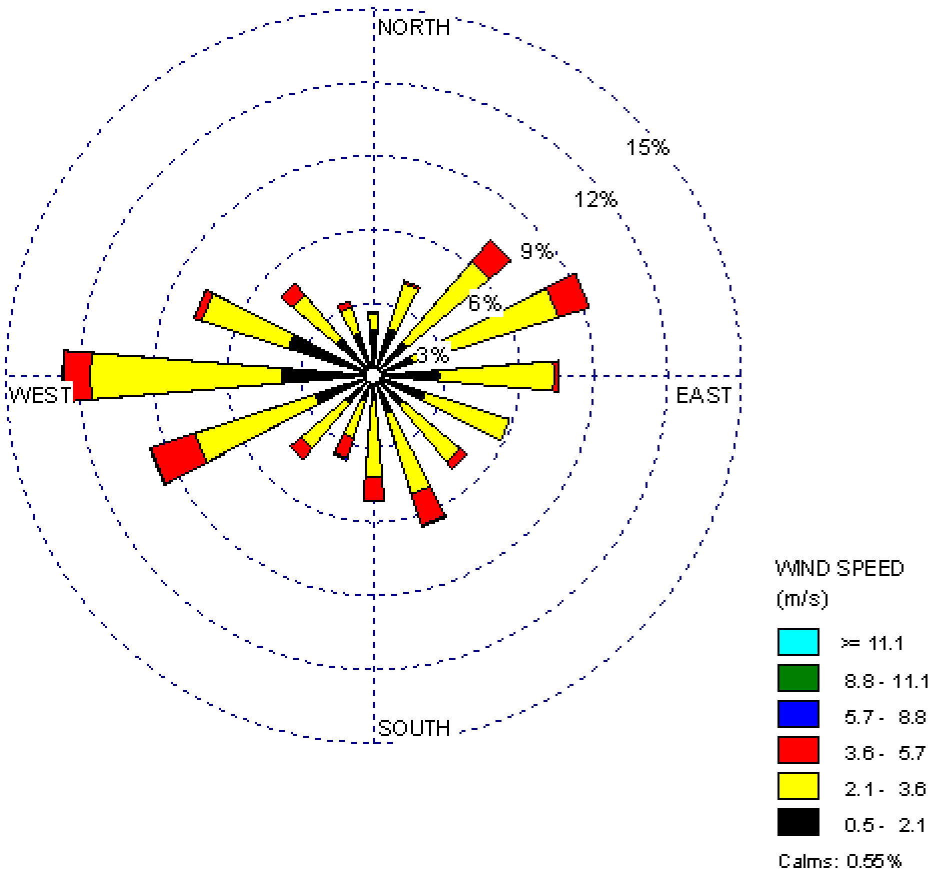
December
1089 Total Observations

Calm *

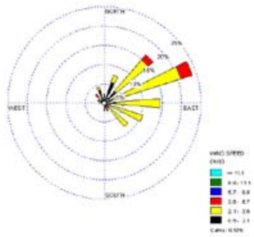
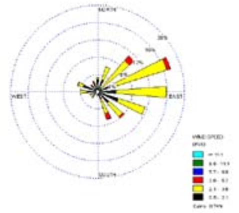
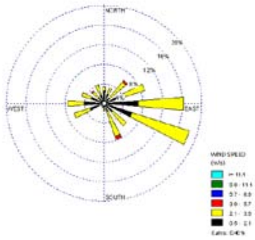
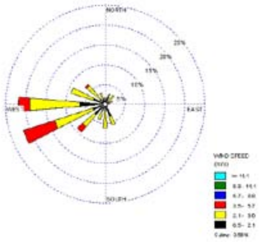
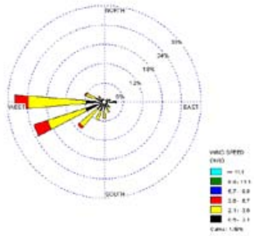
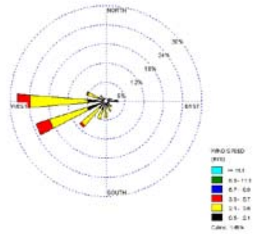
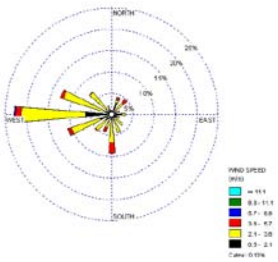
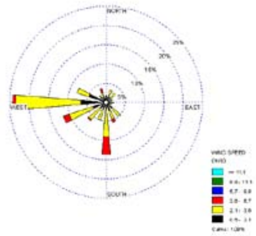
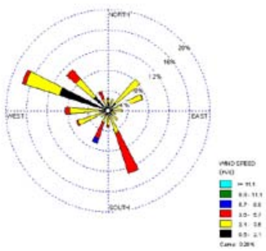
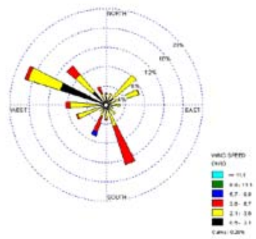
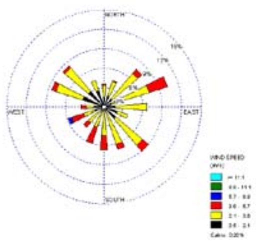
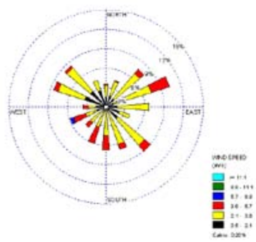


Appendix B

Annual and monthly wind rose plots for the Sydney Observatory Hill BoM station



2006 TAPM generated annual wind rose

January	February
	
March	**April**
	
May	**June**
	
July	**August**
	
September	**October**
	
November	**December**
	

Appendix C

Sample CALPUFF output file

```
************************************************************************
********************************************************
                                             CALPOST  Version 6.223
Level 080924
************************************************************************
********************************************************




 Internal Coordinate Transformations by  ---  COORDLIB   Version: 1.99
Level: 070921



  Run Title:
     NOA



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

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

      Option to run all periods found
      in the met. file(s)  (METRUN)        Default: 0   ! METRUN =   1  !

          METRUN = 0 - Run period explicitly defined below
          METRUN = 1 - Run all periods in CALPUFF data file(s)

      Starting date:    Year   (ISYR)  --    No default   ! ISYR  =  2006
!
                        Month  (ISMO)  --    No default   ! ISMO  =  0  !
                        Day    (ISDY)  --    No default   ! ISDY  =  0  !
      Starting time:    Hour   (ISHR)  --    No default   ! ISHR  =  0  !
                        Minute (ISMIN) --    No default   ! ISMIN =  0  !
                        Second (ISSEC) --    No default   ! ISSEC =  0  !

      Ending date:      Year   (IEYR)  --    No default   ! IEYR  =  0  !
                        Month  (IEMO)  --    No default   ! IEMO  =  0  !
                        Day    (IEDY)  --    No default   ! IEDY  =  0  !
      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)

      All times are in the base time zone of the CALPUFF simulation.
      CALPUFF Dataset Version 2.1 contains the zone, but earlier versions
      do not, and the zone must be specified here.  The zone is the
      number of hours that must be ADDED to the time to obtain UTC (or
GMT).
      Identify the Base Time Zone for the CALPUFF simulation
                              (BTZONE) -- No default   ! BTZONE = -10.0
!
```

```
      Process every period of data?
                            (NREP) -- Default: 1   ! NREP  =  1  !
       (1 = every period processed,
        2 = every 2nd period processed,
        5 = every 5th period processed, etc.)

 Species & Concentration/Deposition Information
 ----------------------------------------------

       Species to process (ASPEC)       -- No default   ! ASPEC = NOA  !
       (ASPEC = VISIB for visibility processing)

       Layer/deposition code (ILAYER)   -- Default: 1   ! ILAYER =  1  !
         '1'  for CALPUFF concentrations,
         '-1' for dry deposition fluxes,
         '-2' for wet deposition fluxes,
         '-3' for wet+dry deposition fluxes.

       Scaling factors of the form:     -- Defaults:    ! A =  0.0    !
             X(new) = X(old) * A + B         A = 0.0    ! B =  0.0    !
         (NOT applied if A = B = 0.0)        B = 0.0

       Add Hourly Background Concentrations/Fluxes?
                               (LBACK)  -- Default: F   ! LBACK =  F !


       Source of NO2 when ASPEC=NO2 (above) or LVNO2=T (Group 2) may be
       from CALPUFF NO2 concentrations OR from a fraction of CALPUFF NOx
       concentrations.  Specify the fraction of NOx that is treated as
NO2
       either as a constant or as a table of fractions that depend on the
       magnitude of the NOx concentration:
                              (NO2CALC) -- Default: 1   ! NO2CALC =   1
!
          0 =  Use NO2 directly (NO2 must be in file)
          1 =  Specify a single NO2/NOx ratio (RNO2NOX)
          2 =  Specify a table NO2/NOx ratios (TNO2NOX)
               (NOTE: Scaling Factors must NOT be used with NO2CALC=2)

       Single NO2/NOx ratio (0.0 to 1.0) for treating some
       or all NOx as NO2, where [NO2] = [NOX] * RNO2NOX
       (used only if NO2CALC = 1)
                              (RNO2NOX) -- Default: 1.0 ! RNO2NOX = 1.0 !

       Table of NO2/NOx ratios that vary with NOx concentration.
       Provide 14 NOx concentrations (ug/m**3) and the corresponding
       NO2/NOx ratio, with NOx increasing in magnitude.  The ratio used
       for a particular NOx concentration is interpolated from the values
       provided in the table.  The ratio for the smallest tabulated NOx
       concentration (the first) is used for all NOx concentrations less
       than the smallest tabulated value, and the ratio for the largest
       tabulated NOx concentration (the last) is used for all NOx
       concentrations greater than the largest tabulated value.
       (used only if NO2CALC = 2)

        NOx concentration(ug / m3)
                              (CNOX)    -- No default
          ! CNOX = 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0,
```

```
                 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0 !

      NO2/NOx ratio for each NOx concentration:
                            (TNO2NOX) -- No default
        ! TNO2NOX = 1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
                    1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0 !


 Source information
 ------------------

   Option to process source contributions:
          0 =  Process only total reported contributions
          1 =  Sum all individual source contributions and process
          2 =  Run in TRACEBACK mode to identify source
               contributions at a SINGLE receptor
                            (MSOURCE) -- Default: 0   ! MSOURCE =  0  !


 Plume Model Output Processing Options
 -------------------------------------

   Output from models other than CALPUFF and CALGRID can be written in
   the CONC.DAT format and processed by CALPOST.  Plume models such as
   AERMOD typically do not treat CALM hours, and do not include such
hours
   in multiple-hour averages, with specific rules about how many calm
hours
   can be removed from an average.  This treatment is known as CALM
   PROCESSING.  Calm periods are identified from wind speeds in the
   meteorological data file for the application, which must be identified
   in Input Group 0 as the single-point meteorological data file MET1DAT.
          0 =  Option is not used for CALPUFF/CALGRID output files
          1 =  Apply CALM processing procedures to multiple-hour averages
                         (MCALMPRO) -- Default: 0   ! MCALMPRO =  0  !

   Format of Single-point Met File
          1 =  AERMOD/AERMET SURFACE file
                          (MET1FMT) -- Default: 1   ! MET1FMT =  1  !


 Receptor information
 --------------------

   Gridded receptors processed?    (LG) -- Default: F   ! LG  = T  !
   Discrete receptors processed?   (LD) -- Default: F   ! LD  = T  !
   CTSG Complex terrain receptors processed?
                                  (LCT) -- Default: F   ! LCT = F  !

 --Report results by DISCRETE receptor RING?
   (only used when LD = T)     (LDRING) -- Default: F   ! LDRING = F  !

 --Select range of DISCRETE receptors (only used when LD = T):

   Select ALL DISCRETE receptors by setting NDRECP flag to -1;
                              OR
   Select SPECIFIC DISCRETE receptors by entering a flag (0,1) for each
      0 = discrete receptor not processed
```

```
     1 = discrete receptor processed
   using repeated value notation to select blocks of receptors:
     23*1, 15*0, 12*1
   Flag for all receptors after the last one assigned is set to 0
   (NDRECP) -- Default: -1
                                             ! NDRECP =  -1  !


 --Select range of GRIDDED receptors (only used when LG = T):

        X index of LL corner (IBGRID) -- Default: -1     ! IBGRID = -1  !
            (-1 OR 1 <= IBGRID <= NX)

        Y index of LL corner (JBGRID) -- Default: -1     ! JBGRID = -1  !
            (-1 OR 1 <= JBGRID <= NY)

        X index of UR corner (IEGRID) -- Default: -1     ! IEGRID = -1  !
            (-1 OR 1 <= IEGRID <= NX)

        Y index of UR corner (JEGRID) -- Default: -1     ! JEGRID = -1  !
            (-1 OR 1 <= JEGRID <= NY)

   Note: Entire grid is processed if IBGRID=JBGRID=IEGRID=JEGRID=-1


 --Specific gridded receptors can also be excluded from CALPOST
   processing by filling a processing grid array with 0s and 1s.  If the
   processing flag for receptor index (i,j) is 1 (ON), that receptor
   will be processed if it lies within the range delineated by IBGRID,
   JBGRID,IEGRID,JEGRID and if LG=T. If it is 0 (OFF), it will not be
   processed in the run.  By default, all array values are set to 1 (ON).

   Number of gridded receptor rows provided in Subgroup (1a) to
   identify specific gridded receptors to process
                         (NGONOFF) -- Default: 0      ! NGONOFF =  0
!

 !END!


 --------------
 Subgroup (1a) -- Specific gridded receptors included/excluded
 --------------

     Specific gridded receptors are excluded from CALPOST processing
     by filling a processing grid array with 0s and 1s.  A total of
     NGONOFF lines are read here.  Each line corresponds to one 'row'
     in the sampling grid, starting with the NORTHERNMOST row that
     contains receptors that you wish to exclude, and finishing with
     row 1 to the SOUTH (no intervening rows may be skipped).  Within
     a row, each receptor position is assigned either a 0 or 1,
     starting with the westernmost receptor.
        0 = gridded receptor not processed
        1 = gridded receptor processed

     Repeated value notation may be used to select blocks of receptors:
        23*1, 15*0, 12*1
```

```
     Because all values are initially set to 1, any receptors north of
     the first row entered, or east of the last value provided in a row,
     remain ON.

     (NGXRECP) -- Default: 1


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

 INPUT GROUP: 2 -- Visibility Parameters (ASPEC = VISIB)
 --------------

     Test visibility options specified to see
     if they conform to FLAG 2008 configuration?
                            (MVISCHECK) -- Default: 1   ! MVISCHECK =   1
!
          0 =  NO checks are made
          1 =  Technical options must conform to FLAG 2008 visibility
guidance
                 ASPEC = VISIB
                 LVNO2 = T
                 NO2CALC = 1
                 RNO2NOX = 1.0
                 MVISBK = 8
                 M8_MODE = 5

     Some of the data entered for use with the FLAG 2008 configuration
     are specific to the Class I area being evaluated. These values can
     be checked within the CALPOST user interface when the name of the
     Class I area is provided.

     Name of Class I Area (used for QA purposes only)
                             (AREANAME) -- Default: User  ! AREANAME =
USER !

     Particle growth curve f(RH) for hygroscopic species
                                 (MFRH) -- Default: 4   ! MFRH   =  4  !

          1 =  IWAQM (1998) f(RH) curve (originally used with MVISBK=1)
          2 =  FLAG (2000) f(RH) tabulation
          3 =  EPA (2003) f(RH) tabulation
          4 =  IMPROVE (2006) f(RH) tabulations for sea salt, and for
small and
               large SULFATE and NITRATE particles;
               Used in Visibility Method 8 (MVISBK = 8 with M8_MODE = 1,
2, or 3)

     Maximum relative humidity (%) used in particle growth curve
                                (RHMAX) -- Default: 98  ! RHMAX  = 98 !

     Modeled species to be included in computing the light extinction
      Include SULFATE?          (LVSO4) -- Default: T   ! LVSO4  = T  !
      Include NITRATE?          (LVNO3) -- Default: T   ! LVNO3  = T  !
      Include ORGANIC CARBON?   (LVOC)  -- Default: T   ! LVOC   = T  !
      Include COARSE PARTICLES? (LVPMC) -- Default: T   ! LVPMC  = T  !
      Include FINE PARTICLES?   (LVPMF) -- Default: T   ! LVPMF  = T  !
      Include ELEMENTAL CARBON? (LVEC)  -- Default: T   ! LVEC   = T  !
```

```
      Include NO2 absorption?   (LVNO2) -- Default: F   ! LVNO2  = T  !
               With Visibility Method 8 -- Default: T
                                           FLAG (2008)

     And, when ranking for TOP-N, TOP-50, and Exceedance tables,
      Include BACKGROUND?       (LVBK)  -- Default: T   ! LVBK   = T  !

     Species name used for particulates in MODEL.DAT file
                    COARSE    (SPECPMC) -- Default: PMC ! SPECPMC = PMC !
                    FINE      (SPECPMF) -- Default: PMF ! SPECPMF = PMF !

 Extinction Efficiency (1/Mm per ug/m**3)
 ---------------------------------------
     MODELED particulate species:
                PM  COARSE      (EEPMC) -- Default: 0.6   ! EEPMC  = 0.6
!
                PM  FINE        (EEPMF) -- Default: 1.0   ! EEPMF  = 1 !
     BACKGROUND particulate species:
                PM  COARSE    (EEPMCBK) -- Default: 0.6   ! EEPMCBK = 0.6
!
     Other species:
               AMMONIUM SULFATE (EESO4) -- Default: 3.0   ! EESO4  = 3 !
               AMMONIUM NITRATE (EENO3) -- Default: 3.0   ! EENO3  = 3 !
               ORGANIC CARBON   (EEOC)  -- Default: 4.0   ! EEOC   = 4 !
               SOIL             (EESOIL)-- Default: 1.0   ! EESOIL = 1 !
               ELEMENTAL CARBON (EEEC)  -- Default: 10.   ! EEEC   = 10 !
               NO2 GAS          (EENO2) -- Default: .1755 ! EENO2  =
0.1755 !
     Visibility Method 8:
               AMMONIUM SULFATE (EESO4S)   Set Internally (small)
               AMMONIUM SULFATE (EESO4L)   Set Internally (large)
               AMMONIUM NITRATE (EENO3S)   Set Internally (small)
               AMMONIUM NITRATE (EENO3L)   Set Internally (large)
               ORGANIC CARBON   (EEOCS)    Set Internally (small)
               ORGANIC CARBON   (EEOCL)    Set Internally (large)
               SEA SALT         (EESALT)   Set Internally

 Background Extinction Computation
 ---------------------------------

     Method used for the 24h-average of percent change of light
extinction:
     Hourly ratio of source light extinction / background light
extinction
     is averaged?               (LAVER) -- Default: F   ! LAVER = F  !



     Method used for background light extinction
                               (MVISBK) -- Default: 8   ! MVISBK =  8  !
                                           FLAG (2008)

          1 =  Supply single light extinction and hygroscopic fraction
               - Hourly F(RH) adjustment applied to hygroscopic
background
                 and modeled sulfate and nitrate
          2 =  Background extinction from speciated PM concentrations (A)
               - Hourly F(RH) adjustment applied to observed and modeled
sulfate
```

```
                 and nitrate
               - F(RH) factor is capped at F(RHMAX)
          3 =  Background extinction from speciated PM concentrations (B)
               - Hourly F(RH) adjustment applied to observed and modeled
sulfate
                 and nitrate
               - Receptor-hour excluded if RH>RHMAX
               - Receptor-day excluded if fewer than 6 valid receptor-
hours
          4 =  Read hourly transmissometer background extinction
measurements
               - Hourly F(RH) adjustment applied to modeled sulfate and
nitrate
               - Hour excluded if measurement invalid (missing,
interference,
                 or large RH)
               - Receptor-hour excluded if RH>RHMAX
               - Receptor-day excluded if fewer than 6 valid receptor-
hours
          5 =  Read hourly nephelometer background extinction
measurements
               - Rayleigh extinction value (BEXTRAY) added to measurement
               - Hourly F(RH) adjustment applied to modeled sulfate and
nitrate
               - Hour excluded if measurement invalid (missing,
interference,
                 or large RH)
               - Receptor-hour excluded if RH>RHMAX
               - Receptor-day excluded if fewer than 6 valid receptor-
hours
          6 =  Background extinction from speciated PM concentrations
               - FLAG (2000) monthly RH adjustment factor applied to
observed and
                 and modeled sulfate and nitrate
          7 =  Use observed weather or prognostic weather information for
               background extinction during weather events; otherwise,
use Method 2
               - Hourly F(RH) adjustment applied to modeled sulfate and
nitrate
               - F(RH) factor is capped at F(RHMAX)
               - During observed weather events, compute Bext from visual
range
                 if using an observed weather data file, or
               - During prognostic weather events, use Bext from the
prognostic
                 weather file
               - Use Method 2 for hours without a weather event
          8 =  Background extinction from speciated PM concentrations
using
               the IMPROVE (2006) variable extinction efficiency
formulation
               (MFRH must be set to 4)
               - Split between small and large particle concentrations of
                 SULFATES, NITRATES, and ORGANICS is a function of
concentration
                 and different extinction efficiencies are used for each
               - Source-induced change in visibility includes the
increase in
```

```
                 extinction of the background aerosol due to the change
in the
                 extinction efficiency that now depends on total
concentration.
               - Fsmall(RH) and Flarge(RH) adjustments for small and
large
                 particles are applied to observed and modeled sulfate
and
                 nitrate concentrations
               - Fsalt(RH) adjustment for sea salt is applied to
background
                 sea salt concentrations
               - F(RH) factors are capped at F(RHMAX)
               - RH for Fsmall(RH), Flarge(RH), and Fsalt(RH) may be
obtained
                 from hourly data as in Method 2 or from the FLAG monthly
RH
                 adjustment factor used for Method 6 where EPA F(RH)
tabulation
                 is used to infer RH, or monthly Fsmall, Flarge, and
Fsalt RH
                 adjustment factors can be directly entered.
                 Furthermore, a monthly RH factor may be applied to
either hourly
                 concentrations or daily concentrations to obtain the 24-
hour
                 extinction.
                 These choices are made using the M8_MODE selection.

     Additional inputs used for MVISBK = 1:
     --------------------------------------
      Background light extinction (1/Mm)
                             (BEXTBK) -- No default   ! BEXTBK = 0 !
      Percentage of particles affected by relative humidity
                             (RHFRAC) -- No default   ! RHFRAC = 0 !

     Additional inputs used for MVISBK = 6,8:
     ----------------------------------------
      Extinction coefficients for hygroscopic species (modeled and
      background) are computed using a monthly RH adjustment factor
      in place of an hourly RH factor (VISB.DAT file is NOT needed).
      Enter the 12 monthly factors here (RHFAC).  Month 1 is January.

      (RHFAC)  -- No default     ! RHFAC = 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !

     Additional inputs used for MVISBK = 7:
     --------------------------------------
      The weather data file (DATSAV abbreviated space-delimited) that
      is identified as VSRN.DAT may contain data for more than one
      station.  Identify the stations that are needed in the order in
      which they will be used to obtain valid weather and visual range.
      The first station that contains valid data for an hour will be
      used.  Enter up to MXWSTA (set in PARAMS file) integer station IDs
      of up to 6 digits each as variable IDWSTA, and enter the
corresponding
      time zone for each, as variable TZONE (= UTC-LST).
```

```
      A prognostic weather data file with Bext for weather events may be
used
      in place of the observed weather file.  Identify this as the
VSRN.DAT
      file and use a station ID of IDWSTA = 999999, and TZONE = 0.

      NOTE:  TZONE identifies the time zone used in the dataset.  The
             DATSAV abbreviated space-delimited data usually are prepared
             with UTC time rather than local time, so TZONE is typically
             set to zero.

      (IDWSTA)   -- No default   * IDWSTA = 000000 *
      (TZONE)    -- No default   * TZONE =      0. *

     Additional inputs used for MVISBK = 2,3,6,7,8:
     ----------------------------------------------
      Background extinction coefficients are computed from monthly
      CONCENTRATIONS of ammonium sulfate (BKSO4), ammonium nitrate
(BKNO3),
      coarse particulates (BKPMC), organic carbon (BKOC), soil (BKSOIL),
and
      elemental carbon (BKEC).  Month 1 is January.
      (ug/m**3)

      (BKSO4)  -- No default     ! BKSO4 = 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !
      (BKNO3)  -- No default     ! BKNO3 = 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !
      (BKPMC)  -- No default     ! BKPMC = 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !
      (BKOC)   -- No default     ! BKOC  = 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !
      (BKSOIL) -- No default     ! BKSOIL= 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !
      (BKEC)   -- No default     ! BKEC  = 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !

     Additional inputs used for MVISBK = 8:
     --------------------------------------
      Extinction coefficients for hygroscopic species (modeled and
      background) may be computed using hourly RH values and hourly
      modeled concentrations, or using monthly RH values inferred from
      the RHFAC adjustment factors and either hourly or daily modeled
      concentrations, or using monthly RHFSML, RHFLRG, and RHFSEA
adjustment
      factors and either hourly or daily modeled concentrations.

      (M8_MODE) -- Default: 5     ! M8_MODE=  5   !
                   FLAG (2008)

           1 = Use hourly RH values from VISB.DAT file with hourly
```

```
               modeled and monthly background concentrations.
           2 = Use monthly RH from monthly RHFAC and EPA (2003) f(RH)
tabulation
               with hourly modeled and monthly background concentrations.
               (VISB.DAT file is NOT needed).
           3 = Use monthly RH from monthly RHFAC with EPA (2003) f(RH)
tabulation
               with daily modeled and monthly background concentrations.
               (VISB.DAT file is NOT needed).
           4 = Use monthly RHFSML, RHFLRG, and RHFSEA with hourly modeled
               and monthly background concentrations.
               (VISB.DAT file is NOT needed).
           5 = Use monthly RHFSML, RHFLRG, and RHFSEA with daily modeled
               and monthly background concentrations.
               (VISB.DAT file is NOT needed).

      Background extinction coefficients are computed from monthly
      CONCENTRATIONS of sea salt (BKSALT).  Month 1 is January.
      (ug/m**3)

      (BKSALT) -- No default     ! BKSALT= 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !

      Extinction coefficients for hygroscopic species (modeled and
      background) can be computed using monthly RH adjustment factors
      in place of an hourly RH factor (VISB.DAT file is NOT needed).
      Enter the 12 monthly factors here (RHFSML,RHFLRG,RHFSEA).
      Month 1 is January.  (Used if M8_MODE = 4 or 5)

      Small ammonium sulfate and ammonium nitrate particle sizes
      (RHFSML) -- No default     ! RHFSML= 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !

      Large ammonium sulfate and ammonium nitrate particle sizes
      (RHFLRG) -- No default     ! RHFLRG= 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !

      Sea salt particles
      (RHFSEA) -- No default     ! RHFSEA= 0, 0, 0, 0,
                                           0, 0, 0, 0,
                                           0, 0, 0, 0 !

     Additional inputs used for MVISBK = 2,3,5,6,7,8:
     ------------------------------------------------
      Extinction due to Rayleigh scattering is added (1/Mm)
                        (BEXTRAY) -- Default: 10.0 ! BEXTRAY = 10 !

 !END!
 -------------------------------------------------------------------------
-------

 INPUT GROUP: 3 -- Output options
 --------------

 Documentation
```

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

    Documentation records contained in the header of the
    CALPUFF output file may be written to the list file.
    Print documentation image?
                                (LDOC) -- Default: F   !  LDOC = F !

Output Units
------------
    Units for All 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

    Visibility: extinction expressed in 1/Mega-meters (IPRTU is ignored)


Averaging time(s) reported
--------------------------

    1-pd averages            (L1PD) -- Default: T   !   L1PD = F  !
    (pd = averaging period of model output)

    1-hr averages            (L1HR) -- Default: T   !   L1HR = T  !

    3-hr averages            (L3HR) -- Default: T   !   L3HR = F  !

    24-hr averages          (L24HR) -- Default: T   !  L24HR = F  !

    Run-length averages     (LRUNL) -- Default: T   !  LRUNL = T  !

    User-specified averaging time in hours, minutes, seconds
    - results for this averaging time are reported if it is not zero

                            (NAVGH) -- Default: 0   !   NAVGH =  0  !
                            (NAVGM) -- Default: 0   !   NAVGM =  0  !
                            (NAVGS) -- Default: 0   !   NAVGS =  0  !


Types of tabulations reported
------------------------------

   1) Visibility: daily visibility tabulations are always reported
                  for the selected receptors when ASPEC = VISIB.
                  In addition, any of the other tabulations listed
                  below may be chosen to characterize the light
                  extinction coefficients.
                  [List file or Plot/Analysis File]


   2) Top 50 table for each averaging time selected
      [List file only]
                             (LT50) -- Default: T   !   LT50 = T  !
```

```
3) Top 'N' table for each averaging time selected
   [List file or Plot file]
                     (LTOPN) -- Default: F   !  LTOPN = T  !

     -- Number of 'Top-N' values at each receptor
        selected (NTOP must be <= 4)
                      (NTOP) -- Default: 4   ! NTOP =  2   !

     -- Specific ranks of 'Top-N' values reported
        (NTOP values must be entered)
              (ITOP(4) array) -- Default:     ! ITOP =  1 , 2   !
                                 1,2,3,4


4) Threshold exceedance counts for each receptor and each averaging
   time selected
   [List file or Plot file]
                     (LEXCD) -- Default: F   !  LEXCD = F  !

     -- Identify the threshold for each averaging time by assigning a
        non-negative value (output units).

                              -- Default: -1.0
        Threshold for  1-hr averages   (THRESH1) !  THRESH1 = -1.0  !
        Threshold for  3-hr averages   (THRESH3) !  THRESH3 = -1.0  !
        Threshold for 24-hr averages  (THRESH24) ! THRESH24 = -1.0  !
        Threshold for NAVG-hr averages (THRESHN) !  THRESHN = -1.0  !


     -- Counts for the shortest averaging period selected can be
        tallied daily, and receptors that experience more than NCOUNT
        counts over any NDAY period will be reported.  This type of
        exceedance violation output is triggered only if NDAY > 0.

        Accumulation period(Days)
                      (NDAY) -- Default: 0   !    NDAY =  0  !
        Number of exceedances allowed
                    (NCOUNT) -- Default: 1   !  NCOUNT =  1  !


5) Selected day table(s)

   Echo Option -- Many records are written each averaging period
   selected and output is grouped by day
   [List file or Plot file]
                     (LECHO) -- Default: F   !  LECHO = F  !

   Timeseries Option -- Averages at all selected receptors for
   each selected averaging period are written to timeseries files.
   Each file contains one averaging period, and all receptors are
   written to a single record each averaging time.
   [TSERIES_ASPEC_ttHR_CONC_TSUNAM.DAT files]
                     (LTIME) -- Default: F   !  LTIME = F  !

   Peak Value Option -- Averages at all selected receptors for
   each selected averaging period are screened and the peak value
   each period is written to timeseries files.
   Each file contains one averaging period.
```

```
      [PEAKVAL_ASPEC_ttHR_CONC_TSUNAM.DAT files]
                          (LPEAK) -- Default: F   !  LPEAK = F  !

        -- Days selected for output
                    (IECHO(366)) -- Default: 366*0
           ! IECHO  = 366*0  !
           (366 values must be entered)

Plot output options
-------------------

     Plot files can be created for the Top-N, Exceedance, and Echo
     tables selected above.  Two formats for these files are available,
     DATA and GRID.  In the DATA format, results at all receptors are
     listed along with the receptor location [x,y,val1,val2,...].
     In the GRID format, results at only gridded receptors are written,
     using a compact representation.  The gridded values are written in
     rows (x varies), starting with the most southern row of the grid.
     The GRID format is given the .GRD extension, and includes headers
     compatible with the SURFER(R) plotting software.

     A plotting and analysis file can also be created for the daily
     peak visibility summary output, in DATA format only.

     Generate Plot file output in addition to writing tables
     to List file?
                            (LPLT) -- Default: F   ! LPLT  = F !

     Use GRID format rather than DATA format,
     when available?
                            (LGRD) -- Default: F   ! LGRD  = F !


Auxiliary Output Files (for subsequent analyses)
------------------------------------------------

      Visibility

      A separate output file may be requested that contains the change
      in visibility at each selected receptor when ASPEC = VISIB.  This
      file can be processed to construct visibility measures that are
      not available in CALPOST.

      Output file with the visibility change at each receptor?
                           (MDVIS) -- Default: 0   ! MDVIS  =  0  !

           0 =  Do Not create file
           1 =  Create file of DAILY (24 hour) Delta-Deciview
           2 =  Create file of DAILY (24 hour) Extinction Change (%)
           3 =  Create file of HOURLY Delta-Deciview
           4 =  Create file of HOURLY Extinction Change (%)


Additional Debug Output
-----------------------

   Output selected information to List file
    for debugging?
```

```
                            (LDEBUG) -- Default: F  ! LDEBUG  = F !

    Output hourly extinction information to REPORT.HRV?
     (Visibility Method 7)
                           (LVEXTHR) -- Default: F  ! LVEXTHR = F !

 !END!

 -------------------------------------------------
 NOTICE: Starting year in control file sets the
         expected century for the simulation.  All
         YY years are converted to YYYY years in
         the range:  1956 2055
 -------------------------------------------------


*************************************************************************
*********************************************************
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*********************************************************




  CALPOST Control File Input Summary ------------------------

     Replace run data with data in Puff file 1=Y:    1
                       Run starting date -- year: 2006
                                           month:    0
                                             day:    0
                                      Julian day:    0
             Time at start of run  -  hour(0-23):    0
                                   -      minute:    0
                                   -      second:    0

                         Run ending date -- year:    0
                                           month:    0
                                             day:    0
                                      Julian day:    0
               Time at end of run  -  hour(0-23):    0
                                   -      minute:    0
                                   -      second:    0


                        Base time zone (Group 1): -10.0

 Every period of data processed -- NREP = 1


  Species & Concentration/Deposition Information
                                         Species: NOA
                         Layer of processed data:    1
     (>0=conc, -1=dry flux, -2=wet flux, -3=wet & dry flux)
                   Multiplicative scaling factor: 0.0000E+00
                         Additive scaling factor: 0.0000E+00
                  Hourly background values used?: F
```

```
SAMPLER option
                             Processing method: 0
                 0= SAMPLER option not used
                 1= Report total modeled impact (list file)
                 2= TRACEBACK mode (DAT files)
                 3= TRACEBACK mode with sampling factor (DAT files)


Source information
                Source contribution processing: 0
                 0= No source contributions
                 1= Contributions are summed
                 2= TRACEBACK mode for 1 receptor
                 3= Reported TOTAL is processed


Receptor information
                  Gridded receptors processed?: T
                 Discrete receptors processed?: T
     CTSG Complex terrain receptors processed?: F

Gridded Receptors Processed

 (All Gridded Receptors are Used)

Discrete Receptors Processed

 (All Discrete Receptors are Used)


Visibility Processing is NOT Selected



Output options
                    Units requested for output:   (ug/m**3)

Averaging time(s) selected
      User-specified averaging time (hr:mm:ss):     0: 0: 0
                               1-pd averages:     F
                               1-hr averages:     T
                               3-hr averages:     F
                              24-hr averages:     F
                       User-specified averages:     F
                        Length of run averages:     T

Output components selected
                                       Top-50:     T
                 Top-N values at each receptor:     T
            Exceedance counts at each receptor:     F
     Output selected information for debugging:     F
                 Echo tables for selected days:     F
                 Time-series for selected days:     F
      Peak value Time-series for selected days:     F

Top "n" table control
```

```
        Number of "top" values at each receptor:     2
        Specific ranks of "top" values reported:   1   2


  Plot file option
                             Plot files created:     F

 MAPSPEC:  Species Mapping
   Number of species-levels in file  :  1
   Number of species-levels processed:  2

   Input ID  Processing ID     Name
       1           1          NOA           1

      Visibility Species
             Processing ID     Name
no2gas             2          NO2           1



 IDENTIFICATION OF PROCESSED MODEL FILE ----------

 CALPUFF     6.263       080827

 NOA




 Averaging time for values reported from model:
       1    HOUR

 Number of averaging periods in file from model:
       8760

 Chemical species names for each layer in model:
 NOA           1



 QA Information -- Internal Representation of Data

 CONTENTS OF CONTROL FILE ------------------------
  METRUN              = 1
      (so times in model output file are used)
  isyr,ismo,isdy      = 2006 1 1
  ishr,ismin,issec    = 0 0 0
  ieyr,iemo,iedy      = 2007 1 1
  iehr,iemin,iesec    = 0 0 0
  nper                = 8760
  aspec,ilayer        =NOA          1
  asplv               =NOA           1
  NO2CALC             = 1
     RNO2NOX          = 1.00000000
  MSOURCE             = 0
  MCALMPRO            = 0
  MET1FMT             = 1
  LG,LD,LCT,LDRING    = T T F F
  IBGRID,IEGRID       = -1 -1
```

```
  JBGRID,JEGRID       = -1 -1
  NDRECP              =
-1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
  a,b,LSCALE          = 0.00000000E+00 0.00000000E+00 F
  LBACK               = F
  MVISBK              = 8
  MVISCHECK           = 1
  AREANAME            =USER
  MFRH                = 4
  RHMAX,BEXTRAY       = 98.0000000 10.0000000
  RHFRAC,BEXTBK       = 0.00000000E+00 0.00000000E+00
  LVSO4,LVNO3,LVNO2   = T T T
  LVOC,LVEC           = T T
  LVPMC,LVPMF,LVBK    = T T T
  SPECPMC,SPECPMF     =PMC         PMF
  EEPMC,EEPMF,EEPMCBK = 0.600000024 1.00000000 0.600000024
  EESO4,EENO3,EEOC    = 3.00000000 3.00000000 4.00000000
  EESO4S,EENO3S,EEOCS = 2.20000005 2.40000010 2.79999995
  EESO4L,EENO3L,EEOCL = 4.80000019 5.09999990 6.09999990
  EESOIL,EEEC,EENO2   = 1.00000000 10.0000000 0.175500005
  navg,ntop           = 0 2
  navgh,navgm,navgs   = 0 0 0
  itop = 1 2
  L[1,3,24]HR         = T F F
  LNAVG, LRUNL        = F T
  LT50, LTOPN, LEXCD  = T T F
  LECHO, LTIME, LPEAK = F F F
  THRESH1             = -1.00000000
  THRESH3             = -1.00000000
  THRESH24            = -1.00000000
  THRESHN             = -1.00000000
  LPLT, LGRD          = F F
  MDVIS               = 0
  LDEBUG              = F
  LCTSG               = F

 CONTENTS OF HEADER OF MODEL OUTPUT FILE ---------
  model :   CALPUFF     6.263       080827
  msyr,mjsday      = 2006 1
  mshr,mssec       = 0 0
  nsecdt (period)  = 3600
  xbtz             = -10.0000000
  mnper,nszout,mavgpd = 8760 1 1
  xorigkm,yorigkm,nssta =  1674.00012 -900.000061 0
  ielmet,jelmet = 14 14
  delx,dely,nz = 1.00000000 1.00000000 1
  iastar,iastop,jastar,jastop = 1 14 1 14
  isastr,isastp,jsastr,jsastp = 1 14 1 14
  (computed) ngx,ngy  = 14 14
  meshdn,npts,nareas  = 1 9 0
  nlines,nvols        = 0 0
  ndrec,nctrec,LSGRID = 57 0 T

 Discrete Receptors (n,x,y,z):
 1 1681.34900 -893.437134 17.0000000
 2 1681.34900 -893.437134 17.0000000
```

```
3 1681.36169 -893.433472 17.0000000
4 1681.36169 -893.433472 17.0000000
5 1681.36926 -893.431335 14.0000000
6 1681.36914 -893.431335 14.0000000
7 1681.37769 -893.428955 14.0000000
8 1681.37817 -893.428955 14.0000000
9 1681.38806 -893.425659 11.8000002
10 1681.38806 -893.425659 11.8000002
11 1681.38806 -893.425659 11.8000002
12 1681.40479 -893.419983 11.8000002
13 1681.40479 -893.419983 11.8000002
14 1681.40479 -893.419983 11.8000002
15 1681.31238 -893.449768 17.0000000
16 1681.31213 -893.449768 17.0000000
17 1681.32935 -893.444580 17.0000000
18 1681.32935 -893.444580 17.0000000
19 1681.28821 -893.457031 17.0000000
20 1681.28809 -893.457031 17.0000000
21 1681.29541 -893.454773 17.0000000
22 1681.29541 -893.454773 17.0000000
23 1681.30603 -893.430847 17.0000000
24 1681.32214 -893.416443 17.0000000
25 1681.33386 -893.240479 9.00000000
26 1681.33411 -893.240479 9.00000000
27 1681.33411 -893.240051 9.00000000
28 1681.33411 -893.240051 9.00000000
29 1681.33411 -893.240051 9.00000000
30 1681.33411 -893.240051 9.00000000
31 1681.33411 -893.240051 9.00000000
32 1681.33411 -893.240051 9.00000000
33 1681.33411 -893.240051 9.00000000
34 1681.36328 -893.231384 9.00000000
35 1681.36316 -893.231079 9.00000000
36 1681.36316 -893.231079 9.00000000
37 1681.36316 -893.231079 9.00000000
38 1681.36316 -893.231079 9.00000000
39 1681.36316 -893.231079 9.00000000
40 1681.36316 -893.231079 9.00000000
41 1681.36316 -893.231079 9.00000000
42 1681.36316 -893.231079 9.00000000
43 1681.29248 -893.253662 11.6000004
44 1681.29211 -893.254089 11.6000004
45 1681.29211 -893.254089 11.6000004
46 1681.29211 -893.254089 11.6000004
47 1681.31372 -893.245544 11.6000004
48 1681.31409 -893.246033 11.6000004
49 1681.31409 -893.246033 11.6000004
50 1681.31409 -893.246033 11.6000004
51 1681.25793 -893.239075 12.0000000
52 1681.25793 -893.239075 12.0000000
53 1681.25793 -893.239075 12.0000000
54 1681.32104 -893.414551 16.5000000
55 1681.32104 -893.414551 16.5000000
56 1681.28296 -893.293945 16.5000000
57 1681.28296 -893.293945 16.5000000

 Control-file POINT Sources :  9
 EMARB-file POINT Sources   :  0
```

```
 Control-file AREA Sources  :  0
 EMARB-file AREA Sources    :  0
 Control-file LINE Sources  :  0
 EMARB-file LINE Sources    :  0
 Control-file VOLUME Sources:  0
 EMARB-file VOLUME Sources  :  0

 Source Names
P1
P2
P3
P4
P5
P6
P7
P8
P9




**************    NOTICE    ***************
NDRECP array reset to full range: all 1s

**************    NOTICE    ***************
Gridded receptor range reset to NGX by NGY


 ------------------------------------------------------------------------
---------------------------------------------------------
          INPUT FILES

 Default Name     Unit No.     File Name and Path
 ------------     --------     ------------------
  CALPOST.INP         5        C:\CALPUFF\MODELL~1\GS\CALPOST2.INP
    MODEL.DAT         4        C:\CALPUFF\MODELL~1\GS\CALPUFF2.CON


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---------------------------------------------------------
          OUTPUT FILES

 Default Name     Unit No.     File Name and Path
 ------------     --------     ------------------
  CALPOST.LST         8        C:\CALPUFF\MODELL~1\GS\CALPOST2.LST

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                                              CALPOST  Version 6.223
Level 080924
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                          NOA           1

             TOP-50    1   HOUR AVERAGE  CONCENTRATION VALUES  (ug/m**3)
```

STARTING YEAR	DAY	TIME(HHMM)	RECEPTOR	TYPE	CONCENTRATION	COORDINATES (km)	
2006	141	0700	(0, 33)	D	1.4832E+03	1681.334	-893.240
2006	141	0700	(0, 32)	D	1.1250E+03	1681.334	-893.240
2006	249	1500	(0, 33)	D	1.0787E+03	1681.334	-893.240
2006	171	1000	(0, 42)	D	1.0522E+03	1681.363	-893.231
2006	232	1500	(0, 33)	D	1.0519E+03	1681.334	-893.240
2006	266	1000	(0, 42)	D	1.0482E+03	1681.363	-893.231
2006	85	1100	(0, 33)	D	1.0465E+03	1681.334	-893.240
2006	266	1100	(0, 42)	D	1.0392E+03	1681.363	-893.231
2006	224	1100	(0, 42)	D	1.0375E+03	1681.363	-893.231
2006	249	1400	(0, 42)	D	9.9647E+02	1681.363	-893.231
2006	169	1100	(0, 42)	D	9.9065E+02	1681.363	-893.231
2006	141	0800	(0, 42)	D	9.5417E+02	1681.363	-893.231
2006	78	1900	(0, 33)	D	9.1777E+02	1681.334	-893.240
2006	141	0800	(0, 33)	D	9.0483E+02	1681.334	-893.240
2006	249	1500	(0, 32)	D	8.8162E+02	1681.334	-893.240
2006	171	1000	(0, 41)	D	8.6769E+02	1681.363	-893.231
2006	266	1000	(0, 41)	D	8.6273E+02	1681.363	-893.231
2006	266	1100	(0, 41)	D	8.5848E+02	1681.363	-893.231
2006	232	1500	(0, 32)	D	8.5532E+02	1681.334	-893.240
2006	224	1100	(0, 41)	D	8.5250E+02	1681.363	-893.231
2006	85	1100	(0, 32)	D	8.5046E+02	1681.334	-893.240
2006	249	1400	(0, 33)	D	8.3798E+02	1681.334	-893.240
2006	103	1300	(0, 33)	D	8.3632E+02	1681.334	-893.240
2006	138	1100	(0, 33)	D	8.2986E+02	1681.334	-893.240
2006	249	1400	(0, 41)	D	8.2355E+02	1681.363	-893.231
2006	141	0700	(0, 31)	D	8.1159E+02	1681.334	-893.240
2006	169	1100	(0, 41)	D	8.0977E+02	1681.363	-893.231

```
             2006  141    0800    (  0,  41)  D     7.8830E+02
1681.363  -893.231
             2006  103    1200    (  0,  42)  D     7.8732E+02
1681.363  -893.231
             2006  141    0800    (  0,  32)  D     7.3950E+02
1681.334  -893.240
             2006  266    1100    (  0,  33)  D     7.3418E+02
1681.334  -893.240
             2006   87    0900    (  0,  33)  D     7.2309E+02
1681.334  -893.240
             2006   78    2000    (  0,  42)  D     7.1551E+02
1681.363  -893.231
             2006   64    0800    (  0,  42)  D     7.0860E+02
1681.363  -893.231
             2006  249    1500    (  0,  31)  D     6.9508E+02
1681.334  -893.240
             2006  171    1000    (  0,  40)  D     6.9110E+02
1681.363  -893.231
             2006  266    1100    (  0,  40)  D     6.8563E+02
1681.363  -893.231
             2006  266    1000    (  0,  40)  D     6.8518E+02
1681.363  -893.231
             2006  249    1400    (  0,  32)  D     6.8356E+02
1681.334  -893.240
             2006  118    1300    (  0,  33)  D     6.8069E+02
1681.334  -893.240
             2006  224    1100    (  0,  40)  D     6.7548E+02
1681.363  -893.231
             2006  141    0900    (  0,  42)  D     6.6965E+02
1681.363  -893.231
             2006  232    1500    (  0,  31)  D     6.6944E+02
1681.334  -893.240
             2006  103    1300    (  0,  32)  D     6.6639E+02
1681.334  -893.240
             2006   85    1100    (  0,  31)  D     6.6516E+02
1681.334  -893.240
             2006  138    1100    (  0,  32)  D     6.6088E+02
1681.334  -893.240
             2006  249    1400    (  0,  40)  D     6.5859E+02
1681.363  -893.231
             2006  169    1100    (  0,  40)  D     6.3709E+02
1681.363  -893.231
             2006  103    1200    (  0,  41)  D     6.3118E+02
1681.363  -893.231
             2006  141    0800    (  0,  40)  D     6.3045E+02
1681.363  -893.231

*************************************************************************
*********************************************************
                                              CALPOST  Version 6.223
Level 080924
*************************************************************************
*********************************************************


                           NOA           1

             TOP-50 8760   HOUR AVERAGE  CONCENTRATION VALUES  (ug/m**3)
```

```
    STARTING YEAR  DAY TIME(HHMM) RECEPTOR  TYPE   CONCENTRATION
COORDINATES (km)

             2006    1    0000    (  0,  42)  D     2.0494E+01
1681.363  -893.231
             2006    1    0000    (  0,  33)  D     1.9547E+01
1681.334  -893.240
             2006    1    0000    (  0,  32)  D     1.1440E+01
1681.334  -893.240
             2006    1    0000    (  0,  41)  D     9.6242E+00
1681.363  -893.231
             2006    1    0000    (  0,  57)  D     9.3193E+00
1681.283  -893.294
             2006    1    0000    (  0,  56)  D     9.3000E+00
1681.283  -893.294
             2006    1    0000    (  0,  31)  D     7.8617E+00
1681.334  -893.240
             2006    1    0000    (  0,  40)  D     7.8481E+00
1681.363  -893.231
             2006    1    0000    (  0,  46)  D     7.5648E+00
1681.292  -893.254
             2006    1    0000    (  0,  45)  D     7.1451E+00
1681.292  -893.254
             2006    1    0000    (  0,  30)  D     7.1075E+00
1681.334  -893.240
             2006    1    0000    (  0,  50)  D     6.9868E+00
1681.314  -893.246
             2006    1    0000    (  0,  44)  D     6.8601E+00
1681.292  -893.254
             2006    1    0000    (  0,  43)  D     6.7959E+00
1681.292  -893.254
             2006    1    0000    (  0,  49)  D     6.6574E+00
1681.314  -893.246
             2006    1    0000    (  0,  29)  D     6.6301E+00
1681.334  -893.240
             2006    1    0000    (  0,  39)  D     6.4949E+00
1681.363  -893.231
             2006    1    0000    (  0,  48)  D     6.4405E+00
1681.314  -893.246
             2006    1    0000    (  0,  47)  D     6.4038E+00
1681.314  -893.246
             2006    1    0000    (  0,  28)  D     6.2931E+00
1681.334  -893.240
             2006    1    0000    (  0,  27)  D     6.0694E+00
1681.334  -893.240
             2006    1    0000    (  0,  38)  D     6.0268E+00
1681.363  -893.231
             2006    1    0000    (  0,  26)  D     5.9361E+00
1681.334  -893.240
             2006    1    0000    (  0,  25)  D     5.9258E+00
1681.334  -893.240
             2006    1    0000    (  8,   7)  G     5.7069E+00
1681.500  -893.500
             2006    1    0000    (  0,  37)  D     5.6897E+00
1681.363  -893.231
             2006    1    0000    (  0,  36)  D     5.4621E+00
1681.363  -893.231
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          2006    1    0000    (  0,   14)  D     5.3981E+00
1681.405  -893.420
          2006    1    0000    (  0,   13)  D     5.3665E+00
1681.405  -893.420
          2006    1    0000    (  0,   12)  D     5.3480E+00
1681.405  -893.420
          2006    1    0000    (  0,   34)  D     5.3046E+00
1681.363  -893.231
          2006    1    0000    (  0,   35)  D     5.3036E+00
1681.363  -893.231
          2006    1    0000    (  0,   53)  D     5.2604E+00
1681.258  -893.239
          2006    1    0000    (  0,   52)  D     5.2350E+00
1681.258  -893.239
          2006    1    0000    (  0,   51)  D     5.2198E+00
1681.258  -893.239
          2006    1    0000    (  0,   55)  D     5.0683E+00
1681.321  -893.415
          2006    1    0000    (  0,   54)  D     5.0577E+00
1681.321  -893.415
          2006    1    0000    (  0,   24)  D     4.9413E+00
1681.322  -893.416
          2006    1    0000    (  0,   11)  D     4.4134E+00
1681.388  -893.426
          2006    1    0000    (  0,   10)  D     4.3975E+00
1681.388  -893.426
          2006    1    0000    (  0,    9)  D     4.3879E+00
1681.388  -893.426
          2006    1    0000    (  0,   23)  D     4.2928E+00
1681.306  -893.431
          2006    1    0000    (  0,   20)  D     4.2659E+00
1681.288  -893.457
          2006    1    0000    (  0,   19)  D     4.2339E+00
1681.288  -893.457
          2006    1    0000    (  0,   22)  D     4.1387E+00
1681.295  -893.455
          2006    1    0000    (  0,    8)  D     4.1383E+00
1681.378  -893.429
          2006    1    0000    (  0,    7)  D     4.1321E+00
1681.378  -893.429
          2006    1    0000    (  0,   21)  D     4.1135E+00
1681.295  -893.455
          2006    1    0000    (  0,    6)  D     4.0057E+00
1681.369  -893.431
          2006    1    0000    (  0,    5)  D     3.9980E+00
1681.369  -893.431

************************************************************************
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                                             CALPOST  Version 6.223
Level 080924
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2 RANKED 1 HOUR AVERAGE CONCENTRATION VALUES AT EACH GRIDDED RECEPTOR (YEAR,DAY,START TIME) (ug/m**3)

RECEPTOR	COORDINATES (km)		1 RANK		2 RANK	
1, 1	1674.500	-899.500	6.8720E+00	(2006,141,2000)	6.4076E+00	(2006,203,0600)
1, 2	1674.500	-898.500	8.1630E+00	(2006,141,1900)	7.4804E+00	(2006,205,0200)
1, 3	1674.500	-897.500	8.0626E+00	(2006,141,1800)	7.9448E+00	(2006,161,0300)
1, 4	1674.500	-896.500	7.5878E+00	(2006,205,0300)	6.9640E+00	(2006,269,0500)
1, 5	1674.500	-895.500	1.4041E+01	(2006,136,0100)	1.2703E+01	(2006,170,0000)
1, 6	1674.500	-894.500	1.1723E+01	(2006,169,2300)	1.1650E+01	(2006,169,2200)
1, 7	1674.500	-893.500	1.2034E+01	(2006,169,2000)	1.0421E+01	(2006,169,2100)
1, 8	1674.500	-892.500	1.3260E+01	(2006,131,2000)	1.2663E+01	(2006,131,1900)
1, 9	1674.500	-891.500	1.1941E+01	(2006,169,1700)	1.0028E+01	(2006,081,0500)
1, 10	1674.500	-890.500	1.2091E+01	(2006,282,2300)	1.0117E+01	(2006,088,0400)
1, 11	1674.500	-889.500	1.1611E+01	(2006,160,1700)	8.4672E+00	(2006,282,2100)
1, 12	1674.500	-888.500	1.1903E+01	(2006,276,2300)	1.1769E+01	(2006,276,2100)
1, 13	1674.500	-887.500	8.3947E+00	(2006,256,0000)	8.2578E+00	(2006,195,0500)
1, 14	1674.500	-886.500	9.3043E+00	(2006,141,0300)	8.5410E+00	(2006,241,2100)
2, 1	1675.500	-899.500	1.3950E+01	(2006,141,2000)	8.9236E+00	(2006,103,1800)
2, 2	1675.500	-898.500	8.9675E+00	(2006,141,2000)	8.5247E+00	(2006,136,2000)
2, 3	1675.500	-897.500	8.6315E+00	(2006,161,0600)	8.5431E+00	(2006,205,0200)
2, 4	1675.500	-896.500	1.0131E+01	(2006,161,0400)	1.0105E+01	(2006,243,0100)
2, 5	1675.500	-895.500	1.2824E+01	(2006,135,2300)	1.1825E+01	(2006,136,0000)
2, 6	1675.500	-894.500	1.5604E+01	(2006,131,2300)	1.5121E+01	(2006,169,2300)
2, 7	1675.500	-893.500	1.4041E+01	(2006,169,2000)	1.2593E+01	(2006,169,2100)
2, 8	1675.500	-892.500	1.5475E+01	(2006,131,1900)	1.3627E+01	(2006,131,2000)
2, 9	1675.500	-891.500	1.3823E+01	(2006,283,0100)	1.3492E+01	(2006,283,0000)
2, 10	1675.500	-890.500	1.2035E+01	(2006,172,0600)	1.1980E+01	(2006,172,0500)
2, 11	1675.500	-889.500	1.4971E+01	(2006,276,2300)	1.4039E+01	(2006,276,2200)
2, 12	1675.500	-888.500	1.0561E+01	(2006,195,0500)	1.0468E+01	(2006,073,2000)

2, 13   1675.500 -887.500   1.0576E+01 (2006,141,0300) 1.0190E+01
(2006,141,0200)
2, 14   1675.500 -886.500   1.0372E+01 (2006,141,0400) 1.0122E+01
(2006,249,1800)
3, 1   1676.500 -899.500   8.7119E+00 (2006,103,1800) 8.3344E+00
(2006,170,2000)
3, 2   1676.500 -898.500   1.6672E+01 (2006,141,2000) 1.3867E+01
(2006,103,1800)
3, 3   1676.500 -897.500   1.5198E+01 (2006,141,1900) 1.1121E+01
(2006,136,2000)
3, 4   1676.500 -896.500   1.3167E+01 (2006,183,1800) 1.2951E+01
(2006,141,1800)
3, 5   1676.500 -895.500   2.8087E+01 (2006,183,1700) 1.1960E+01
(2006,205,0300)
3, 6   1676.500 -894.500   2.3808E+01 (2006,131,2300) 1.9492E+01
(2006,136,0200)
3, 7   1676.500 -893.500   1.5924E+01 (2006,169,2000) 1.4959E+01
(2006,169,2100)
3, 8   1676.500 -892.500   1.6952E+01 (2006,131,1800) 1.6480E+01
(2006,169,1800)
3, 9   1676.500 -891.500   1.5163E+01 (2006,282,2300) 1.4604E+01
(2006,283,0000)
3, 10   1676.500 -890.500   1.7571E+01 (2006,160,1700) 1.3667E+01
(2006,282,2000)
3, 11   1676.500 -889.500   1.3424E+01 (2006,064,0000) 1.3286E+01
(2006,276,1900)
3, 12   1676.500 -888.500   1.2481E+01 (2006,141,0200) 1.2041E+01
(2006,135,0200)
3, 13   1676.500 -887.500   1.4095E+01 (2006,249,1800) 1.2023E+01
(2006,141,0400)
3, 14   1676.500 -886.500   1.2008E+01 (2006,141,0600) 1.0991E+01
(2006,249,1900)
4, 1   1677.500 -899.500   1.4541E+01 (2006,141,2100) 8.8645E+00
(2006,204,2300)
4, 2   1677.500 -898.500   1.0709E+01 (2006,170,2100) 1.0478E+01
(2006,205,0000)
4, 3   1677.500 -897.500   1.8428E+01 (2006,141,2000) 1.3991E+01
(2006,103,1800)
4, 4   1677.500 -896.500   3.4476E+01 (2006,183,1800) 2.4372E+01
(2006,141,1900)
4, 5   1677.500 -895.500   4.5796E+01 (2006,183,1700) 2.0099E+01
(2006,183,1800)
4, 6   1677.500 -894.500   4.9977E+01 (2006,183,1700) 2.2974E+01
(2006,131,2300)
4, 7   1677.500 -893.500   1.7982E+01 (2006,169,2000) 1.7976E+01
(2006,169,2100)
4, 8   1677.500 -892.500   2.1181E+01 (2006,082,0600) 2.0390E+01
(2006,081,0200)
4, 9   1677.500 -891.500   1.6943E+01 (2006,179,1700) 1.5866E+01
(2006,282,2200)
4, 10   1677.500 -890.500   2.1097E+01 (2006,277,0000) 2.0629E+01
(2006,276,2000)
4, 11   1677.500 -889.500   1.5524E+01 (2006,141,0200) 1.5440E+01
(2006,135,0200)
4, 12   1677.500 -888.500   1.7566E+01 (2006,249,1800) 1.4163E+01
(2006,141,0400)
4, 13   1677.500 -887.500   1.4464E+01 (2006,141,0600) 1.2281E+01
(2006,084,2200)

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   4, 14    1677.500  -886.500   1.3052E+01 (2006,227,1900)  1.1162E+01
(2006,160,0100)
   5,  1    1678.500  -899.500   9.6916E+00 (2006,141,2100)  9.1955E+00
(2006,204,2200)
   5,  2    1678.500  -898.500   1.5463E+01 (2006,141,2100)  1.1605E+01
(2006,103,1900)
   5,  3    1678.500  -897.500   1.8693E+01 (2006,183,1800)  1.3119E+01
(2006,119,0600)
   5,  4    1678.500  -896.500   4.5102E+01 (2006,183,1800)  2.0913E+01
(2006,141,2000)
   5,  5    1678.500  -895.500   2.9115E+01 (2006,183,1700)  2.3946E+01
(2006,183,1800)
   5,  6    1678.500  -894.500   6.1545E+01 (2006,183,1700)  2.2806E+01
(2006,243,0000)
   5,  7    1678.500  -893.500   3.3042E+01 (2006,183,1600)  2.3513E+01
(2006,106,2100)
   5,  8    1678.500  -892.500   3.5491E+01 (2006,283,0100)  3.5355E+01
(2006,082,0600)
   5,  9    1678.500  -891.500   2.4273E+01 (2006,276,2300)  2.3925E+01
(2006,277,0000)
   5, 10    1678.500  -890.500   2.0826E+01 (2006,208,1900)  2.0108E+01
(2006,135,0200)
   5, 11    1678.500  -889.500   1.9491E+01 (2006,249,1900)  1.8543E+01
(2006,208,1900)
   5, 12    1678.500  -888.500   1.6864E+01 (2006,084,2300)  1.5738E+01
(2006,160,0300)
   5, 13    1678.500  -887.500   1.5831E+01 (2006,227,2000)  1.5684E+01
(2006,227,1900)
   5, 14    1678.500  -886.500   1.3504E+01 (2006,070,0200)  1.3130E+01
(2006,134,1700)
   6,  1    1679.500  -899.500   9.4714E+00 (2006,103,2000)  8.7092E+00
(2006,090,0600)
   6,  2    1679.500  -898.500   1.3760E+01 (2006,103,2000)  1.1734E+01
(2006,090,0500)
   6,  3    1679.500  -897.500   2.3130E+01 (2006,183,1800)  1.8589E+01
(2006,141,2100)
   6,  4    1679.500  -896.500   4.1386E+01 (2006,183,1800)  1.8376E+01
(2006,074,0600)
   6,  5    1679.500  -895.500   2.3447E+01 (2006,170,1900)  2.3349E+01
(2006,205,0000)
   6,  6    1679.500  -894.500   6.9255E+01 (2006,183,1700)  3.3046E+01
(2006,161,0700)
   6,  7    1679.500  -893.500   7.5555E+01 (2006,183,1600)  3.4903E+01
(2006,203,0200)
   6,  8    1679.500  -892.500   3.7107E+01 (2006,082,0600)  3.1093E+01
(2006,282,2200)
   6,  9    1679.500  -891.500   2.9115E+01 (2006,141,0200)  2.7871E+01
(2006,135,0200)
   6, 10    1679.500  -890.500   2.6714E+01 (2006,084,2200)  2.6620E+01
(2006,242,0100)
   6, 11    1679.500  -889.500   2.3534E+01 (2006,227,1900)  2.0743E+01
(2006,158,1700)
   6, 12    1679.500  -888.500   2.0777E+01 (2006,070,0100)  1.8192E+01
(2006,070,0200)
   6, 13    1679.500  -887.500   1.5165E+01 (2006,134,2000)  1.4706E+01
(2006,134,1700)
   6, 14    1679.500  -886.500   1.1890E+01 (2006,134,2000)  1.1718E+01
(2006,134,1900)
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   7,  1    1680.500  -899.500   1.2324E+01 (2006,243,0500)  1.1557E+01
(2006,103,2100)
   7,  2    1680.500  -898.500   1.5513E+01 (2006,103,2100)  1.3349E+01
(2006,243,0500)
   7,  3    1680.500  -897.500   2.6220E+01 (2006,183,1900)  1.7065E+01
(2006,103,2100)
   7,  4    1680.500  -896.500   3.1730E+01 (2006,183,1800)  3.0472E+01
(2006,090,0600)
   7,  5    1680.500  -895.500   4.6384E+01 (2006,090,0600)  4.6039E+01
(2006,203,0700)
   7,  6    1680.500  -894.500   7.7503E+01 (2006,074,0600)  5.6427E+01
(2006,203,0700)
   7,  7    1680.500  -893.500   1.0030E+02 (2006,183,1600)  5.3427E+01
(2006,183,1700)
   7,  8    1680.500  -892.500   5.6064E+01 (2006,070,0600)  4.8831E+01
(2006,064,0000)
   7,  9    1680.500  -891.500   4.7894E+01 (2006,227,1900)  4.5212E+01
(2006,227,1800)
   7, 10    1680.500  -890.500   3.6490E+01 (2006,070,0100)  3.1396E+01
(2006,099,2100)
   7, 11    1680.500  -889.500   2.3747E+01 (2006,227,2100)  2.2188E+01
(2006,132,1800)
   7, 12    1680.500  -888.500   1.8809E+01 (2006,132,1900)  1.7816E+01
(2006,220,1800)
   7, 13    1680.500  -887.500   1.6381E+01 (2006,117,2100)  1.6203E+01
(2006,117,2000)
   7, 14    1680.500  -886.500   1.4163E+01 (2006,117,2100)  1.3968E+01
(2006,117,2000)
   8,  1    1681.500  -899.500   1.1537E+01 (2006,103,2200)  7.4491E+00
(2006,141,2200)
   8,  2    1681.500  -898.500   1.2983E+01 (2006,103,2200)  1.2953E+01
(2006,183,1900)
   8,  3    1681.500  -897.500   4.2172E+01 (2006,183,1900)  1.6941E+01
(2006,208,2000)
   8,  4    1681.500  -896.500   2.0938E+01 (2006,103,2200)  1.9183E+01
(2006,298,0500)
   8,  5    1681.500  -895.500   3.5426E+01 (2006,126,1900)  2.9679E+01
(2006,298,0500)
   8,  6    1681.500  -894.500   6.2572E+01 (2006,126,1900)  5.2906E+01
(2006,298,0400)
   8,  7    1681.500  -893.500   3.2549E+02 (2006,243,0700)  2.8887E+02
(2006,204,1000)
   8,  8    1681.500  -892.500   8.1208E+01 (2006,227,2200)  7.2571E+01
(2006,185,1900)
   8,  9    1681.500  -891.500   4.3674E+01 (2006,185,1900)  3.9927E+01
(2006,132,2000)
   8, 10    1681.500  -890.500   3.2435E+01 (2006,227,2200)  2.9360E+01
(2006,146,1800)
   8, 11    1681.500  -889.500   1.9895E+01 (2006,227,2200)  1.9755E+01
(2006,250,0000)
   8, 12    1681.500  -888.500   1.5934E+01 (2006,250,0000)  1.5473E+01
(2006,237,2300)
   8, 13    1681.500  -887.500   1.3830E+01 (2006,250,0000)  1.3365E+01
(2006,146,1800)
   8, 14    1681.500  -886.500   1.2063E+01 (2006,250,0000)  1.1582E+01
(2006,146,1800)
   9,  1    1682.500  -899.500   9.5613E+00 (2006,103,2300)  9.2664E+00
(2006,139,0200)
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9, 2 1682.500 -898.500 1.2132E+01 (2006,183,1900) 1.1697E+01
(2006,103,2300)
9, 3 1682.500 -897.500 3.6390E+01 (2006,183,1900) 1.9643E+01
(2006,243,0700)
9, 4 1682.500 -896.500 3.1216E+01 (2006,243,0700) 2.1594E+01
(2006,206,1700)
9, 5 1682.500 -895.500 3.8737E+01 (2006,243,0700) 2.9828E+01
(2006,239,0500)
9, 6 1682.500 -894.500 5.0322E+01 (2006,270,2000) 4.5704E+01
(2006,284,0500)
9, 7 1682.500 -893.500 7.5112E+01 (2006,089,0500) 7.4692E+01
(2006,277,0400)
9, 8 1682.500 -892.500 1.3986E+02 (2006,293,0500) 7.5364E+01
(2006,171,0600)
9, 9 1682.500 -891.500 4.3962E+01 (2006,145,1800) 4.0088E+01
(2006,222,2000)
9, 10 1682.500 -890.500 2.4690E+01 (2006,227,2300) 2.1526E+01
(2006,132,0300)
9, 11 1682.500 -889.500 2.0149E+01 (2006,177,1800) 2.0005E+01
(2006,132,0300)
9, 12 1682.500 -888.500 2.1908E+01 (2006,177,1700) 1.7148E+01
(2006,146,2200)
9, 13 1682.500 -887.500 1.8413E+01 (2006,177,1700) 1.4332E+01
(2006,185,2000)
9, 14 1682.500 -886.500 1.2525E+01 (2006,185,2000) 1.2159E+01
(2006,177,1700)
10, 1 1683.500 -899.500 1.1319E+01 (2006,206,1700) 1.0660E+01
(2006,239,0300)
10, 2 1683.500 -898.500 1.8903E+01 (2006,104,0000) 1.4145E+01
(2006,239,0500)
10, 3 1683.500 -897.500 2.7280E+01 (2006,183,1900) 1.9630E+01
(2006,104,0100)
10, 4 1683.500 -896.500 2.0730E+01 (2006,239,0400) 1.8021E+01
(2006,104,0200)
10, 5 1683.500 -895.500 2.6083E+01 (2006,284,0500) 2.2425E+01
(2006,086,0200)
10, 6 1683.500 -894.500 4.5407E+01 (2006,259,0400) 4.4285E+01
(2006,235,2000)
10, 7 1683.500 -893.500 7.0931E+01 (2006,283,0300) 5.8004E+01
(2006,283,0400)
10, 8 1683.500 -892.500 9.4598E+01 (2006,164,1600) 7.3983E+01
(2006,164,1700)
10, 9 1683.500 -891.500 3.4582E+01 (2006,231,1800) 3.3011E+01
(2006,159,0300)
10, 10 1683.500 -890.500 2.6205E+01 (2006,159,0100) 2.5269E+01
(2006,251,2300)
10, 11 1683.500 -889.500 2.0495E+01 (2006,133,1900) 1.8793E+01
(2006,145,1800)
10, 12 1683.500 -888.500 1.6259E+01 (2006,132,0400) 1.3458E+01
(2006,113,1900)
10, 13 1683.500 -887.500 1.3548E+01 (2006,132,0300) 1.1372E+01
(2006,177,1900)
10, 14 1683.500 -886.500 1.3444E+01 (2006,132,0300) 9.9504E+00
(2006,168,2000)
11, 1 1684.500 -899.500 1.6523E+01 (2006,104,0100) 1.3265E+01
(2006,104,0000)
11, 2 1684.500 -898.500 1.6645E+01 (2006,104,0200) 1.0517E+01
(2006,239,0400)

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(2006,086,0100)
  11,  4    1684.500  -896.500   1.8350E+01 (2006,284,0500)  1.4861E+01
(2006,068,0300)
  11,  5    1684.500  -895.500   2.7643E+01 (2006,243,0600)  2.6949E+01
(2006,068,0600)
  11,  6    1684.500  -894.500   5.4324E+01 (2006,170,0300)  4.9643E+01
(2006,077,0500)
  11,  7    1684.500  -893.500   5.8520E+01 (2006,283,0300)  4.8716E+01
(2006,283,0400)
  11,  8    1684.500  -892.500   5.5457E+01 (2006,164,1700)  3.8172E+01
(2006,104,0500)
  11,  9    1684.500  -891.500   4.2216E+01 (2006,171,0500)  3.6615E+01
(2006,085,0300)
  11, 10    1684.500  -890.500   2.3875E+01 (2006,159,0300)  2.3356E+01
(2006,231,1800)
  11, 11    1684.500  -889.500   2.2455E+01 (2006,165,1800)  1.8461E+01
(2006,147,2200)
  11, 12    1684.500  -888.500   1.8381E+01 (2006,159,0100)  1.8085E+01
(2006,145,1800)
  11, 13    1684.500  -887.500   1.6986E+01 (2006,185,2200)  1.4679E+01
(2006,159,0100)
  11, 14    1684.500  -886.500   1.1772E+01 (2006,185,2200)  1.0605E+01
(2006,132,0500)
  12,  1    1685.500  -899.500   8.5966E+00 (2006,104,0200)  6.4086E+00
(2006,087,0400)
  12,  2    1685.500  -898.500   1.0210E+01 (2006,087,0300)  8.4952E+00
(2006,183,2000)
  12,  3    1685.500  -897.500   1.4222E+01 (2006,284,0500)  1.3454E+01
(2006,087,0300)
  12,  4    1685.500  -896.500   1.9026E+01 (2006,068,0500)  1.7830E+01
(2006,068,0600)
  12,  5    1685.500  -895.500   2.7931E+01 (2006,077,0400)  2.4825E+01
(2006,170,0300)
  12,  6    1685.500  -894.500   3.9357E+01 (2006,170,0400)  3.2287E+01
(2006,224,2300)
  12,  7    1685.500  -893.500   3.8445E+01 (2006,283,0400)  3.7028E+01
(2006,283,0300)
  12,  8    1685.500  -892.500   2.9807E+01 (2006,186,0200)  2.9672E+01
(2006,060,0200)
  12,  9    1685.500  -891.500   7.4987E+01 (2006,164,1700)  2.8309E+01
(2006,136,0500)
  12, 10    1685.500  -890.500   3.3482E+01 (2006,171,0500)  2.8146E+01
(2006,064,0500)
  12, 11    1685.500  -889.500   2.2120E+01 (2006,092,1900)  1.9909E+01
(2006,159,0400)
  12, 12    1685.500  -888.500   2.3984E+01 (2006,165,1800)  1.9437E+01
(2006,147,2300)
  12, 13    1685.500  -887.500   1.5279E+01 (2006,251,2300)  1.4191E+01
(2006,147,2100)
  12, 14    1685.500  -886.500   1.7832E+01 (2006,145,1800)  1.3071E+01
(2006,159,0100)
  13,  1    1686.500  -899.500   8.2287E+00 (2006,087,0300)  6.8836E+00
(2006,068,0300)
  13,  2    1686.500  -898.500   1.0459E+01 (2006,284,0500)  9.2598E+00
(2006,068,0400)
  13,  3    1686.500  -897.500   1.4254E+01 (2006,068,0500)  1.1645E+01
(2006,257,0600)
```

13, 4 1686.500 -896.500 1.7311E+01 (2006,260,0500) 1.7299E+01
(2006,087,0500)
13, 5 1686.500 -895.500 2.6580E+01 (2006,077,0500) 2.4519E+01
(2006,107,0200)
13, 6 1686.500 -894.500 3.3476E+01 (2006,170,0500) 3.1218E+01
(2006,225,0000)
13, 7 1686.500 -893.500 3.1760E+01 (2006,283,0400) 2.4878E+01
(2006,283,0300)
13, 8 1686.500 -892.500 3.0755E+01 (2006,089,0400) 2.7209E+01
(2006,067,0200)
13, 9 1686.500 -891.500 6.3492E+01 (2006,164,1700) 4.2815E+01
(2006,164,1800)
13, 10 1686.500 -890.500 2.2231E+01 (2006,085,0400) 2.1877E+01
(2006,171,0500)
13, 11 1686.500 -889.500 2.8532E+01 (2006,171,0600) 2.3992E+01
(2006,085,0300)
13, 12 1686.500 -888.500 2.1517E+01 (2006,092,1900) 1.6986E+01
(2006,130,2000)
13, 13 1686.500 -887.500 1.6820E+01 (2006,165,1800) 1.5476E+01
(2006,112,1800)
13, 14 1686.500 -886.500 1.1192E+01 (2006,116,2200) 1.0738E+01
(2006,159,0200)
14, 1 1687.500 -899.500 9.1493E+00 (2006,086,0400) 8.7402E+00
(2006,086,0300)
14, 2 1687.500 -898.500 1.2259E+01 (2006,068,0500) 1.0010E+01
(2006,077,0400)
14, 3 1687.500 -897.500 1.5595E+01 (2006,087,0500) 1.3442E+01
(2006,260,0500)
14, 4 1687.500 -896.500 2.4524E+01 (2006,077,0400) 1.6787E+01
(2006,259,0400)
14, 5 1687.500 -895.500 3.2907E+01 (2006,170,0400) 2.7772E+01
(2006,077,0500)
14, 6 1687.500 -894.500 3.1951E+01 (2006,170,0500) 2.4419E+01
(2006,225,0100)
14, 7 1687.500 -893.500 2.6237E+01 (2006,283,0400) 2.4144E+01
(2006,170,0700)
14, 8 1687.500 -892.500 2.9660E+01 (2006,089,0400) 2.3690E+01
(2006,223,2200)
14, 9 1687.500 -891.500 4.4693E+01 (2006,164,1800) 2.4185E+01
(2006,164,1700)
14, 10 1687.500 -890.500 4.3456E+01 (2006,164,1800) 2.3459E+01
(2006,136,0500)
14, 11 1687.500 -889.500 2.5934E+01 (2006,171,0500) 1.6890E+01
(2006,136,0600)
14, 12 1687.500 -888.500 2.4393E+01 (2006,171,0600) 2.2513E+01
(2006,085,0300)
14, 13 1687.500 -887.500 1.4439E+01 (2006,064,0500) 1.3814E+01
(2006,092,1900)
14, 14 1687.500 -886.500 1.2623E+01 (2006,112,1800) 1.1658E+01
(2006,165,1800)

1 - RANK HIGHEST VALUES FOR PERIOD

Multiply all values by 10 ** -1

14 I 93 104 120 131 135 119 142 121 125 134 118
178 112 126

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
13	84	106	141	145	158	152	164	138	184	135	170	153	168	144
12	119	106	125	176	169	208	188	159	219	163	184	240	215	244
11	116	150	134	155	195	235	237	199	201	205	225	221	285	259
10	121	120	176	211	208	267	365	324	247	262	239	335	222	435
9	119	138	152	169	243	291	479	437	440	346	422	750	635	447
8	133	155	170	212	355	371	561	812	1399	946	555	298	308	297
7	120	140	159	180	330	756	1003	3255	751	709	585	384	318	262
6	117	156	238	500	615	693	775	626	503	454	543	394	335	320
5	140	128	281	458	291	234	464	354	387	261	276	279	266	329
4	76	101	132	345	451	414	317	209	312	207	184	190	173	245
3	81	86	152	184	187	231	262	422	364	273	133	142	143	156
2	82	90	167	107	155	138	155	130	121	189	166	102	105	123
1	69	139	87	145	97	95	123	115	96	113	165	86	82	91

2 - RANK HIGHEST VALUES FOR PERIOD

Multiply all values by 10 ** -1

```
  14 I   85   101   110   112   131   117   140   116   122   100   106
131   107   117
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
  13 I   83   102   120   123   157   147   162   134   143   114   147
142   155   138
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
  12 I  118   105   120   142   157   182   178   155   171   135   181
194   170   225
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
  11 I   85   140   133   154   185   207   222   198   200   188   185
199   240   169
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
  10 I  101   120   137   206   201   266   314   294   215   253   234
281   219   235
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   9 I  100   135   146   159   239   279   452   399   401   330   366
283   428   242
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   8 I  127   136   165   204   354   311   488   726   754   740   382
297   272   237
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   7 I  104   126   150   180   235   349   534  2889   747   580   487
370   249   241
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   6 I  116   151   195   230   228   330   564   529   457   443   496
323   312   244
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   5 I  127   118   120   201   239   233   460   297   298   224   269
248   245   278
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   4 I   70   101   130   244   209   184   305   192   216   180   149
178   173   168
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   3 I   79    85   111   140   131   186   171   169   196   196   109
135   116   134
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   2 I   75    85   139   105   116   117   133   130   117   141   105
85    93   100
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
```

```
   1 I   64    89    83    89    92    87   116    74    93   107   133
64    69    87
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
     ------------------------------------------------------------------
---------------
          1     2     3     4     5     6     7     8     9    10    11
12    13    14
                                                          NOA          1

 2 RANKED     1   HOUR AVERAGE  CONCENTRATION VALUES AT EACH DISCRETE
RECEPTOR  (YEAR,DAY,START TIME)   (ug/m**3)

RECEPTOR     COORDINATES (km)            1 RANK                     2
RANK
      1     1681.349  -893.437   2.9890E+02 (2006,183,1400)  2.9768E+02
(2006,141,1000)
      2     1681.349  -893.437   2.9903E+02 (2006,183,1400)  2.9782E+02
(2006,141,1000)
      3     1681.362  -893.433   3.0175E+02 (2006,183,1400)  3.0053E+02
(2006,141,1000)
      4     1681.362  -893.433   3.0189E+02 (2006,183,1400)  3.0066E+02
(2006,141,1000)
      5     1681.369  -893.431   2.9329E+02 (2006,183,1400)  2.9206E+02
(2006,141,1000)
      6     1681.369  -893.431   2.9344E+02 (2006,183,1400)  2.9221E+02
(2006,141,1000)
      7     1681.378  -893.429   2.9436E+02 (2006,183,1400)  2.9312E+02
(2006,141,1000)
      8     1681.378  -893.429   2.9451E+02 (2006,183,1400)  2.9327E+02
(2006,141,1000)
      9     1681.388  -893.426   2.8820E+02 (2006,183,1400)  2.8695E+02
(2006,141,1000)
     10     1681.388  -893.426   2.8838E+02 (2006,183,1400)  2.8712E+02
(2006,141,1000)
     11     1681.388  -893.426   2.8866E+02 (2006,183,1400)  2.8741E+02
(2006,141,1000)
     12     1681.405  -893.420   2.8877E+02 (2006,183,1400)  2.8749E+02
(2006,141,1000)
     13     1681.405  -893.420   2.8895E+02 (2006,183,1400)  2.8766E+02
(2006,141,1000)
     14     1681.405  -893.420   2.8923E+02 (2006,183,1400)  2.8795E+02
(2006,141,1000)
     15     1681.312  -893.450   2.9098E+02 (2006,233,1100)  2.8542E+02
(2006,183,1400)
     16     1681.312  -893.450   2.9206E+02 (2006,233,1100)  2.8548E+02
(2006,183,1400)
     17     1681.329  -893.445   2.9212E+02 (2006,183,1400)  2.9092E+02
(2006,141,1000)
     18     1681.329  -893.445   2.9225E+02 (2006,183,1400)  2.9105E+02
(2006,141,1000)
     19     1681.288  -893.457   3.1032E+02 (2006,274,0900)  2.7389E+02
(2006,183,1400)
     20     1681.288  -893.457   3.1149E+02 (2006,274,0900)  2.7397E+02
(2006,183,1400)
     21     1681.295  -893.455   2.9647E+02 (2006,274,0900)  2.8248E+02
(2006,233,1100)
```

22	1681.295	-893.455	2.9768E+02	(2006,274,0900)	2.8316E+02	(2006,233,1100)
23	1681.306	-893.431	2.9203E+02	(2006,183,1400)	2.9081E+02	(2006,141,1000)
24	1681.322	-893.416	3.0224E+02	(2006,183,1400)	3.0100E+02	(2006,141,1000)
25	1681.334	-893.240	2.7234E+02	(2006,183,1400)	2.7107E+02	(2006,141,1000)
26	1681.334	-893.240	2.7255E+02	(2006,183,1400)	2.7128E+02	(2006,141,1000)
27	1681.334	-893.240	2.7460E+02	(2006,183,1400)	2.7333E+02	(2006,141,1000)
28	1681.334	-893.240	3.2215E+02	(2006,249,1500)	2.9938E+02	(2006,232,1500)
29	1681.334	-893.240	4.1162E+02	(2006,249,1500)	3.9163E+02	(2006,141,0700)
30	1681.334	-893.240	5.6656E+02	(2006,141,0700)	5.3594E+02	(2006,249,1500)
31	1681.334	-893.240	8.1159E+02	(2006,141,0700)	6.9508E+02	(2006,249,1500)
32	1681.334	-893.240	1.1250E+03	(2006,141,0700)	8.8162E+02	(2006,249,1500)
33	1681.334	-893.240	1.4832E+03	(2006,141,0700)	1.0787E+03	(2006,249,1500)
34	1681.363	-893.231	2.7185E+02	(2006,183,1400)	2.7052E+02	(2006,141,1000)
35	1681.363	-893.231	2.7188E+02	(2006,183,1400)	2.7055E+02	(2006,141,1000)
36	1681.363	-893.231	2.7474E+02	(2006,266,1100)	2.7409E+02	(2006,183,1400)
37	1681.363	-893.231	3.3195E+02	(2006,266,1100)	3.2929E+02	(2006,171,1000)
38	1681.363	-893.231	4.1818E+02	(2006,266,1100)	4.1754E+02	(2006,171,1000)
39	1681.363	-893.231	5.3847E+02	(2006,171,1000)	5.3637E+02	(2006,266,1100)
40	1681.363	-893.231	6.9110E+02	(2006,171,1000)	6.8563E+02	(2006,266,1100)
41	1681.363	-893.231	8.6769E+02	(2006,171,1000)	8.6273E+02	(2006,266,1000)
42	1681.363	-893.231	1.0522E+03	(2006,171,1000)	1.0482E+03	(2006,266,1000)
43	1681.292	-893.254	2.7450E+02	(2006,087,0900)	2.7432E+02	(2006,183,1400)
44	1681.292	-893.254	2.7664E+02	(2006,087,0900)	2.7449E+02	(2006,183,1400)
45	1681.292	-893.254	3.1003E+02	(2006,087,0900)	3.0032E+02	(2006,118,1300)
46	1681.292	-893.254	3.5547E+02	(2006,087,0900)	3.4682E+02	(2006,118,1300)
47	1681.314	-893.246	2.7789E+02	(2006,183,1400)	2.7664E+02	(2006,141,1000)
48	1681.314	-893.246	2.7832E+02	(2006,183,1400)	2.7708E+02	(2006,141,1000)
49	1681.314	-893.246	2.9081E+02	(2006,085,1100)	2.9019E+02	(2006,232,1500)
50	1681.314	-893.246	3.4420E+02	(2006,085,1100)	3.4306E+02	(2006,232,1500)

```
     51     1681.258  -893.239   3.5545E+02 (2006,136,1000)  3.5345E+02
(2006,067,0900)
     52     1681.258  -893.239   3.5655E+02 (2006,136,1000)  3.5452E+02
(2006,067,0900)
     53     1681.258  -893.239   3.5838E+02 (2006,136,1000)  3.5629E+02
(2006,067,0900)
     54     1681.321  -893.415   3.0100E+02 (2006,183,1400)  2.9977E+02
(2006,141,1000)
     55     1681.321  -893.415   3.0114E+02 (2006,183,1400)  2.9991E+02
(2006,141,1000)
     56     1681.283  -893.294   2.9696E+02 (2006,183,1400)  2.9569E+02
(2006,141,1000)
     57     1681.283  -893.294   2.9708E+02 (2006,183,1400)  2.9582E+02
(2006,141,1000)

************************************************************************
*********************************************************
                                              CALPOST  Version 6.223
Level 080924
************************************************************************
*********************************************************




     8760   HOUR AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD
STARTING   YEAR: 2006 DAY: 365 HOUR: 23 SEC:    0

 GRIDDED RECEPTORS:

 NOA           1

 Multiply all values by 10 **  -3

  14 I   40    51    64    78    92   110    99    73    78    72    55
60    55    60
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
  13 I   46    56    68    90   109   136   133    94   107    81    75
73    84   105
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
  12 I   59    63    71    91   128   160   182   125   144    94    93
101   143   130
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
  11 I   63    82    84    97   139   194   273   189   184   126   122
173   168   156
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
  10 I   88    98   104   124   138   225   384   304   215   176   228
223   213   197
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   9 I   82   108   135   162   197   235   463   477   347   388   402
344   339   323
```

```
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   8 I   88   112   141   190   272   406   560  1347  1077   977   889
727   549   409
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   7 I   70    91   118   162   242   414  1175  5707  2899  1411   880
641   491   379
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   6 I   71    95   126   174   249   426   674   550   739   630   544
435   374   311
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   5 I   70    89   116   164   230   289   276   239   321   308   303
263   261   245
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   4 I   63    84   110   144   171   181   152   146   189   191   182
192   162   144
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   3 I   61    80    96   111   127   117    97   106   134   137   122
125   130   112
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   2 I   58    69    80    91    88    81    68    75    95   101    98
87    89    90
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
   1 I   47    57    66    68    64    57    51    54    69    76    74
66    63    62
     I    +     +     +     +     +     +     +     +     +     +     +
+     +     +
     -------------------------------------------------------------------
---------------
          1     2     3     4     5     6     7     8     9    10    11
12    13    14

      DISCRETE RECEPTORS:  NOA           1

RECEPTOR    COORDINATES (km)         CONCENTRATION            RECEPTOR
COORDINATES (km)         CONCENTRATION


     1     1681.349  -893.437         3.8521E+00                  29
1681.334  -893.240         6.6301E+00
     2     1681.349  -893.437         3.8616E+00                  30
1681.334  -893.240         7.1075E+00
     3     1681.362  -893.433         3.9664E+00                  31
1681.334  -893.240         7.8617E+00
     4     1681.362  -893.433         3.9751E+00                  32
1681.334  -893.240         1.1440E+01
     5     1681.369  -893.431         3.9980E+00                  33
1681.334  -893.240         1.9547E+01
     6     1681.369  -893.431         4.0057E+00                  34
1681.363  -893.231         5.3046E+00
     7     1681.378  -893.429         4.1321E+00                  35
1681.363  -893.231         5.3036E+00
```

```
     8     1681.378  -893.429        4.1383E+00                 36
1681.363  -893.231        5.4621E+00
     9     1681.388  -893.426        4.3879E+00                 37
1681.363  -893.231        5.6897E+00
    10     1681.388  -893.426        4.3975E+00                 38
1681.363  -893.231        6.0268E+00
    11     1681.388  -893.426        4.4134E+00                 39
1681.363  -893.231        6.4949E+00
    12     1681.405  -893.420        5.3480E+00                 40
1681.363  -893.231        7.8481E+00
    13     1681.405  -893.420        5.3665E+00                 41
1681.363  -893.231        9.6242E+00
    14     1681.405  -893.420        5.3981E+00                 42
1681.363  -893.231        2.0494E+01
    15     1681.312  -893.450        3.8346E+00                 43
1681.292  -893.254        6.7959E+00
    16     1681.312  -893.450        3.8560E+00                 44
1681.292  -893.254        6.8601E+00
    17     1681.329  -893.445        3.7191E+00                 45
1681.292  -893.254        7.1451E+00
    18     1681.329  -893.445        3.7337E+00                 46
1681.292  -893.254        7.5648E+00
    19     1681.288  -893.457        4.2339E+00                 47
1681.314  -893.246        6.4038E+00
    20     1681.288  -893.457        4.2659E+00                 48
1681.314  -893.246        6.4405E+00
    21     1681.295  -893.455        4.1135E+00                 49
1681.314  -893.246        6.6574E+00
    22     1681.295  -893.455        4.1387E+00                 50
1681.314  -893.246        6.9868E+00
    23     1681.306  -893.431        4.2928E+00                 51
1681.258  -893.239        5.2198E+00
    24     1681.322  -893.416        4.9413E+00                 52
1681.258  -893.239        5.2350E+00
    25     1681.334  -893.240        5.9258E+00                 53
1681.258  -893.239        5.2604E+00
    26     1681.334  -893.240        5.9361E+00                 54
1681.321  -893.415        5.0577E+00
    27     1681.334  -893.240        6.0694E+00                 55
1681.321  -893.415        5.0683E+00
    28     1681.334  -893.240        6.2931E+00                 56
1681.283  -893.294        9.3000E+00
                                                                57
1681.283  -893.294        9.3193E+00

*************************************************************************
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                                             CALPOST  Version 6.223
Level 080924
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                                                        SUMMARY SECTION

                                                        NOA           1
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(ug/m**3)

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 RECEPTOR      COORDINATES (km)    TYPE      PEAK (YEAR,DAY,START TIME)
FOR RANK    FOR AVERAGE PERIOD

   8,  7    1681.500  -893.500   GRIDDED    3.2549E+02 (2006,243,0700)
RANK  1          1   HOUR
   8,  7    1681.500  -893.500   GRIDDED    2.8887E+02 (2006,204,1000)
RANK  2          1   HOUR
     33     1681.334  -893.240  DISCRETE    1.4832E+03 (2006,141,0700)
RANK  1          1   HOUR
     33     1681.334  -893.240  DISCRETE    1.0787E+03 (2006,249,1500)
RANK  2          1   HOUR

   8,  7    1681.500  -893.500   GRIDDED    5.7069E+00
RANK  1       8760   HOUR
     42     1681.363  -893.231  DISCRETE    2.0494E+01
RANK  1       8760   HOUR
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Appendix D

Ozone limiting method calculations

PARSONS BRINCKERHOFF

2.4m stack height option

OLM Calc Method 2 Level 1 - hourly - Peak Operation Max Predicted plus measured value at that time - contemporaneous assessment

Location	Co-ordinates (AMG)	Co-ordinates (LCC)	Height of receptor (m)	Factor	Predicted Nox (ug/m3)			Predicted NOx ug/m3		O3 bckgrd ug/m3			NO2 (ug/m3)	NO2 (ug/m3) Total	Date of maximum predicted concentration
					(Model)			(Model)		O3 Conc			NO2 Conc		
Receptor 1 - Building 2 (4)	333345.461, 6250089.291	1681.362 -893.433	3	0.1	301.89	**30.189**	0.9	301.89	**271.701**	0.96	14.98	**14.356**	**34.85**	**79.395**	2/07/2006 at 10am
Receptor 2 - Building 4 (8)	333361.298, 6250096.736	1681.378 -893.429	3	0.1	294.51	**29.451**	0.9	294.51	**265.059**	0.96	14.98	**14.356**	**34.85**	**78.657**	2/07/2006 at 10am
Receptor 3 - Building 5 (14)	333387.991, 6250110.702	1681.405 -893.420	4.5	0.1	289.23	**28.923**	0.9	289.23	**260.307**	0.96	14.98	**14.356**	**34.85**	**78.129**	2/07/2006 at 10am
Receptor 4 - Building 8 (18)	333313.734, 6250072.290	1681.329 -893.445	3	0.1	292.25	**29.225**	0.9	292.25	**263.025**	0.96	14.98	**14.356**	**34.85**	**78.431**	2/07/2006 at 10am
Receptor 5 - Building 9 (20)	333273.165, 6250052.332	1681.288 -893.457	3	0.1	311.49	**31.149**	0.9	311.49	**280.341**	0.96	38.52	**36.915**	**20.5**	**88.564**	1/10/2006 at 9am
Receptor 6 - Building 10 (24)	333301.446, 6250100.23	1681.322 -893.416	1.5	0.1	302.24	**30.224**	0.9	302.24	**272.016**	0.96	14.98	**14.356**	**34.85**	**79.430**	2/07/2006 at 1400
Receptor 7 - Building 11 (33)	333283.732, 6250285.048	1681.334 -893.240	40	0.1	1483.2	**148.32**	0.9	1483.2	**1334.88**	0.96	8.56	**8.203**	**32.8**	**189.323**	21/05/2006 at 7am
Receptor 8 - Building 12 (46)	333242.988, 6250264.331	1681.292 -893.254	15	0.1	355.47	**35.547**	0.9	355.47	**319.923**	0.96	6.42	**6.153**	**67.65**	**109.350**	28/03/2006 at 9am
Receptor 9 - Building 13 (53)	333204.66, 6250273.653	1681.258 -893.239	4.5	0.1	358.38	**35.838**	0.9	358.38	**322.542**	0.96	10.7	**10.254**	**45.1**	**91.192**	16/05/2006 10am
Receptor 10 - Building 15 (55)	333299.96, 6250102.045	1681.321 -893.415	3	0.1	301.14	**30.114**	0.9	301.14	**271.026**	0.96	14.98	**14.356**	**34.85**	**79.320**	2/07/2006 at 1400
													Limit	**246**	

OLM Calc Method 2 Level 1 - Annual - Peak Operation - max predicted plus measured for year

Location				Factor	Predicted Nox (ug/m3)			Predicted NOx ug/m3		O3 bckgrd ug/m3			NO2 (ug/m3)	NO2 (ug/m3) Total Annual
					(Model)			(Model)		Ann (of 1 hour avs)			Ann Av of 1 hour averages	
Receptor 1 - Building 2 (4)	333345.461, 6250089.291	1681.362 -893.433	3	0.1	3.97	**0.397**	0.9	3.97	**3.573**	0.96	**31.25**	**29.948**	**26.9**	**30.870**
Receptor 2 - Building 4 (8)	333361.298, 6250096.736	1681.378 -893.429	3	0.1	4.14	**0.414**	0.9	4.14	**3.726**	0.96	**31.25**	**29.948**	**26.9**	**31.040**
Receptor 3 - Building 5 (14)	333387.991, 6250110.702	1681.405 -893.420	4.5	0.1	5.4	**0.54**	0.9	5.4	**4.86**	0.96	**31.25**	**29.948**	**26.9**	**32.300**
Receptor 4 - Building 8 (16)	333297.049, 6250064.001	1681.312 -893.450	3	0.1	3.86	**0.386**	0.9	3.86	**3.474**	0.96	**31.25**	**29.948**	**26.9**	**30.760**
Receptor 5 - Building 9 (20)	333273.165, 6250052.332	1681.288 -893.457	3	0.1	4.27	**0.427**	0.9	4.27	**3.843**	0.96	**31.25**	**29.948**	**26.9**	**31.170**
Receptor 6 - Building 10 (24)	333301.446, 6250100.23	1681.322 -893.416	1.5	0.1	4.94	**0.494**	0.9	4.94	**4.446**	0.96	**31.25**	**29.948**	**26.9**	**31.840**
Receptor 7 - Building 11 (42)	333312.736, 6250299.55	1681.363 -893.231	40	0.1	20.49	**2.049**	0.9	20.49	**18.441**	0.96	**31.25**	**29.948**	**26.9**	**47.390**
Receptor 8 - Building 12 (46)	333242.988, 6250264.331	1681.292 -893.254	15	0.1	7.56	**0.756**	0.9	7.56	**6.804**	0.96	**31.25**	**29.948**	**26.9**	**34.460**
Receptor 9 - Building 13 (53)	333204.66, 6250273.653	1681.258 -893.239	4.5	0.1	5.26	**0.526**	0.9	5.26	**4.734**	0.96	**31.25**	**29.948**	**26.9**	**32.160**
Receptor 10 - Building 15 (57)	333239.88, 6250220.824	1681.283 -893.294	3	0.1	9.32	**0.932**	0.9	9.32	**8.388**	0.96	**31.25**	**29.948**	**26.9**	**36.220**
													Limit	**62**