AIR QUALITY IMPACT ASSESSMENT:
READYMIX REGIONAL DISTRIBUTION CENTRE AT ROOTY HILL

3 November 2005

Prepared for
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1. INTRODUCTION

This report has been prepared by Holmes Air Sciences for National Environmental Consulting Services (NECS) who are in turn acting on behalf of Readymix Holdings Pty Ltd (Readymix). Readymix proposes to construct and operate a Regional Distribution Centre (RDC) off Kellogg Road at Rooty Hill. The purpose of this report is to quantitatively assess dust impacts that may be associated with the operation of the project.

The assessment is based on the use of a computer-based dispersion model to predict ground-level dust concentrations and deposition levels in the vicinity of the project area. To assess the effect that the dust emissions would have on existing air quality, the dispersion model predictions have been compared to relevant air quality goals.

The assessment is based on a conventional approach following the procedures outlined in the NSW Department of Environment and Conservation's (DEC, formerly EPA) document titled "Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW" (**NSW EPA, 2001**).

In summary, the report provides information on the following:

- A description of the proposed operations and the local setting
- Air quality goals that need to be met to protect the air quality environment
- Meteorological conditions in the area
- A discussion as to the likely existing air quality conditions in the area
- The methods used to estimate dust emissions and the way in which dust emissions from the proposal would disperse and fallout
- The expected dispersion and dust fallout patterns due to emissions from the plant and a comparison between the predicted dust concentration and fallout levels and the relevant air quality criteria
- The control methods to be used by the plant to reduce dust impacts

2. LOCAL SETTING PROJECT DESCRIPTION

Figure 1 shows the proposed location for the RDC project. Landuse in the area is a mixture of industrial premises and residential areas. Terrain is considered to be flat for the purposes of the assessment however it can be seen from **Figure 2** that the local creeks follow some shallow valleys.

The RDC would see construction materials brought to the site by rail. These materials would be sourced predominantly from quarries outside the Sydney Basin and the purpose of the RDC is to blend and distribute construction materials to the Sydney market.

The project would have the capacity to handle up to 4 million tonnes of product each year however in the early stages of operation it is intended to handle between 2 and 2.5 Mtpa. Material received would include single size crushed aggregate, blended aggregates and natural and manufactured sand and would be blended to suit customer requirements. Distribution of all products would be by road.

Figure 3 shows the proposed layout of the plant and associated facilities. These facilities would include:

- A rail siding with aggregate unloading facility
- Storage bin area and load out facilities
- Ground storage and reclaim facilities
- Blending plant / Pug mill
- A conveyor system which links the unloading station to the storage and truck load out facilities
- Office buildings, workshops and amenities
- Concrete batching plant

The process begins with delivery of quarry materials by rail to the RDC site. Materials would be unloaded at the unloading station which houses two hoppers beneath the tracks. The unloading station would be enclosed on three sides and would have a "louvre" system to minimise the escape of air and to control dust emissions from the unloading hopper. Each train would carry approximately 3500 t of product with delivery proposed on a 24-hour, seven day a week basis.

Under normal operation conveyors would transfer product from the unloading station to the storage area where it would be deposited in a designated closed top storage bin by shuttle conveyor. A total of 30 storage bins are proposed with each bin being over 24 metres high, 12 metres in diameter and capable of holding up to 2,200 tonnes depending on product type. There would be reclaim feeders and conveyors under the bins to deliver material to truck loading points.

Additional blending would occur at a Pug Mill adjacent to the storage bins. Material would be fed from the main storage bins via conveyor. The capacity of the Pug Mill would be 400 tph.

In the event of a malfunction with the main storage system the product would be diverted directly to a radial stacker and placed in ground bays separated by concrete walls. Water sprays would be used for dust suppression. A front end loader would be used to feed the reclaim hopper which transfers material back into the main storage bins and trucks. The radial stacker has been proposed as a fail safe measure and would not be used under normal operations.

There would also be five on-ground storage bins used for temporary storage of materials, dumping of materials from overloaded trucks and storage of special products. Each bin would have a capacity of approximately 500 t.

Operations at the site are proposed for 24 hours per day and seven days per week. All road surfaces would be paved, conveyors would be covered and enclosed and transfer points enclosed to minimise dust emissions.

A Concrete Batching Plant (CBP) would also be constructed on the site as part of the RDC project. The CBP would be designed to have a maximum annual production rate of 200,000 m^3 however during typical operations the annual production would be approximately 100,000 m^3. Normal operating hours would be for 24 hours per day.

The CBP would consist of the following:

- 8 on-ground aggregate storage bins with three-sided concrete walls
- 6 holding bins with 3 weigh bins underneath
- Covered 900 mm belt conveyor
- 2 x 10 m^3 holding bins enclosed within building
- 4 x 120 t silos

All vehicles intended for the CBP would enter and exit the site via Kellogg Road with one access point located at the northern boundary of the site. All road surfaces would be paved. Delivery and dispatch vehicles would enter the site and proceed in a clockwise direction around the site facilities. Sand and aggregates delivery trucks would proceed directly to the on-ground storage bins for dumping of materials before leaving the site. A front end loader (FEL) would then be used to transfer the raw materials from the ground bins to the 6 holding bins. Weighing of materials would take place below the holding bins before being transferred by conveyor to the 10 m^3 enclosed holding bins and then by gravity to the agitator.

Loading of cement and flyash to the 120 t silos would use current technology reverse pulse silo filters. Potential volumes of air that may be released from a cement tanker into a cement silo are of the order of 108 m^3/min. In practice the volume of air would be less than this as there are operational procedures that tanker drivers can follow to reduce the volume of air entering the silo.

Concrete trucks would be loaded via a full 'gravity' system. Dust generated during loading would be collected by a dry dust extraction system. Material may be stockpiled up to 2.5 m high with the open bins. A water spray system is proposed to control dust in the stockpile area.

The dust generating activities associated with the RDC will include:

- Material loading and unloading points
- Trucks travelling over road surfaces
- Wind erosion from stockpiles

3. AIR QUALITY GOALS

Table 1 and **Table 2** summarise the air quality assessment criteria that are relevant to this study. The air quality goals relate to the total dust burden in the air and not just the dust from the project. In other words, some consideration of background levels needs to be made when using these goals to assess impacts. This will be discussed later.

Table 1 : Air quality assessment criteria for particulate matter concentrations

POLLUTANT	STANDARD / GOAL	AVERAGING PERIOD	AGENCY
Total suspended particulate matter (TSP)	90 µg/m^3	Annual mean	NHMRC
Particulate matter < 10 µm (PM_{10})	50 µg/m^3	24-hour maximum	DEC
	30 µg/m^3	Annual mean	DEC
	50 µg/m^3	(24-hour average, 5 exceedances permitted per year)	NEPM
Particulate matter < 2.5 µm ($PM_{2.5}$)	8 µg/m^3	Annual mean	NEPM*
	25 µg/m^3	24-hour maximum	NEPM*

** Long-term reporting goal, not applied to projects in NSW.*

Also included in **Table 1** are the NEPM goals for the fine fraction of PM_{10} namely $PM_{2.5}$. Epidemiological studies (**Dockery et al, 1993** for example) indicate that it is the finer particles, that is those below 2.5 µm in diameter and referred to as $PM_{2.5}$, that cause health impacts as they are taken deeper into the lung. Australia has no ambient goal for $PM_{2.5}$ applied on a project basis.

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces. **Table 2** shows the maximum acceptable increase in dust deposition over the existing dust levels. These criteria for dust fallout levels are set to protect against nuisance impacts (**NSW EPA, 2001**).

Table 2 : NSW DEC criteria for dust fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

4. EXISTING ENVIRONMENT

This section describes the dispersion meteorology, local climatic conditions and existing dust levels in the area.

4.1 Dispersion Meteorology

The Gaussian dispersion model used for this assessment, AUSPLUME, requires information about the dispersion characteristics of the area. In particular, data are required on wind speed, wind direction, atmospheric stability class[1] and mixing height[2]. Meteorological data collected in the study area are discussed below.

The DEC have collected meteorological information in the area from St Marys, approximately 7 km to the west of the project site. These data consist of hourly records of wind speed, wind direction and temperature and have been prepared into a form suitable for dispersion modelling. Data for 2003 are available for this study. Wind-roses prepared from these data are shown in **Figure 4**.

It can be seen from the wind-roses that, annually, the most common winds were from the SSW, S and N. This pattern is evident in all seasons to various degrees. In the summer months winds from the ESE were also common. Of the 8,760 hours of records available the wind speed was less than 0.5 m/s for 23% of the time.

Meteorological data has also been collected adjacent to the Project site by OneSteel. These data were collected in 2004 and include records of wind speed and wind direction. The OneSteel data were not suitable for dispersion modelling purposes as the data did not contain date and time records, wind directions were only recorded in ten degree increments and there were no sigma-theta records to determine atmospheric stability. Wind-roses prepared from these data are shown in **Figure 5**. The pattern of winds exhibited some similarities to the St Marys data.

The St Marys data could be considered representative of the conditions experienced at the project location and have been used in the dispersion modelling.

To use the wind data to assess dispersion it is necessary to also have available data on atmospheric stability. A stability class was calculated for each hour of the meteorological data using sigma-theta according to the method recommended by the US EPA (**US EPA, 1986**). **Table 3** shows the frequency of occurrence of the stability categories expected in the area. The most common stability occurrences at the St Marys site were calculated to be F class stabilities (29%) which suggests that dust emissions will disperse slowly for a significant proportion of the time.

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[1] In dispersion modelling stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme, as used in this study, there are six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

[2] The term mixing height refers to the height of the turbulent layer of air near the earth's surface into which ground-level emissions will be rapidly mixed. A plume emitted above the mixed-layer will remain isolated from the ground until such time as the mixed-layer reaches the height of the plume. The height of the mixed-layer is controlled mainly by convection (resulting from solar heating of the ground) and by mechanically generated turbulence as the wind blows over the rough ground.

Table 3 : Frequency of occurrence of stability classes in the area

Stability Class	St Marys, 2003 data
A	18.9
B	6.6
C	10.5
D	24.0
E	11.3
F	28.7
Total	**100**

Mixing height was determined using a scheme defined by **Powell** (**1976**) for day-time conditions and an approach described by **Venkatram**, (**1980**) for night-time conditions. These two methods provide a good estimate of mixing height in the absence of upper air data.

Joint wind speed, wind direction and stability class frequency tables for the St Marys data are presented in **Appendix A**.

4.2 Local Climatic Conditions

The Bureau of Meteorology collects climatic information from Prospect Dam. A range of meteorological data collected from this station are presented in **Table 4** (**Bureau of Meteorology, 2003**).

Temperature data show that January is typically the warmest month with a mean daily maximum of 28 ^{o} C. July is the coldest month with a mean daily minimum of 6.1 ^{o}C. Rainfall data collected at Prospect Dam show that March is the wettest month with a mean rainfall of 98 mm over 11 rain days. Annually the area experiences, on average, 879 mm of rain per year.

Table 4 : Climate information for the study area

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean daily maximum temperature - deg C	28.0	27.7	26.1	23.5	20.1	17.2	16.7	18.4	20.9	23.4	25.0	27.2	22.8	34.8
Highest daily Max Temp - deg C	44.7	42.5	39.5	37.1	29.4	25.6	26.5	29.4	35.0	39.0	41.2	42.7	44.7	35.2
Mean daily minimum temperature - deg C	17.5	17.7	16.1	13.0	10.2	7.5	6.1	6.8	9.3	12.1	14.1	16.4	12.3	34.6
Lowest daily Min Temp - deg C	10.0	10.8	7.9	4.5	1.2	0.1	0.0	0.0	2.6	4.5	6.9	7.8	0.0	35.2
Mean 9am air temp - deg C	21.0	20.8	19.6	16.7	13.4	10.4	9.3	10.8	14.1	17.0	18.1	20.4	16.0	32.0
Mean 9am wet bulb temp - deg C	18.3	18.5	17.3	14.5	11.8	8.8	7.5	8.5	11.0	13.5	15.1	17.0	13.5	29.5
Mean 9am dew point - deg C	16.4	16.9	15.4	12.5	10.1	6.7	5.1	5.7	7.6	10.2	12.4	14.5	11.1	29.5
Mean 9am relative humidity - %	76.0	80.0	78.0	77.0	81.0	79.0	77.0	72.0	67.0	67.0	71.0	71.0	75.0	29.5
Mean 3pm air temp - deg C	26.6	26.3	24.8	22.4	19.2	16.4	15.9	17.4	19.6	21.8	23.4	25.7	21.7	30.3
Mean 3pm wet bulb temp - deg C	20.0	20.0	18.8	16.5	14.4	11.9	10.9	11.6	13.1	15.2	16.9	18.6	15.7	27.8
Mean 3pm dew point - deg C	15.6	15.8	14.5	11.5	9.9	7.1	5.1	4.9	6.3	9.1	11.6	13.5	10.4	27.8
Mean 3pm relative humidity - %	53.0	55.0	55.0	53.0	57.0	56.0	51.0	46.0	45.0	48.0	50.0	50.0	51.0	27.8
Mean monthly rainfall - mm	95.9	92.2	98.2	75.9	73.6	75.6	59.3	52.2	48.1	59.2	72.4	76.1	878.5	114.3
Median (5th decile) monthly rainfall - mm	72.6	58.9	78.3	55.1	39.7	39.0	34.8	31.1	41.2	43.3	61.6	56.0	851.8	114.0
Mean no. of rain days	10.6	10.5	10.8	9.4	9.2	9.4	7.6	8.0	8.6	9.2	9.3	9.8	112.3	114.0
Highest monthly rainfall - mm	426.7	519.1	380.7	363.5	556.0	531.3	323.7	458.5	186.3	269.0	391.3	338.1		114.3
Lowest monthly rainfall - mm	3.9	2.8	5.1	2.0	1.8	1.0	0.0	0.0	0.0	0.0	0.8	2.2		114.3
Highest recorded daily rainfall - mm	161.2	164.6	153.9	163.1	314.2	163.4	143.5	321.0	96.5	102.1	126.2	154.9	321.0	114.0
Mean no. of clear days	6.6	5.2	6.8	8.9	9.2	10.1	11.5	13.5	11.7	8.5	6.9	7.2	106.2	32.3
Mean no. of cloudy days	12.5	11.8	12.0	8.2	9.8	8.5	6.7	6.5	7.3	9.5	11.2	10.8	114.7	32.3
Mean daily evaporation - mm	5.5	5.0	4.1	3.1	2.1	1.7	1.9	2.6	3.7	4.5	5.1	6.0	3.8	25.8

Climate averages for Station: 067019 PROSPECT DAM. Commenced: 1887; Last record: 2001; Latitude (deg S): -33.8193; Longitude (deg E): 150.9127; State: NSW

Source : Bureau of Meteorology (2003)

4.3 Existing air quality

Air quality standards and goals refer to pollutant levels which include the project and existing sources. To fully assess impacts against all the relevant air quality standards and goals (see **Section 3**) it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the project is likely to contribute to these levels.

No measurements of dust deposition or TSP or PM_{10} concentrations have been made specifically for this project. The DEC operate an air quality monitoring station at St Marys and at Blacktown. Concentrations of PM_{10} are measured continuously at these sites using a Tapered Element Oscillating Microbalance (TEOM) and summaries of these data are published in quarterly air quality monitoring reports by the DEC (**NSW EPA, 2003**). Monitoring data from the DEC's St Marys and Blacktown sites for 2003 are shown below in **Table 5**.

Table 5 : DEC monitoring data for the area

Month	PM_{10} concentrations by TEOM (µg/m^3)			
	St Marys		Blacktown	
	Average	Maximum 24-hourly value	Average	Maximum 24-hourly value
January 2003	29	***71***	31	***76***
February 2003	19	31	18	27
March 2003	20	***211***	23	***187***
April 2003	16	***57***	14	28
May 2003	11	30	14	23
June 2003	7	28	17	32
July 2003	13	32	17	35
August 2003	15	31	18	31
September 2003	18	42	23	49
October 2003	13	23	16	24
November 2003	18	35	18	35
December 2003	19	41	19	33
Annual 2003	**17**	**211**	**19**	**187**

One of the main reasons for analysing monitoring data is to determine existing air quality so that the assessment criteria can be determined in accordance with the DEC's modelling guidelines (**NSW EPA, 2001**).

The annual average PM_{10} concentration recorded in 2003 at the St Marys and Blacktown sites by TEOM was 17 and 19 µg/m^3 respectively. This is below the DEC air quality goal of 30 µg/m^3.

Maximum 24-hour concentrations were above the DEC 50 µg/m^3 goal on several occasions at both the St Marys and Blacktown sites. The highest 24-hour average PM_{10} concentration were generally measured in the warmer months of the year. Bushfires were reported in January and March of 2003 at locations that would have influenced PM_{10} measurements at St Marys and Blacktown.

Neither TSP concentrations nor dust deposition are measured at the St Marys or Blacktown sites and a value of 45 µg/m^3 has been assumed to represent the existing annual average TSP concentration. This value has been derived from the annual average PM_{10} (18 $\mu g/m^3$) and assumes that 40% of the TSP is PM_{10}. From a site inspection a value of between 2 and 3 g/m^2/month would appear to be a reasonable estimate of the annual average dust deposition at the Rooty Hill site.

From the monitoring data available it has been assumed that the following background concentrations apply at the nearest residences.

- Annual average TSP of 45 $\mu g/m^3$
- Annual average PM_{10} of 18 $\mu g/m^3$
- Annual average dust deposition of 3 g/m^2/month

In addition, the DEC guidelines require an assessment against 24-hour PM_{10} concentrations. This assessment adopts the approach that the predicted 24-hour average PM_{10} concentration from the development should be less than 50 $\mu g/m^3$ at the nearest residences.

5. ESTIMATED DUST EMISSIONS

Dust emissions will arise from a range of activities associated with the RDC. Total dust emissions due to the project have been estimated by analysing the activities taking place at the site during selected years of operation.

The operations which apply in each case have been combined with emission factors developed, both locally and by the US EPA, to estimate the amount of dust produced by each activity. There have been significant revisions to the US EPA emission factors for dust generating activities in 2003. The emission factors applied are considered to be the most up to date methods for determining dust generation rates. The fraction of fine, inhalable and coarse particles for each activity has been taken into account for the dispersion modelling.

The operational description for the project has been used to determine truck movement distances and routes, stockpile locations and areas, activity operating hours, truck sizes and other details that are necessary to estimate dust emissions.

The assessment has taken a conservative approach to estimating dust emissions as it has been assumed that the amount of material unloaded from trains and diverted to the radial stacker will be at a maximum of 10%. This increases the quantity of material that is rehandled by front end loader to the reclaim hopper for transfer to the main storage bins. As the radial stacker has been proposed as a fail safe measure this method of transfer would be minimal in each year. Operations at the CBP have assumed that annual production would be 200,000 m^3/y.

Also, it is recognised that a street sweeper will be employed to minimise dust emissions from vehicles traveling on-site. The calculated dust emissions for this assessment have not taken into account any reduction in dust emissions with the operation of a street sweeper due to the scientific uncertainty of likely reductions. The estimated dust emissions from vehicles traveling on-site are therefore considered to be conservative.

The most significant dust generating activities from the project have been identified and the dust emission estimates are presented below in **Table 6**. Details of the calculations of the dust emissions are presented in **Appendix B**.

Table 6 : Estimated dust emissions due to the project

Activity	*TSP emission rate (kg/y)*
RDC: Trains unloading to unloading station	1,097
RDC: Transfer conveyors unloading to storage bins*	877
RDC: Transfer conveyors unloading to radial stacker	366
RDC: Loading to reclaim hopper from radial stacker	366
RDC: Transfer and unloading from radial stacker to storage bins	110
RDC: FEL transferring to on ground storage bins	366
RDC: FEL transferring from on ground storage bins to trucks	366
RDC: Trucks movements on site (sealed road)	18,182
RDC: Dispatch/loadout of materials to trucks	3,656
RDC: Wind erosion from stockpiles and exposed areas	3,504
RDC: Vehicles on CBP site	5,486
RDC: Vehicle exhausts at CBP	1,295
RDC: Dumping to ground bins at CBP	366
RDC: FEL loading to hoppers at CBP	366
RDC: Unloading to storage bins at CBP	110
RDC: Residual dust from loading cement/ash to silos at CBP**	658
RDC: Unloading from bins to trucks at CBP	366
RDC: Wind erosion from exposed areas at CBP	1,051
TOTAL	**38,585**

** Assumes that 10% materials are diverted directly to the radial stacker and rehandled to reclaim hopper before being unloaded to the main storage bins.*
*** The closed system design feeds residual dust back into the silos. Inclusion of this dust emission is therefore a conservative approach to the assessment.*

The calculations have assumed some reduction to dust emissions from enclosing transfer points or from dust collection systems. It can be seen from **Table 6** that vehicle movements on-site are determined to generate the most dust on an annual basis.

6. DUST CONTROL MEASURES

The controls that are available for the plant can be summarised in three broad categories:

1. Engineering controls
2. Planning controls (which increase the separation between dust emission sources on the plant and sensitive areas)
3. Operational controls which vary operations when adverse meteorological conditions occur

Engineering controls involve measures such as covering and enclosing conveyors, enclosing transfer points and using dust collection systems at the rail unloading station, transfer points and the concrete-mix loading point and installation of spray systems on stockpiles etc.

Planning controls include the maintenance of adequate buffer distances between dust sources and sensitive receptors. In this respect the dust generating activities at the plant would have a reasonable separation distance of over 500 m from the nearest residential areas. A steel mill and the M7 motorway separate the project site from the residential areas to the west.

The dust control measures that are proposed for the project are listed below:

- All transfer, load-out and unloading points would be enclosed and will include dust control equipment
- All material carrying conveyors would be covered or enclosed on three sides
- Enclosed storage bins
- Water sprays would be used periodically on stockpiles
- Cementitious products would be loaded to silos pneumatically using well-proven technology
- A dry-dust collection system would be used to control dust at the point where transit trucks are loaded and this area would be enclosed on three sides
- Paved areas likely to generate wind borne dust would be swept as required by a permanently stationed street sweeper to minimise wind erosion dust

7. APPROACH TO ASSESSMENT

In August 2001 the NSW DEC published new guidelines for the assessment of air pollution sources using dispersion models (**NSW EPA, 2001)**. The guidelines specify how assessments based on the use of air dispersion models should be undertaken. They include guidelines for the preparation of meteorological data to be used in dispersion models, the way in which emissions should be estimated and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the proposal. The approach taken in this assessment follows as closely as possible the approaches suggested by the guidelines.

Off-site dust concentration and dust deposition levels due to the proposed RDC have been predicted using AUSPLUME. AUSPLUME (Version 6.0) is an advanced Gaussian dispersion model developed on behalf of the Victorian EPA (**VEPA, 1986**) and is based on the United States Environmental Protection Agency's Industrial Source Complex (ISC) model. It is widely used throughout Australia and is regarded as a "state-of-the-art" model. AUSPLUME is the model required for use by the NSW DEC unless project characteristics dictate otherwise (**NSW EPA, 2001**).

This section is provided so that technical reviewers can appreciate how the modelling of different particle size categories was carried out. The modelling has been based on the use of three particle-size categories (0 to 2.5 µm - referred to as $PM_{2.5}$, 2.5 to 10 µm - referred to as CM (coarse matter) and 10 to 30 µm - referred to as the Rest). Mass emission rates in each of these size ranges have been determined using the factors derived from the **SPCC (1986)** study and TSP emission rates calculated using emission factors derived from **US EPA (1985)** and **NERDDC (1988)** work (see **Appendix B**).

The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 0.0468 of the TSP
- $PM_{2.5-10}$ (CM) is 0.3440 of TSP
- PM_{10-30} (Rest) is 0.6090 of TSP.

Modelling was done using three AUSPLUME source groups. Each group corresponded to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 μm. The predicted concentration in the three plot output files for each group were then combined according to the weightings above to determine the concentration of PM_{10} and TSP.

The AUSPLUME model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions on dust generating industries where wind speed is an important factor in determining the rate at which dust is generated.

For the current study the operations were represented by a series of volume sources located according to the site layout. **Figure 6** shows the location of the modelled sources. Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this in the AUSPLUME model to ensure that long-term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds. Light winds at a RDC site would correspond with periods of low dust generation (because wind erosion and other wind dependent emissions rates will be low) and also correspond with periods of poor dispersion. If these measures are not taken then the model has the potential to significantly overstate impacts.

Dust concentrations and deposition rates have been predicted in the vicinity of the project area. Local terrain has been taken to be flat for the modelling.

The modelling has been performed using the meteorological data discussed in **Section 4.1** and the dust emission estimates from **Section 5**. All dust sources have been modelled assuming 24-hour per day operations.

As an example the AUSPLUME model output file is provided in **Appendix C**.

The ISCST3 model has been the most widely used model in NSW for assessing the dust impacts of extractive industries however a calibration study (**Holmes Air Sciences, 2002**) has suggested that ISCST3 over predicts short term (24-hour average) concentrations by roughly 260%. Comparisons between ISCST3 and AUSPLUME (see **Holmes Air Sciences, 2003** for example) have also suggested that a correction factor is appropriate for short term ISCST3 predictions as AUSPLUME has consistently predicted almost 50% lower than uncorrected ISCST3 predictions. A comparison of results from the two dispersion models for the RDC operations has also been presented in this study (**Appendix D**). The ratio of ISCST3 to AUSPLUME results ranged from 0.8 to 2.0 with a mean of 1.4.

8. ASSESSMENT OF IMPACTS

8.1 Preamble

This section provides an interpretation of the predicted dust concentrations and deposition levels.

Dust concentrations and deposition rates due to the proposed activities have been presented as isopleth diagrams showing the following:

1. Predicted maximum 24-hour average PM_{10} concentration
2. Predicted annual average PM_{10} concentration
3. Predicted annual average TSP concentration, and
4. Predicted annual average dust deposition

The maximum 24-hour average contour plots do not represent the dispersion pattern for any particular day, but show the highest predicted 24-hour average concentration that occurred at each location. The maxima are used to show concentrations which can possibly be reached under the modelled conditions.

8.2 Assessment of Impacts

Figure 7 shows the predicted maximum 24-hour average PM_{10} concentrations due to proposed operations. At the residential areas to the west, south and east of the site the predicted concentrations are less than 10 $\mu g/m^3$. The prediction at each location on the plot represents the worst day due to emissions from the RDC. The nearest residential areas are approximately 500 m from the proposed site. Predicted concentrations are below the DEC 50 $\mu g/m^3$ goal at the nearest residential areas and the impact of the RDC is therefore taken to be acceptable.

Figure 8 shows the predicted annual average PM_{10} concentrations due to the RDC operations. Assuming a background concentration of 18 $\mu g/m^3$ it can be seen that the dust emissions from the project would not cause exceedances of the air quality goal (30 $\mu g/m^3$) at any neighbouring residential areas. The predicted highest PM_{10} contribution from the RDC to existing levels is less than 2 $\mu g/m^3$ at the nearest residential area. As discussed in **Section 5** the emission estimates have assumed that up to 10% of all material delivered to the site would diverted to the radial stacker and rehandled. This is a conservative approach which increases the emissions from transferring material to the main storage bins. Annual average predictions would be over estimated.

Predicted annual average TSP concentrations are shown in **Figure 9**. The model predictions show that the nearest residential area would experience annual average TSP concentrations less than 2 $\mu g/m^3$ due to the operations of the RDC. Compliance with the annual average 90 $\mu g/m^3$ TSP would be anticipated even when considering typical background levels of around 45 $\mu g/m^3$.

Figure 10 shows the predicted annual average dust deposition. The contribution of dust emissions to existing dust deposition levels is predicted to be low at less than 0.1 g/m^2/month at the nearest residential area. It is unlikely that the operation of the RDC would be the cause of exceedances of the 4 g/m^2/month air quality goal.

Air quality impacts at the adjacent Nurragingy and Aquilina Reserves have also been considered. These reserves can see up to 2,000 visitors in one day and the critical assessment criteria will be short-term (24-hour) dust concentrations. Predicted maximum 24-hour average PM_{10} concentrations due to the RDC are shown in **Figure 7**. It can be seen from this figure that the 50 µg/m^3 contour level encroaches into some areas of the Nurragingy reserve. These areas are on the western side of the reserve adjacent to the industrial area. The model has been configured to predict a 24-hour average, consistent with the DEC air quality goal.

An assessment of the likely frequency of the highest 24-hour average PM_{10} concentrations at the Nurragingy Reserve has also been conducted. The dispersion model has been configured to predict PM_{10} concentrations due to the RDC at the reserve (location 301300, 6261832 - approximately 100 m from north-west boundary of site) for each day in the meteorological year. Results have been presented in the form of a histogram as shown in **Figure 11**. There were two days in the modelled year when the predicted 24-hour average PM_{10} concentrations were above 50 ug/m^3 at this location.

Further to the discussion, visitors to the reserves could spend up to about 12 hours in the area however there is no air quality goal for PM_{10} in NSW for averaging times less than 24-hours. The dispersion model has been re-run to predict maximum 12-hour average PM_{10} concentrations and the results are shown in **Figure 12**. The purpose of these results is to show the likely concentrations during daytime hours when there would be visitors at the reserves. Although there is no 12-hour average PM_{10} goal the results from **Figure 12** show that concentrations are below 50 µg/m^3 during daytime hours. This level of impact is considered to be acceptable.

8.3 Construction Issues

Air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities associated with the facilities construction. The total amount of dust generated would depend on the silt and moisture content of the soil, the types of operations being carried out, exposed area, frequency of water spraying and speed of machinery. The detailed approach to construction will depend on decisions that will be made by the successful contractor and changes to the construction methods and sequences are expected to take place during the detailed design development.

As construction is likely to continue for up to two years, it is important that exposed areas be stabilised as quickly as possible and that appropriate dust suppression methods be used to keep dust impacts to a minimum. It is desirable that monitoring be carried out during the construction phase of the project to assess compliance with DEC goals. A minimum of three deposition monitors would be required, ideally at the closest residences or other sensitive receptors.

9. GREENHOUSE ISSUES

Without the project Readymix would deliver all materials direct to customer by road from outside the metropolitan area. This would see an increase in truck kilometres travelled both within and outside the metropolitan area. In contrast the project would see the bulk of raw materials brought to the RDC by rail from outside the Sydney Basin. This will require fewer trucks travelling within the metropolitan area and a reduction in longer distance haul.

Greenhouse emission statistics and CO_2-equivalent emissions for trucks and trains associated with distribution to Sydney customers are provided in **Table 7**. This table presents calculations for the with and without project scenarios.

Table 7 : Greenhouse emission statistics

	Without project	With project	
Mode of transport	By road	By road	Additional by rail
Fuel consumption (l/km)	0.521[1]	0.521[1]	12[2]
VKT (millions of km)	38.8	7.3	0.422
Total fuel consumed (millions of l/y)	20.2	3.80	5.06
CO_2-e emission factor for transport fuel (t/l)[3]	0.0027	0.0027	0.0027
Total CO_2-e emissions (t/y)	54,540	10,269 + 13,673 = 23,942	

[1] Australian Greenhouse Office, 2002
[2] Estimate from personal communication between Pacific National and Readymix (4 L/loco/km and 3 locos per train)
[3] Full fuel cycle analysis, Australian Greenhouse Office, 2003

It is also estimated that there would be an additional 422,180 km per year of travel by rail with the project. From these calculations, the estimated CO_2-equivalent emissions with the project are 30,598 tonnes per year lower than without the project.

Greenhouse gases would also be released indirectly from the use of electricity. To estimate these emissions the annual electrical requirement has been estimated by the proponent. In summary the electrical requirement will be 7,575,600 kWh/y.

In converting the information to estimates of CO_2-e emissions it has been assumed that each kWh of electrical energy used results in the release of 0.968 kg of CO_2–e (**Australian Greenhouse Office, 2003** – figure for NSW generators). Therefore, the estimated annual CO_2-e emissions due to electricity consumption is 7,333 t/y.

10. CONCLUSIONS

This report has assessed the air quality impacts associated with the operation of a Regional Distribution Centre off Kellogg Road, Rooty Hill. Dispersion modelling has been used to assess the impact that dust emissions from the operation of the plant would have on the local air quality. It is concluded that air quality impacts would be at acceptable levels and that air quality goals would not be exceeded at sensitive locations due to the operation of the plant at full capacity of 4 Mtpa.

The implementation of proposed dust control measures should ensure that air quality impacts are lower than those predicted in this study.

Air quality monitoring data have indicated that existing short-term dust concentrations are above air quality goals on occasions. Particulate matter concentrations arising from non-Project related sources, such as bushfires and dust storms, may continue to result in elevated levels on occasions.

The Department of Planning and DEC have commented on an earlier version of this air quality assessment. Information requested by the Department of Planning is provided in **Appendix E**.

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APPENDIX A
JOINT WIND SPEED, WIND DIRECTION AND STABILITY CLASS FREQUENCY TABLES

St Marys 2003

STATISTICS FOR FILE: C:\Jobs\RHillRDC\metdata\StMarys\StMarys2003.aus

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.010046	0.006050	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.016096
NE	0.005822	0.004566	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010388
ENE	0.004566	0.002626	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007192
E	0.003995	0.002511	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.006621
ESE	0.002968	0.002740	0.000799	0.000000	0.000000	0.000000	0.000000	0.000000	0.006507
SE	0.001941	0.002397	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.004452
SSE	0.005936	0.001370	0.000457	0.000000	0.000000	0.000000	0.000000	0.000000	0.007763
S	0.006050	0.002169	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.008790
SSW	0.008219	0.001941	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.010274
SW	0.004795	0.002169	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006963
WSW	0.002283	0.000685	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.003196
W	0.002397	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003311
WNW	0.002740	0.001142	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.004224
NW	0.003995	0.000913	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.005023
NNW	0.012443	0.001826	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.014269
N	0.014954	0.007420	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.022374
CALM									0.051826
TOTAL	0.093151	0.041438	0.002740	0.000114	0.000000	0.000000	0.000000	0.000000	0.189269

MEAN WIND SPEED (m/s) = 1.12
NUMBER OF OBSERVATIONS = 1658

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001826	0.002055	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.003995
NE	0.000457	0.001941	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.002511
ENE	0.000913	0.003311	0.001256	0.000000	0.000000	0.000000	0.000000	0.000000	0.005479
E	0.000342	0.002397	0.001370	0.000000	0.000000	0.000000	0.000000	0.000000	0.004110
ESE	0.000571	0.003082	0.001370	0.000000	0.000000	0.000000	0.000000	0.000000	0.005023
SE	0.000913	0.002626	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.004110
SSE	0.000342	0.001484	0.000457	0.000114	0.000000	0.000000	0.000000	0.000000	0.002397
S	0.001826	0.002740	0.000342	0.000114	0.000000	0.000000	0.000000	0.000000	0.005023
SSW	0.002511	0.002968	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.005594
SW	0.001256	0.001256	0.000342	0.000114	0.000000	0.000000	0.000000	0.000000	0.002968
WSW	0.000457	0.001142	0.000228	0.000114	0.000000	0.000000	0.000000	0.000000	0.001941
W	0.000457	0.000913	0.001370	0.000228	0.000000	0.000000	0.000000	0.000000	0.002968
WNW	0.000228	0.000685	0.001142	0.000799	0.000000	0.000000	0.000000	0.000000	0.002854
NW	0.000571	0.000457	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.001256
NNW	0.002169	0.002626	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.005023
N	0.002397	0.005936	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.008562
CALM									0.001941
TOTAL	0.017237	0.035616	0.009475	0.001484	0.000000	0.000000	0.000000	0.000000	0.065753

MEAN WIND SPEED (m/s) = 2.19
NUMBER OF OBSERVATIONS = 576

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
NE	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
ENE	0.000114	0.001142	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.001941
E	0.000114	0.002511	0.004224	0.000342	0.000000	0.000000	0.000000	0.000000	0.007192
ESE	0.000000	0.002511	0.007648	0.002854	0.000000	0.000000	0.000000	0.000000	0.013014
SE	0.000228	0.002169	0.005822	0.002626	0.000000	0.000000	0.000000	0.000000	0.010845
SSE	0.000457	0.002968	0.003995	0.001484	0.000000	0.000000	0.000000	0.000000	0.008904
S	0.002740	0.005822	0.004566	0.000799	0.000000	0.000000	0.000000	0.000000	0.013927
SSW	0.002740	0.003425	0.003425	0.000685	0.000000	0.000000	0.000000	0.000000	0.010274
SW	0.000799	0.002968	0.001941	0.000913	0.000000	0.000000	0.000000	0.000000	0.006621
WSW	0.000571	0.000799	0.001941	0.000799	0.000000	0.000000	0.000000	0.000000	0.004110
W	0.000000	0.000571	0.002397	0.002055	0.000000	0.000000	0.000000	0.000000	0.005023
WNW	0.000114	0.000571	0.003767	0.004338	0.000000	0.000000	0.000000	0.000000	0.008790
NW	0.000000	0.000571	0.001826	0.001027	0.000000	0.000000	0.000000	0.000000	0.003425
NNW	0.001256	0.001370	0.000913	0.000571	0.000000	0.000000	0.000000	0.000000	0.004110
N	0.001142	0.003881	0.000685	0.000457	0.000000	0.000000	0.000000	0.000000	0.006164
CALM									0.000457
TOTAL	0.010274	0.031507	0.043836	0.018950	0.000000	0.000000	0.000000	0.000000	0.105023

MEAN WIND SPEED (m/s) = 3.33
NUMBER OF OBSERVATIONS = 920

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000571	0.000457	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001027
NE	0.000000	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000685
ENE	0.000457	0.001256	0.000457	0.000000	0.000000	0.000000	0.000000	0.000000	0.002169
E	0.000571	0.002626	0.001712	0.000000	0.000000	0.000000	0.000000	0.000000	0.004909
ESE	0.000913	0.005365	0.007306	0.002968	0.000342	0.000000	0.000000	0.000000	0.016895
SE	0.001142	0.004795	0.005137	0.001712	0.000799	0.000000	0.000000	0.000000	0.013584
SSE	0.003881	0.004224	0.004566	0.001027	0.000114	0.000114	0.000000	0.000000	0.013927
S	0.020205	0.010731	0.006050	0.002169	0.000114	0.000000	0.000000	0.000000	0.039269
SSW	0.022945	0.026142	0.008219	0.000913	0.000114	0.000000	0.000000	0.000000	0.058333
SW	0.011187	0.010046	0.003311	0.001598	0.000228	0.000000	0.000000	0.000000	0.026370
WSW	0.001712	0.002740	0.001826	0.001256	0.001027	0.000342	0.000000	0.000000	0.008904
W	0.000000	0.000571	0.002511	0.001142	0.000685	0.000000	0.000000	0.000000	0.004909
WNW	0.000228	0.003653	0.003311	0.001826	0.002740	0.000114	0.000000	0.000000	0.011872
NW	0.000228	0.002397	0.002968	0.001826	0.000913	0.000571	0.000342	0.000000	0.009247
NNW	0.001712	0.005137	0.002169	0.000685	0.000685	0.000228	0.000228	0.000000	0.010845
N	0.004795	0.006507	0.001826	0.000114	0.000114	0.000000	0.000000	0.000000	0.013356
CALM									0.003881
TOTAL	0.070548	0.087329	0.051370	0.017237	0.007877	0.001370	0.000571	0.000000	0.240183

MEAN WIND SPEED (m/s) = 2.58
NUMBER OF OBSERVATIONS = 2104

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.002055	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002283
NE	0.002397	0.001712	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004110
ENE	0.003425	0.003767	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007192
E	0.001484	0.002740	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004224
ESE	0.001256	0.002283	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003539
SE	0.000571	0.001598	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002169
SSE	0.004338	0.001142	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005479
S	0.019292	0.001370	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.020776
SSW	0.018265	0.001826	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.020091
SW	0.007763	0.001256	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.009132
WSW	0.001484	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002055
W	0.000342	0.000799	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001142
WNW	0.000685	0.001484	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.002283
NW	0.000913	0.001142	0.000342	0.000000	0.000000	0.000000	0.000000	0.000000	0.002397
NNW	0.001142	0.002055	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.003767
N	0.005822	0.002968	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008790
CALM									0.013470
TOTAL	0.071233	0.026941	0.001256	0.000000	0.000000	0.000000	0.000000	0.000000	0.112900

MEAN WIND SPEED (m/s) = 1.19
NUMBER OF OBSERVATIONS = 989

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.008333	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008904
NE	0.007420	0.001598	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.009018
ENE	0.005365	0.001941	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007306
E	0.002169	0.001027	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003196
ESE	0.001484	0.000799	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002283
SE	0.002397	0.000457	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002854
SSE	0.004566	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004795
S	0.013014	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.013927
SSW	0.013356	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.014041
SW	0.010388	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010959
WSW	0.005137	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005251
W	0.002740	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003311
WNW	0.001712	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001941
NW	0.002055	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002626
NNW	0.004110	0.000799	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.004909
N	0.011986	0.001142	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.013128
CALM									0.178425
TOTAL	0.096233	0.012215	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.286872

MEAN WIND SPEED (m/s) = 0.69
NUMBER OF OBSERVATIONS = 2513

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.022831	0.009475	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.032420
NE	0.016096	0.010616	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.026826
ENE	0.014840	0.014041	0.002397	0.000000	0.000000	0.000000	0.000000	0.000000	0.031279
E	0.008676	0.013813	0.007420	0.000342	0.000000	0.000000	0.000000	0.000000	0.030251
ESE	0.007192	0.016781	0.017123	0.005822	0.000342	0.000000	0.000000	0.000000	0.047260
SE	0.007192	0.014041	0.011644	0.004338	0.000799	0.000000	0.000000	0.000000	0.038014
SSE	0.019521	0.011416	0.009475	0.002626	0.000114	0.000114	0.000000	0.000000	0.043265
S	0.063128	0.023744	0.011644	0.003082	0.000114	0.000000	0.000000	0.000000	0.101712
SSW	0.068037	0.036986	0.011758	0.001712	0.000114	0.000000	0.000000	0.000000	0.118607
SW	0.036187	0.018265	0.005708	0.002626	0.000228	0.000000	0.000000	0.000000	0.063014
WSW	0.011644	0.006050	0.004224	0.002169	0.001027	0.000342	0.000000	0.000000	0.025457
W	0.005936	0.004338	0.006279	0.003425	0.000685	0.000000	0.000000	0.000000	0.020662
WNW	0.005708	0.007763	0.008676	0.006963	0.002740	0.000114	0.000000	0.000000	0.031963
NW	0.007763	0.006050	0.005479	0.002854	0.000913	0.000571	0.000342	0.000000	0.023973
NNW	0.022831	0.013813	0.003881	0.001256	0.000685	0.000228	0.000228	0.000000	0.042922
N	0.041096	0.027854	0.002740	0.000571	0.000114	0.000000	0.000000	0.000000	0.072374
CALM									0.250000
TOTAL	0.358676	0.235046	0.108676	0.037785	0.007877	0.001370	0.000571	0.000000	1.000000

MEAN WIND SPEED (m/s) = 1.66
NUMBER OF OBSERVATIONS = 8760

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 18.9%
B : 6.6%
C : 10.5%
D : 24.0%
E : 11.3%
F : 28.7%

STABILITY CLASS BY HOUR OF DAY

Hour	A	B	C	D	E	F
01	0000	0000	0000	0097	0079	0189
02	0000	0000	0000	0099	0076	0190
03	0000	0000	0000	0100	0066	0199
04	0000	0000	0000	0105	0056	0204
05	0000	0000	0000	0091	0064	0210
06	0026	0009	0007	0084	0035	0204
07	0087	0022	0039	0078	0016	0123
08	0176	0038	0059	0060	0005	0027
09	0191	0054	0072	0048	0000	0000
10	0198	0054	0076	0037	0000	0000
11	0209	0052	0072	0032	0000	0000
12	0199	0059	0081	0026	0000	0000
13	0202	0047	0085	0031	0000	0000
14	0168	0058	0100	0039	0000	0000
15	0120	0074	0118	0053	0000	0000
16	0054	0068	0116	0091	0009	0027
17	0024	0034	0080	0143	0027	0057
18	0004	0007	0015	0199	0059	0081
19	0000	0000	0000	0148	0093	0124
20	0000	0000	0000	0122	0093	0150
21	0000	0000	0000	0103	0079	0183
22	0000	0000	0000	0117	0067	0181
23	0000	0000	0000	0101	0088	0176
24	0000	0000	0000	0100	0077	0188

STABILITY CLASS BY MIXING HEIGHT

Mixing height	A	B	C	D	E	F
<=500 m	0346	0076	0092	0772	0930	2421
<=1000 m	0688	0226	0336	0738	0012	0038
<=1500 m	0624	0274	0492	0566	0047	0054
<=2000 m	0000	0000	0000	0027	0000	0000
<=3000 m	0000	0000	0000	0001	0000	0000
>3000 m	0000	0000	0000	0000	0000	0000

MIXING HEIGHT BY HOUR OF DAY

Hour	0000 to 0100	0100 to 0200	0200 to 0400	0400 to 0800	0800 to 1600	1600 to 3200	Greater than 3200
01	0211	0067	0036	0028	0023	0000	0000
02	0215	0056	0030	0042	0020	0002	0000
03	0227	0045	0034	0042	0016	0001	0000
04	0222	0043	0039	0040	0020	0001	0000
05	0266	0038	0022	0025	0012	0002	0000
06	0190	0075	0075	0013	0011	0001	0000
07	0115	0058	0114	0077	0000	0001	0000
08	0000	0071	0120	0174	0000	0000	0000
09	0000	0000	0101	0182	0082	0000	0000
10	0000	0000	0000	0235	0130	0000	0000
11	0000	0000	0000	0140	0225	0000	0000
12	0000	0000	0000	0092	0273	0000	0000
13	0000	0000	0000	0000	0365	0000	0000
14	0000	0000	0000	0000	0365	0000	0000
15	0000	0000	0000	0000	0365	0000	0000
16	0000	0000	0000	0000	0365	0000	0000
17	0026	0008	0004	0013	0314	0000	0000
18	0056	0042	0005	0034	0225	0003	0000
19	0115	0080	0015	0031	0121	0003	0000
20	0155	0089	0025	0042	0051	0003	0000
21	0194	0068	0030	0046	0027	0000	0000
22	0197	0057	0041	0039	0031	0000	0000
23	0201	0073	0029	0039	0023	0000	0000
24	0207	0061	0038	0035	0024	0000	0000

APPENDIX B
ESTIMATED DUST EMISSIONS

ESTIMATED DUST EMISSIONS : ROOTY HILL RDC

The dust emission inventories have has been formulated from the operational description provided by NECS. Estimated emissions are presented for all significant dust generating activities associated with the operations. The relevant emission factors used for the study are described below.

Loading, unloading and transferring material

The dust emission from this activity will depend on wind speed according to the **US EPA (1985)** emission factor equation. This means that the emissions will vary with wind speed. The actual emission is given by Equation 1.

Equation 1

$$E_{TSP} = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right) \quad kg/t$$

where,

$E_{TSP} = TSP\ \ emissions$

$k = 0.74$

$U = wind\ speed\ (m/s)$

$M = moisture\ \ content\ (\%)$

$[where\ 0.25 \le M \le 4.8]$

In cases where transfer points include some form of enclosure a reduction to emissions of 70% (Table 3 of **NPI, 2001**) has been used.

Vehicle movements on sealed road surfaces

The emission factor used for vehicles movements on the sealed surfaces of the site was 0.2 kg per vehicle kilometre travelled (kg/VKT). No reductions in emissions from the use of water sprays or street sweepers have been considered.

Vehicle exhausts

Emissions from heavy diesel vehicle exhausts can be estimated using the **US EPA (1985)** emission factor of 0.7 g/brake-horsepower hour (g/hp-h). Assume that the average power level of each truck on site 100 hp. This includes slowly maneuvering on site and idling. Also assume that each truck spends 10 minutes on site.

Residual dust from loading cement/ash to silos

Estimated dust emissions due to loading fly-ash and cement to the silo can be made by assuming the concentration of dust in the air discharged after de-dusting the conveying air and dry dust collection system when dry concrete mix is loaded to trucks is 50 mg/Nm^3 (the EPA licence limit). The volume of air handled is approximately 108 Nm^3/minute. It has been assumed that it will take one minute per tonne to load.

Wind erosion from exposed areas and stockpiles

The emissions factor for wind erosion dust is 0.4 kg/ha/hour (**SPCC, 1983**). The emissions will also depend on the state of cleanliness of the area. This also varies with wind speed in the model.

ACTIVITY	TSP (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units
RDC: Trains unloading to unloading station	3656	4,000,000	t/y	0.00125	kg/t	0.772	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)		bcm
RDC: Transfer conveyors unloading to storage bins	-	-	t/y	0.00125	kg/t	0.772	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)		bcm
RDC: Transfer conveyors unloading to radial stacker	3656	4,000,000	t/y	0.00125	kg/t	0.772	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)		bcm
RDC: Loading to reclaim hopper or trucks from radial stacker	3656	4,000,000	t/y	0.00125	kg/t	0.772	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)		bcm
RDC: Transfer and unloading from radial stacker to storage bins	3291	3,600,000	t/y	0.00125	kg/t	0.772	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)		bcm
RDC: FEL transferring to on ground storage bins	366	400,000	t/y	0.00125	kg/t	0.772	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)		bcm
RDC: FEL transferring from on ground storage bins to trucks	366	400,000	t/y	0.00125	kg/t	0.772	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)		bcm
RDC: Trucks movements on site (sealed road)	18182	4,000,000	t/y	0.00909	kg/t	33	t/truck load	0.75	km/return trip	0.2	kg/VKT
RDC: Dispatch/loadout of materials to trucks	3656	4,000,000	t/y	0.00125	kg/t	0.772	average of (wind speed/2.2)^1.3 in m/s	2	moisture content (%)		bcm
RDC: Wind erosion from stockpiles and exposed areas	3504	1	ha	3504	kg/ha/y	0.4	kg/ha/h	8760	h/y		
CBP: Vehicles on site		trips per year	return km	factor (kg/VKT)	Emission (kg/y)		BUSY	200000	m3/y		
	Delivery - cement	3000	0.4	0.2	240			667	m3/d		
	Delivery - ash	1500	0.4	0.2	120			111	m3/h		
	Delivery - aggregates	11100	0.5	0.2	1110						
	Dispatch - concrete (5m3)	39900	0.5	0.2	3990						
	Staff	12900	0.1	0.02	26	5486					
CBP: Vehicle exhausts	hp	hours/truck	trucks/year	kg/hp-h	Emission (kg/y)						
	100	0.17	55500	0.0007		648					
CBP: Dumping to ground bins	(U/2.2)^1.3	moisture(%)	factor(kg/t)	tonne per year (t/y)	Emission (kg/y)						
	0.772	1	0.0005	400000		139					
CBP: FEL loading to hoppers	(U/2.2)^1.3	moisture(%)	factor(kg/t)	tonne per year (t/y)	Emission (kg/y)						
	0.772	1	0.0005	400000		139					
CBP: Unloading to storage bins	(U/2.2)^1.3	moisture(%)	factor(kg/t)	tonne per year (t/y)	Emission (kg/y)						
	0.772	1	0.0005	400000		139					
CBP: Residual dust from loading cement/ash to silos	Conc limit (mg/Nm3)	Air volume (Nm3/minute)	Time (min/t)	t/y	Emission (kg/y)						
	50	108	1	121500		658					
CBP: Unloading from bins to trucks	(U/2.2)^1.3	moisture(%)	factor(kg/t)	tonne per year (t/y)	Emission (kg/y)						
	0.772	1	0.0005	400000		139					
CBP: Wind erosion from exposed areas		Exposed area (ha)	factor(kg/ha/hour)	Hours/year	Emission (kg/y)						
		0.3	0.4	8760		1051					

A summary of dust emission estimates for each activity, activity type, location of emission sources and activity hours are provided below. The location of the sources can be obtained from **Figure 6**.

```
-------------------------------      15-Apr-2005 09:29
  DUST EMISSION CALCULATIONS V2
 -------------------------------

 Output emissions file  : C:\Jobs\RHillRDC\ausplume\emiss.src
 Meteorological file    : C:\Jobs\RHillRDC\metdata\StMarys\StMarys2003.aus
 Number of dust sources : 30
 Number of activities   : 18
 Wind sensitive factor  : 0.772 (0.772 adjusted for activity hours)
 Wind erosion factor    : 17.629

  -----ACTIVITY SUMMARY-----
 ACTIVITY NAME : RDC: Trains unloading to unloading station
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 3656 kg/y
 FROM SOURCES  : 1
30
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: Transfer conveyors unloading to storage bins
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 0 kg/y
 FROM SOURCES  : 3
12 13 14
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: Transfer conveyors unloading to radial stacker
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 3656 kg/y
 FROM SOURCES  : 2
28 29
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: Loading to reclaim hopper or trucks from radial stacker
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 3656 kg/y
 FROM SOURCES  : 2
28 29
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: Transfer and unloading from radial stacker to storage bins
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 3291 kg/y
 FROM SOURCES  : 3
12 13 14
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: FEL transferring to on ground storage bins
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 366 kg/y
 FROM SOURCES  : 2
10 11
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: FEL transferring from on ground storage bins to trucks
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 366 kg/y
 FROM SOURCES  : 2
10 11
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: Trucks movements on site (sealed road)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 18182 kg/y
 FROM SOURCES  : 9
1 2 3 4 5 6 7 8 9
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: Dispatch/loadout of materials to trucks
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 3656 kg/y
 FROM SOURCES  : 1
5
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : RDC: Wind erosion from stockpiles and exposed areas
```

```
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 3504 kg/y
 FROM SOURCES  : 4
10 11 28 29
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CBP: Vehicles on site
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 5486 kg/y
 FROM SOURCES  : 12
1 15 16 17 18 19 20 21 22 23 24 25
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CBP: Vehicle exhausts
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 648 kg/y
 FROM SOURCES  : 1
20
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CBP: Dumping to ground bins
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 190 kg/y
 FROM SOURCES  : 1
27
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CBP: FEL loading to hoppers
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 190 kg/y
 FROM SOURCES  : 1
27
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CBP: Unloading to storage bins
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 190 kg/y
 FROM SOURCES  : 1
20
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CBP: Residual dust from loading cement/ash to silos
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 658 kg/y
 FROM SOURCES  : 1
20
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CBP: Unloading from bins to trucks
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 190 kg/y
 FROM SOURCES  : 1
20
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : CBP: Wind erosion from exposed areas
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 1051 kg/y
 FROM SOURCES  : 1
27
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

APPENDIX C
AUSPLUME MODEL OUTPUT FILE

AUSPLUME MODEL OUTPUT FILE:

Some parts of this file have been deleted to save paper.

```
1                   __________________________________________

                      Rooty Hill Regional Distribution Cente
                                  Dust Concentration
                    __________________________________________

 Concentration or deposition                          Concentration
 Emission rate units                                  grams/second
 Concentration units                                  microgram/m3
 Units conversion factor                              1.00E+06
 Constant background concentration                             0.00E+00
 Terrain effects                                      Egan method
 Plume depletion due to dry removal mechanisms included.
 Smooth stability class changes?                      No
 Other stability class adjustments ("urban modes")    None
 Ignore building wake effects?                        Yes
 Decay coefficient (unless overridden by met. file)   0.000
 Anemometer height                                    10 m
 Roughness height at the wind vane site               0.500 m
 Use the convective PDF algorithm?                    No

                   DISPERSION CURVES
 Horizontal dispersion curves for sources <100m high  Pasquill-Gifford
 Vertical  dispersion  curves for sources <100m high  Pasquill-Gifford
 Horizontal dispersion curves for sources >100m high  Briggs Rural
 Vertical  dispersion  curves for sources >100m high  Briggs Rural
 Enhance horizontal plume spreads for buoyancy?       Yes
 Enhance  vertical  plume spreads for buoyancy?       Yes
 Adjust horizontal P-G formulae for roughness height? Yes
 Adjust  vertical  P-G formulae for roughness height? Yes
 Roughness height                                     0.500m
 Adjustment for wind directional shear                None

                    PLUME RISE OPTIONS
 Gradual plume rise?                                  Yes
 Stack-tip downwash included?                         Yes
 Building downwash algorithm:                        Schulman-Scire method.
 Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
 Partial penetration of elevated inversions?          No
 Disregard temp. gradients in the hourly met. file?   No

 and in the absence of boundary-layer potential temperature gradients
 given by the hourly met. file, a value from the following table
 (in K/m) is used:

    Wind Speed                Stability Class
     Category       A      B      C      D      E      F
   _________________________________________________________
        1         0.000  0.000  0.000  0.000  0.020  0.035
        2         0.000  0.000  0.000  0.000  0.020  0.035
        3         0.000  0.000  0.000  0.000  0.020  0.035
        4         0.000  0.000  0.000  0.000  0.020  0.035
        5         0.000  0.000  0.000  0.000  0.020  0.035
        6         0.000  0.000  0.000  0.000  0.020  0.035

 WIND SPEED CATEGORIES
 Boundaries between categories (in m/s) are:  1.54,  3.09,  5.14,  8.23, 10.80

 WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

 AVERAGING TIMES
 24 hours
  average over all hours

 _____________________________________________________________________________

                    __________________________________________

                      Rooty Hill Regional Distribution Cente

                                  SOURCE GROUPS

                    __________________________________________

              Group No.    Members
              ________________________________________________________________
                    1      1      2      3      4      5      6      7
                           8      9      10     11     12     13     14

                           15     16     17     18     19     20     21

                           22     23     24     25     26     27     28

                           29     30     ###### ###### ###### ###### ######

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2      31     32     33     34     35     36     37
       38     39     40     41     42     43     44

       45     46     47     48     49     50     51

       52     53     54     55     56     57     58

       59     60     ###### ###### ###### ###### ######

       ###### ###### ###### ###### ###### ###### ######

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3      61     62     63     64     65     66     67
       68     69     70     71     72     73     74

       75     76     77     78     79     80     81

       82     83     84     85     86     87     88

       89     90     ###### ###### ###### ###### ######

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1

Rooty Hill Regional Distribution Cente

SOURCE CHARACTERISTICS

VOLUME SOURCE: 1

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
300988	6261799	1m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	1.0	2.50

VOLUME SOURCE: 31

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
300988	6261799	1m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	5.0	2.50

VOLUME SOURCE: 61

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
300988	6261799	1m	2m	20m	2m

(Constant) emission rate = 1.00E+00 grams/second

Hourly multiplicative factors will be used with this emission factor.

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
1.0000	17.3	2.50

1

Rooty Hill Regional Distribution Cente

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
299000.m 299500.m 300000.m 300500.m 301000.m 301500.m 302000.m
302500.m 303000.m

and these y-values (or northings):
6260000.m 6260500.m 6261000.m 6261500.m 6262000.m 6262500.m 6263000.m
6263500.m 6264000.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	300907	6261636	1.0	0.0	49	301367	6261073	1.0	0.0
2	300987	6261658	1.0	0.0	50	301082	6260934	1.0	0.0
3	301053	6261628	1.0	0.0	51	300885	6260904	1.0	0.0
4	301075	6261584	1.0	0.0	52	300673	6260926	1.0	0.0
5	301053	6261526	1.0	0.0	53	300512	6261116	1.0	0.0
6	301016	6261453	1.0	0.0	54	300337	6261299	1.0	0.0
7	300958	6261424	1.0	0.0	55	300373	6261570	1.0	0.0
8	300878	6261445	1.0	0.0	56	300410	6261782	1.0	0.0
9	300892	6261533	1.0	0.0	57	300403	6261431	1.0	0.0
10	300841	6261636	1.0	0.0	58	300454	6262104	1.0	0.0
11	300929	6261709	1.0	0.0	59	300615	6262089	1.0	0.0
12	301038	6261701	1.0	0.0	60	300790	6262243	1.0	0.0
13	301126	6261658	1.0	0.0	61	301119	6262308	1.0	0.0
14	301133	6261548	1.0	0.0	62	301338	6262206	1.0	0.0
15	301089	6261438	1.0	0.0	63	301645	6262184	1.0	0.0
16	300973	6261358	1.0	0.0	64	301798	6261804	1.0	0.0
17	300878	6261365	1.0	0.0	65	301762	6261248	1.0	0.0
18	300775	6261482	1.0	0.0	66	301784	6261497	1.0	0.0
19	300739	6261599	1.0	0.0	67	301747	6260985	1.0	0.0
20	300819	6261731	1.0	0.0	68	301652	6260765	1.0	0.0
21	300914	6261855	1.0	0.0	69	301294	6260736	1.0	0.0
22	301075	6261804	1.0	0.0	70	300775	6260707	1.0	0.0
23	301177	6261731	1.0	0.0	71	300322	6260831	1.0	0.0
24	301250	6261592	1.0	0.0	72	300183	6261277	1.0	0.0

25	301214	6261460	1.0	0.0	73	300227	6261738	1.0	0.0
26	301111	6261321	1.0	0.0	74	300286	6262235	1.0	0.0
27	300958	6261248	1.0	0.0	75	300688	6262455	1.0	0.0
28	300775	6261299	1.0	0.0	76	301126	6262623	1.0	0.0
29	300666	6261416	1.0	0.0	77	301659	6262403	1.0	0.0
30	300644	6261679	1.0	0.0	78	301974	6262272	1.0	0.0
31	300746	6261848	1.0	0.0	79	302259	6262221	1.0	0.0
32	300921	6261950	1.0	0.0	80	302251	6261987	1.0	0.0
33	301119	6261935	1.0	0.0	81	302244	6261753	1.0	0.0
34	301250	6261848	1.0	0.0	82	302222	6261321	1.0	0.0
35	301338	6261672	1.0	0.0	83	302003	6261709	1.0	0.0
36	301323	6261431	1.0	0.0	84	302200	6260751	1.0	0.0
37	301265	6261263	1.0	0.0	85	301214	6260312	1.0	0.0
38	301075	6261138	1.0	0.0	86	300673	6260327	1.0	0.0
39	300856	6261116	1.0	0.0	87	299789	6261241	1.0	0.0
40	300673	6261219	1.0	0.0	88	299782	6261679	1.0	0.0
41	300578	6261380	1.0	0.0	89	299840	6262206	1.0	0.0
42	300512	6261606	1.0	0.0	90	300235	6263537	1.0	0.0
43	300563	6261855	1.0	0.0	91	300242	6262776	1.0	0.0
44	300753	6262052	1.0	0.0	92	300739	6262835	1.0	0.0
45	301111	6262118	1.0	0.0	93	301236	6263230	1.0	0.0
46	301389	6261987	1.0	0.0	94	301732	6262754	1.0	0.0
47	301535	6261679	1.0	0.0	95	302120	6262732	1.0	0.0
48	301528	6261350	1.0	0.0	96	302207	6263237	1.0	0.0

METEOROLOGICAL DATA : EPA St Marys AUSPLUME Modelling File

HOURLY VARIABLE EMISSION FACTOR INFORMATION

The input emission rates specfied above will be multiplied by hourly varying factors entered via the input file:
C:\Jobs\RHillRDC\ausplume\emiss.src
For each stack source, hourly values within this file will be added to each declared exit velocity (m/sec) and temperature (K).

Title of input hourly emission factor file is:
AUSPLUME Variable emissions file (Met MANAGER)

HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION

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Prefix 3      allocated: 3
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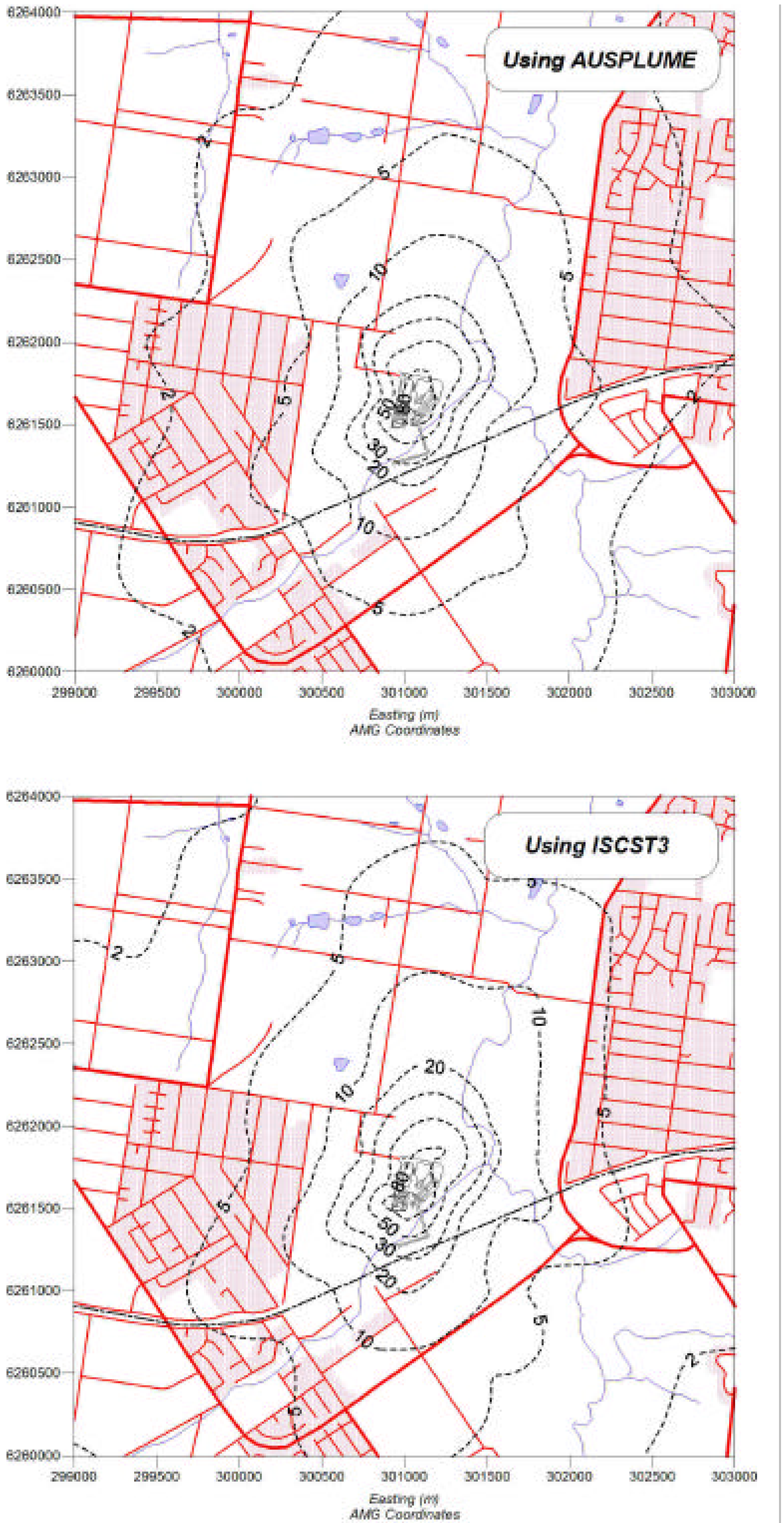
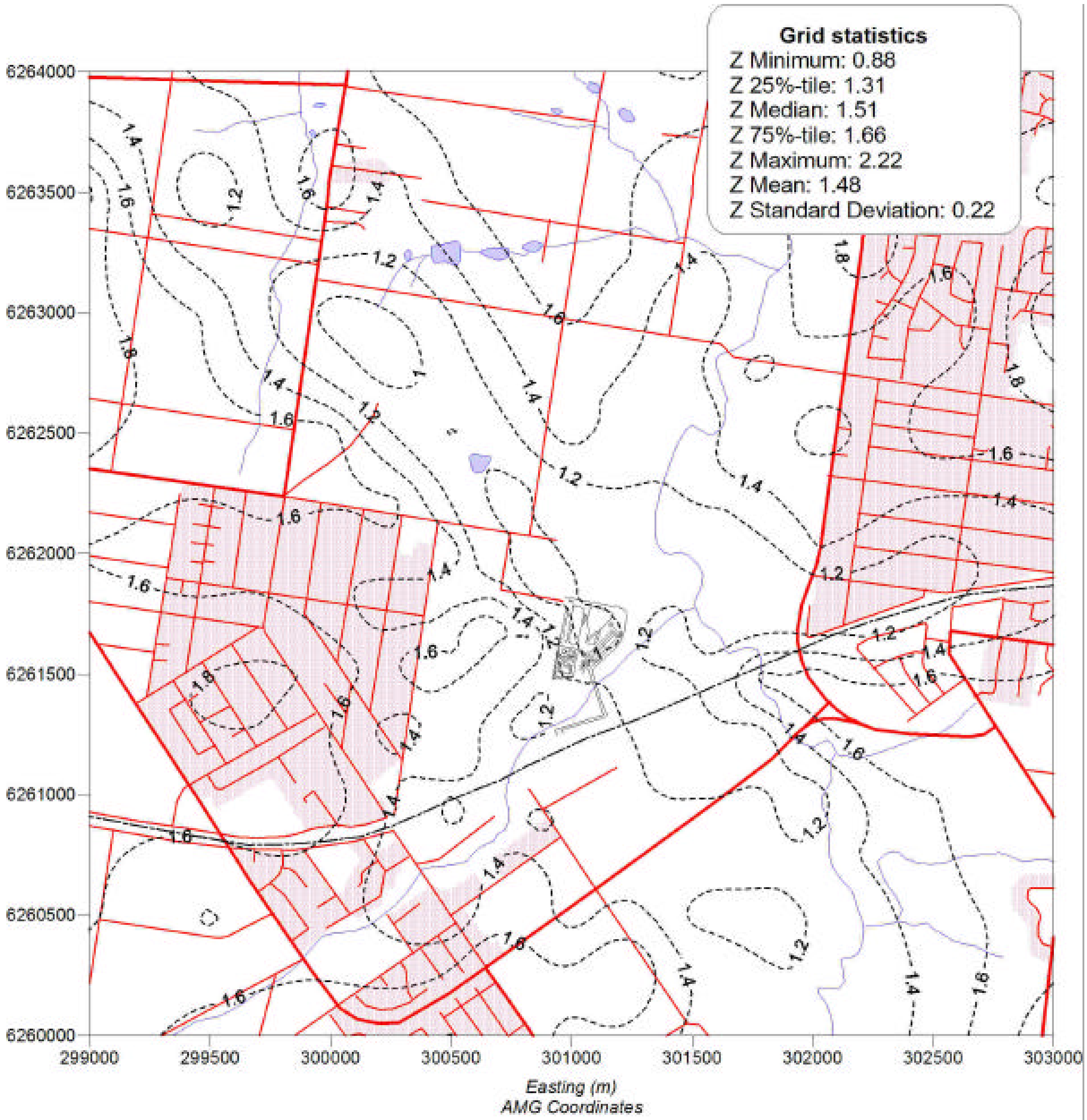
APPENDIX D
ISCST3 DISPERSION MODEL RESULTS



Predicted maximum 24-hour average PM_{10} concentrations using different dispersion models - µg/m^3

FIGURE D1



Ratio of ISCST3 over AUSPLUME model predictions for maximum 24-hour average PM_{10} concentrations - µg/m^3

FIGURE D2

APPENDIX E
RESPONSE TO DEPARTMENT OF PLANNING
COMMENTS ON AIR QUALITY ASSESSMENT

RESPONSE TO DEPARTMENT OF PLANNING COMMENTS ON AIR QUALITY ASSESSMENT

The DEC and Department of Planning have commented on the air quality impact assessment report (dated 30 June 2005) for the Rooty Hill RDC project. The comments have been reviewed by Holmes Air Sciences and more work has been conducted to provide the Department of Planning with the information requested.

The main comment regarding the air quality impact assessment from the Department of Planning is copied below:

- "provide a detailed cumulative assessment of 24-hour average PM_{10} impact at all sensitive receiver locations including residential areas, offices and recreation areas, with a revision of the statement of commitments accordingly."

The air quality assessment adopted the approach that the model predicted 24-hour average PM_{10} concentrations from the development should be less than 50 $\mu g/m^3$ at the nearest sensitive receptors. Recent conditions of consent for mines in the Hunter Valley have assisted with the interpretation of this criterion.

The conventional approach to assessment of air quality impacts from a proposal is to add the predicted incremental impact of the project to background levels and to compare the result with the relevant air quality goal. This approach is referred to as a cumulative assessment.

Assessment of cumulative 24-hour average PM_{10} air quality impacts is often complicated as there may be many occasions when background concentrations are already above the 24-hour average air quality goal. For a more refined analysis, the DEC recommends (**DEC, 2005**) that there should be no additional exceedances of the 50 $\mu g/m^3$ goal. Contemporaneous hourly average meteorological and PM_{10} monitoring data are required for this assessment and these data are available for Blacktown, approximately five kilometres to the east of the project site. These data were collected by the EPA in 2002.

The additional work to address cumulative PM_{10} impacts is summarised below:

- Re-run the AUSPLUME dispersion model for five sensitive receptor locations in the area;
- Use contemporaneous meteorological and TEOM PM_{10} monitoring data from Blacktown;
- Tabulate results of 24-hour average PM_{10} concentrations at each location showing highest background with corresponding increment from project and highest predicted increment with corresponding background.

The PM_{10} monitoring data for Blacktown in 2002 are presented in **Figure E1** below. There were several occasions when the measured 24-hour average PM_{10} concentration was above the 50 $\mu g/m^3$ goal. The exceedances were generally in the warmer months and were likely to be associated with bushfires. There were also many days when the measured 24-hour average PM_{10} concentration was slightly below the goal – around, say, 49 $\mu g/m^3$.

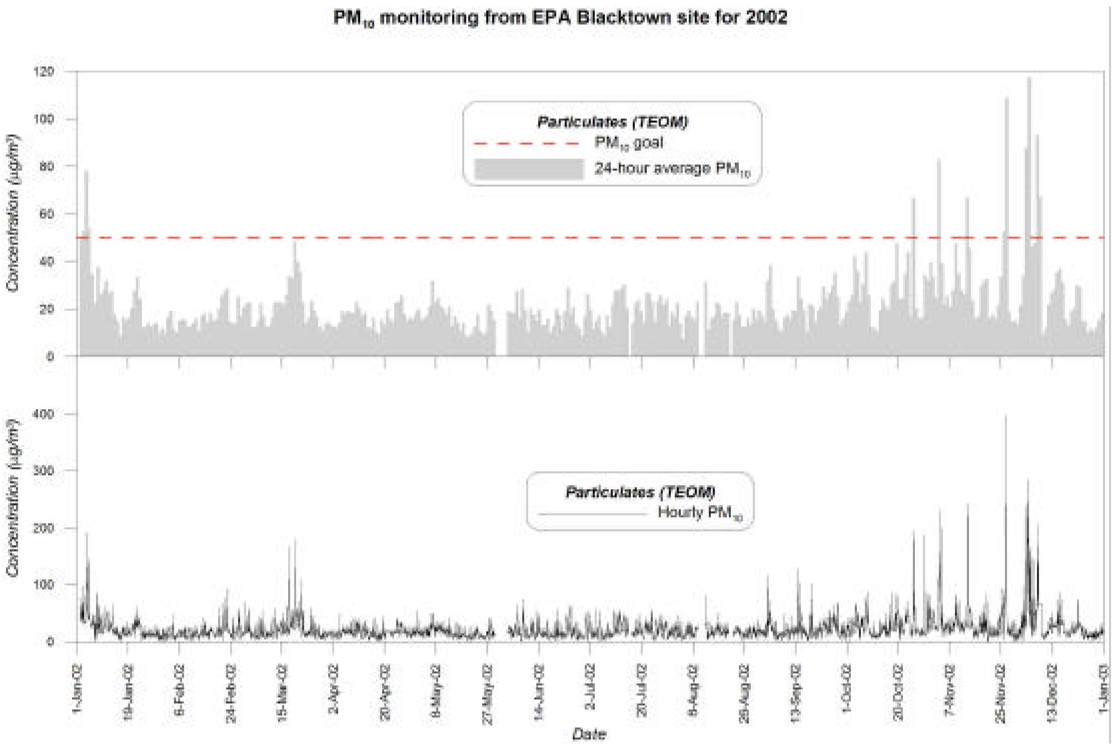
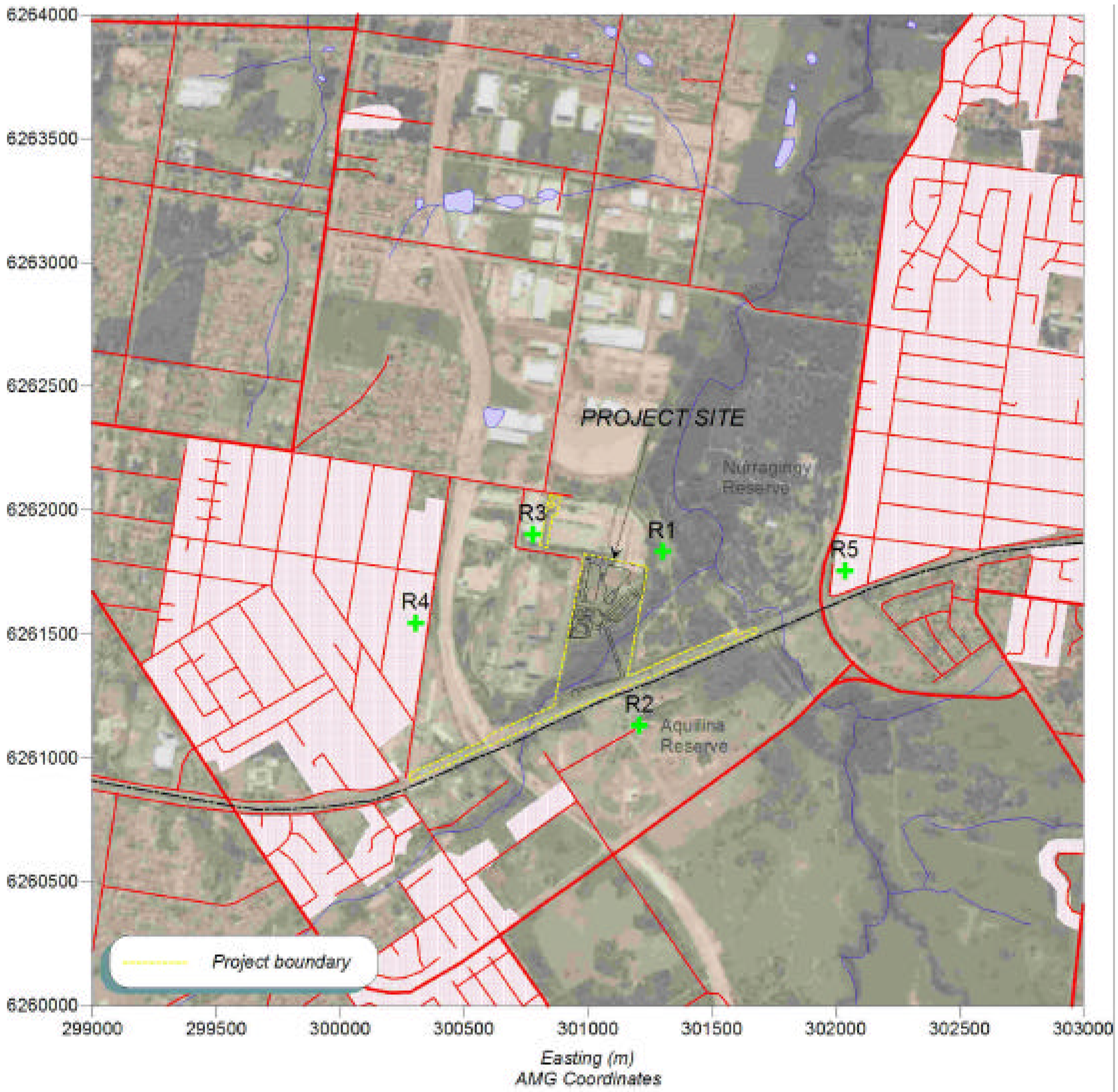


FIGURE E1

The five sensitive receptor locations used for this assessment are marked on **Figure E2** below. Receptors R1 and R2 represent locations of the adjacent recreational reserves, R3 represents an office location and R5 and R6 represent the neighbouring residential areas.

Increment from the project at receptors representing recreational and office areas was modelled by predicting 12-hour average concentrations during the day-time. This is an estimate of the length of time that people may spend at these locations.



Receptor locations chosen for additional assessment

FIGURE E2

Table E1 summarises the dispersion model results for 24-hour average PM_{10} concentrations at the selected sensitive receptor locations. The top 20 background levels and predicted PM_{10} increments are shown.

Table E1 : Summary of dispersion model results for PM_{10} at sensitive receptors

Date	24-hour average PM_{10} (µg/m^3)			Date	24-hour average PM_{10} (µg/m^3)		
	Background (highest to lowest)	Predicted PM_{10} increment	Total cumulative impact		Background	Predicted PM_{10} increment (highest to lowest)	Total cumulative impact
Receptor 1 (Nurragingy Reserve)							
5/12/2002	118	0.695	118	28/05/2002	19	12.487	31
27/11/2002	109	0.635	110	19/04/2002	15	11.692	27
8/12/2002	93	0.000	93	6/06/2002	27	11.045	38
4/12/2002	88	1.120	89	18/04/2002	10	10.422	20
3/11/2002	83	1.505	84	2/07/2002	20	10.372	30
4/01/2002	78	0.834	79	23/04/2002	15	9.782	24
9/12/2002	67	0.000	67	30/06/2002	17	9.057	26
13/11/2002	67	0.259	67	20/03/2002	40	8.957	49
25/10/2002	67	0.224	67	14/05/2002	13	8.068	21
5/01/2002	54	1.477	55	24/05/2002	11	7.453	18
3/01/2002	53	2.711	56	18/06/2002	10	7.399	17
26/11/2002	53	0.012	53	8/06/2002	28	7.297	36
2/01/2002	49	0.637	50	23/06/2002	19	7.291	26
19/03/2002	48	0.386	49	3/05/2002	16	7.097	23
19/10/2002	48	0.396	48	17/06/2002	16	7.081	23
7/12/2002	48	0.579	48	1/07/2002	26	6.842	33
9/11/2002	48	0.000	48	14/04/2002	12	6.715	19
6/12/2002	46	3.208	49	22/06/2002	11	6.665	18
14/11/2002	46	2.462	48	30/04/2002	16	6.520	22
8/10/2002	44	0.380	44	17/04/2002	11	6.123	17
Receptor 2 (Aqualina Reserve)							
5/12/2002	118	0.340	118	12/06/2002	18	6.992	25
27/11/2002	109	0.002	109	19/07/2002	24	5.657	29
8/12/2002	93	0.408	94	27/05/2002	22	5.049	27
4/12/2002	88	0.197	88	14/06/2002	20	4.322	24
3/11/2002	83	0.463	83	21/06/2002	18	4.210	22
4/01/2002	78	0.366	79	18/05/2002	14	4.194	18
9/12/2002	67	0.000	67	8/06/2002	28	3.982	32
13/11/2002	67	0.269	67	11/07/2002	28	3.834	32
25/10/2002	67	0.929	68	26/03/2002	19	3.728	23
5/01/2002	54	0.000	54	18/07/2002	22	3.390	25
3/01/2002	53	0.008	53	2/08/2002	23	3.252	26
26/11/2002	53	1.127	54	9/05/2002	25	3.217	28
2/01/2002	49	0.273	50	23/06/2002	19	3.141	22
19/03/2002	48	0.549	49	15/06/2002	13	2.959	16
19/10/2002	48	0.084	48	8/05/2002	23	2.904	26
7/12/2002	48	0.000	48	20/07/2002	19	2.809	22
9/11/2002	48	0.012	48	13/06/2002	15	2.783	18
6/12/2002	46	0.030	46	7/07/2002	8	2.657	11
14/11/2002	46	0.136	46	27/06/2002	13	2.644	16
8/10/2002	44	0.757	45	3/07/2002	11	2.576	14
Receptor 3 (Office location)							
5/12/2002	118	0.000	118	28/03/2002	12	8.106	21
27/11/2002	109	1.681	111	29/04/2002	16	7.480	24
8/12/2002	93	0.111	93	17/06/2002	16	6.532	22

Date	24-hour average PM10 (µg/m³)			Date	24-hour average PM10 (µg/m³)		
	Background (highest to lowest)	Predicted PM10 increment	Total cumulative impact		Background	Predicted PM10 increment (highest to lowest)	Total cumulative impact
4/12/2002	88	0.001	88	5/06/2002	18	5.649	24
3/11/2002	83	0.000	83	22/03/2002	23	4.567	27
4/01/2002	78	0.189	78	15/05/2002	17	4.546	22
9/12/2002	67	1.982	69	18/02/2002	15	4.532	20
13/11/2002	67	1.592	68	5/03/2002	13	4.066	17
25/10/2002	67	0.485	67	30/11/2002	15	3.950	19
5/01/2002	54	1.174	55	20/06/2002	20	3.620	24
3/01/2002	53	0.309	53	26/08/2002	12	3.614	16
26/11/2002	53	0.000	53	17/02/2002	18	3.539	22
2/01/2002	49	0.000	49	6/02/2002	15	3.344	18
19/03/2002	48	1.673	50	29/03/2002	11	3.173	14
19/10/2002	48	1.958	50	30/01/2002	9	2.880	12
7/12/2002	48	0.868	49	23/09/2002	29	2.850	32
9/11/2002	48	2.328	50	10/10/2002	12	2.842	15
6/12/2002	46	0.000	46	12/05/2002	18	2.842	21
14/11/2002	46	0.676	46	11/11/2002	28	2.777	31
8/10/2002	44	0.000	44	25/08/2002	13	2.747	15
Receptor 4 (Residential – west of site)							
5/12/2002	118	0.000	118	14/02/2002	17	5.621	23
27/11/2002	109	0.085	109	20/01/2002	20	5.601	26
8/12/2002	93	2.015	95	12/11/2002	26	5.569	32
4/12/2002	88	0.152	88	5/05/2002	17	4.349	22
3/11/2002	83	0.181	83	24/02/2002	15	4.313	19
4/01/2002	78	1.403	80	28/12/2002	11	3.970	15
9/12/2002	67	0.216	67	18/12/2002	16	3.766	19
13/11/2002	67	2.990	70	29/10/2002	34	3.737	38
25/10/2002	67	0.014	67	22/01/2002	34	3.712	37
5/01/2002	54	0.530	55	19/08/2002	19	3.624	22
3/01/2002	53	1.111	54	19/11/2002	32	3.514	36
26/11/2002	53	0.292	53	24/11/2002	21	3.427	25
2/01/2002	49	0.012	49	15/12/2002	36	3.262	39
19/03/2002	48	1.082	49	22/10/2002	35	3.181	38
19/10/2002	48	0.551	48	6/01/2002	34	3.142	38
7/12/2002	48	0.592	48	22/08/2002	15	3.017	18
9/11/2002	48	0.295	48	13/11/2002	67	2.990	70
6/12/2002	46	0.010	46	30/12/2002	15	2.928	18
14/11/2002	46	0.378	46	2/12/2002	21	2.887	24
8/10/2002	44	0.444	44	19/12/2002	13	2.682	16
Receptor 5 (Residential – east of site)							
5/12/2002	118	0.516	118	10/04/2002	23	7.653	30
27/11/2002	109	0.190	109	2/04/2002	13	7.628	20
8/12/2002	93	0.407	94	12/09/2002	19	6.856	26
4/12/2002	88	0.947	89	27/05/2002	22	6.051	28
3/11/2002	83	0.390	83	30/04/2002	16	5.655	21
4/01/2002	78	1.716	80	16/04/2002	17	5.053	22
9/12/2002	67	0.013	67	22/03/2002	23	4.666	27
13/11/2002	67	0.268	67	28/05/2002	19	4.643	24
25/10/2002	67	0.922	68	20/02/2002	20	4.341	24
5/01/2002	54	0.315	54	25/01/2002	12	4.035	17

Date	24-hour average PM_{10} (µg/m³)			Date	24-hour average PM_{10} (µg/m³)		
	Background (highest to lowest)	Predicted PM_{10} increment	Total cumulative impact		Background	Predicted PM_{10} increment (highest to lowest)	Total cumulative impact
3/01/2002	53	0.456	53	6/04/2002	18	3.922	22
26/11/2002	53	0.198	53	2/10/2002	23	3.625	27
2/01/2002	49	0.979	50	19/03/2002	48	3.529	**52**
19/03/2002	48	3.529	**52**	19/09/2002	21	3.517	25
19/10/2002	48	0.068	48	27/01/2002	12	3.461	16
7/12/2002	48	0.623	48	22/06/2002	11	3.325	15
9/11/2002	48	0.000	48	27/08/2002	16	3.196	19
6/12/2002	46	1.175	47	28/01/2002	14	3.166	17
14/11/2002	46	0.994	47	17/04/2002	11	3.153	14
8/10/2002	44	0.423	44	22/08/2002	15	3.128	18

It can be seen from **Table E1** that, by this methodology, there is one instance whereby the background PM_{10} concentration was below 50 µg/m³ and the predicted increment from the project causes the total cumulative impact to be above 50 µg/m³. The occasion is highlighted in the table and occurs for Receptor 5 to the east of the site. It should be noted that the 50 µg/m³ goal is exceeded when the background level was high (48 µg/m³) and the increment from the project was relatively low (3.5 µg/m³).

The method recommended by the DEC for assessing cumulative PM_{10} impacts has indicated that there may be a very small possibility that the incremental impact of the project will cause an exceedance of the 24-hour average PM_{10} goal (50 µg/m³) at close sensitive receptor locations due to existing high background levels. The occurrence of any exceedance is likely to be when the background PM_{10} concentrations are already close to the goal.

The DEC have highlighted the potential cumulative impacts of the RDC with the adjacent OneSteel facility. It is understood that there are no publicly available data to allow detailed estimation of dust emissions from the OneSteel site. Reporting to NPI, however, indicated that PM_{10} emissions to air for 1-Jul-2003 to 30-Jun-2004 were approximately 96,000 kg (**NPI, 2005**). No comprehensive monitoring data around the OneSteel site are available to assess the off-site impact of these emissions. It should be noted that the PM_{10} measurements from Blacktown include all background sources relevant to that location including some possible contribution from OneSteel activities.

The Western Sydney Orbital (M7) is due to open in late 2005. The possibility of cumulative PM_{10} impacts of the M7 with the proposed RDC has also been raised by the DEC. An air quality assessment of the M7 project was undertaken by Holmes Air Sciences in 2001 (**Holmes Air Sciences, 2001**) and this report provided information on the likely PM_{10} impacts in the vicinity of the road.

The M7 air quality assessment predicted that the maximum 1-hour average PM_{10} concentrations 30 m from the kerb of the section south of Power Street, Rooty Hill would be of the order of 12 µg/m³. The predicted levels of PM_{10} were for 1-hour averaging periods, which will always be higher than the 24-hour average. An empirical averaging time correction factor of 0.24 was suggested by **Katestone Scientific (1995)** to convert 1-hour predictions to 24 hour averages. This factor will obviously vary with site, and cannot be regarded as rigorous. Therefore, the estimated 24-hour average PM_{10} concentration in the residential area to the west of the proposed RDC site due to the M7 is likely to be of the order of 3 µg/m³ or less. This would be considered a low level in comparison with the 50 µg/m³ goal. Also, this level would not represent an incremental increase since vehicles on Phillip Parkway will already contribute to PM_{10} concentrations in the area. A value of 3 µg/m^3 could be added to the predicted maximum 24-hour PM_{10} concentrations due to the RDC in the vicinity of the M7 (Receptor 4 from Table E1) without causing cumulative PM_{10} impacts to be above the 50 µg/m^3 goal.

It was also concluded from the M7 air quality assessment that the annual motor vehicle emissions of PM_{10} in the Sydney network in 2006 would be 1.2% lower than without the M7.

Particulate matter emissions from the RDC project will be the subject of ongoing monitoring as part of an Environmental Management Plan.

References

DEC (2005)

“Approved Methods for the Modelling and Assessment of Air Pollutants in NSW”, NSW DEC, August 2005.

Holmes Air Sciences (2001)

“Air quality assessment: Western Sydney Orbital – Representations Report”. Prepared by Holmes for Roads and Traffic Authority of NSW”, 20 July 2001.

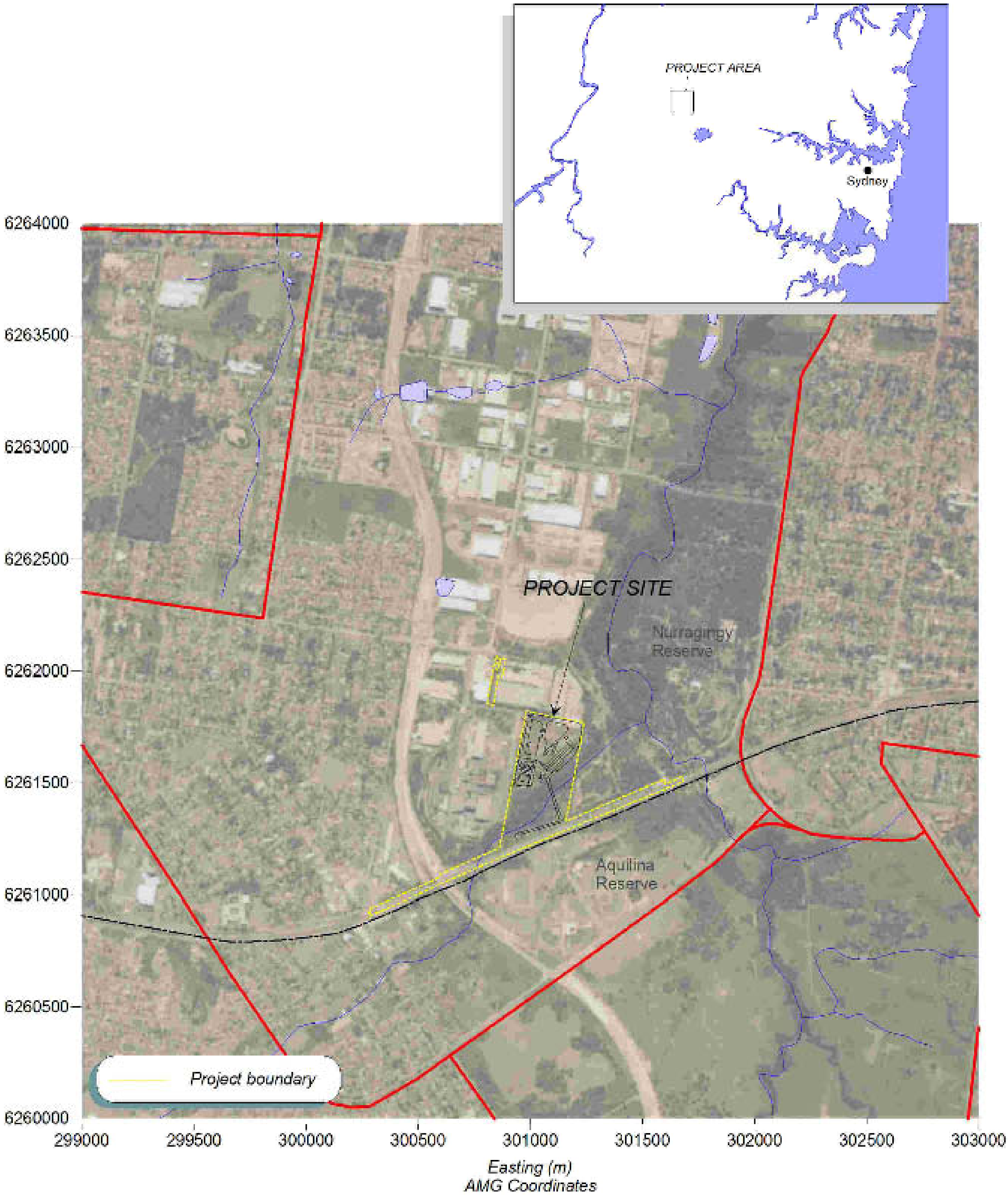
Katestone Scientific (1995)

“Road Traffic Pollution at Facilities Housing Sensitive Receptors- Design Criteria” prepared for the Brisbane City Council by Katestone Scientific, September 1995.

NPI (2005)

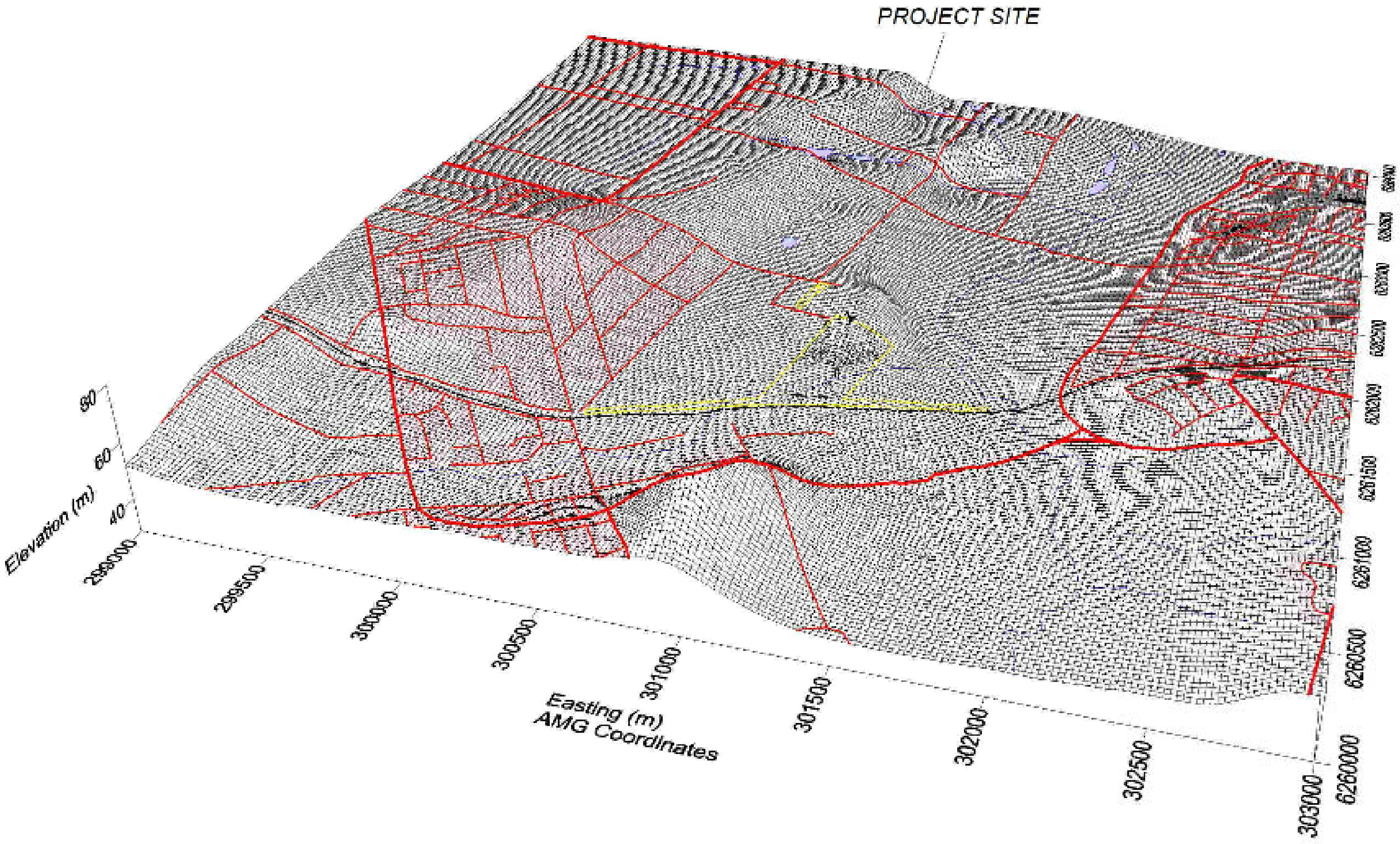
Website: www.npi.gov.au

FIGURES



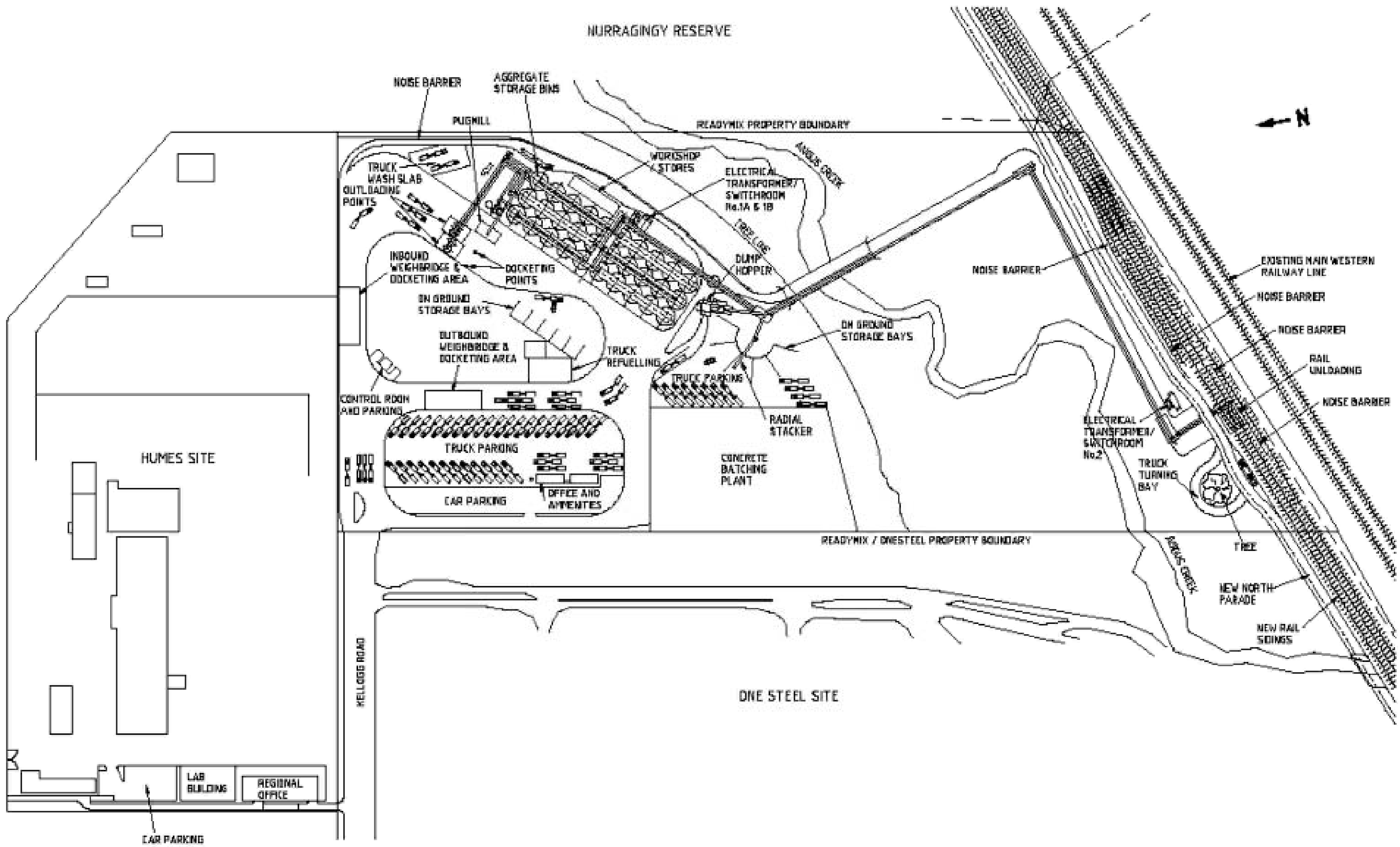
Location of study area and project site

FIGURE 1



Pseudo 3-dimensional representation of local area

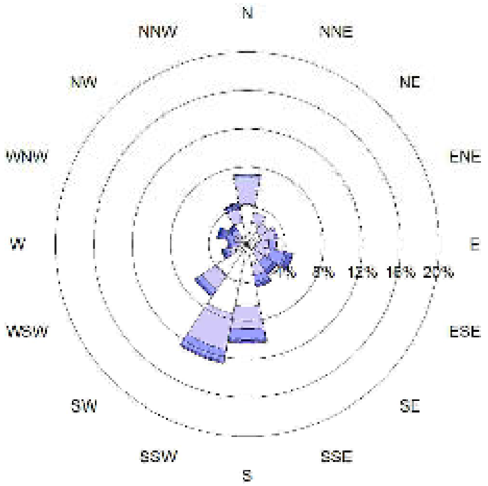
FIGURE 2



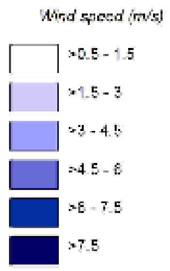
Proposed plant layout and facilities

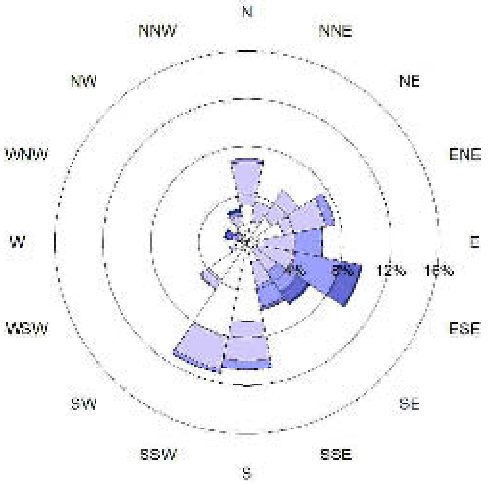
FIGURE 3

Annual and seasonal windroses for St Marys (2003)

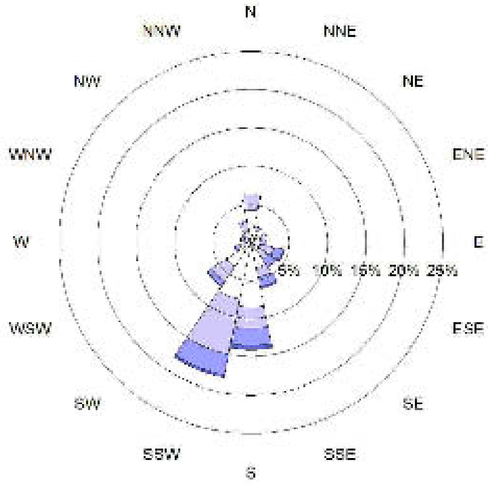


Annual
Calms = 22.6%

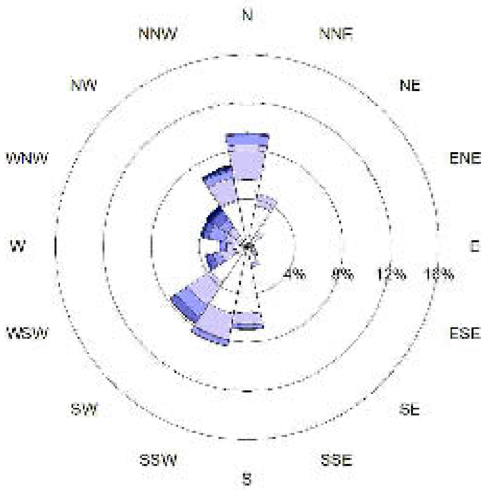




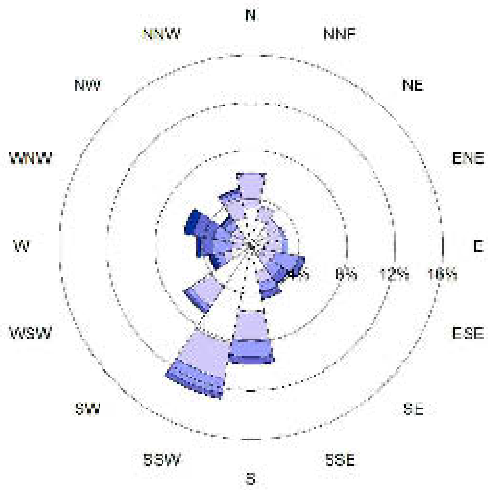
Summer
Calms = 13.8%



Autumn
Calms = 23.7%



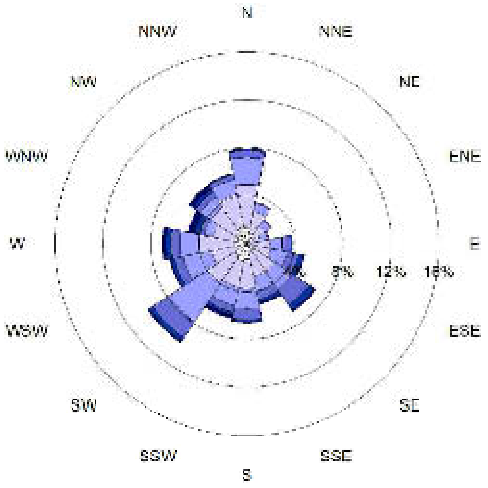
Winter
Calms = 35.8%



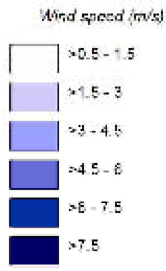
Spring
Calms = 16.9%

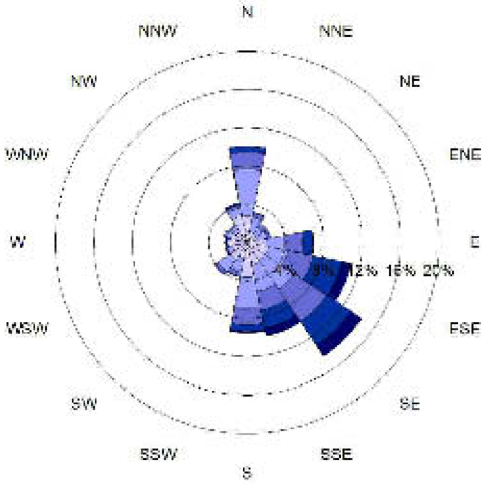
FIGURE 4

Annual and seasonal windroses for OneSteel site (2004)

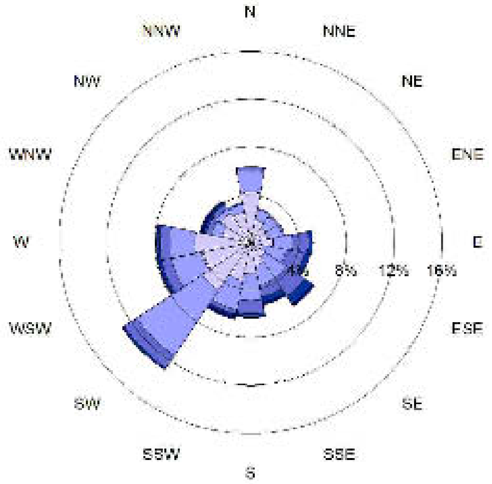


Annual
Calms = 10.2%

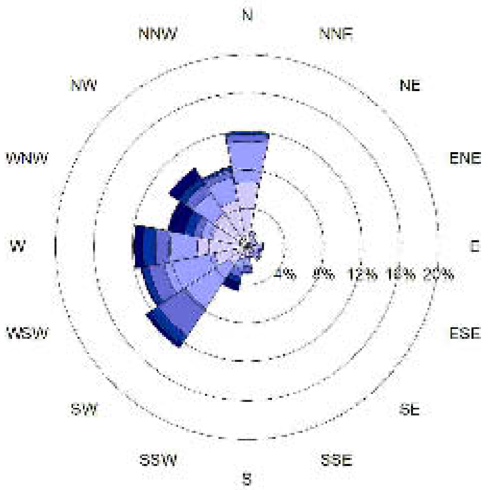




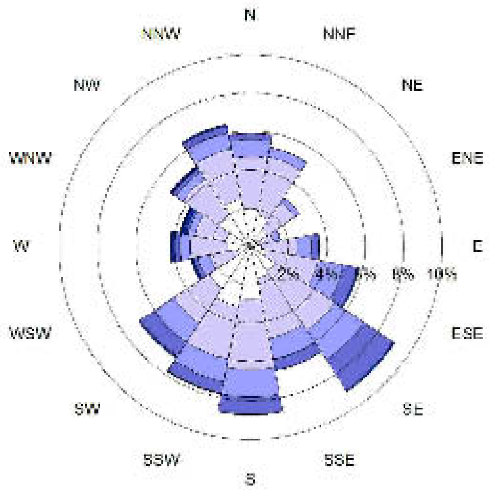
Summer
Calms = 8.5%



Autumn
Calms = 9.4%

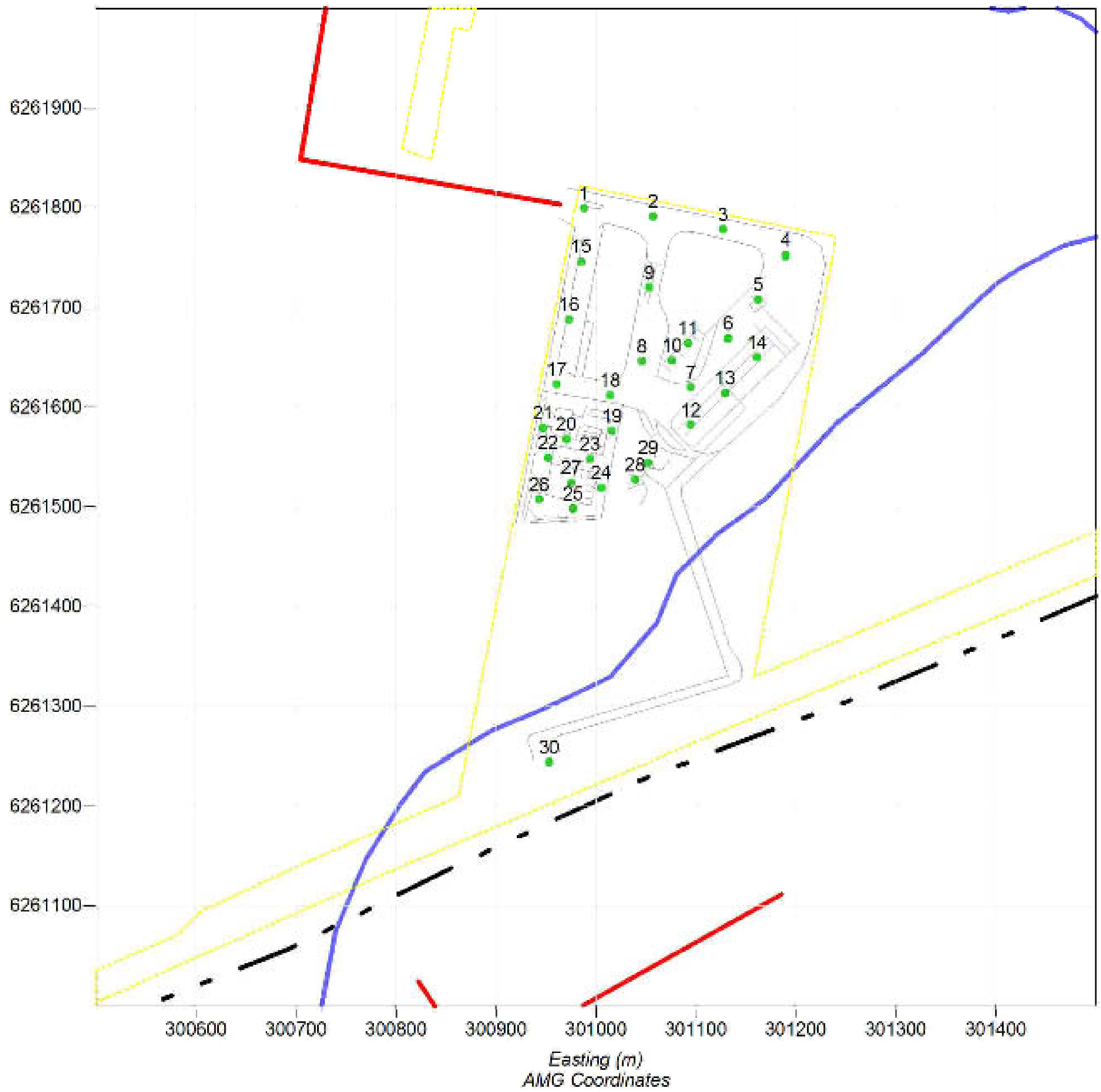


Winter
Calms = 7.7%



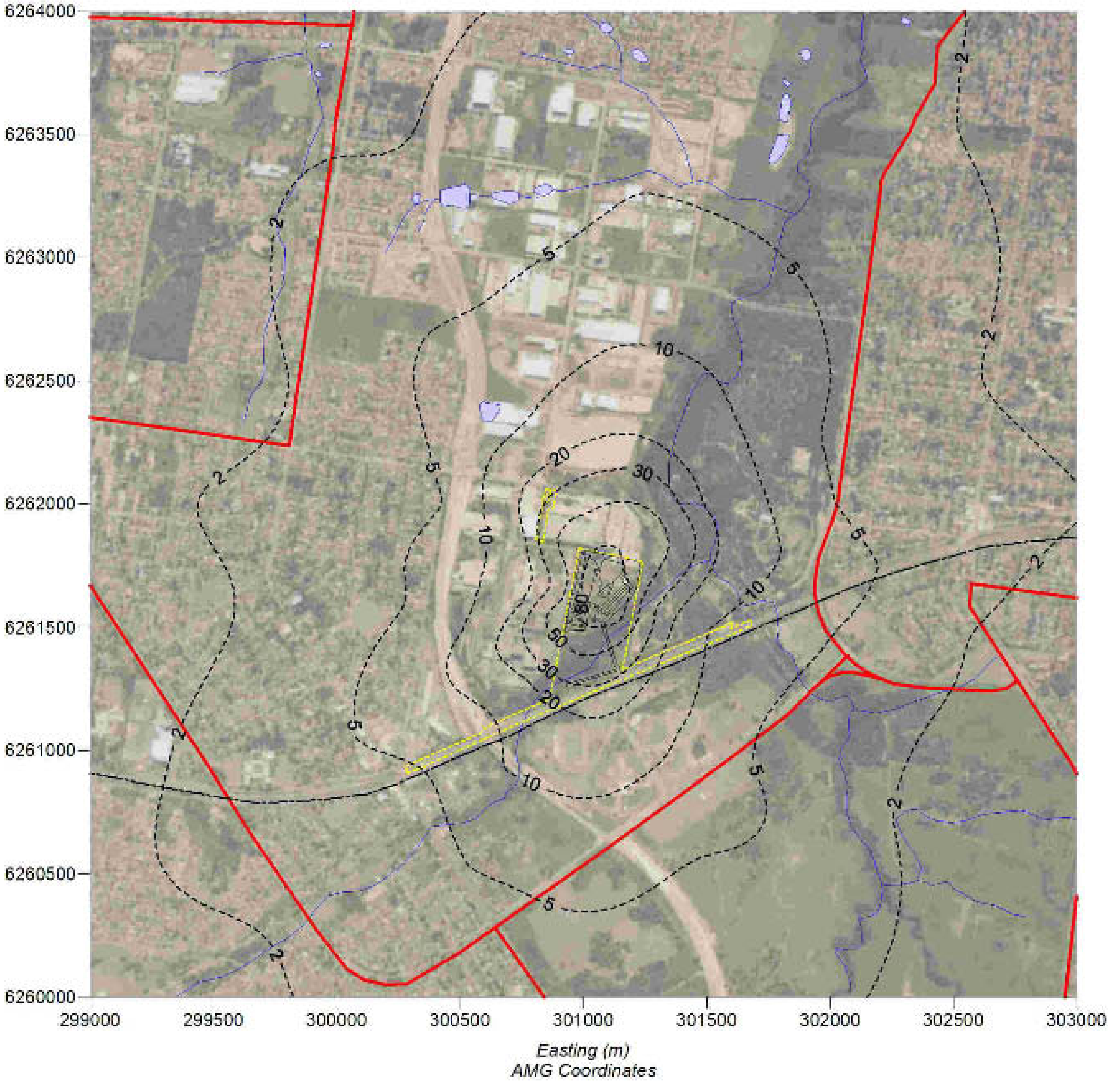
Spring
Calms = 12.9%

FIGURE 5



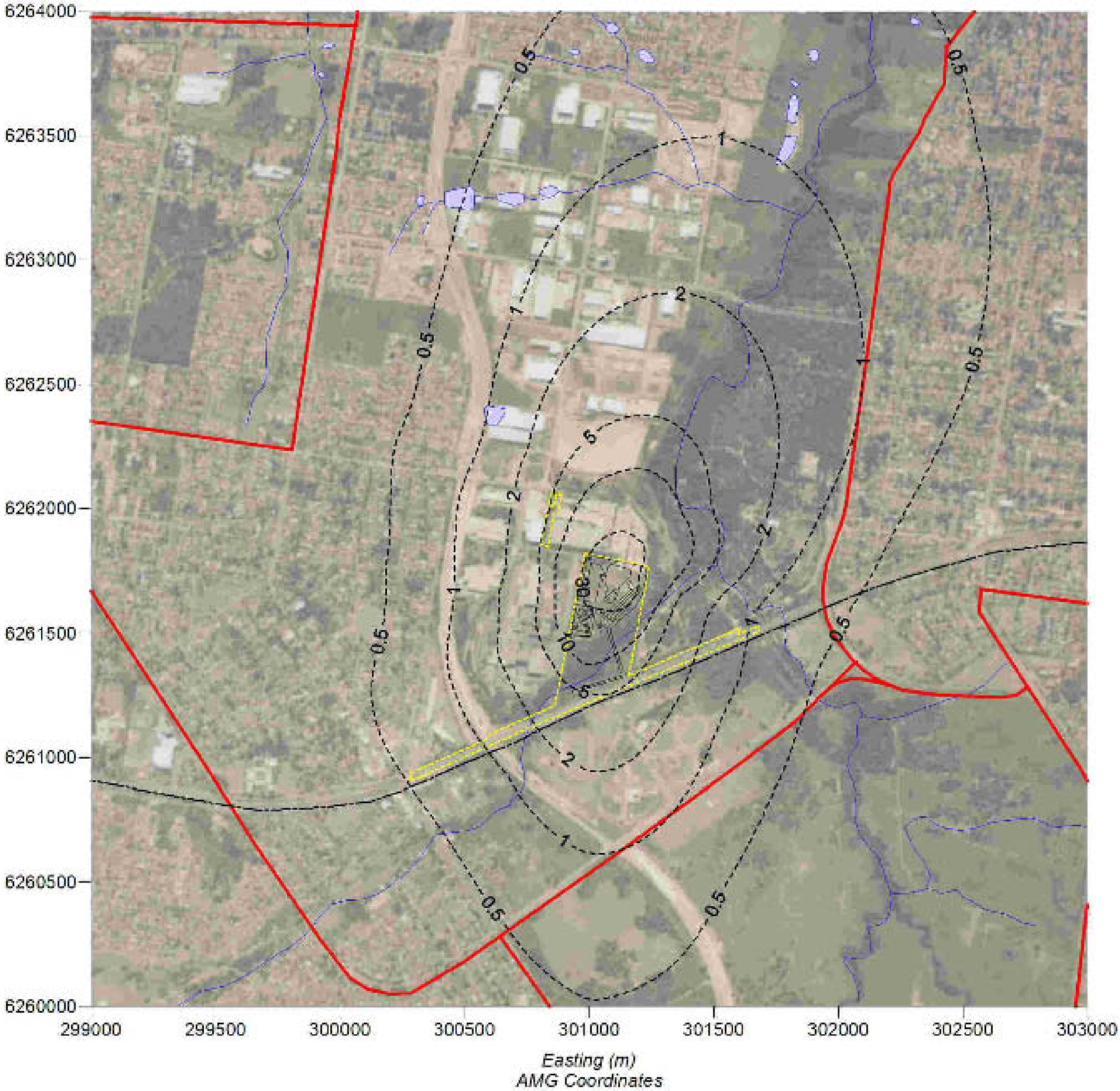
Location of modelled dust emission sources

FIGURE 6



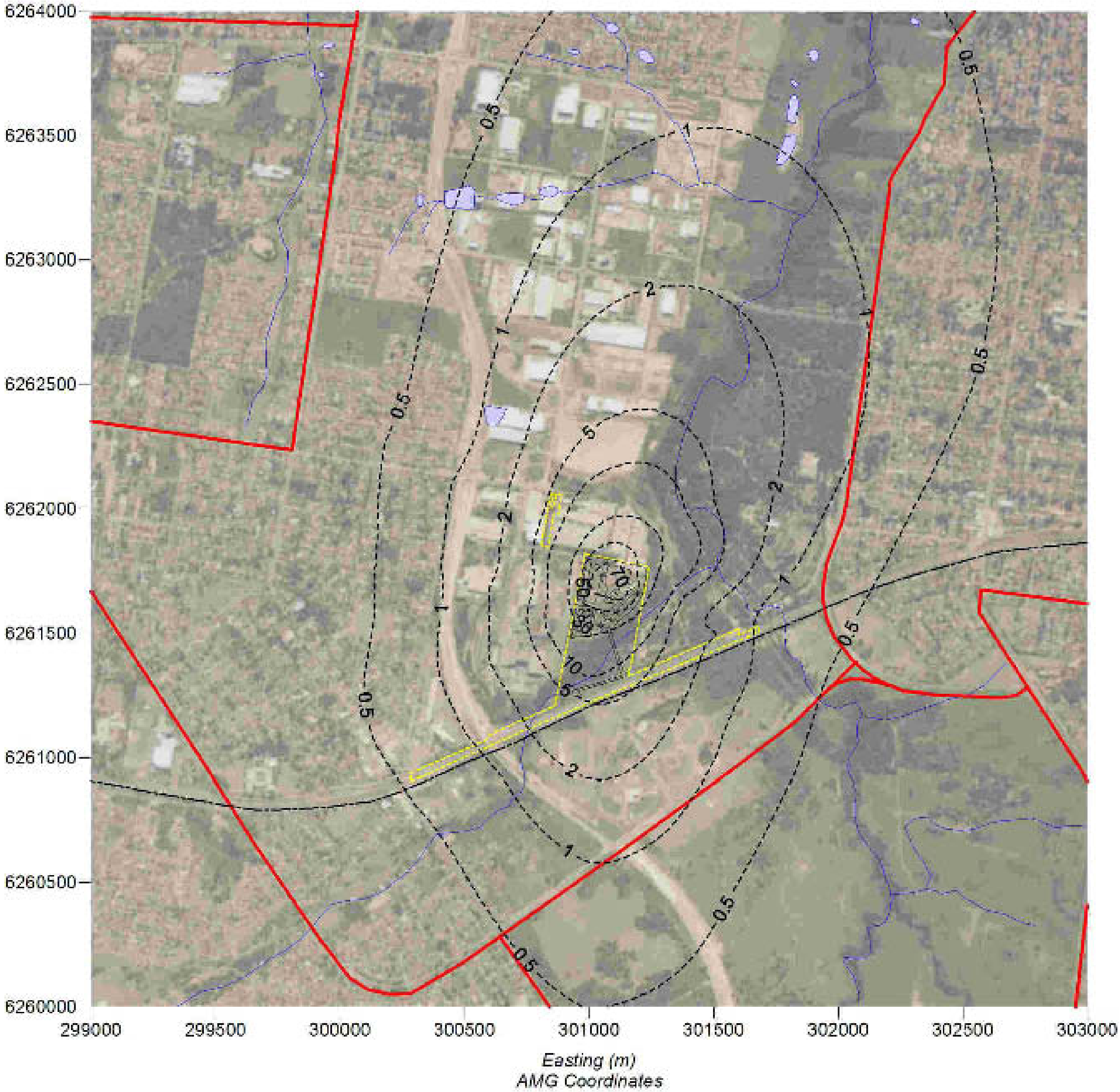
Predicted maximum 24-hour average PM_{10} concentrations due to Rooty Hill RDC - µg/m^3

FIGURE 7



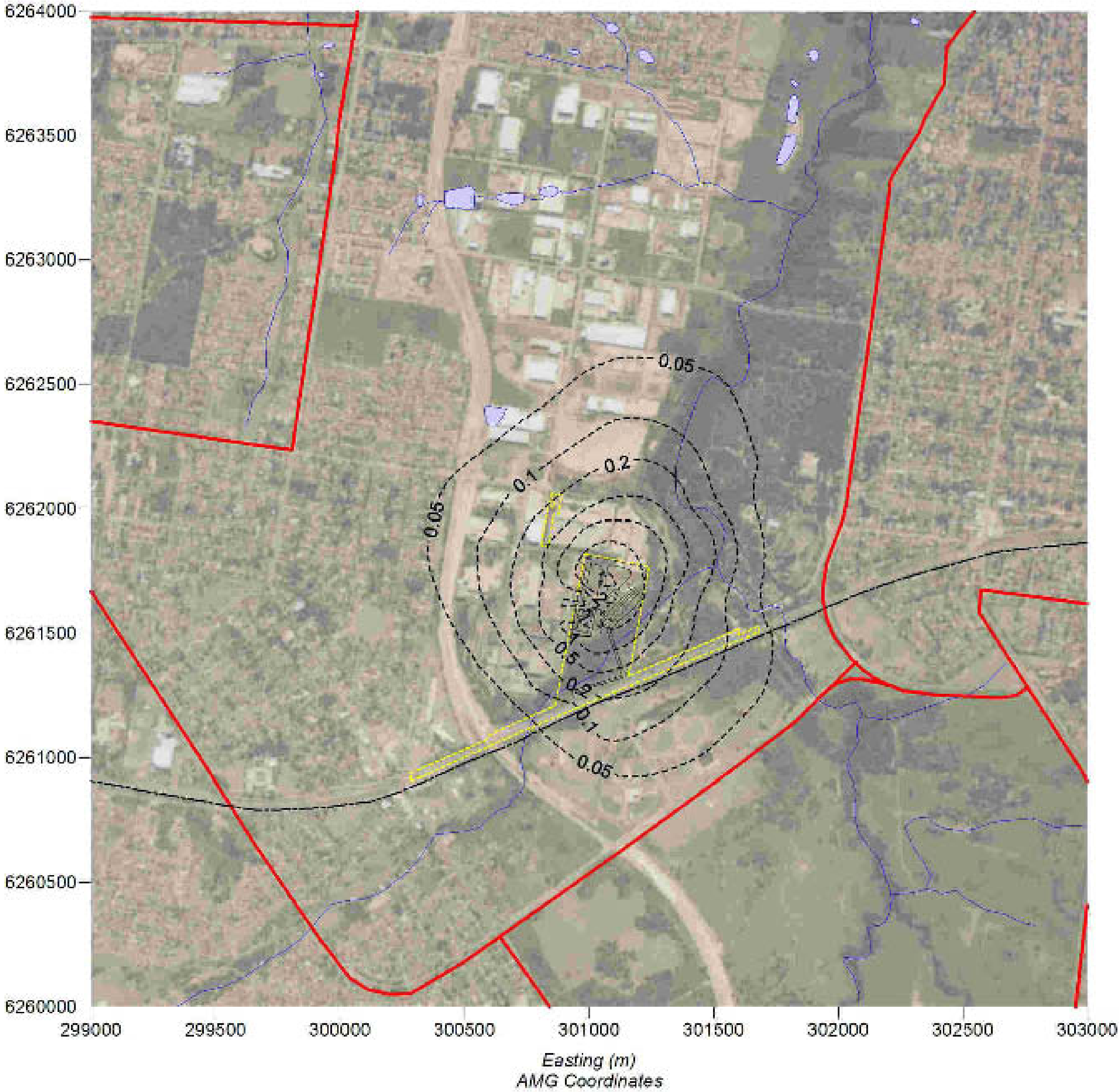
Predicted annual average PM_{10} concentrations due to Rooty Hill RDC - $\mu g/m^3$

FIGURE 8



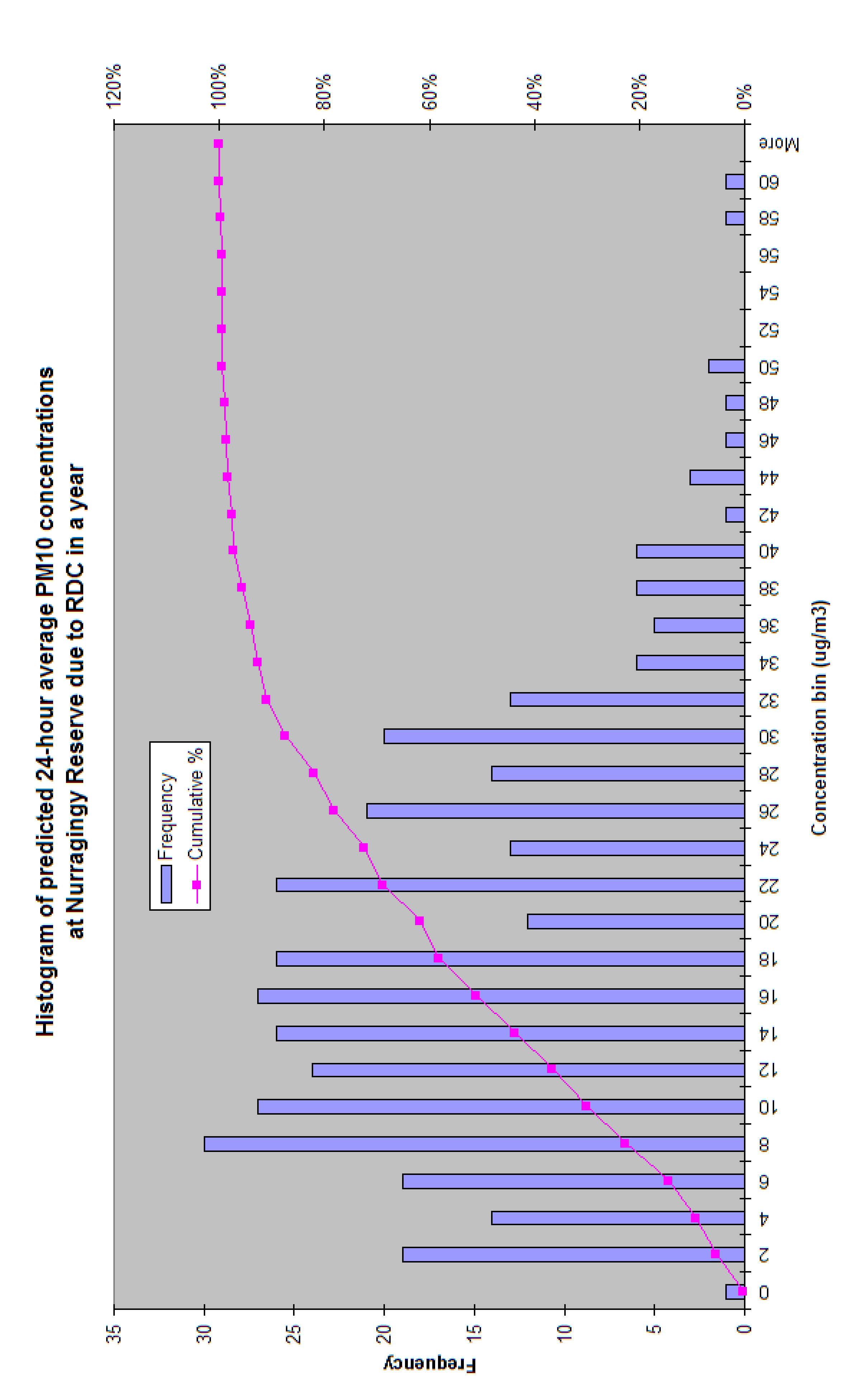
Predicted annual average TSP concentrations due to Rooty Hill RDC - µg/m³

FIGURE 9



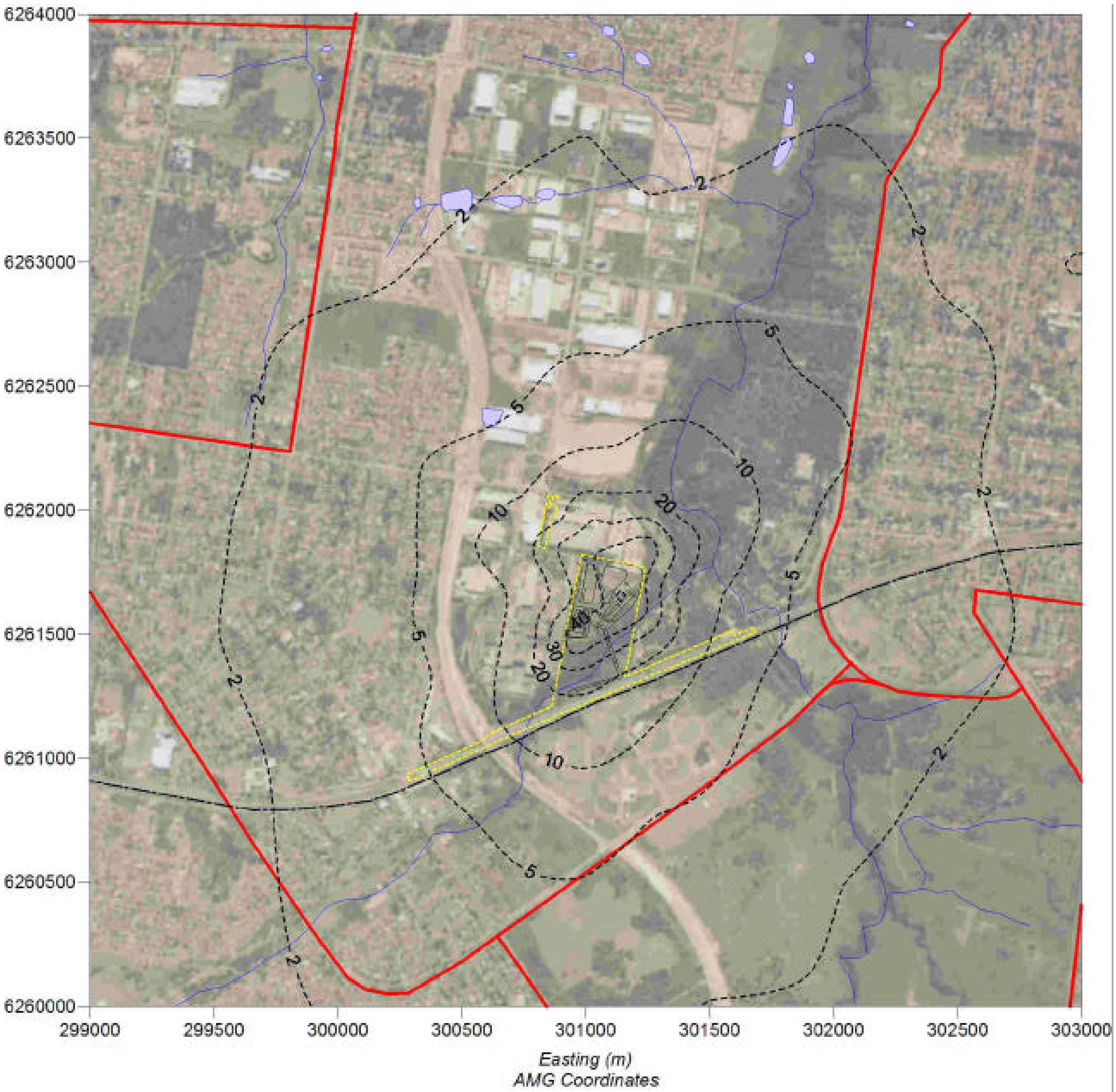
Predicted annual average dust deposition due to Rooty Hill RDC - g/m²/month

FIGURE 10



Histogram of predicted 24-hour average PM10 concentrations
at Nurragingy Reserve due to RDC in a year
Frequency
Cumulative %
Frequency
Concentration bin (ug/m3)
0
5
10
15
20
25
30
35
0%
20%
40%
60%
80%
100%
120%
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
More

FIGURE 11



Predicted maximum 12-hour average PM_{10} concentrations during daytime hours due to Rooty Hill RDC - µg/m^3

FIGURE 12

READYMIX REGIONAL DISTRIBUTION CENTRE AT ROOTY HILL

Potential for Adverse Respiratory Effects

1st June 2005

Prepared for National Environmental Consulting Services by:

Associate Professor David McKenzie
The Chest and Sleep Centre
Prince of Wales Private Hospital
Barker Street
Randwick NSW 2035

INTRODUCTION:

The following report is based on my experience in the diagnosis and management of respiratory disorders with a particular interest in Occupational Health problems. It is also based on an assessment of the medical literature related to exposure to dusts of various kinds and urban pollution. The following document discusses the likely composition and concentrations of dust that will be emitted by the Regional Distribution Centre and considers the possible health consequences of such exposures. It will also discuss the medical evidence concerning exposure to small particles of respirable dust. These observations will be related to the predicted concentrations of dust particles contained in the air quality impact assessment prepared by Holmes Air Sciences (May 2005).

CONCENTRATION AND COMPOSITION OF EMISSIONS FROM THE REGIONAL DISTRIBUTION CENTRE:

The Regional Distribution Centre is designed to enable temporary storage of a variety of materials prior to loading onto road vehicles for distribution in the Sydney metropolitan area. The raw materials would come by rail. The air quality impact assessment details the facilities that would be present at the site for unloading trains, storage and reloading for delivery.

The materials handled that have a potential to liberate dust of respirable size include various aggregates of rock, some of which will have been crushed elsewhere, sand and cement. The bulk of dust likely to be liberated from such materials is considered to be relatively non-toxic and labelled as “nuisance dust”. It is possible that there would be some very small concentrations of respirable silica released during the handling of the sand and some of the aggregates. However, I understand that these emissions would mostly be suppressed with water sprays and other dust suppression measures in operation. Silica is capable of producing damage to lungs and the allowable limits for the concentration of airborne silica of respirable size is substantially lower than that for the nuisance dust.

The health effects from exposure to suspended particulate matter in the air depend on the chemical nature or the particles, the concentration of the particles in the air, the percentage of particles which are in the respirable size range of 1-10 micron in diameter (ie small enough to be inhaled deep into the lung and large enough to be deposited in the lung rather than to be exhaled) and the susceptibility of the individual inhaling the dust.

There is always a small amount of particulate matter in the air we breathe and the concentration varies substantially from place to place and from time to time. In a rural community, the airborne dust is likely to contain high concentrations of grain pollens, ordinary dust and in winter, smoke from wood burning. In urban areas by contrast, the main source of suspended particulate matter is the burning of fossil fuels, principally in motor vehicles. There would be a contribution from dusty processes such as excavation, road building and demolition works.

…/2

Regardless of the composition of the airborne dust, the concentration will vary because of a number of influences. The major ones are air temperature and wind velocity. In Sydney, airborne pollution tends to be greatest on hot days with very little wind, particularly if there is an atmospheric inversion. The highest levels of airborne particulates occur when there are bushfires surround Sydney. On those occasions, a smoke haze is visible and the background levels of respirable dust in the atmosphere can exceed the current regulated level which is a 24 hour maximum of particulates less than 10 micrometres of 50 $\mu g/m^3$. In some cities, particularly in the past, airborne levels of pollutants increased on still days in winter due to the burning of fossil fuels in such as coal or wood in domestic homes. This may be an issue in some rural communities, but is less noticeable in the metropolitan area.

As mentioned above, urban air pollution contains not only airborne particles of a variety of mineral dusts, but also a variety of gases and vapours which have a complex composition. Many of the particulates in the respirable of faction of 1 to 10 microns are formed as products of combustion associated with moisture droplets in the atmosphere. These may contain a range of toxic products of combustion, including polyaromatic hydrocarbons. Urban air pollution includes sulphur dioxide, carbon monoxide, ozone, benzine, various oxides of nitrogen, hydrocarbons, lead and a range of toxic organic micropollutants. The latter include polyaromatic hydrocarbons, polychlorinated biphenyls, dioxins and furans.

There is abundant medical literature which shows that increases in the concentration of airborne pollution, including respirable particulates (PM_{10}) are associated with a range of adverse health effects. These include increases in respiratory symptoms such as cough and wheeze, particularly among susceptible individuals such as patients with asthma or emphysema. A number of studies have also shown increases in death rates on days when airborne pollution is especially high. These deaths are due to range of diseases including cardiac and respiratory disorders. The increase in mortality is almost entirely among people over the age of 65 usually with severe pre-existing medical problems. Close examination of these studies suggests that there is a threshold airborne concentration for small particulates above which increases in death rates can be observed and this level is approximately 50 $\mu g/m^3$. It is for this reason that the New South Wales Environmental Protection Agency in 2001 set the 24 hour maximum concentration of PM10 at 50 $\mu g/m^3$ and an annual average of less than 30 $\mu g/m^3$.

CURRENT LEVELS OF PM_{10}:
The air quality impact assessment includes data obtained from dust monitors in the vicinity of the Distribution Centre during the year 2003. This data showed an average monthly PM_{10} concentration of 17 $\mu g/m^3$. The maximum 24 hour values exceeded 50 $\mu g/m^3$ on four occasions during the year. The New South Wales Department of Environment and Conservation allows the 24 hour average value to exceed to exceed 50 $\mu g/m^3$ five times per year. Thus, the pre-existing dust levels are, on average, well within the Department criteria but the number of days in which the allowable level was exceeded is close to the maximum. A review of the data for that year revealed that highest concentrations were associated with bushfires rather than natural variation in urban generated pollution.

CONTRIBUTION OF THE DISTRIBUTION CENTRE TO AIRBORNE CONCENTRATIONS OF PARTICULATES:

The air quality (assessment) indicates that the Regional Distribution Centre will increase airborne levels of particulates by a relatively small amount compared with the current background levels. As mentioned above, the bulk of this dust will be "nuisance dust" rather than the toxic particles mentioned above. The contribution of particulates from the trucks involved in this operation will be trivial compared with the existing number of vehicles on the roads of Sydney. Indeed, the use of rail to bring the materials in decreases the amount of kilometres driven by trucks in the Sydney metropolitan area.

The Regional Distribution Centre is situated at some distance from the nearest residential areas. The concentration of airborne particulates is highest at the point where the dust is liberated. The concentration will decrease, on average, according to the cube of distance over the first kilometre or more. This means that the dust is rapidly diluted in the surrounding air. The finer particles of dust which are the ones capable of entering and being retained in the lungs tend to rise higher and travel further before settling to ground level. This means that the bulk of dust depositing within 1 to 2 kilometres of the source would be non-respirable dust. The bulk of respirable dust would travel more than several kilometres and will be highly diluted before settling towards ground level and therefore becoming potentially respirable.

The current standard of 50 $\mu g/m^3$ can be compared with the occupational health standards for workers in dusty industries. The allowable peak level for exposure of a worker to nuisance dust is in the range of 5,000 to 10,000 $\mu g/m^3$. In other words the environmental standard for residents is over 100 times more stringent than the maximum safety standards for employees.

The environmental standard is deliberately set to a conservative level for several reasons. Firstly, the environmental levels are set for 24 hour per day exposure, 7 days per week. More importantly, the environmental standards are set to be safe for even the most highly susceptible individuals. Most workers in dusty trades are fit and healthy and therefore not at significant risk from levels not exceeding the occupational standards listed above. Individuals in the community include some who are critically ill with respiratory and cardiac disorders for whom a small change in air quality could results in severe symptoms or even death. For healthy members of the community, there is no need for any concern if the airborne concentration of particulates exceeds the 50 $\mu g/m^3$ standard, provided that this does not occur frequently.

Impact on residential areas

Examination of the Air Quality Impact Statement includes diagrams which show the likely concentrations of dust surrounding the Distribution Centre and the rate of dilution of that dust with distance. It is seen that relatively small sections of the nearest residential areas will be exposed to levels up to 5 $\mu g/m^3$ depending upon atmospheric conditions. These values are the predicted maximum 24 hour average values but the anticipated annual values are lower. All these values are well within the standards set by the Department of Environment and Conservation and would not be expected to produce adverse health effects in the short or long term.

Impact on Nurragingy Reserve:
The Nurragingy Reserve is a large bushland area adjacent to the eastern boundary of the proposed site. This contains a number of picnic and barbecue areas, walking tracks and children's playground. It also contains a Function Centre. Examination of the diagrams indicating the predicted maximum 24 hour average PM_{10} concentrations shows that there is likely to be a gradual decrease in airborne dust concentration moving from the western end of the reserve to the eastern end of the reserve. A small portion of the reserve to the north east of the site boundary will be within the zone that is predicted to reach values between 50 and 80 $\mu g/m^3$. Concentrations in the remaining area are predicted to decrease gradually from 50 $\mu g/m^3$.

Thus, most of the park is within the environmental standard of 50 $\mu g/m^3$. That standard is set for residents who are likely to be exposed to levels up to that concentration 24 hours a day 7 days a week. .

There is no reason to expect any respiratory problems in casual visitors even if they spent all their time in the corner of the reserve with the highest predicted concentrations. Thus, there is no potential for staff or visitors to the reserve to suffer any adverse consequences from inhalation of dust related to the Regional Distribution Centre.

Impact on Blacktown Olympic Centre (Aquilina Reserve):
The Blacktown Olympic Centre is situated to the south of the railway line which is at the southern end of the proposed site. Examination of the diagrams indicates that the bulk of the site is within regions predicted to have PM_{10} concentrations in the range of 10 to 20 $\mu g/m^3$. These values are well within the current standards and are therefore safe even for residents with continual exposure. Most of the people using Blacktown Olympic Centre would not be present for more than a few hours daily and many would visit the site no more than once or twice a week. The site will be used by athletes and during events their ventilation rate will be much higher than average resting levels for the duration of the event. Thus, a greater amount of airborne dust would be inhaled per unit time during those events.

However, the environmental standard is set in the knowledge that some people will be exposed to that level during maximal or near maximal exertion for at least part of the time. Thus, there is no need for concern about exposure to levels of 10 to 20 $\mu g/m^3$ during exercise for relatively short periods of time. Employees at the site might be exposed to levels of 10 to 20 $\mu g/m^3$ for up to 40 hours per week. This is still well within the environmental standard and is not a cause for concern.

CONCLUSION:

My examination of the data included in the Air Quality Impact Statement leads me to conclude that there is no reason for concern about adverse health effects from the proposed Regional Distribution Centre. The anticipated levels of respirable dust in the adjacent residential areas will be well below the criteria set by the Department of Environment and Conservation.

The bulk of the dust liberated by the Distribution Centre will be in the from of "nuisance dust" which is relatively non-toxic compared with the airborne suspended particulates that currently comprise the bulk of the airborne pollution. In my view, there is no reason for concern about the safety of even the most susceptible individuals living in the vicinity of the distribution centre. There is also no reason for concern about the safety of people using or working in the adjacent recreational areas.

Associate Professor David McKenzie