Mannering Colliery

Environmental Assessment

Appendix K

AIR QUALITY IMPACT ASSESSMENT

MANNERING COLLIERY

CONTINUATION OF MINING ENVIRONMENTAL ASSESSMENT

AIR QUALITY AND GREENHOUSE GAS IMPACTASSESSMENT

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1 INTRODUCTION

This report has been prepared for Hansen Bailey by Holmes Air Sciences. It provides an air quality and greenhouse gas assessment for the continued operation of the Mannering Underground Mine (Mannering Colliery) (the Project) operated by Centennial Coal Company Limited (Centennial).

The Colliery began operations in 1960, in conjunction with the construction of the Vales Point Power Station. It was previously known as Wyee Colliery, which was operated by the NSW Government-owned Powercoal Pty Ltd (Powercoal) until 2002 when Centennial secured the Powercoal assets renaming Wyee Colliery as Mannering Colliery.

Due to recent amendments to the *Environmental Planning and Assessment Act 1979* (EP&A Act) it is required that Centennial obtain relevant planning approval under Part 3A of the EP&A Act for continuation of mining at Mannering.

2 LOCAL SETTING

Mannering is located approximately 40 kilometres (km) south of Newcastle on the shores of Lake Macquarie and approximately 110 km north of Sydney in New South Wales.

The existing surface facilities including the administration buildings, workshops and Mannering Coal Crushing Facility (MCCF), are located approximately 3 km south of the township of Mannering Park (see **Figures 1** and **2**). The Colliery is located within the proclaimed West Lake Macquarie and Swansea – North Entrance Mine Subsidence Districts and falls within both the Lake Macquarie and Wyong Local Government Areas (LGA).

Apart from the lake, the surrounding area comprises gently undulating land, which supports (in parts) densely wooded areas, which have been cleared to make way for residential developments and major industrial infrastructure including the Vales Point Power Station.

3 DESCRIPTION OF THE PROJECT

Extraction of coal at Mannering is undertaken using a form of bord and pillar mining using continuous miners. Coal is extracted by the continuous miners, which feed to a conveyor system, which transfers coal to the surface. The mine has produced Run of Mine (ROM) coal at a rate of up to 1.7 million tonnes per annum (Mtpa) and in the 2006/2007 reporting period is expected to produce 0.879 Mtpa.

The surface infrastructure comprises the MCCF, administration offices, workshops, water management structures, tarred access roads, ventilation shafts, boreholes and a small 25,000 tonne (t) coal stockpile, which serves as a supply buffer. All ROM coal is crushed and sized to a sub-50 mm size and transferred via a dedicated overland conveyor to the Vales Point Power Station.

The Project will comprise the following components/activities, which are potential sources of emissions (including greenhouse gases):

- Ventilation shafts, which will liberate CO_2, CH_4 (greenhouse gases) and particulate matter (and minor quantities of exhaust emissions from internal combustion engines used underground although most equipment is electrically powered);

- The Crusher (Hammer, Roll Crusher to -50 mm) with a capacity of 400 tonnes per hour (tph);
- Loading of coal to stockpile, which will be a potential source of particulate matter;
- Wind erosion from the 25,000 t capacity stockpile, which has a disturbance area of less than 0.35 ha; and
- Reclaiming of stacked out coal using an underground reclaim tunnel with coal pushed up towards the reclaim feed using an excavator or Front End Loader (FEL): and
- The conveyor from Mannering to Vales Point Power Station.

The stockpile serves as a surge stockpile and coal is only required to be diverted to the stockpile at times when Vales Point Power Station is unable to receive coal. It has been assumed for the purposes of modelling that this activity occurs for up to 10% of the time.

There will be no other handling of coal on the surface and no other transport of coal other than by the conveyor.

4 REVIEW OF METEOROLOGICAL CONDITIONS

To assess the potential for the surface operations to give rise to air quality impacts, it is useful to review the meteorological and climatic conditions that prevail in the area. The review considers:

- Wind speed and direction;
- Temperature and humidity; and
- Rainfall.

4.1 Wind speed and direction

Hourly wind speed and wind direction data are available from three meteorological stations referred to as Wyee/Vales, Munmorah and Munmorah Power Station (see **Figure 1**). This data has been made available for the study. The data has been reviewed and cover the periods 2004, 2005 and 2006 (up to 31 October 2006). The data for 2004 for the Munmorah Power Station site is incomplete and the data for all stations are incomplete for 2006 because the year had not ended at the time of writing. To enable a comparison of the data from the three sites unbiased in time, seasonal and annual wind roses from the only complete year at the three sites, namely 2005, have been prepared. The wind roses are presented as **Figures 3**, **4** and **5**.

Comparison of the three sets of wind roses shows that all three sites experience significantly different wind regimes. The complexity of the local winds is probably a consequence of the complex arrangement of water and land and the local effects of sea and lake breezes combined with the effects of the local topography.

Over the year, all three stations show some common influences, in particular sea-breeze effects (north-easterly winds) are observed at all three sites in summer and westerly winds are common in winter. The northeast winds (sea/lake breezes) are most common in spring, summer and to a lesser extent autumn, which also experiences a high frequency of winds from the southwest. Westerly winds (south-westerly, west or north-westerly depending on the site) are common in winter.

Annual average wind speeds at the three sites in 2005 were as follows:

- Wyee/Vales – 1.5 m/s (based on 98.4% valid data);
- Munmorah – 2.1 m/s (based on 97.2% valid data); and
- Munmorah Power Station – 2.1 m/s (based on 98.4% valid data).

The data suggest that winds in the area are light and this is further confirmed by the fact that the maximum hourly wind speeds observed were also low - 7.5 m/s at Wyee/Vales, 8.7 m/s at Munmorah Power Station and 10.2 m/s at Munmorah.

Data from Munmorah has been determined to be most representative due to the close proximity to site, although as discussed further in this document, in practice, the emissions from the Project are too small to create a significant risk of air quality exceedances regardless of which data set is used.

4.2 Local Climatic Conditions, temperature, humidity and rainfall

The Bureau of Meteorology also collects climatic information in the vicinity of the study area. A range of climatic information collected from Norah Head Lighthouse (located approximately 12 km to the south of the Project area) are presented in **Table 1** (**Bureau of Meteorology, 2006**).

Temperature and humidity data consisting of monthly averages of 9 am and 3 pm observations are presented in **Table 1**. Also presented are monthly averages of maximum and minimum temperatures and rainfall data consisting of mean and median monthly rainfall and the average number of rain days per month. The latter data are required for estimating emissions from wind erosion sources.

Table 1 : Climate information for the study area

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean 9 am dry-bulb temperature (deg C)	22.1	22.1	21.3	19.3	16	13.2	12.3	13.8	16.4	18.5	19.4	21.4	18
Mean 9 am wet-bulb temperature (deg C)	19.9	20.2	19.1	17	14	11.3	10.4	11.3	13.3	15.5	16.8	18.8	15.6
Mean 9 am humidity (%)	82	83	81	79	79	78	77	72	70	72	76	78	77
Mean 3 pm dry-bulb temperature (deg C)	23.7	23.9	23	21.2	18.8	16.6	16.1	17.1	18.4	19.6	20.9	23	20.2
Mean 3 pm wet-bulb temperature (deg C)	20.7	21.1	20	18.1	15.6	13.4	12.6	13.2	14.4	16.1	17.7	19.6	16.9
Mean 3 pm relative humidity (%)	76	77	75	73	71	69	66	63	65	70	73	73	71
Mean daily maximum temperature (deg C)	25	25.2	24.4	22.7	20.1	17.7	17.2	18.4	20.2	21.8	22.6	24.8	21.7
Mean daily minimum temperature (deg C)	19.3	19.6	18.4	15.7	12.9	10.2	9.3	9.9	11.9	14.2	16	18.2	14.6
Mean rainfall (mm)	106.4	142	129	118.1	132.2	126.5	80.4	69.4	73.7	72.7	96.5	80.6	1227
Median rainfall (5^{th} decile) (mm)	86	107.9	114.3	89.1	115.6	102.7	68.6	43	54.6	56.9	103.4	66.2	1196
Mean number of rain days	12.2	11.9	13	11.2	12.9	11.3	9.9	9.1	9.8	11	12.7	10.7	135.6

Climate averages for Station: 061273 NORAH HEAD LIGHTHOUSE. Commenced: 1969; Last record: 2004; Latitude (deg S): -33.2815; Longitude (deg E): 151.5759; State: NSW. Source: ***Bureau of Meteorology (2006)***

Temperature data show that February is typically the warmest month with a mean daily maximum of 25.2°C. July is the coldest month with a mean daily minimum of 9.3°C.

Rainfall data collected at Norah Head show that February is the wettest month with an average rainfall of 142 mm over 12 rain days. Annually the area experiences, on average, 1227 mm of rain, which falls on 136 days.

5 AIR QUALITY ASSESSMENT CRITERIA

The Project will result in the liberation of a number of classes of particulate matter (PM) described as total suspended particulate matter (TSP)[1], particulate matter with equivalent aerodynamic diameters 10 µm or less (PM_{10})[2] and particles with equivalent aerodynamic diameters of 2.5 µm and less ($PM_{2.5}$). These emissions would occur primarily as fugitive dust from the surface facilities and in the mine ventilation air.

There will also be emissions from vehicles and underground equipment. These emissions will include carbon monoxide (CO) and minor quantities of sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). In practice, these gaseous emissions will be minor and at levels that will not give rise to any substantive environmental impacts. For this reason, these pollutants are not considered further in this report. The focus of the report is on the potential impacts due to dust.

5.1 Particulate matter

Table 2 and **Table 3** summarise the relevant air quality goals. The air quality goals relate to the total dust burden in the air and not just the dust from the Project. In other words, consideration of background levels needs to be made when using these goals to assess impacts. The assessment criteria are designed to protect human health as well as to protect against nuisance effects.

Table 2. Air quality standards/goals for particulate matter concentrations (Source: DEC, 2005)

POLLUTANT	STANDARD / GOAL	AVERAGING PERIOD	AGENCY
Total suspended particulate matter (TSP)	90 µg/m^3	Annual mean	National Health and Medical Research Council (NSW DEC, 2005)
Particulate matter < 10 µm (PM_{10})	50 µg/m^3	24-hour maximum	NSW DEC (2005) (assessment criteria)
	30 µg/m^3	Annual mean	NSW DEC (2005) (long-term reporting goal)

µg/m^3 – micrograms per cubic metre
µm – micrometre

Ambient air quality standards for $PM_{2.5}$ have been developed as part of the National Environment Protection Measures (Air-NEPMs), but at this stage, these are not part of the NSW DEC's assessment criteria, which uses PM_{10} as the primary criterion for assessing the health effects of particulate matter.

[1] TSP is particulate matter suspended in the air and measured using a high volume sampler operated according to AS2724.3-1984. The size range of particles is indeterminate and depend on the measurement conditions. TSP is usually taken to comprise particles in the size range up to 0 to 50 µm. Particles larger than 50 µm are generally too large to remain suspended in the air for long enough to be considered as air pollutants.

[2] A particle is said to have an equivalent aerodynamic diameter of x µm if its dynamical behavior in the atmosphere is the same as a sphere of diameter x and with density 1 g/cm^3.

5.2 *Dust deposition*

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces and possibly vegetation/crops. **Table 3** shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. The criteria for dust fallout levels are set to protect against nuisance impacts (**DEC, 2005**).

Table 3. DEC criteria for dust (insoluble solids) 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

6 REVIEW OF EXISTING AIR QUALITY

6.1 *Dust deposition*

Mannering operates a network of five dust deposition gauges within the Colliery Surface Lease. The locations of these gauges are shown on **Figure 2**.

Table 4 shows the annual average dust (insoluble solids) deposition levels measured at the five sites over the period January 2001 to June 2006. The monthly data used to compile the annual average shown **Table 4** are provided in **Appendix A**. The monitoring network is subject to occasional vandalism, which has caused minor loss of data, and the field notes provided with the raw data show that samples are frequently (more than half the data) contaminated by insects and bird dropping samples are contaminated although the level of contamination appears to be low and no data has been excluded from reporting because of the contamination. Thus the results may overestimate actual dust deposition levels.

Generally both monthly and annual deposition levels are low and comply with the DEC's annual average assessment criteria of 4 g/m^2/month. The data show that air quality complies with the assessment criteria, which is consistent with the fact that the Colliery has not received any complaints in relation to air quality impacts.

Table 4. Annual average dust deposition (insoluble solids) - g/m^2/month

Date	**DG1**	**DG2**	**DG3**	**DG4**	**DG5**
2001	1.3	0.9	1.0	1.4	0.8
2002	2.9	0.7	1.0	1.1	0.7
2003	1.2	0.6	1.0	0.7	0.8
2004	0.5	0.5	1.0	0.6	0.7
2005	1.0	0.8	1.0	0.7	1.0
2006 (Jan to June)	0.8	1.0	1.0	0.7	0.9

6.2 *TSP (and inferred PM_{10})*

Twenty-four hour average TSP concentrations have been monitored by Delta Electricity, every sixth day, since 3 January 2004 at the site identified on **Figure 1**.

Table 5. Summary of 24-hour average TSP concentrations (six-day cycle) - µg/m^3

Year	Minimum	Maximum	Annual average
2004	4	126	35
2005	4	88	39
2006 (to October)	0	119	45

The entries in **Table 5** show that annual average TSP concentrations comply with the DEC annual average assessment criterion of 90 µg/m^3.

No direct measurements of PM_{10} concentrations are available but annual average concentration of PM_{10} in mining areas are typically 40% of the annual average TSP concentration. In the Central Coast the ratio may be closer to 50% (which would be more representative of an urban area) and so annual average PM_{10} concentrations are likely to be in the range 18 to 23 µg/m^3.

No estimate can be made of the 24-hour average PM_{10} concentrations because the relationship between PM_{10} and TSP concentrations is highly variable when viewed over short periods. Occasional exceedances of the 24-hour PM_{10} assessment criterion are likely to occur during times when bushfire smoke is present, but in general, PM_{10} concentrations are likely to comply with the assessment criterion of 50 µg/m^3.

7 EMISSION SOURCES

From an air quality perspective, the Project involves the following major elements:

- The 400 tph Hammer, Roll Crusher to -50 mm; and
- Stockpile -25 000 t capacity occupying 0.35 ha.

Stacked-out coal is reclaimed via a reclaim tunnel, which will require some handling of the coal with Excavator or FEL. There is no other handling of the coal.

The Hammer Roll Crusher is enclosed and dust emissions from this are negligible.

Wind erosion from the stockpile occurs as coal is loaded to the stockpile and from the effects of wind erosion and from the use of the FEL or Excavator to push coal to the underground reclaim slot.

The estimated TSP emission from each of these sources is discussed below.

7.1 Mine ventilation system

Mine ventilation air is currently discharged at 190 to 200 m^3/s. Over the longer term the ventilation rate is expected to increase to 300 m^3/s. The precise concentration of particulate matter in the ventilation air is unknown and will depend on a number of factors, in particular the effectiveness of dust controls in the mine. Concentrations are unlikely to exceed 5 mg/m^3 and so an upper limit for the estimated dust emissions from the ventilation system, working at 300 m^3/s, is 47,304 kg/y [300 m^3/s x 5 x 10^{-6} kg/m^3 x 3600 s/h x 8760 h/y].

7.2 Loading raw coal to stockpile

The stockpile is only used to stack coal in the event that the overland belt fails or the power station cannot take coal. In the unlikely event that this continued for an entire week, and the total weeks production was stacked out, it would result in 15,000 to 20,000 tonnes (around 2% of production) being stacked.

Each tonne of coal loaded to the stockpile will generate a quantity of TSP depending on the wind speed and the moisture content of the coal. Equation 1 (**US EPA, 1985**) shows the relationship between these variables.

Equation 1

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

where,
E_{TSP} = *TSP emissions*
$k = 0.74$
U = wind speed (m/s)
M = moisture content (%)
[where 0.25 ≤ M ≤ 4.8]

The average of $(U/2.2)^{1.3}$ in the Munmorah Power Station data set for 2005 (taken because it was the site with the highest annual average wind speed) is 1.059. Assuming that the coal moisture content is 4.8% (the highest value for which the equation has been validated, but less than the expected moisture content of the coal), the emission factor is 0.00037 kg/t. Further, assuming a ROM coal production rate of 1.1 Mtpa and use of the stockpile for 2% of the throughput (at the maximum expected production) the estimated TSP emission rate is 8 kg/y [0.00037 kg/t x 0.02 x 1,100,000 tpa].

7.3 Wind erosion from stockpile

The emission factor for wind erosion can be calculated from Equation 2 below (**US EPA, 1985**).

Equation 2

$$\mathrm{E}_{\mathrm{TSP}} = 1.9 \times \left(\frac{s}{1.5}\right) \times \left(\frac{365 - p}{235}\right) \times \left(\frac{f}{15}\right) \qquad \text{kg/ha/day}$$

where,
s = silt content (%)
p = number of rain days per year, and
f = percentage of the time that wind speed is above 5.4 m/s

From the Munmorah Power Station site f is 2.6% and the average number of rain days (from data collected by the Bureau of Meteorology observation site at Norah Head is 135.6 days/y). If the silt content of the ROM coal is taken to be 10%, then the TSP emission factor is estimated to be 2.1 kg/ha/day. Assuming the stockpile area is 0.35 ha the estimated TSP emission is 268 kg/y.

7.4 Excavator/FEL pushing coal

There is no emission factor specifically for FELs pushing coal on stockpiles, but the operation is similar to a bulldozer working on coal where the emission factor equation is presented as Equation 3 (**US EPA, 1985**).

Equation 3

$$E_{TSP} = 35.6 \times \frac{s^{1.2}}{M^{1.4}} \qquad \text{kg/hour}$$

where,
s = silt content (%), and
M = moisture content (%)

Taking M to be 6%[3] and s to be 10%, the emission factor is estimated to be approximately 45.9 kg/hour.

As noted previously, the stockpile is only used to stack coal in the event that the overland belt fails or the power station cannot take coal. In the unlikely event that this continued for an entire week, and the total weeks production was stacked out, it would result in 15,000 to 20,000 tonnes (around 2% of production) being stacked. This would then need to be reloaded to the conveyor. Assuming this is done using a 25 tonne excavator, assuming all reclaim chutes are being utilised, a reclaim rate of 2000 t/h would be easily achieved and so the reloading would be completed in 10 hours resulting in the emission of 459 kg of TSP.

7.5 Conveyor to power station

There will be some emission of coal dust from the conveyor that transfers coal from Mannering to Vales Point Power Station. In practice, these emissions will be very small and will not change from current levels. Currently they do not give rise to any adverse impacts and would not be expected to in the future.

7.6 Summary

The emissions from the major dust sources associated with the Project are summarised below in kilograms of TSP emission per year:

• Crusher (enclosed)	negligible
• The mine ventilation system	47,304
• Loading 2% of coal to stockpile	8
• Wind erosion from stockpile	268
• Pushing coal on the stockpile using an Excavator/FEL	459
• Dust loss from the conveyor system (both on site and off-site)	negligible
• **Total**	**48,039 kg/y**

[3] The value of 6% is used here because the US EPA emission factor for bulldozing does not specify an upper limit on M for use in the equation.

The estimated emission of 48,039 kg/y is equivalent to 1.5 g/s, which is clearly a negligible emission in the context that the closest residential receptors are located approximately 800 m from the emission sources. The closest residential location for Mannering is shown as Property 8 on Figure 2.

In practice, since the mine's ventilation system is already part of the existing operations and the effect of the emissions from the ventilation system would be captured in the historical monitoring data, the only new emissions (TSP) would be 735 kg/y or 0.023 g/s, which is even less than the 1.5 g/s due to all sources. A screening model test to assess the significance of these emissions suggests that the maximum 24-hour PM_{10} concentration and annual average concentration at the most affected receptor would be less than 0.5 $\mu g/m^3$ and less than 0.05 $\mu g/m^3$ respectively. These are extremely small levels and more detailed modelling is not justified.

8 GREENHOUSE GAS EMISSIONS

A number of conventions on the determination, assessment and the reporting of greenhouse gas emissions from human activity have been developed. These are discussed in the AGO Factors and Methods Workbook (**AGO, 2005**). The Workbook adopts the reporting approach known as the *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* which will be referred to as *The GHG Protocol*. This divides emissions into three categories or Scopes referred to as Scopes 1, 2 and 3.

The GHG Protocol defines the three scopes of emission as follows:

Scope 1 covers direct emissions from sources within the boundary of an organisation such as fuel combustion and manufacturing processes. In the case of Mannering this includes use of diesel fuel by mining equipment.

Scope 2 covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation. Scope 2 emissions result from the combustion of fuel to generate the electricity, steam or heat and do not include emissions associated with the production of fuel. Scopes 1 and 2 are carefully defined to ensure that two or more organisations do not report the same emissions in the same scope.

Scope 3 includes all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation.

The estimation and reporting of greenhouse gas emissions are calculated via a number of different methods. The procedures specified in the Australian Greenhouse Office's (AGO) Workbook (**AGO, 2005**) have been used here. These are consistent with internationally applied methods.

The protocol identifies greenhouse gases as follows:

1. carbon dioxide (CO_2);
2. methane (CH_4);
3. nitrous oxide (N_2O);
4. hydrofluorocarbons (HFCs);
5. perfluorocarbons (PFCs); and
6. sulphur hexafluoride (SF_6).

Carbon dioxide and N_2O are formed and released during the combustion of gaseous, liquid and solid fuels. The most significant gases for the Project are CO_2 and N_2O, which will be liberated when fuels are burnt in diesel-powered equipment and in the generation of the electrical energy that will be used by the Project. In addition, there will be emissions of CH_4 and CO_2 as the coal seams being mined are broken up during mining.

Inventories of greenhouse gas emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (potentials) and emission factors take into account the global warming potentials of the gases created during combustion.

The global warming potentials assumed in the Australian Greenhouse Office (AGO) (**AGO, 2005**) emission factors are as follows:

1. CO_2 – 1
2. CH_4 – 21
3. N_2O – 310
4. NO_2 – not included.

When the global warming potentials are applied to the estimated emissions then the resulting estimate is referred to as a "CO_2-equivalent emission".

The emission factors published by the Australian Greenhouse Office (AGO) (**AGO, 2005**) have been used to convert fuel usage, the use of explosives and electricity consumption into CO_2-equivalent emissions. The relevant emission factors are:

1. 3.0 kg CO_2-equivalent/litre for diesel usage – based on full fuel cycle analysis (see Table 3 of **AGO (2005)**), which includes 2.7 kg CO_2-equivalent/litre and 0.3 kg CO_2-equivalent/litre required to produce the fuel; and
2. 0.985 kg CO_2-equivalent/kWh of electrical energy used in NSW, which includes 0.835 kg CO_2-equivalent/kWh from the coal burnt in the power station and 0.150 kg CO_2-equivalent/kWh for the provision of the fuel used in the power station and losses in the distribution system that delivers the power to the mine (see Table 5 of **AGO (2005)**).

8.1 Ventilation air

The **AGO (2005)** workbook (Table 6 in the Workbook) suggests values for underground mines in NSW, however direct measurement of CO_2 and CH_4 are available for the Project and these have been used in this assessment rather than the default factors. Tests indicate that the CO_2 and CH_4 concentrations in the mine ventilation air are 0.3% and 0.40% respectively. The ventilation rate is approximately 300 m^3/s, which, assuming an air temperature of 20 ºC, would give a flow rate of
275 m^3/s at 0 ºC and 1 atmosphere. The annual CO_2-equivalent emission from the ventilation air assuming a ventilation rate of 275 m^3/s is 571,449 t/y [275 m^3/s x 3,600 s/h x 8,760 h/y x (0.3/100 x 44 kg/mole / 22.4 m^3/mole + 21 x 0.4/100 x 16 kg/mole / 22.4 m^3/mole)][4].

8.2 Electricity consumption

Mannering has provided information on electricity consumption for the financial year 2005/2006. The consumption was 5,336,559 kWh and this was associated with the production

[4] Note 44 kg/Mole is the molecular weight of CO_2, 16 kg/Mole is the molecular weight of CH_4 and 22.4 m^3 is the volume occupied by 1 Mole of any gas at 0 ºC and 1 atmosphere, 21 is the greenhouse warming potential of CH_4 relative to CO_2.

of 492 065 t of coal. At a production rate 1.1 Mtpa, the electricity consumption would be approximately 2.23 times greater, namely 11,929,755 kWh. This would result in the emission of 11,750,809 kg CO_2-e [0.985 kg CO_2-e/kWh x 11,929,755 kWh]. This includes the emission for the full fuel cycle in generating the electricity[5].

8.3 Diesel use

The mine will consume some diesel to power the FEL used to work the stockpile and for other purposes. Mannering has estimated that the quantity of diesel used would be 124,000 L per year. This would result in 372,000 kg/y [124,000 L/y x 3.0 kg/L].

8.4 End use of the coal

Data from Mannering states that the coal has a specific energy 22.5 MJ/kg and according to the **AGO (2005)** (Table 1) the Scope 1 emission factor for NSW power stations burning black coal is 89.8 kg CO_2-equivalent/GJ. Thus if a nominal 1.1 Mtpa of ROM coal is transported via overland conveyor and burnt in the Vales Point Power Station then the CO_2-equivalent emission would be 2.223 Mtpa [1.1 x 10^6 t/year x 22.5 GJ/t x 89.8 kg/GJ].

8.5 Summary

In summary the annual greenhouse gas emissions in tonnes of CO_2-equivalent, from each of the sources discussed above would be:

CO_2 and CH_4 in the ventilation air	571,449 t (of CO_2-equivalent)
Electricity usage	11,751 t
Diesel usage	372 t
End use of the coal	2,223,000 t
Total	**2,806,572 t**

9 ASSESSMENT OF IMPACTS

9.1 Dust

The Project involves no changes to the current operations of the mine. The mine ventilation system, MCCF, coal stockpile and all other aspects of the mine remain consistent with current operations. The estimated total emissions from the mine remains small at less than 2 g/s. It is clear that this level of emission would not affect the PM_{10}, TSP or deposition levels significantly at the closest residential locations, which are 800 m or so from the stockpile.

Currently annual average TSP, inferred annual average PM_{10} and annual average deposition levels comply with the DEC assessment criteria. The 24-hour PM_{10} concentrations will exceed the 50 $\mu g/m^3$ assessment criterion during periods when bushfires are contributing high concentrations of smoke to the air, or remote dust storms transport significant quantities of particulate matter into the Lake Macquarie airshed.

9.2 Greenhouse gas emissions

To assess the effects of the greenhouse gas emissions associated with the Project, it is useful to consider the contribution of total emissions from both mining and burning of the coal to global warming.

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[5] This produces a slight inconsistency in the estimation method since the coal from the Mannering Colliery is being supplied to generate the power that is used by the Colliery. Therefore using the full fuel cycle emission factor, which includes the emissions associated in mining the coal to power the power station, will result in some double counting of emissions.

The International Energy Agency (**IEA, 2006**), estimates that in 2004, the global emissions of CO_2-equivalent from burning fossil fuels was 26,583.3 Mt and Australia's emissions of CO_2 from burning fossil fuels (energy sector) was 387.2 Mt CO_2-equivalent (i.e. 1.46% of the global emission due to total fossil fuel use). The IEA figure is consistent with estimates published by the Oak Ridge National Laboratories (http://cdiac.ornl.gov/trends/emis/tre_glob.htm) which estimates that CO_2 emissions due to burning fossil fuels and cement production in 2003 was 26.777 Gt.

There are other sources of greenhouse gas emissions namely land clearing, agriculture and waste disposal. When these are taken into account Australia's emissions for 2004 were 564.7 Mt. An equivalent figure is not available for global emissions. If it is assumed that land clearing, agriculture and waste account for similar proportions of emissions in the rest of the world then the global CO_2-equivalent emissions in 2004 would be of the order of 40 Gt. Thus, the emissions of 2.8 Mtpa would be 0.007% of global emissions. Thus, the Project could be considered to contribute 0.007% to the increase in global temperatures caused by the increase in GHG emissions as they are currently. This invites the question as to what temperature rise might be attributed to the GHG emission arising from the Project.

As the relationship between global warming and greenhouse gas concentrations is not linear[6] there is no accepted method to determine the contribution that a given emission of greenhouse gases might make to global warming. (To understand this point it is useful to consider the discussion from Section 1.3.1 of the Second Assessment Report prepared by the IPCC (**IPCC, 1996**), which explains the relationship between the concentration of greenhouse gases and global temperature.) However, in the interim the following approach can be used. The estimated quantity of carbon stored in the atmosphere now is approximately 750 Gt, which is equivalent to 2,750 Gt of carbon dioxide (**Seinfeld and Pandis, 1998**).

Based on the IPPC estimate, a doubling of the CO_2-equivalent concentration in the atmosphere would lead to a 2.5 °C increase in global average temperature, and that the current global CO_2 load is 2,750 Gt, we can estimate that the emissions from the Project would lead to an increase in global temperature of 0.0000025 °C [$(2.8 \times 10^6/2{,}750 \times 10^9) \times 2.5$ °C].

There will clearly be no measurable environmental effect due to the emissions of GHG from the Project even when the customer's use of the coal is taken into account. Any environmental assessment would conclude that the effects of the emissions from the Project are unmeasurable.

In practice of course, the effects of global warming and associated climate change are the cumulative effect of many thousands of such sources and it is the cumulative effects that pose a threat to Environmental Sustainable Development (ESD) principles.

This analysis highlights the problem of dealing with climate change on a mine-by-mine, or project-by-project basis. Indeed if this approach is adopted it is likely to be ineffective since the coal will simply be sourced from some other place.

Ultimately, the control of GHG emissions is likely to occur via economic instruments such as carbon taxes set as suggested in the recently released Stern Review and elsewhere (**Stern, 2006**). These taxes, set at appropriate levels, would encourage increases in efficiencies in the way that carbon-based fuels (including coal) are used, encourage the development of carbon capture and

[6] The warming effect of a given quantity of greenhouse gases to the atmosphere is less and less as the concentration becomes higher and higher (see Section 1.3 of **IPCC (1996)**).

sequestration and encourage the development of renewable forms of energy generation, and improve the efficiency with which fossil fuels are used.

10 CONCLUSIONS

The Project has been assessed to identify potential impacts due to emissions of dust and greenhouse gases.

The dust emissions associated with the development are estimated to be no more than 2 g/s and would not be expected to produce a noticeable or measurable change in the concentrations of particulate matter in the residential areas within close proximity of the mine.

There will be greenhouse gas emissions as a result of the Project and as a result of burning the coal that will be produced by the Project. These emissions will not by themselves have any significant impact on global warming.

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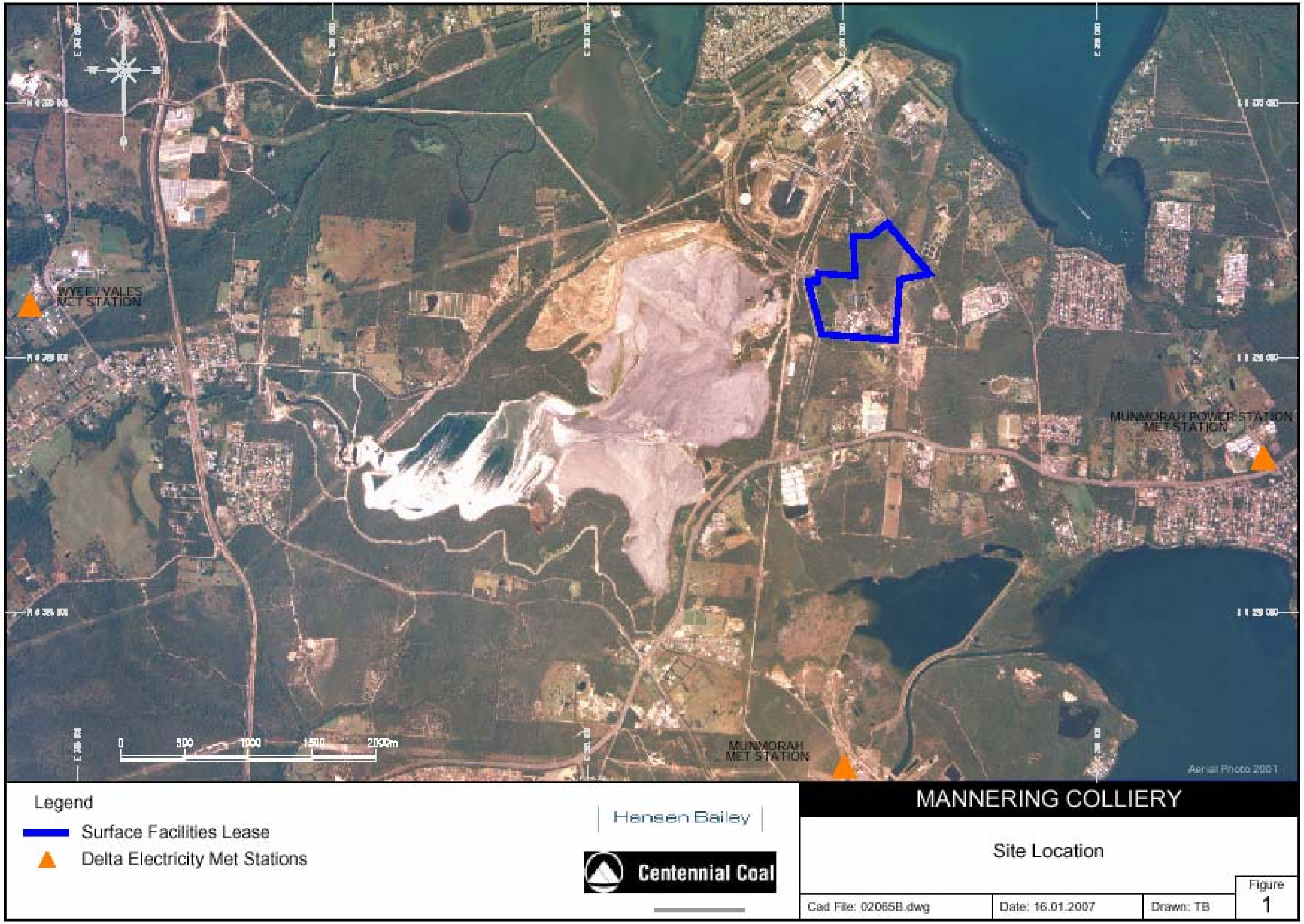
APPENDIX A
MONTHLY DUST DEPOSITION (INSOLUBLE SOLIDS) RESULTS

Date	DG1	DG2	DG3	DG4	DG5
Jan	0.9	0.5	0.7	2.7	0.8
Feb	0.8	1.1	0.6	1.6	0.4
Mar	3.0	0.6	0.8	0.4	0.5
Apr	1.0	1.0	0.4	2.9	0.4
May	2.4	1.7	0.7	1.0	0.2
Jun		1.4	0.9	0.5	0.5
Jul	0.6	1.0	3.8	0.5	0.8
Aug	0.6	0.6	0.8	2.1	0.3
Sep	0.9	0.8	0.8	3.5	3.1
Oct	0.7	0.9	1.0	0.5	0.7
Nov	1.1	0.4	1.1	0.9	0.6
Dec	2.7	0.6	0.8	0.6	1.1
Annual 2001	**1.3**	**0.9**	**1.0**	**1.4**	**0.8**
Jan	1.7	1.4	1.3	1.1	1.3
Feb	1.5	0.3	0.6	0.8	0.5
Mar	2.8	1.1	0.8	1.0	0.9
Apr	2.3	0.3	0.3	0.4	0.5
May	0.6	0.7	0.8	1.9	0.4
Jun	0.7	0.4	0.5	1.4	0.3
Jul	0.6	0.8	0.6	0.6	0.3
Aug	1.1	0.1	1.2	0.5	0.6
Sep	0.6	1.0	0.6	1.2	0.8
Oct	16.6	1.0	1.5	1.3	1.1
Nov	4.8	1.0	2.5	1.6	1.2
Dec	1.1	0.6	1.1	1.1	0.8
Annual 2002	**2.9**	**0.7**	**1.0**	**1.1**	**0.7**
Jan	2.2	1.5	2.3	1.5	0.9
Feb	2.7	0.8	0.7	0.5	0.8
Mar	2.2	0.7	0.9	0.8	0.7
Apr	1.2	0.1	2.8	0.8	0.8
May	0.3	0.1	0.2	0.1	0.1
Jun	0.5	0.3	0.4	0.2	0.4
Jul	1.0	0.5	0.8	0.4	1.9
Aug	1.0	0.7	0.7	0.8	0.8
Sep					1.1
Oct	1.6	1.1	1.1	0.9	0.5
Nov	0.4	0.6	0.3	0.7	0.5
Dec	0.5	0.6	0.8	1.0	0.5
Annual 2003	**1.2**	**0.6**	**1.0**	**0.7**	**0.8**
Jan	1.3	1.3	1.5	1.2	1.6
Feb	0.5	0.8	0.6	0.8	0.9
Mar	0.6		1.1	0.7	0.7
Apr	0.3		2.1	0.4	0.6
May	0.8	0.5	1.5	0.7	0.7
Jun	0.2	0.5	0.3	0.2	0.2
Jul	0.4	0.5	0.7	0.6	0.5
Aug	0.5	0.4	0.5	0.5	0.5
Sep	0.2	0.1	0.3	0.3	0.2
Oct	0.4	0.4	0.8	0.5	0.3

Date	DG1	DG2	DG3	DG4	DG5
Nov	0.3	0.3	0.7	0.6	0.4
Dec	0.8	0.6	1.4	0.8	1.4
Annual 2004	**0.5**	**0.5**	**1.0**	**0.6**	**0.7**
Jan	0.9	1.1	0.7	0.7	0.5
Feb	1.2	0.4	1.1	0.7	
Mar		0.4	0.3	0.4	0.7
Apr	1.2	1.2	1.0	0.6	0.5
May		0.4	0.1	0.4	0.1
Jun	0.7	0.8	1.3	0.7	0.6
Jul	0.2	0.3	0.3	0.2	0.4
Aug	0.8	0.8	0.9	0.7	1.1
Sep	0.8	0.7	1.8	missing	3.7
Oct	2.1	1.1	2.3	1.2	1.1
Nov	0.7	0.6	1.1	0.8	1.5
Dec	1.6	2.2	1.1	0.9	0.9
Annual 2005	**1.0**	**0.8**	**1.0**	**0.7**	**1.0**
Jan	0.7	0.7	1.5	0.8	0.9
Feb	0.6	2.5	0.6	0.6	0.5
Mar	1.7	0.2	0.7	1.0	0.8
Apr	0.5	1.0	1.8	0.5	1.6
May	1.1	0.9	0.7	0.8	1.0
Jun	0.4	0.7	0.5	0.4	0.3
Average to date	**0.8**	**1.0**	**1.0**	**0.7**	**0.9**

FIGURES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2000m
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Delta Electricity Met Stations
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Centennial Coal
MANNERING COLLIERY
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Date: 16.01.2007
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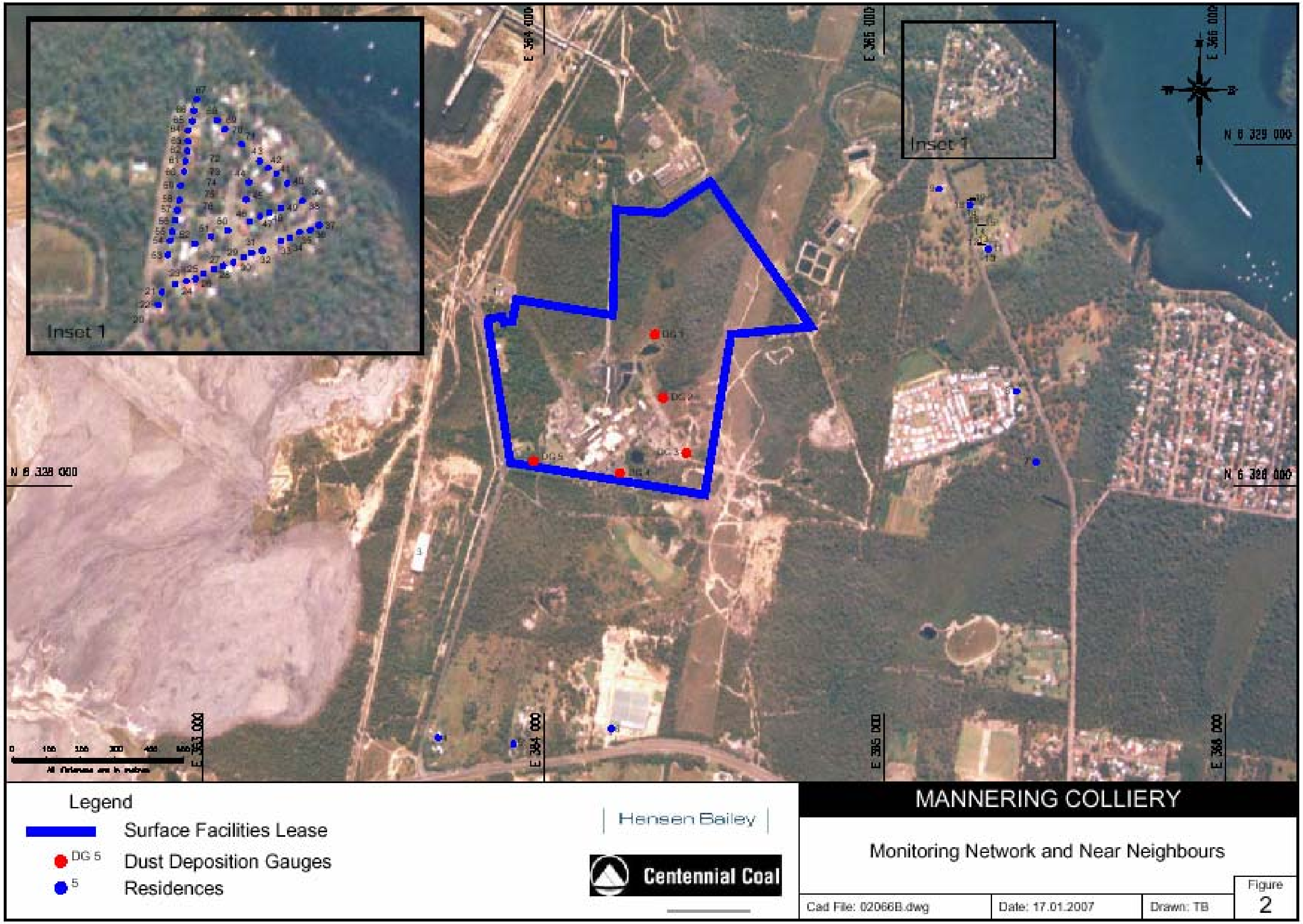
Figure
1


Inset 1
Inset 1
DG 1
DG 2
DG 3
DG 4
DG 5
E 363 000
E 364 000
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E 366 000
N 6 328 000
N 6 329 000
Legend
Surface Facilities Lease
DG 5 Dust Deposition Gauges
5 Residences
Hensen Bailey
Centennial Coal
MANNERING COLLIERY
Monitoring Network and Near Neighbours
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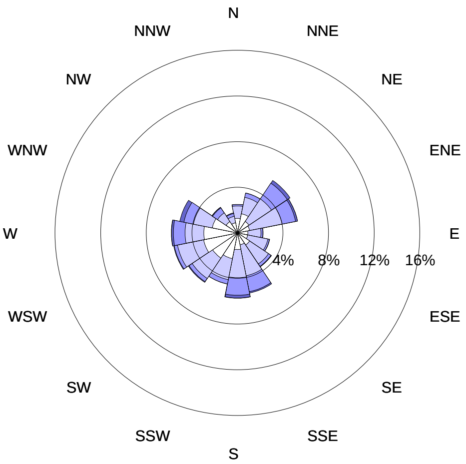
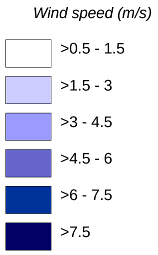
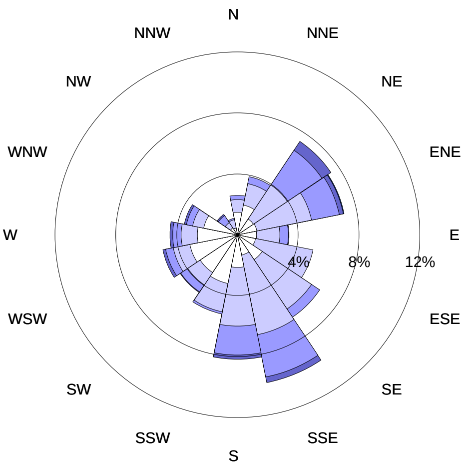
Figure 2

Annual and seasonal wind roses prepared from meteorological data collected at Wyee/Vales during the period 1 January to 31 December 2005

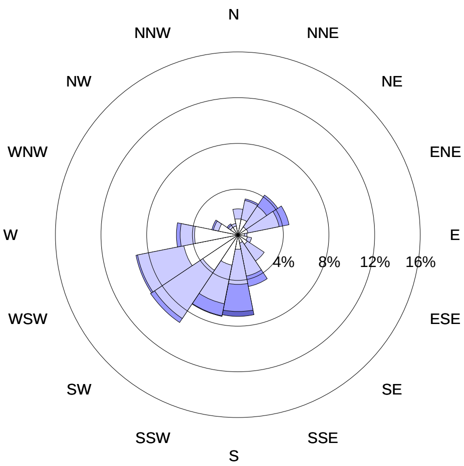


Annual
Calms = 32.4%

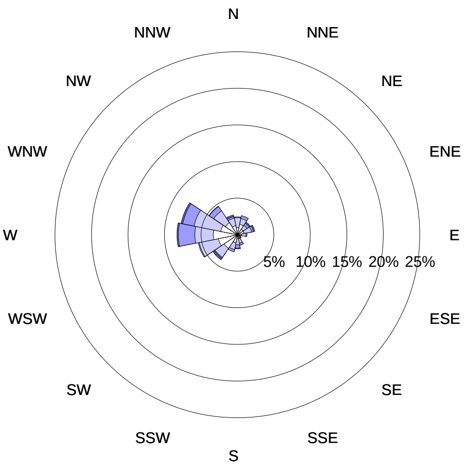




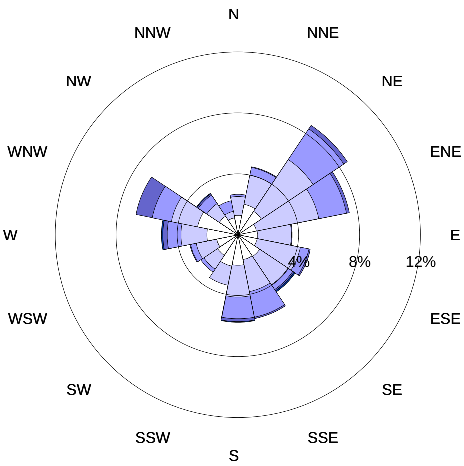
Summer
Calms = 20.4%



Autumn
Calms = 33.8%

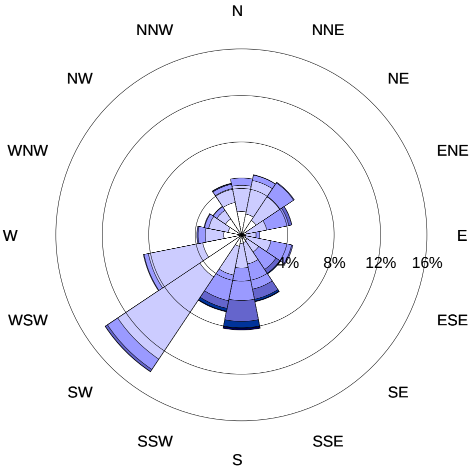


Winter
Calms = 49.1%

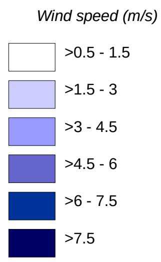


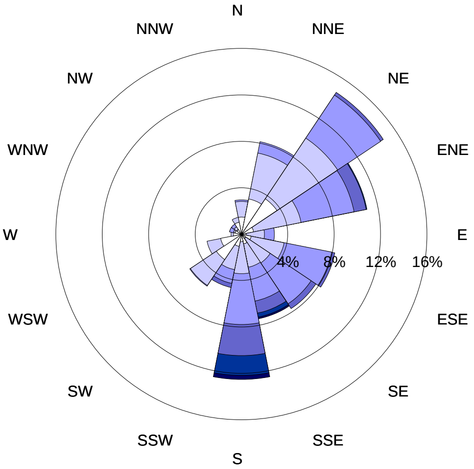
Spring
Calms = 25.5%

Annual and seasonal wind roses prepared from meteorological data collected at Munmorah during the period 1 January 2005 to 31 December 2005

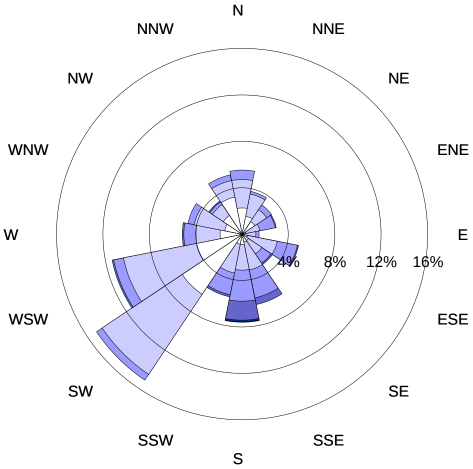


Annual
Calms = 11.7%

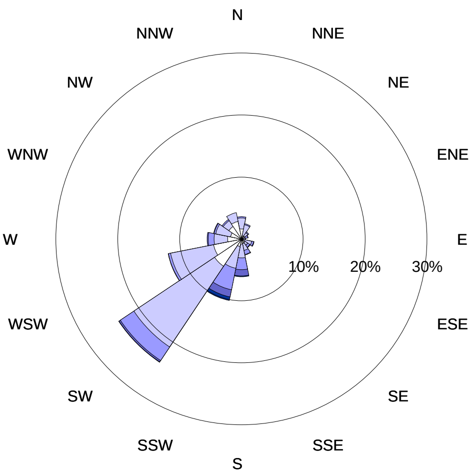




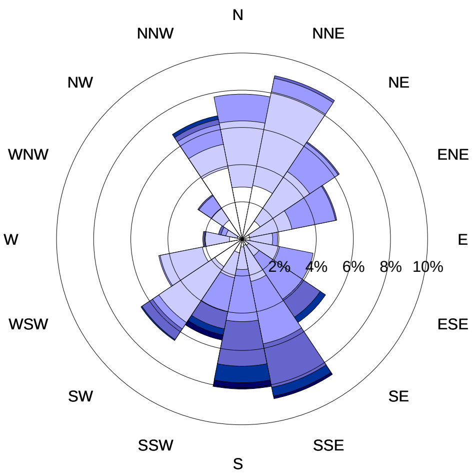
Summer
Calms = 7.0%



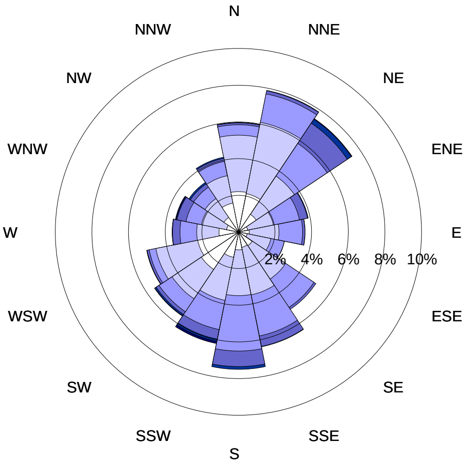
Autumn
Calms = 10.8%



Winter
Calms = 13.9%

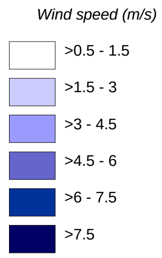


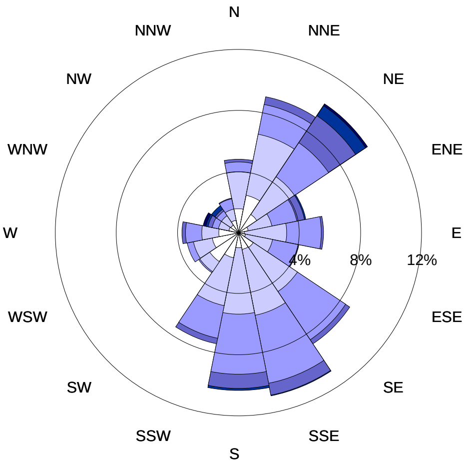
Spring
Calms = 14.1%



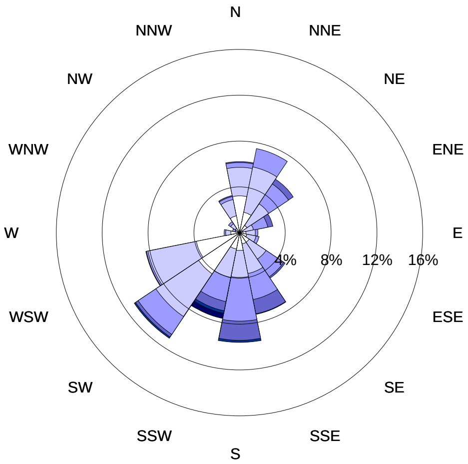
Annual
Calms = 18.2%

Annual and seasonal wind roses prepared from data Munmorah Power Station meteorological station during 2005

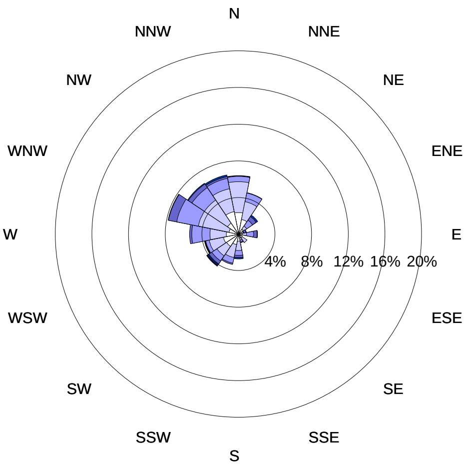




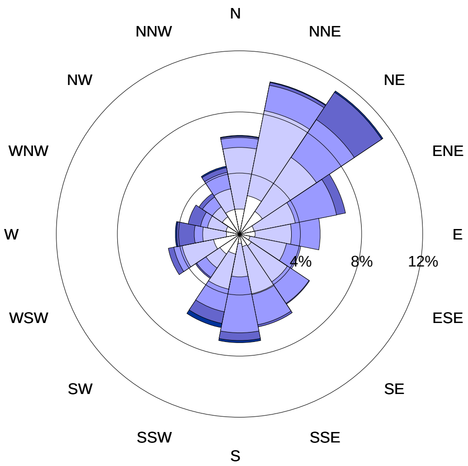
Summer
Calms = 7.2%



Autumn
Calms = 18.8%



Winter
Calms = 40.5%



Spring
Calms = 7.1%