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Annual Technical Report: 2004

(1 January 2004 to 31 December 2004)

Prepared for

RBCAA

AQ002

28 February 2005

RICHARDS BAY
CLEAN AIR ASSOCIATION
An Association Incorporated under Section 21

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EXECUTIVE SUMMARY

This is Ecoserv's annual technical report to the Richards Bay Clean Air Association (RBCAA) for the year 2004.

Compliance

A summary of the number of SO_2 guideline exceedances is listed below. There were 37 measured exceedances of the 10-minute average SO_2 guideline (191 ppb) at the monitoring stations, and three exceedances of the 24-hour average guideline (48 ppb) during the reporting period. Of the 18 10-minute exceedances recorded at Arboretum Ext., 16 were associated with an undetermined localised source not in the industrial emission inventory. These exceedances were associated with poor dispersion conditions and were confined to the winter months of June and July.

Station	10-minute average (>191 ppb)	24-hour average (> 48 ppb)
Arboretum	2	0
Arboretum Extension	18	0
Brackenham	1	0
Civic Centre	10	1
John Ross/Foskor intersection	6	2
TOTAL	**37**	**3**

Concentration ranges

Annual average SO_2 concentrations at the monitoring stations were as follows:

Station	Concentration	SO_2 data availability
Arboretum	4.6 ppb	84.2 %
Arboretum Extension	2.7 ppb	95.0 %
Brackenham	4.0 ppb	96.8 %
Civic Centre	6.8 ppb	96.0 %
John Ross/Foskor intersection	10.6 ppb	85.0 %

The annual average measured SO_2 at the monitoring stations is in a similar range to previous years, for those stations where comparable data exists. The annual average DEAT guideline for SO_2 is 19 ppb.

Annual average PM_{10} is provided below

Station	Concentration	PM_{10} data availability
Civic Centre	25 µg/m^3	72.1 %
Yacht Club	24 µg/m^3	22.4 %

Operations

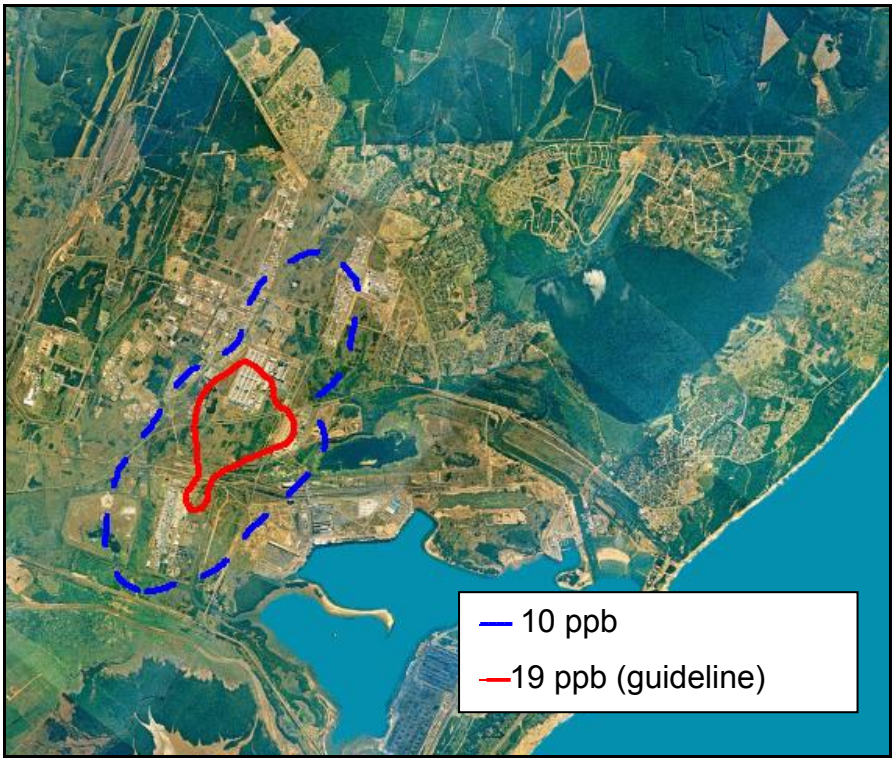
SO_2 data capture was above target (80%) for all five monitoring stations during the reporting period. PM_{10} data capture at the Civic Centre (Caravan) station was initialized during April and at the Yacht Club during July.

Modelled SO_2 distribution

The Hawk Dispersion model was used to determine estimated concentrations of SO_2 over the Richards Bay area. The model makes use of available meteorological data, an emission inventory and topographical data to predict the possible ground-level SO_2 concentrations caused by defined sources at given points.

The report details modelled data for the period 01 January 2004 to 31 December 2004 and results are presented in Figure A. This shows that distribution is skewed along the major wind vectors, with the highest concentrations located in the central industrial area. The only model predicted annual SO_2 exceedances (>19 ppb) that are evident are over the Hillside Aluminium, Foskor, and Bayside Aluminium plants itself, and the area between these plants.

Figure A: Hawk model average concentration dose map for the period 01 January 2004 to 31 December 2004.

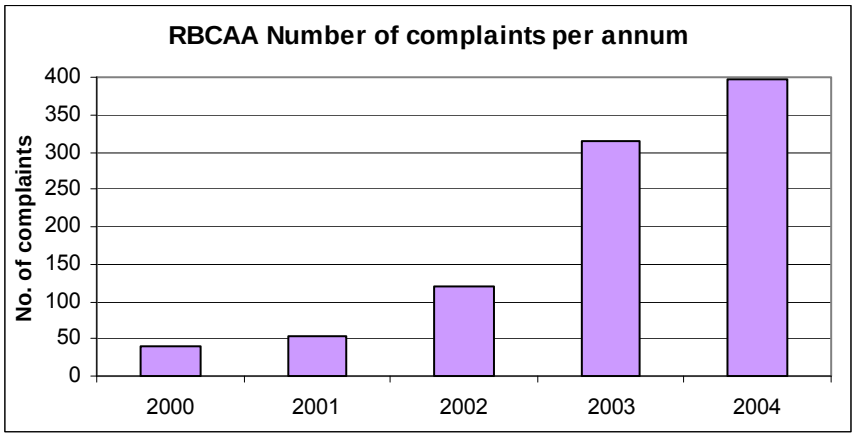


It is suggested that areas falling within the blue isopleth (half-guideline value) should be regarded as areas in which no further industrial development should take place for SO_2 emitting industries.

Complaints

A total of 397 air quality complaints were received during the reporting period, representing a continued increase since 2000. The majority of complaints were received from the residential areas of Veldenvlei, Arboretum and Arboretum Extension and the Richards Bay Central Business District. Most of the complaints were odour related.

Figure B: Air quality complaints logged by the RBCAA since 2000.



REPORT DETAILS

REFERENCE	**AQ002**
REPORT TITLE	**Annual report: 2004**
DATE SUBMITTED	12 August 2010
CLIENT	**Richards Bay Clean Air Association** **John Selby (Chairman)** **P O Box 21229, Richards Bay, 3900** **(035) 786 0076**
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STATUS	**Final**
NOTICE	**This report has been prepared by ECOSERV (Pty) Ltd with all reasonable skill, care and diligence within the terms of the contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.** **We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.** **This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to which this report or any part thereof is made known. Any such party relies upon the report at their own risk.**

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Acronyms

CBD	Central Business District
DEAT	Department of Environment Affairs and Tourism
EPA	See US EPA
FTC	Fume treatment centre (normally associated with the baking process)
GTC	Gas treatment centre (normally associated with potroom gas emission treatment)
HFO	Heavy fuel oil
ISO	International Standards Organisation
O_3	Ozone
PM_{10}	Particulate matter of aerodynamic diameter less than 10um
PMT	Photo-multiplier tube (analyser)
ppb	Parts per billion
ppm	Parts per million
RBCAA	Richards Bay Clean Air Association
SABS	South African Bureau of Standards
SANAS	South African National Accreditation Service
SANS	South African National Standards
SO_2	Sulphur dioxide
US EPA	United States Environmental Protection Agency
UV	Ultra-violet (light)
VOCs	Volatile Organic Compounds
WHO	World Health Organisation

1 INTRODUCTION

This, the 8th annual technical report by Ecoserv for the Richards Bay Clean Air Association (RBCAA), summarises the sulphur dioxide (SO_2), particulate matter (PM_{10}) and meteorological monitoring data collected by the monitoring network for the period January to December 2004. The monitoring network consists of five monitoring stations designated Brackenham, Arboretum, Arboretum Extension, the Scorpio substation (corner of John Ross Highway and Foskor/West Central Arterial) and a mobile caravan situated near the Civic Centre. The monitoring system as maintained by Ecoserv is accredited by the South African National Accreditation Service (SANAS) for the measurement of SO_2. The applicable quality controls and measurement methods are listed in Appendix 1. The measured results pertain to instantaneous samples drawn from air passing the above fixed stations, and care should be taken when extrapolating these results to surrounding areas. Opinions, interpretations and Hawk model findings presented in this report do not form part of the SANAS accreditation.

Since July 2003 Ecoserv's contract with the RBCAA was amended to include increased modelling using the Hawk air pollution dispersion model. The Hawk model concentrations are based on ambient meteorological conditions and an emission inventory. The monthly reporting format was changed as a result and the annual report format has also been updated to reflect these changes. This report includes details on annual average SO_2 concentrations, as well as monthly and daily average trends at all monitoring stations. Measured annual average SO_2 concentrations are compared to concentrations predicted by the Hawk air pollution dispersion model. Basic statistical analyses of measured SO_2 concentrations are also presented and discussed and a summary of the relevant meteorological data are included in Appendix 2. Air quality complaints lodged with the RBCAA are also discussed.

The monitoring network was expanded during 2004 to include the measurement of particulate matter (PM_{10}) at the caravan station (near the Civic Centre) and at the Yacht Club. PM_{10} at the caravan is measured continuously by means of a TEOM monitor, and the data was validated from April 2004. PM_{10} at the Yacht Club is measured using

a minivol instrument, which is of coarser resolution and provides daily averaged data, validated from July onwards.

It is also the intention of this report to highlight certain incidents and exceedances of the National Guidelines for SO_2. The National Department of Environment and Tourism (DEAT) guidelines for SO_2 (Government Notice No. 1387 of Government Gazette 22491, 21 February 2001) and PM_{10} are listed in Table 1.

Table 1: DEAT South African National guidelines.

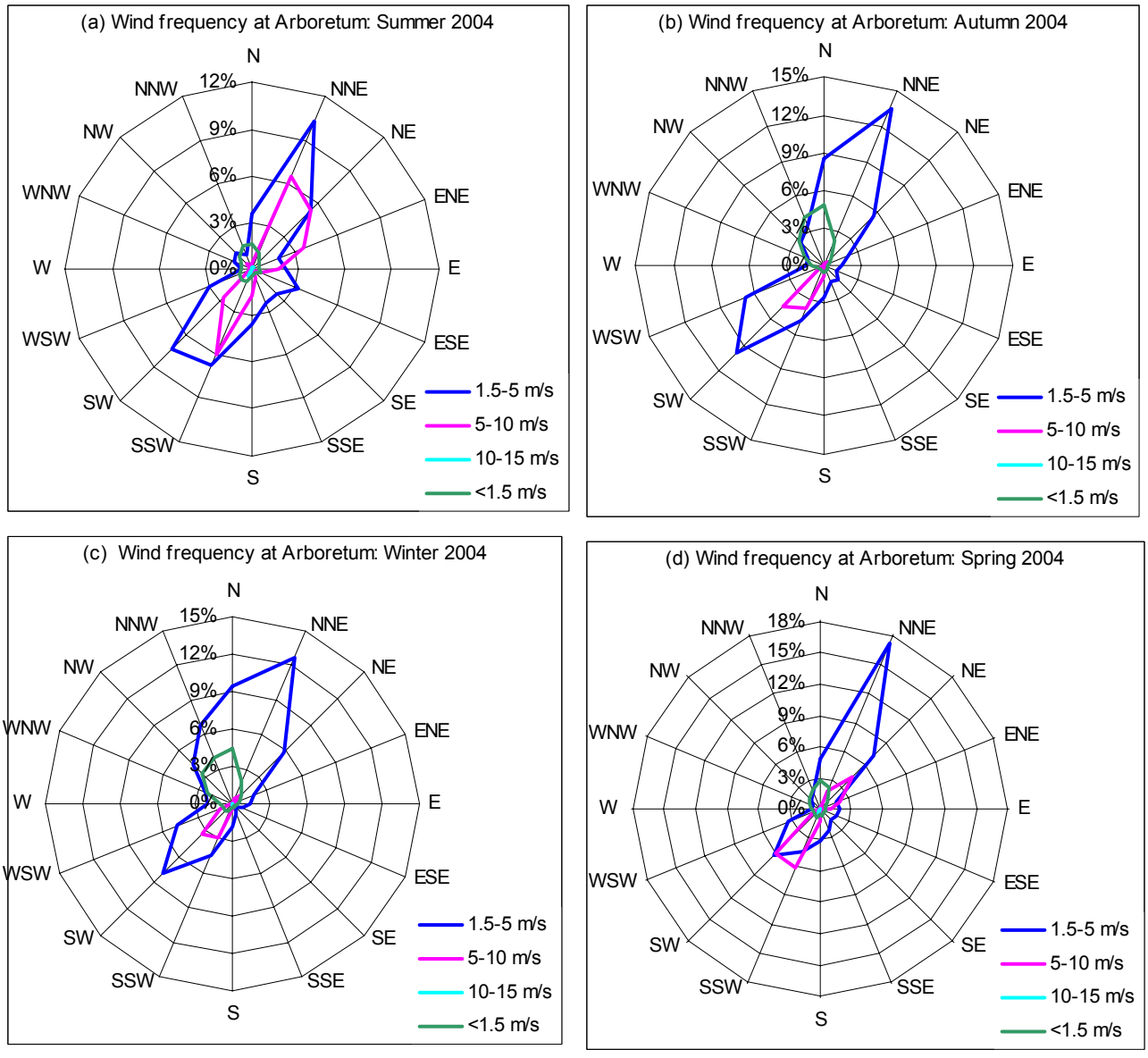
Pollutant	10-minute average	24-hour average	Annual average
Sulphur dioxide (SO_2)	191 ppb	48 ppb	19 ppb
Particulate Matter (PM_{10}) 1965	N/A	180 µg/m^3	70 µg/m^3
Particulate Matter (PM_{10}) Oct 2004	N/A	75 µg/m^3	40 µg/m^3

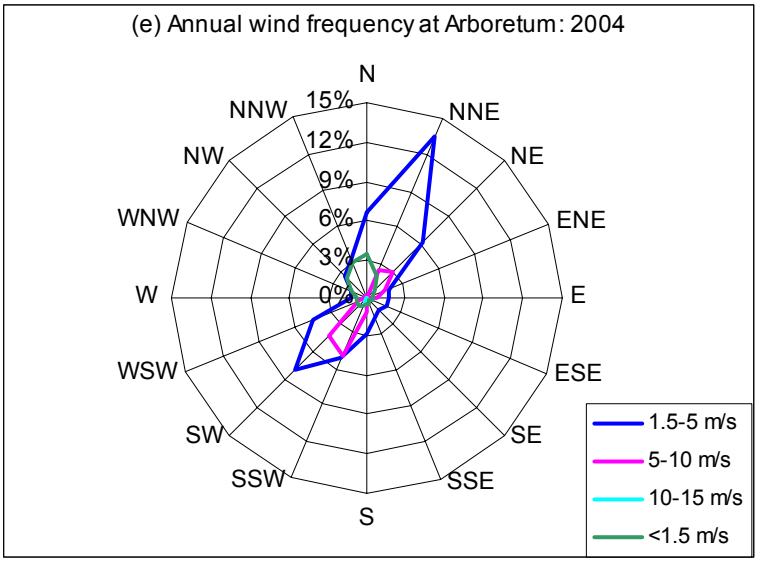
Note that the new guideline for PM_{10} published by SANS is only applicable from October onwards. In the draft standards an hourly average limit of 133 ppb has been set for SO_2 for cases where no shorter-term data are available.

2 PREVAILING WIND CONDITIONS

The wind frequency rose, based on 5-minute averages, for the seasons and year 2004 at Arboretum is shown in Figures 1(a) to (e) below.

Figure 1(a) to (e) : Seasonal and annual wind roses for 2004.





The annual wind rose (Fig. 1 (a)) shows winds were largely consistent with previous years and blew mainly from the north to north-east and WSW to SSW, with the NNE and SSW vectors predominating. Northerly to north-easterly winds are generally associated with fair weather, while southerly to WSW winds are usually associated with the passage of coastal lows and cold fronts. There were very few episodes greater than 10 m/s and these winds were mainly from the SSW, associated with the arrival of coastal lows. Light winds of less than 1.5 m/s blew mainly from the north to north-west and were largely in the form of land breezes at night and early morning, particularly during the cooler and more stable autumn and winter months. Note the increase in light winds < 1.5 m/s from the north to north-west during autumn (Fig. 1(b)) and winter (Fig. 1(c)). There was a seasonal increase in NNE to north-east winds during spring and a higher proportion of 5-10 m/s winds during spring and summer. Meteorological data for the year 2004 is presented in Appendix 2.

3 SO_2 MONITORING AND MODELLED RESULTS

The trends of SO_2 at the RBCAA monitoring stations are presented in this section, along with predictions by the Hawk dispersion model. Data capture rates are discussed in Chapter 5.3 and Appendix 3, data quality control check procedures are provided in Appendix 4, periods for which data are missing are detailed in Appendix 5, and corrections applied to the raw data are given in Appendix 6.

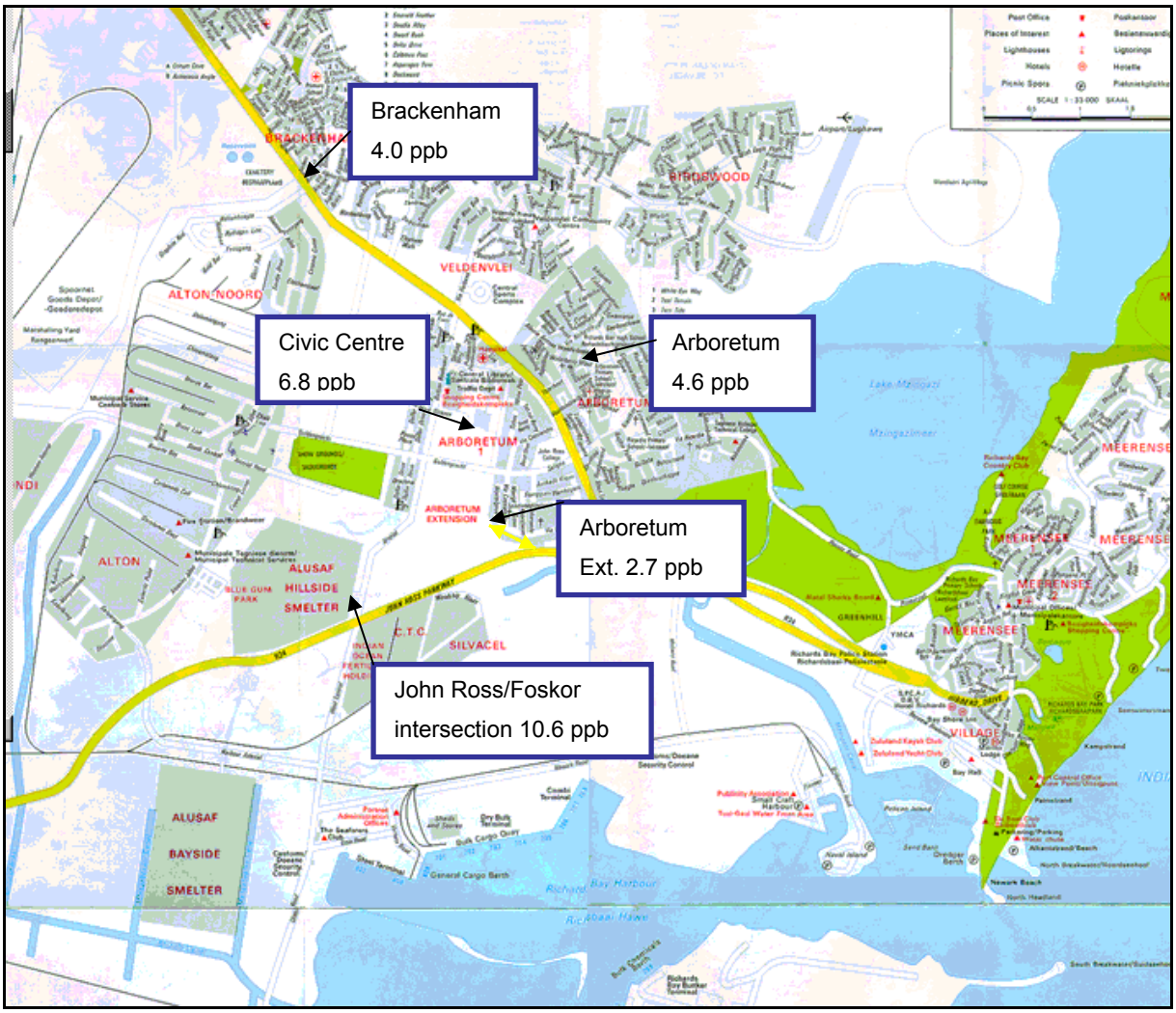
SO_2 concentrations measured at the fixed monitoring stations and SO_2 concentrations predicted by the Hawk dispersion model are compared. The Hawk dispersion model uses meteorological and topographical data, and an emission inventory to simulate the prevailing conditions in order to estimate the concentration of SO_2 at any given point within the area of interest. This requires the use of certain assumptions resulting in a variation between the modelled and measured SO_2 concentrations presented.

3.1 Annual average SO_2

3.1.1 Measured SO_2 concentrations

The annual average SO_2 concentrations for 2004 at all the stations are displayed in Figure 2. The Caravan station is at the Civic Centre and Scorpio station is at the intersection of the John Ross Highway and Foskor/West Central Arterial. The highest annual average SO_2 concentration was measured at the John Ross/Foskor intersection, which is located closest to major industry (Foskor, Hillside Aluminium, and Bayside Aluminium). The John Ross/Foskor intersection annual average SO_2 was 56% of the DEAT guideline.

Figure 2: Annual average SO_2 at RBCAA monitoring stations during 2004 (DEAT guideline = 19 ppb).



3.1.2 Consolidated Monitoring Data

Table 2 lists the 2004 averages along with those of 1997 to 2003 for comparison. The available averages for PM_{10} (particulate matter < 10 microns) and ozone are also provided. Note the monitoring system is not accredited by SANAS for the measurement of these variables, thus these are provided for interest only. Data are also provided for historic stations, which were later relocated.

Table 2: Comparison of RBCAA annual averages (all concentrations in ppb, apart from PM_{10}, which is in $\mu g/m^3$).

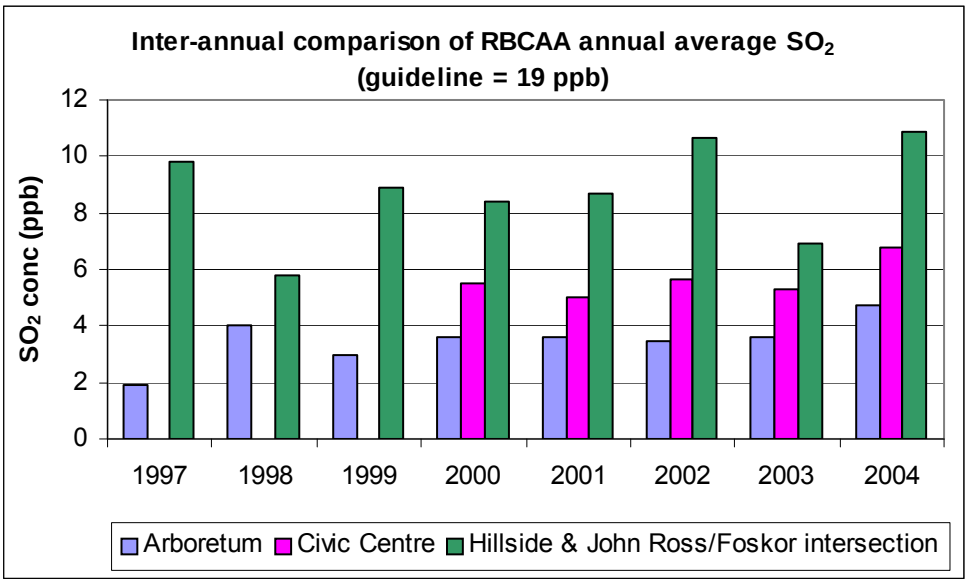
Station Name	1997	1998	1999	2000	2001	2002	2003	2004
Arboretum SO_2	1.9	4.0	3.0	3.5	3.7	3.5	3.6	**4.6**
*Arboretum Ext. SO_2						4.3	2.6	**2.7**
*Civic Centre (Caravan) SO_2					5.0	5.7	5.3	**6.8**
*Hillside SO_2	9.8	5.8	8.9	8.9	8.7			
*John Ross/Foskor intersection (Scorpio) SO_2							6.9	**10.6**
*Brackenham SO_2							3.1	**4.0**
*Wildenweide SO_2	2.4	2.2	3.7	2.9	2.9			
*Veldenvlei SO_2					2.9			
*Veldenvlei/ Brackenham O_3					18.2	14.9		
*Esikhawini SO_2	<0.5	1.6	2.1					
*Esikhawini O_3		17.0						
*Umhlatuze SO_2	4.2	2.8	2.4					
*Hillside PM_{10}		30	40					
*Caravan PM_{10}								25

*** Where no data are presented in the table, the station was not located at that site during the given period or station relocation had occurred and data capture was below quality assurance. Only five SO_2 monitoring stations were ever operated within the operational area at one time.**

The annual average SO_2 at all stations during 2004 was overall slightly higher than previous years, with the most significant increase at the John Ross/Foskor intersection station. Annual average SO_2 at the Civic Centre, Arboretum and Brackenham was approximately 1 ppb higher than the previous year, while there was no significant increase at Arboretum Ext.

A comparison of long-term annual average SO_2 for those stations where long-term monitoring data exists is shown in Figure 3. The Hillside station is included for comparison as it was relatively close to the present station at the John Ross/Foskor intersection and is an indicator of pollution levels in that vicinity.

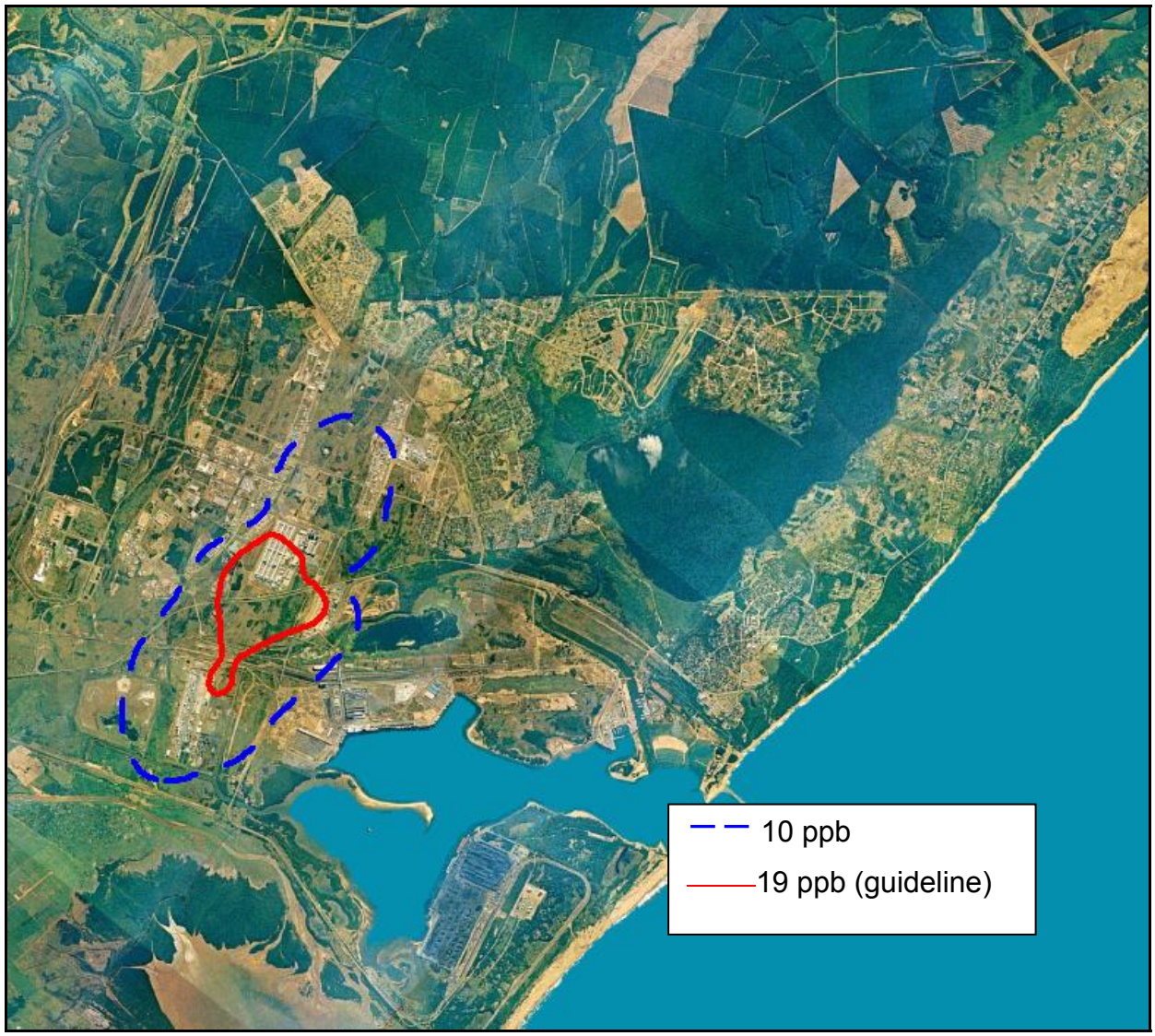
Figure 3: Comparison of long-term annual average SO_2



3.1.3 Modelled annual average SO_2 concentrations

The dose maps presented in this report represent the cumulative concentrations predicted at pre-defined receptor grid points by means of concentration isopleths, averaged over the required time period, based on measured meteorological data and an emission inventory. This is represented as isopleths (lines of equal concentration) overlaid on an aerial photograph of the Richards Bay region (Fig 4). The area within a respective isopleth indicates that the area was exposed to SO_2 concentrations greater than the respective isopleth concentration. The predicted concentrations are those estimated using the Hawk dispersion model and may vary from actual concentrations.

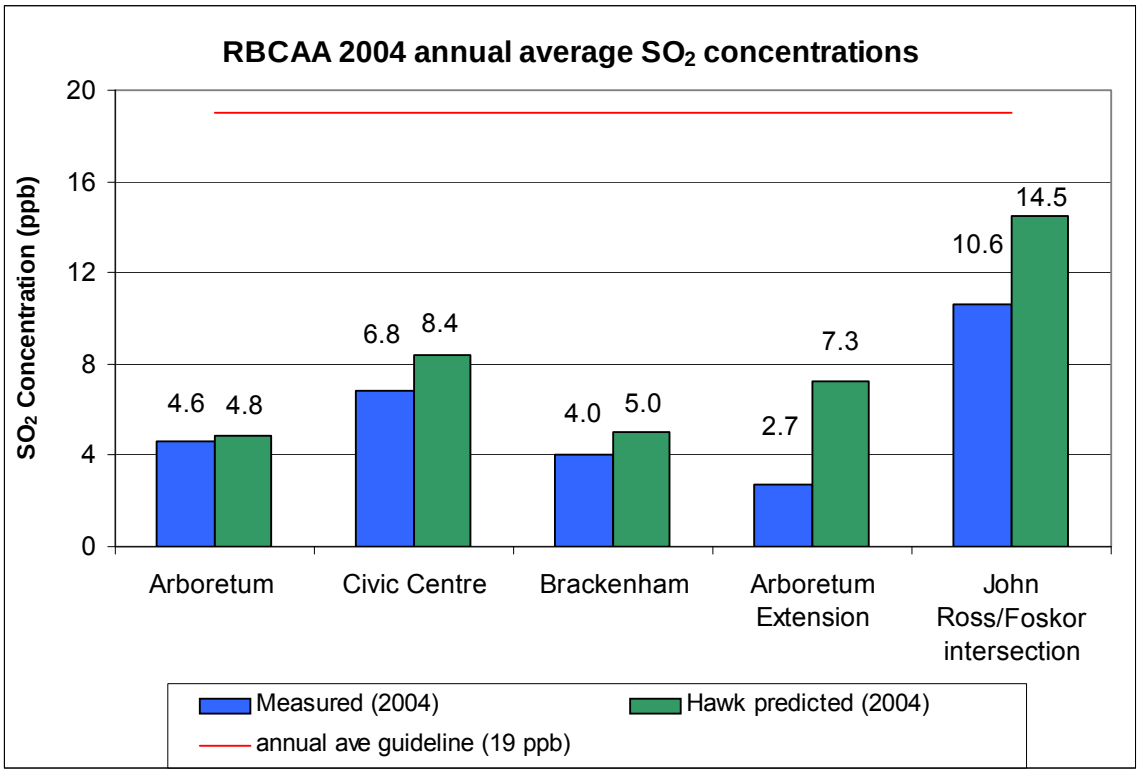
Figure 4: Hawk model average concentration dose map for the period 01 January 2004 to 31 December 2004



The dose map shows SO_2 concentrations as distributed over the Richards Bay area. The red isopleth indicates the annual average guideline (—19 ppb) for the averaging period 01 January 2004 to 31 December 2004. The model predicted that the industrial area covering Hillside Aluminium, Foskor, Bayside Aluminium, and part of the Industrial Development Zone would have experienced annual average SO_2 concentrations in excess of the guideline. It is suggested that areas falling within the blue isopleth (half-guideline value) should be regarded as areas in which no further industrial development should take place for SO_2 emitting industries.

The average SO_2 measured at each of the monitoring stations during 2004 and the Hawk predicted average for the period is shown in Figure 5.

Figure 5: Hawk modelled average SO_2 at RBCAA monitoring stations for the averaging period January to December 2004 and comparison with measured SO_2 (DEAT guideline = 19 ppb).

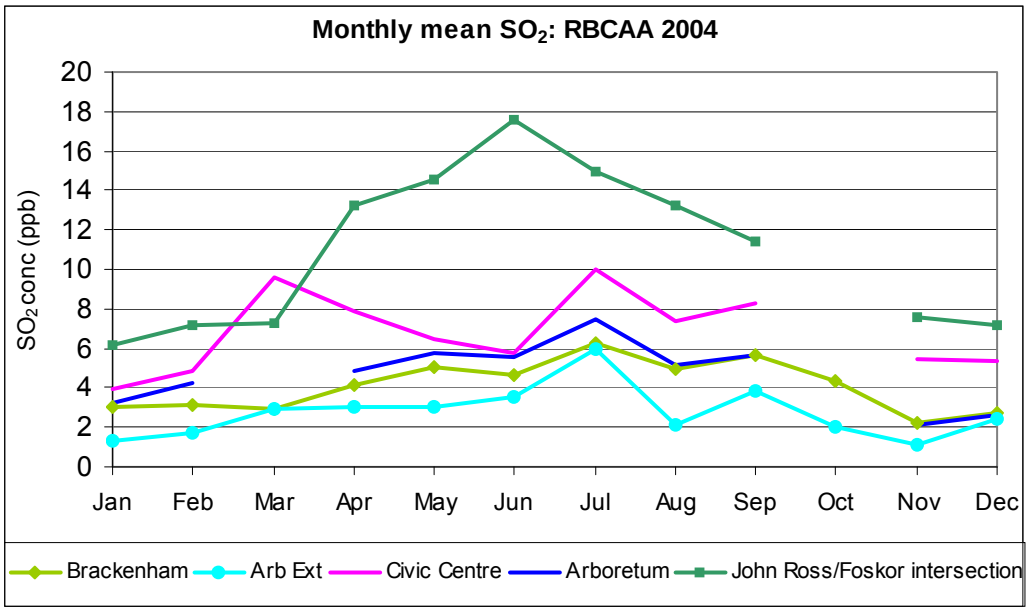


There was fairly good agreement between the Hawk model predicted SO_2 concentrations and those measured at the monitoring stations, with the exception of Arboretum Extension. The Arboretum Extension analyser is currently being checked to ensure the accuracy of this SO_2 analyser. The Hawk model has been refined and certain checks have been performed on the emission inventory to improve model predictions.

3.2 Monthly Monitoring Information

The monthly average SO_2 measured at each of the monitoring stations is provided in Figure 6. Monthly data are provided to view the trend in SO_2 over the annual period. There is no monthly average guideline for the measurement of SO_2. The highest monthly average SO_2 (18 ppb) was measured at the John Ross/Foskor intersection station during June, mainly related to poor dispersion conditions and the station's location relative to the Hillside, Bayside Aluminium and Foskor plants. All the other stations measured maximum monthly average SO_2 during July related to both an increased frequency of south-westerly winds associated with the passage of cold fronts, interspersed with increased air stability and therefore an increased frequency of poor dispersion episodes during winter. These stations measured increased SO_2 concentrations during winds from the south-west sector as the stations are located generally north-east of the major sources of Foskor and Hillside and Bayside Aluminium.

Figure 6: Monthly mean SO_2 measured at the five RBCAA stations during 2004.



3.3 Daily Monitoring Information

3.3.1 Measured daily average SO_2 trends

Trends in daily average SO_2 at each of the RBCAA monitoring stations are provided in Figures 7 to 11. The guideline (48 ppb) is indicated on each graph. Note the variation in Y-axis scale for Scorpio. A brief explanation of the trends is provided.

Figure 7: Daily average SO_2 concentration measured at Arboretum.

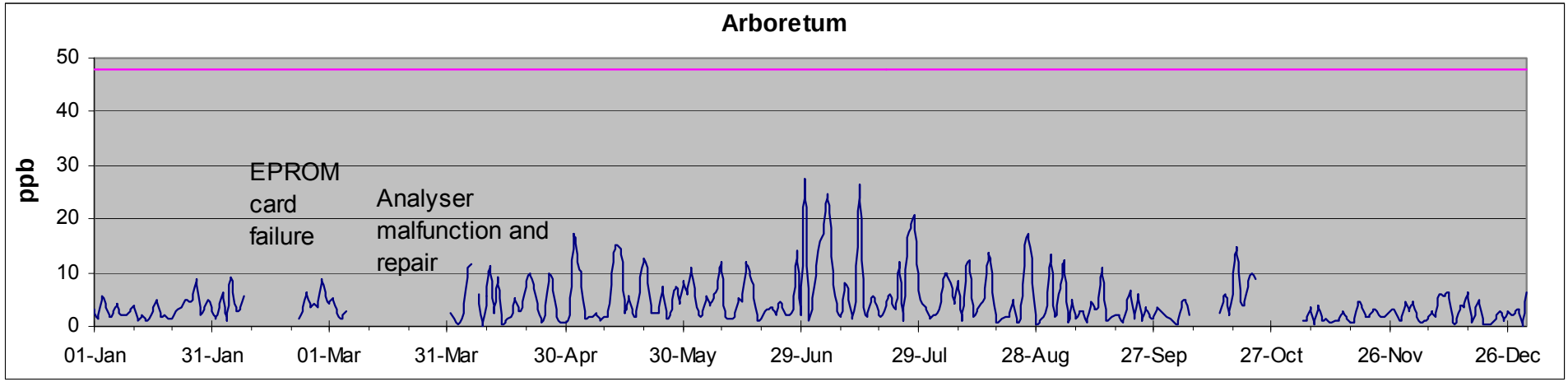
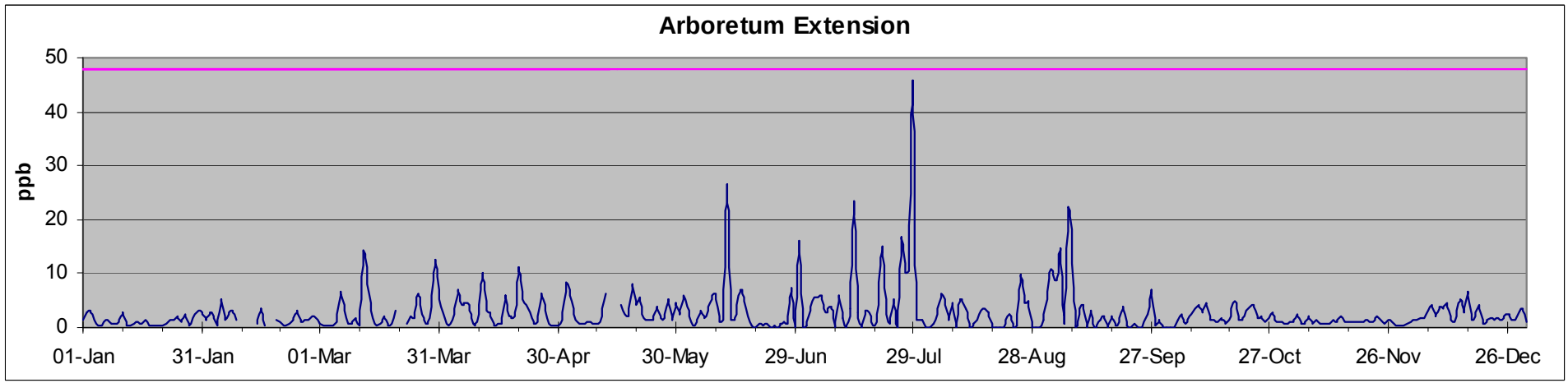
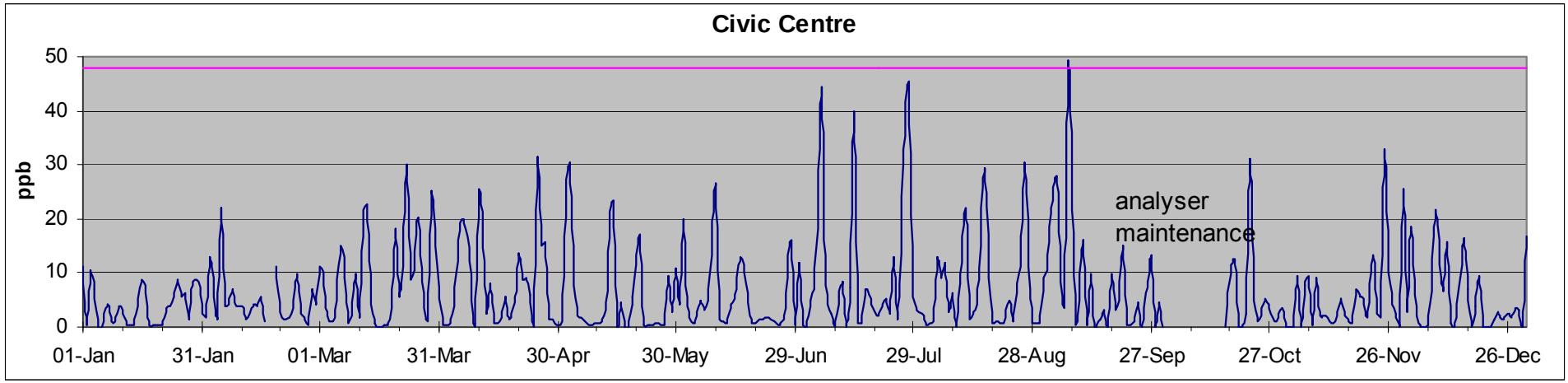


Figure 8: Daily average SO_2 concentration measured at Arboretum Extension.



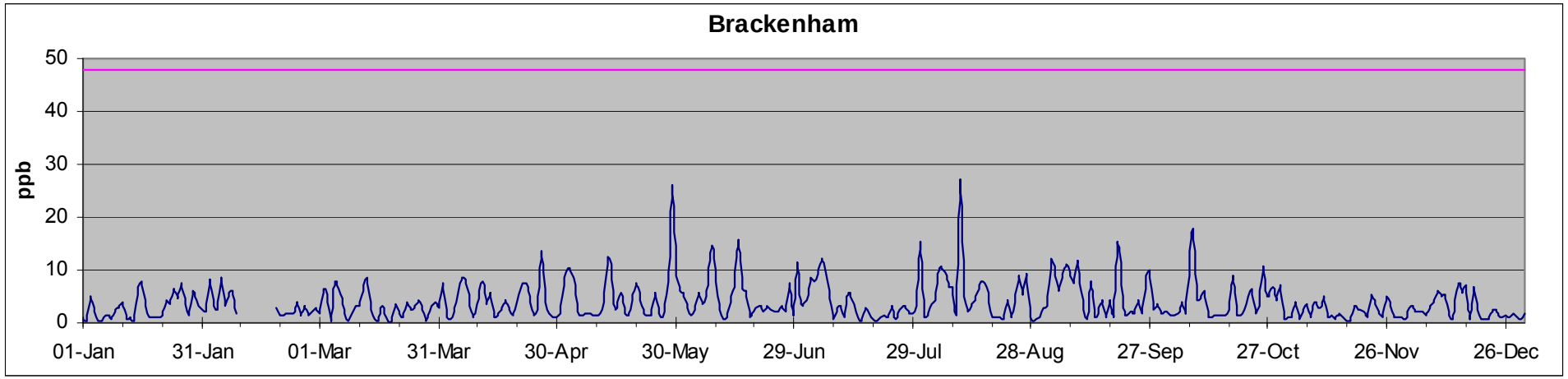
The elevated daily average SO_2 at Arboretum Ext. (Fig. 8) on 12 June and 29 July were associated with the unknown local source, which contributed to a number of 10-minute average exceedances (Appendix 7). These peaks were not evident at the other measurement stations. Elevated SO_2 concentrations at Arboretum and Arboretum Ext. were generally recorded during moderate to fresh south-westerly to west-south-west winds. Peaks in SO_2 associated with this wind field generally originate from Hillside Aluminium or Foskor, although Bayside Aluminium may also contribute to a lesser extent. Elevated SO_2 was also recorded during westerly winds on occasions. In this case the most likely source is Mondi Richards Bay.

Figure 9: Daily average SO_2 concentration measured at the Civic Centre (Caravan).



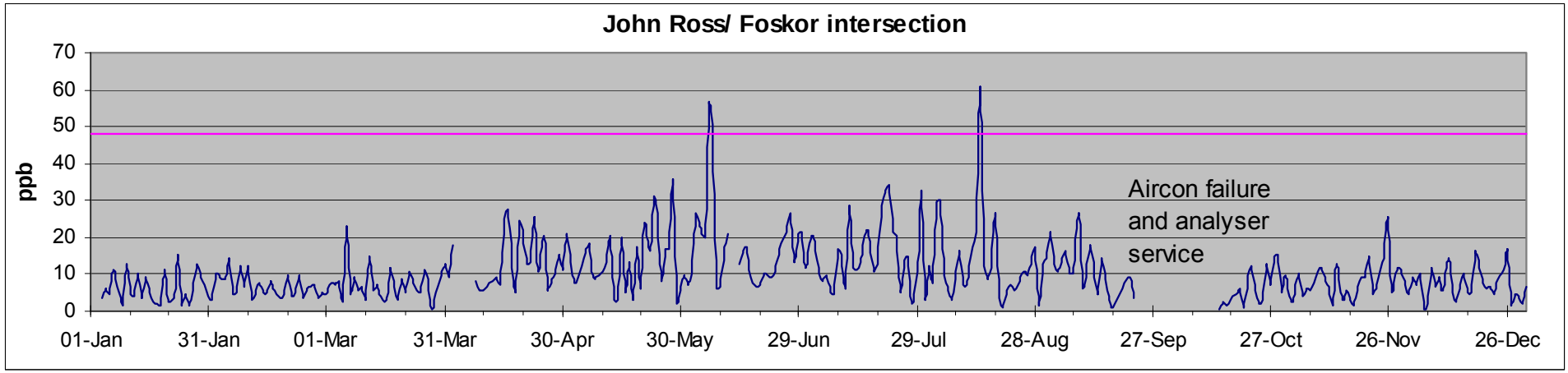
The Civic Centre station measures elevated SO_2 concentrations during moderate to fresh winds from the SSW to WSW sector, which corresponds to the direction of major industry relative to the measurement station. The maximum daily average SO_2 at the Civic Centre on 6 September exceeded the DEAT guideline (refer Appendix 7). The south-westerly to west-south-west (WSW) winds indicated Hillside Aluminium as the most likely source. The guideline was also closely approached on the 6th, 14th and 28th July, associated with fresh south-westerly winds. Peaks in daily average SO_2 were also measured at Arboretum on these days (refer Fig. 7) and at Arboretum Ext. (Fig. 8) on 14 July.

Figure 10: Daily average SO_2 concentration measured at Brackenham.



Brackenham tended to measure higher daily average SO_2 during southerly to SSW winds, which corresponds mainly to the vectors from Hillside Aluminium and Foskor. The peaks on 29 May and 10 August were associated with fresh to strong SSW to south-west winds.

Figure 11: Daily average SO_2 concentration measured at Scorpio substation (cnr John Ross and West Central Arterial).



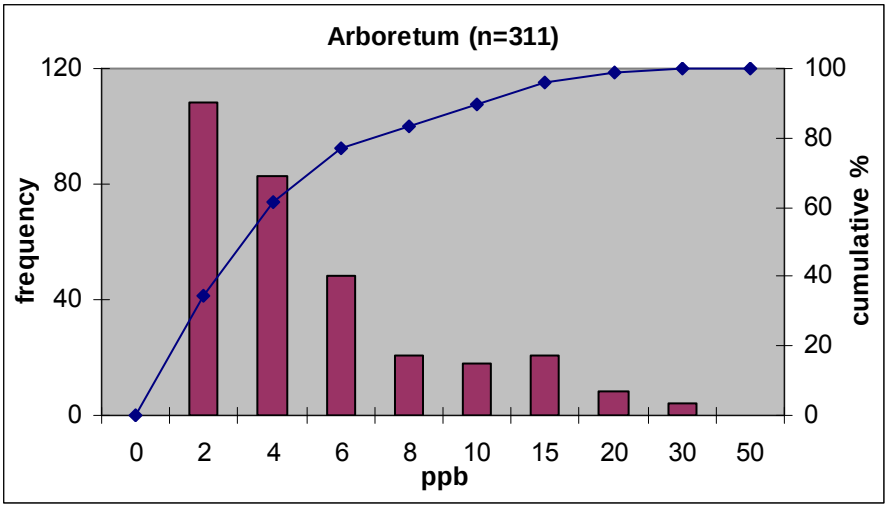
Note the variation in Y-axis scale to the previous trends reflected in Figs 7 to 10. Elevated daily average SO_2 at the John Ross/Foskor intersection (Scorpio) (Fig. 11) was mainly associated with moderate north-north-easterly winds, which corresponds to the vector from the Hillside Aluminium FTC, and with light north-westerly land breezes, the main source of which is the Hillside Aluminium GTC4. Short-term peaks are possible during wind switches through south-east, the source of which is Foskor, however owing to the short duration of winds from this direction; there is little influence in concentrations over the 24-hour average period. The daily average exceedance on 6 June (Appendix 7) was associated with poor dispersion conditions and light to moderate winds, varying from north-west to north-east and the exceedance on 14 August was associated with light to moderate winds from the north to north-east.

3.3.2 Frequency distribution of daily average SO_2

A frequency analysis of environmental data is customarily performed in order to classify the air pollution for a region. It is also useful when working with large data sets. A frequency distribution of the data reveals the predominant SO_2 concentrations (as categories) over a period of time. The frequency distribution (histogram graph) and cumulative percent (line graph) of daily mean SO_2 data for each station is given in Figures 12 to 16. Note the variation in sample sizes, depending on the data capture for each station and note the variation in Y1-axis scale. The X-axis scale indicates the upper SO_2 concentration, i.e. 2 ppb refers to the range of concentrations > 0 ppb and <= 2 ppb. The cumulative percentage curve shows the cumulative percent of data (indicated on the Y2 axis) below each concentration class, e.g. at Arboretum 61% of daily averages were less than 4 ppb. A steep curve indicates a predominance of daily averages of low concentrations (i.e. air quality is very good), while a gentler curve indicates a more even frequency distribution of concentrations and poorer air quality.

The mode (most frequently occurring category) was the 0-2 ppb class (denoted as 2 ppb on the graphs) at all stations apart from at the John Ross/Foskor intersection station.

Figure 12: Frequency distribution of daily mean SO_2 at Arboretum for 2004.



The Arboretum, distribution (Fig. 12) showed a smooth logarithmic curve, with a high proportion of daily averages of low concentration and progressively fewer high concentration events.

Figure 13: Frequency distribution of daily mean SO_2 at Arboretum Ext. for 2004.

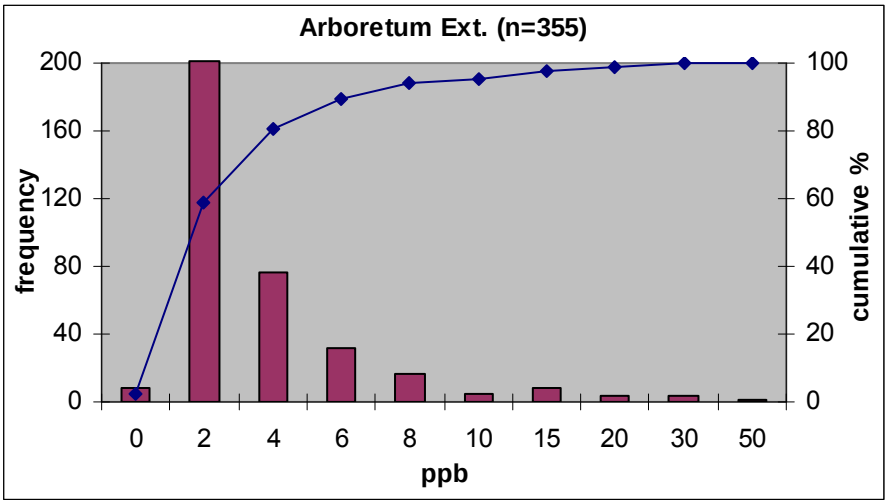
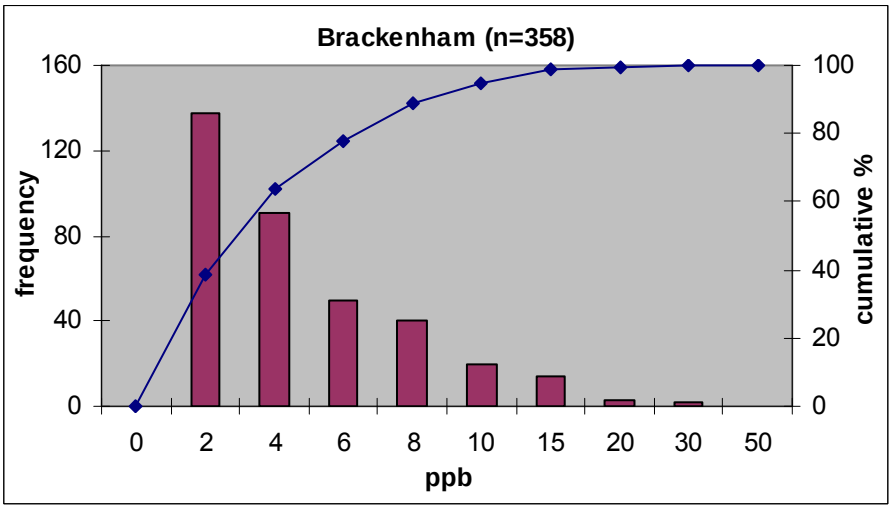
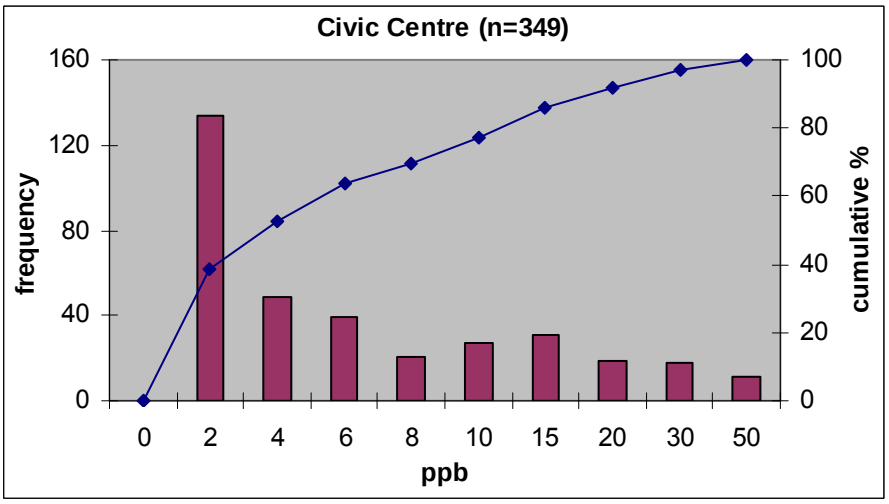


Figure 14: Frequency distribution of daily mean SO_2 at Brackenham for 2004.



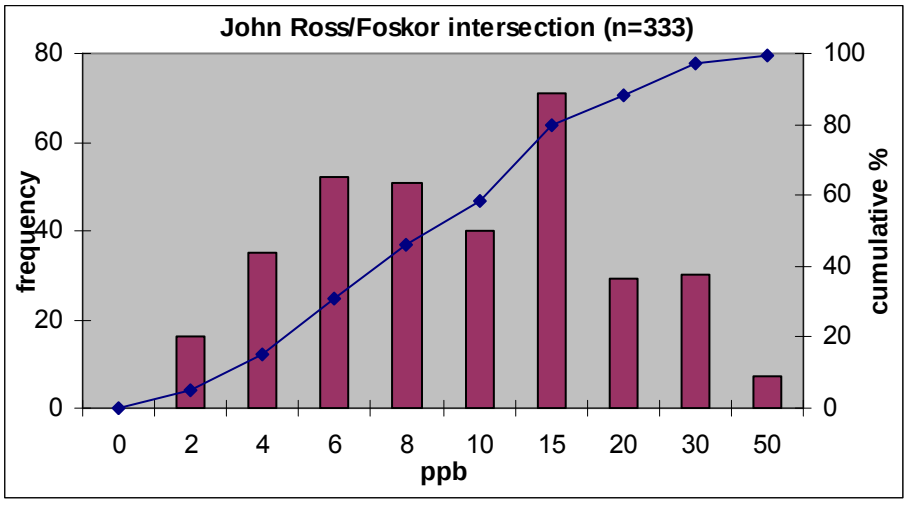
The cumulative percentage curves for Arboretum Ext. (Fig. 13) and Brackenham (Fig. 14) were steeper, particularly in the case of Arboretum Ext., indicating a higher proportion of daily averages within lower concentration classes, i.e. better air quality.

Figure 15: Frequency distribution of daily mean SO_2 at the Civic Centre for 2004.



While 38% of daily averages at the Civic Centre were less than 2 ppb, the cumulative percentage graph was gentler than at the afore-mentioned stations, indicating a tendency for a number of daily averages at higher concentration classes and poorer air quality.

Figure 16: Frequency distribution of daily mean SO_2 at John Ross/Foskor intersection for 2004.



The trend at John Ross/Foskor intersection (Fig. 16) differed somewhat to the other stations in that the most frequently occurring class was at 10 to 15 ppb, and a number of occurrences were within the 4 to 6 ppb and 6 to 8 ppb classes. Few occurrences fell within the lowest 0 to 2 ppb class, as with the other measurement stations. This indicates a tendency for higher daily average SO_2 at the John Ross/Foskor intersection station, i.e. poorer air quality. A "normal' distribution was evident in the John

Ross/Foskor intersection frequency histogram, compared to the positively skewed distribution (i.e. dominance of low concentration classes) at the other stations.

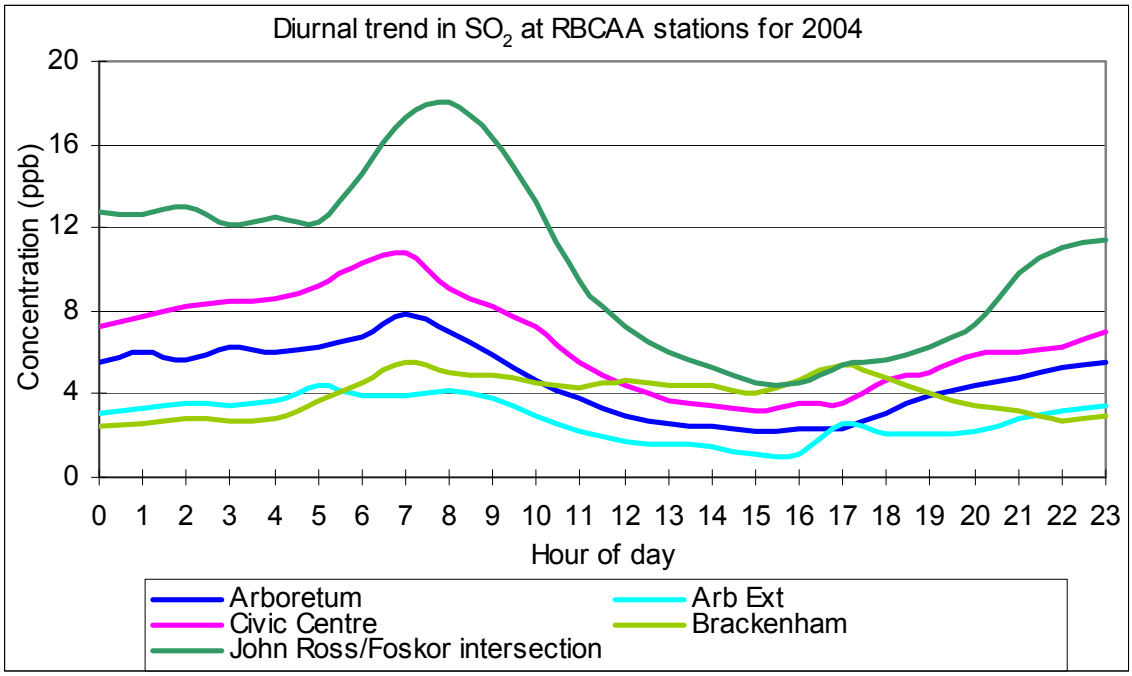
Percentiles show the spread of the data by giving an indication of the concentration below which the specified percentage of the data occurs, e.g. 95% of SO_2 daily averages at the Civic Centre were less than 24.9 ppb, and conversely, 5% of daily averages were above this concentration. 95^{th}, 75^{th} and 50^{th} percentiles of the daily mean data from all the monitoring stations are shown in Table 3. The 95^{th} percentile was highest at the Civic Centre and John Ross/Foskor intersection station; however the 75^{th} and 50^{th} percentiles were highest at the John Ross/Foskor intersection, indicating air quality was poorest at that station.

Table 3: Percentiles for the daily mean SO_2 at each station for 2004.

Percentile	SO_2 (ppb)				
	Arboretum	Arboretum Ext.	Civic Centre	Brackenham	John Ross/ Foskor intersection
95^{th}	13.9	9.0	24.9	10.2	25.8
75^{th}	5.9	3.2	9.3	5.5	13.4
50^{th}	3.0	1.5	3.6	2.7	8.9

3.4 Diurnal SO_2 trends

Figure 17: RBCAA diurnal hourly mean data for 2004.



Diurnal trends indicate variations with time of the day. The diurnal trend in SO_2 for each station for 2004 is shown in Figure 17. The X-axis represents the hour of day, i.e. 14 represents the hourly average from 14:00 to 14:59. All stations, apart from Brackenham, measured increased SO_2 concentrations during the morning, particularly between 07h00 and 08h00, and lower concentrations during the afternoon, when dispersion conditions were enhanced. The higher concentration measured at Brackenham during late afternoon is most likely related to diurnal winds during inclement weather events shifting from WSW to south-west in the morning, which corresponds to the vector from Mondi, to SSW and southerly in the afternoon, which then corresponds to the vectors from Foskor, Hillside and Bayside Aluminium. The diurnal trends were similar to the previous reporting periods for those stations that were comparable. The strongest diurnal trend was exhibited at the John Ross/Foskor intersection station where the higher evening to early morning concentrations coincide mainly with the land breeze circulation (north-westerly), which transports SO_2 mainly from the direction of Hillside, combined with the effects of poor dispersion conditions.

3.5 Maximum measured SO_2 concentrations

The maximum 24-hour average, hourly average and 10-minute average SO_2 concentrations (in ppb) measured during 2004 are shown in Table 4. The maximum for the 24-hour and 10-minute averaging periods is reflected as a percentage of the DEAT guidelines. Although there is no longer an applicable DEAT hourly average SO_2 guideline, the hourly average maxima are presented for interest and in order that comparisons can be made to the SANS recommended limit of 133 ppb for instances where no 10-minute average data are available. In addition the UK classification scheme regards hourly averages greater than 125 ppb as poor and in Canada an hourly average guideline of 130 ppb is applied. Figures 20 to 22 show the maximum SO_2 concentrations measured per month.

Table 4: Highest SO_2 concentrations (ppb) measured at each RBCAA station during 2004 and percent of DEAT National guideline and SANS recommended hourly average limit

STATION	DAILY AVERAGE (guideline=48ppb)		HOURLY AVERAGE (limit = 133 ppb)		10-MIN AVERAGE (guideline=191ppb)	
	SO_2 (ppb)	Date	SO_2 (ppb)	Date & time	SO_2 (ppb)	Date & time
Arboretum	26.6	04/06/30	100.2	04/07/14 04:00	287.4	04/07/14 04:35
% of guideline	55%		75.3%		150%	
Arboretum Ext.	45.8	04/07/29	439.5	04/07/29 17:00	959.3	04/07/29 17:40
% of guideline	95%		330.5%		502%	
Civic Centre	48.6	04/09/06	169	04/05/03 07:00	897.3	04/11/25 21:00
% of guideline	101%		127.1%		470%	
Brackenham	27.3	04/08/10	108.4	04/06/14 23:00	210.9	04/06/14 23:40
% of guideline	57%		81.5%		110%	
John Ross/ Foskor intersection	61	04/08/14	155.8	04/08/14 05:00	866.8	04/01/23 11:00
% of guideline	127%		100.2	04/07/14 04:00	454%	

Figure 18: Maximum 10-minute average SO_2 per month.

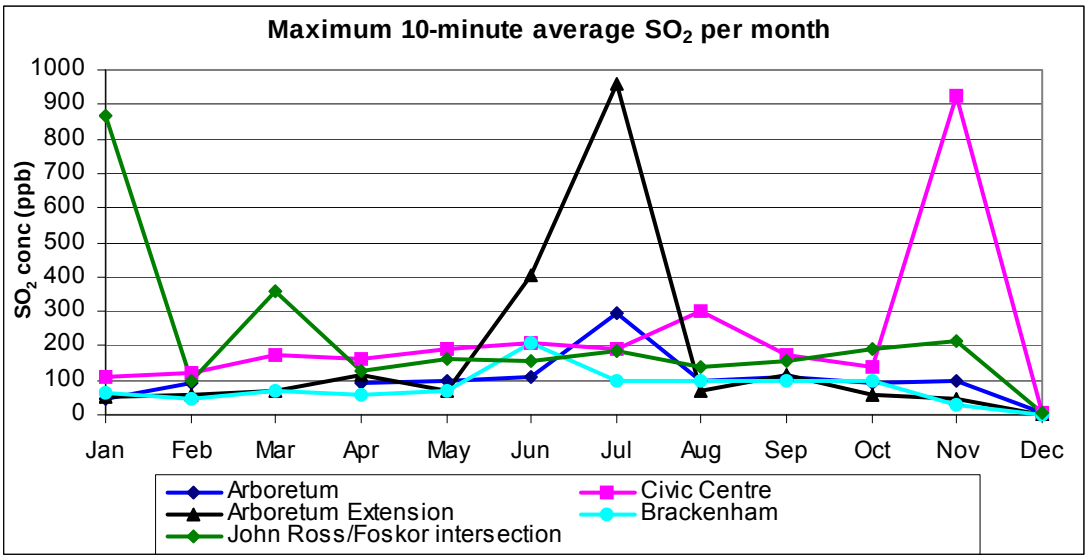


Figure 19: Maximum hourly average SO_2 per month.

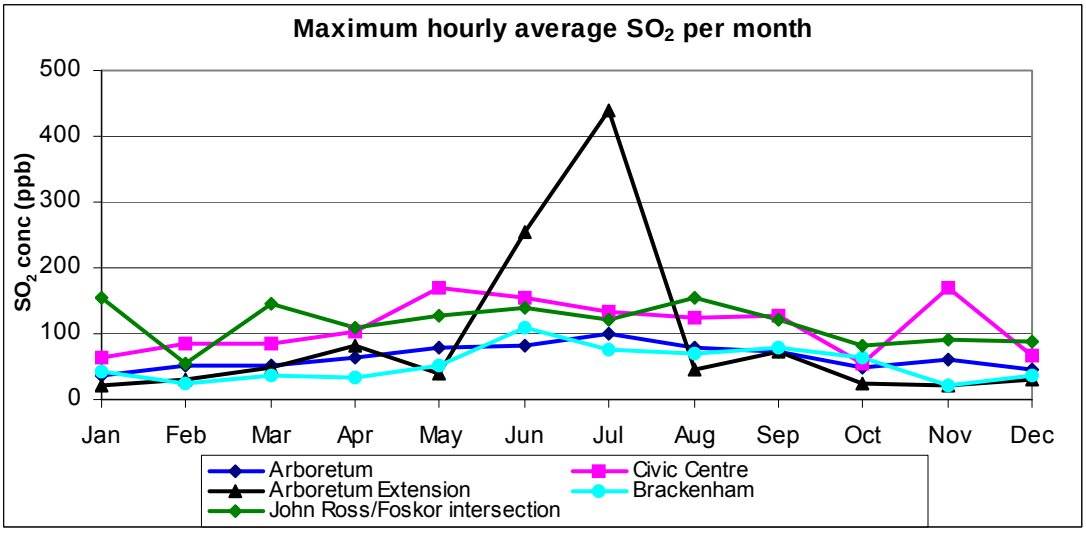
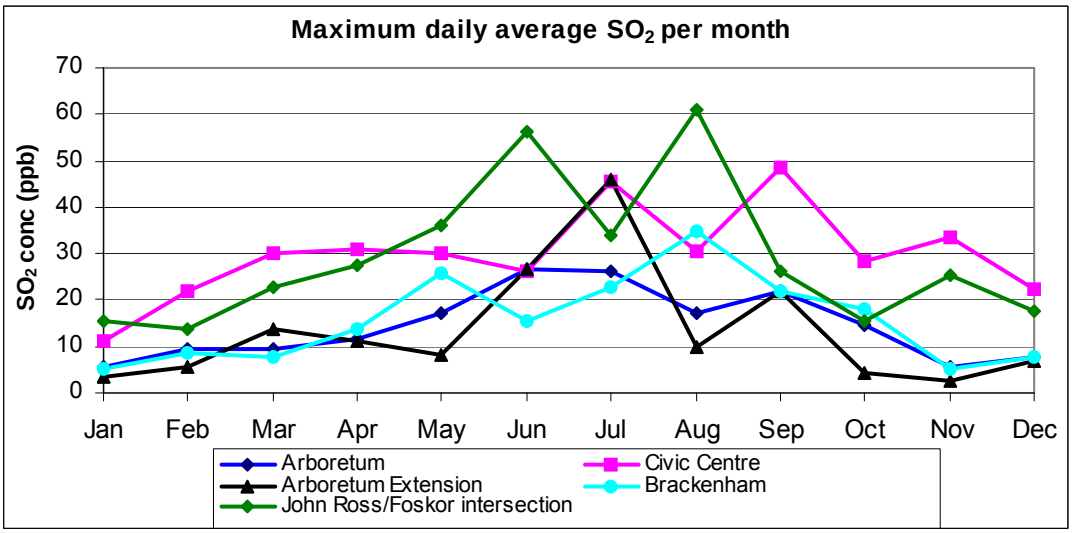


Figure 20: Maximum daily average SO_2 per month.



The maximum 10-minute averages exceeded the guideline at all stations. The exceedances are discussed in the following chapter and are listed in Appendix 7. Detailed descriptions of the maxima are available in the monthly reports. The maximum hourly averages display close relation to the periods of maximum 10-minute average SO_2.

3.6 Compliance and peak analysis

The number of exceedances measured at each station during 2004 and the previous year, 2003, are listed in Table 5 and graphed in Figure 21, while Figure 22 illustrates the sources of the exceedances. There was an increase in the number of exceedances compared to the previous year, both over the 24-hour and 10-minute averaging periods. The exceedances are listed in Appendix 7, along with the wind direction and speed and probable source. The increased number of exceedances recorded at Arboretum Ext. was mainly due to 16 exceedances recorded during poor dispersion conditions during June and July, related to an undetermined, localized source. Based on the prevailing meteorological conditions and the fact that elevated SO_2 concentrations were not measured at any other RBCAA monitoring stations at a similar time, it is unlikely the source was related to major industrial emissions, but was most likely a nearby, localized source not in the emission inventory. Foskor and Hillside Aluminium were the main contributors to the 10-minute average exceedances at the Civic Centre, John Ross/Foskor intersection and Arboretum stations, while Hillside Aluminium was the main contributor to the daily average exceedances.

Table 5: Exceedances of the DEAT SO_2 10-minute average and 24-hour average guidelines during 2004, compared to previous year's exceedances.

Station	**24-hour average (>48 ppb)**		**10-minute average (>191 ppb)**	
	2003	**2004**	2003	**2004**
Arboretum	0		2	**2**
Arboretum Ext.	0		2	**18**
Civic Centre	0	**1**	4	**10**
Brackenham	0		0	**1**
John Ross/ Foskor intersection	0	**2**	2	**6**
Total	0	**3**	10	**37**

Figure 21: Number of exceedances of SO_2 guidelines per month at RBCAA monitoring stations during 2003 and 2004.

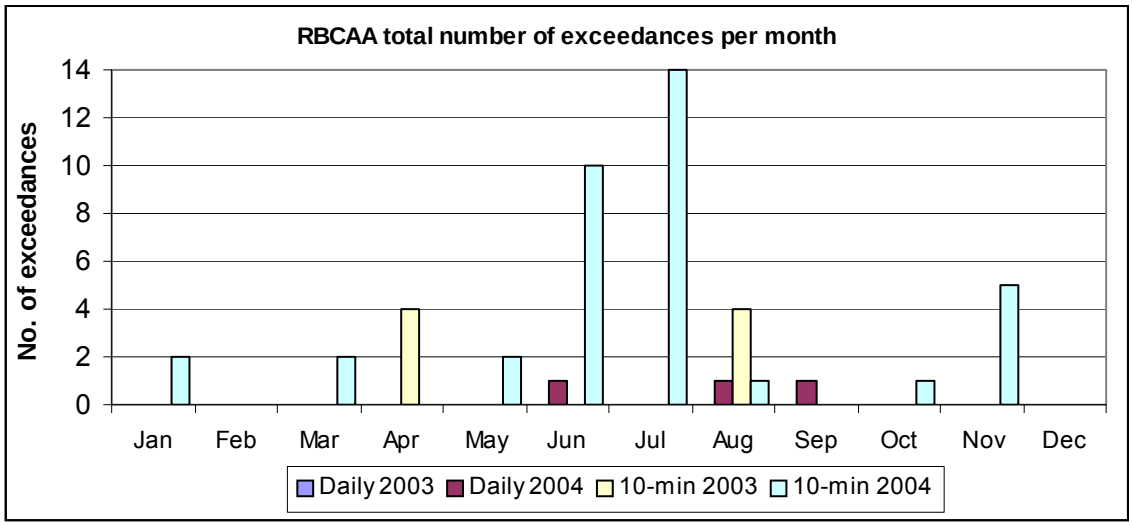
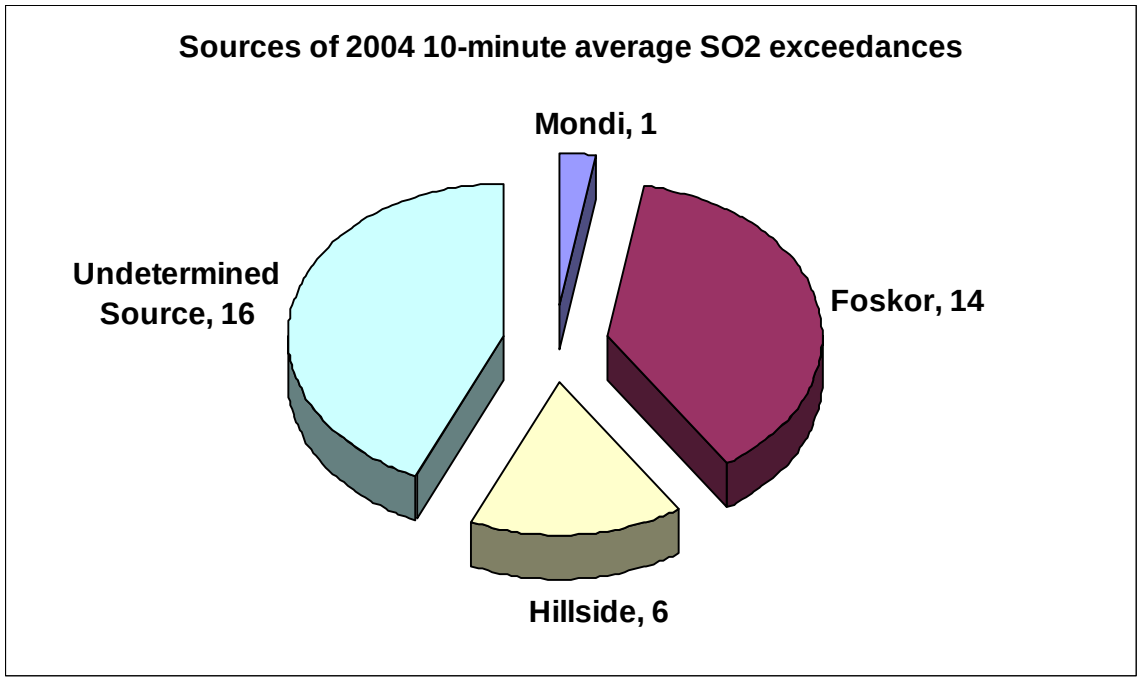


Figure 22: Sources of SO_2 guideline exceedances at RBCAA monitoring stations during 2004.



4 AIR QUALITY COMPLAINTS

4.1 Field Observations

A total of 397 air quality complaints were received during 2004. The historical count of complaints logged per annum with the RBCAA since 2000 is reflected in Fig. 23 and the number of complaints per month during 2004 and the previous year is shown in Fig. 24. It is possible that a contributing factor to the increase in the number of complaints logged is associated with increased publicity and public awareness of the RBCAA and air quality issues. The number of complaints increased during autumn and winter both last year and this year. Poor dispersion conditions during autumn and winter and industrial plant operational problems are contributing factors to this increase in complaints. The increase in number of complaints during July 2004 was noted as being mainly related to operational problems at Mondi and the increase during April 2004 was ascribed mainly to operational problems at Mondi and Hillside Aluminium.

Figure 23: Number of complaints per annum.

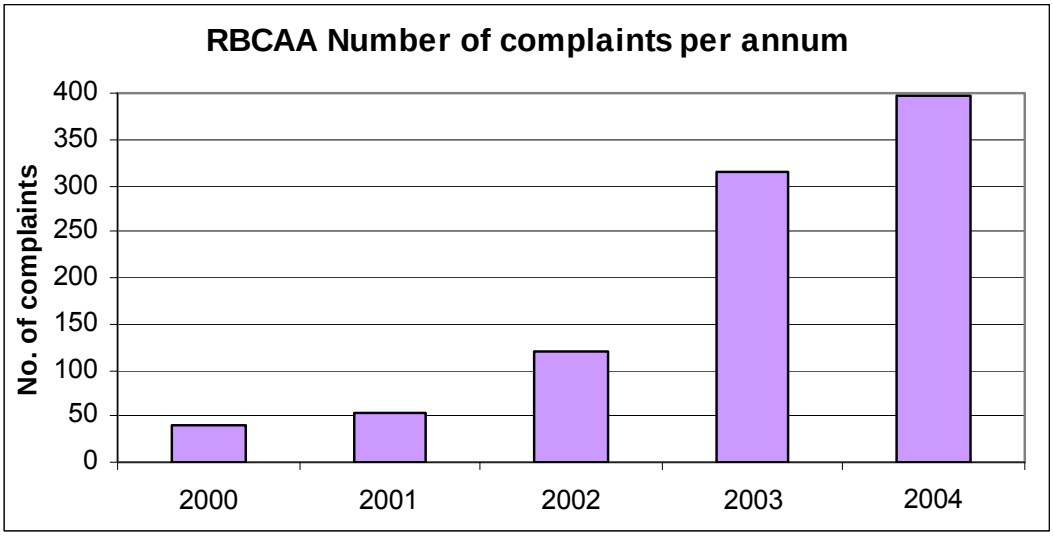
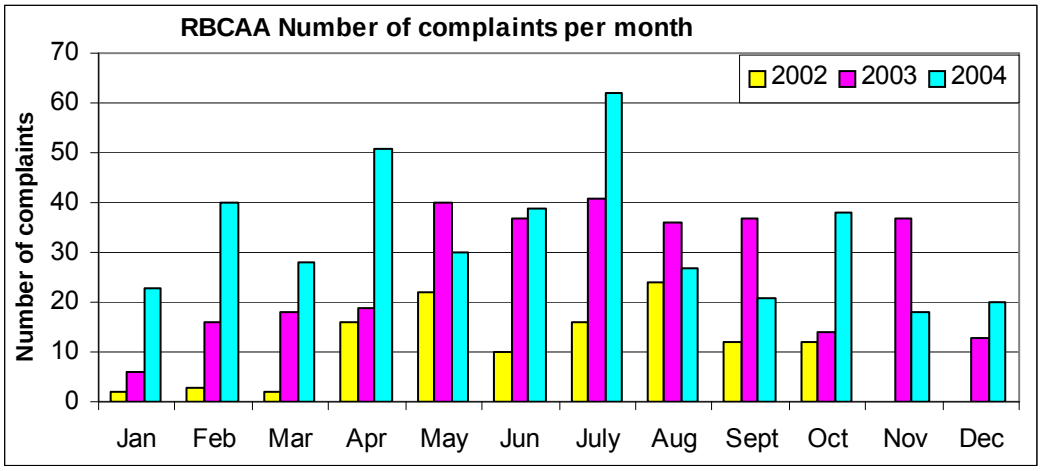


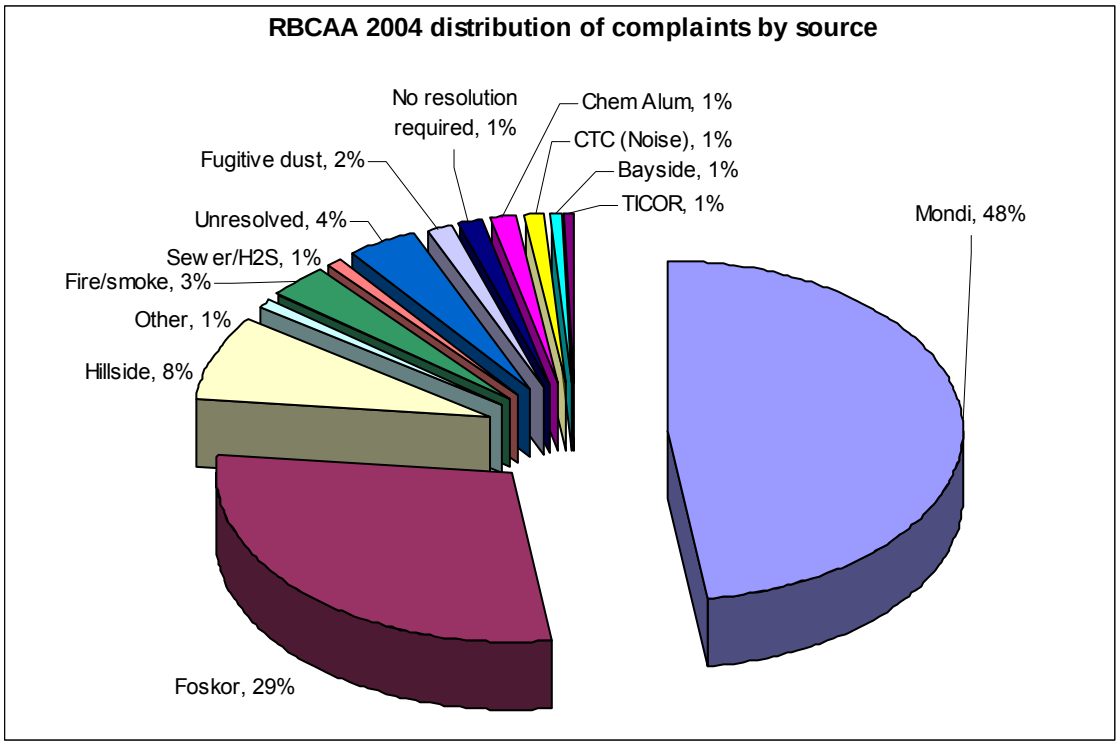
Figure 24: Comparison of number of complaints per month.



4.2 Distribution of Complaints by Source

The distribution of complaints by source is shown in Figure 25. Almost half the complaints were due to emissions from Mondi, and almost one-third of complaints were related to Foskor. The majority of complaints were related to odours, although visible emissions were noted during plant upsets.

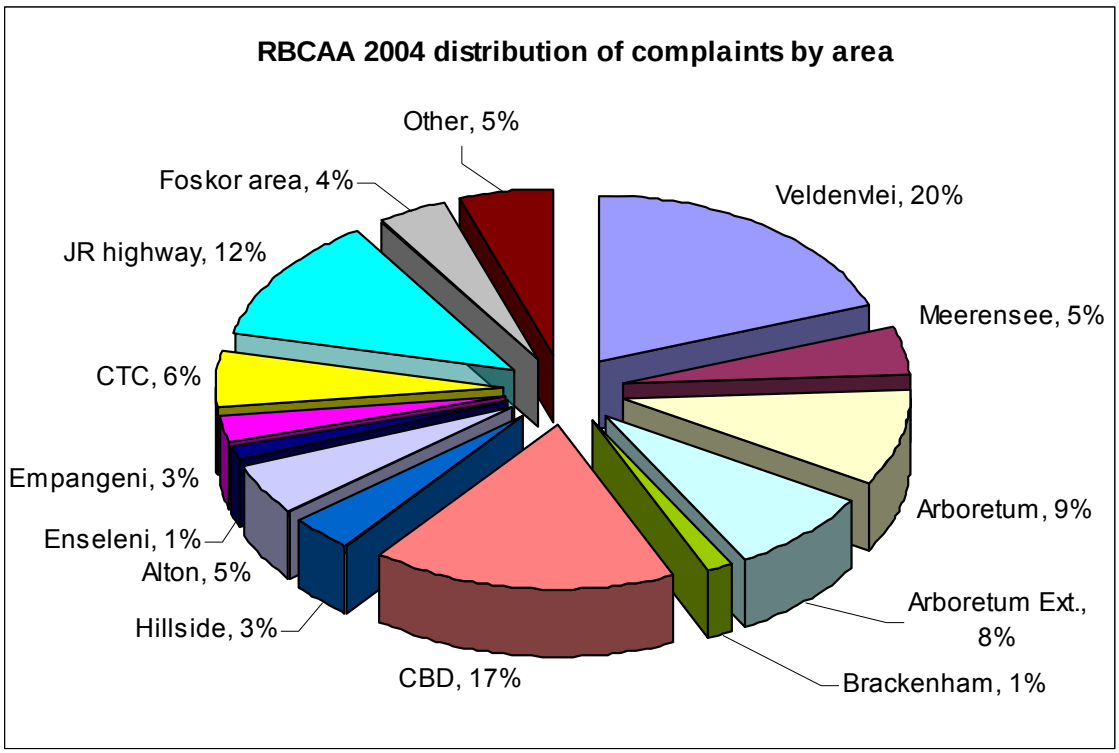
Figure 25: 2004 distribution of complaints by source.



4.3 Distribution of Complaints by Region

The distribution of complaints by area is shown in Figure 26. Most complaints were from the residential areas of Veldenvlei, Arboretum and Arboretum Ext. and from the Richards Bay CBD. The areas close to major industry, such as the John Ross Highway in the vicinity of Mondi and the area around Foskor also featured prominently in the complaints logged.

Figure 26: 2004 distribution of complaints by area.



5 PARTICULATE MONITORING

The monitoring network was expanded during 2004 to include the measurement of particulate matter (PM_{10}) at the caravan station (near the Civic Centre) and at the Yacht Club. PM_{10} at the caravan is measured continuously by means of a TEOM monitor, and the data was validated from April 2004. PM_{10} at the Yacht Club is measured using a minivol instrument, which is of coarser resolution and provides daily averaged data, validated from July onwards.

5.1 Annual averages and data capture

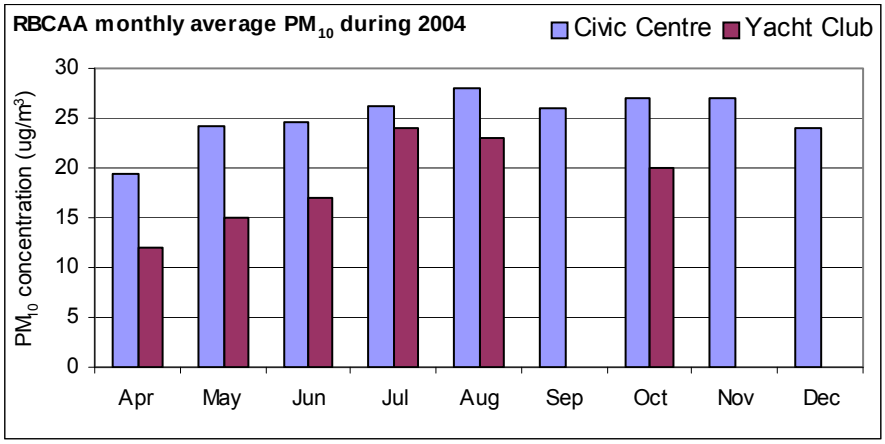
The percentage data capture and annual average PM_{10}, based on available data, is reflected in Table 6. Data capture for both stations was below quality assurance, thus the annual averages are included for interest only. Data capture from the Yacht Club was reduced owing to a failure of the minivol instrument battery supply during August and September and a perished diaphragm from November to year-end.

Table 6: Percentage PM_{10} data capture and annual average concentrations for 2004 (old guideline = 70 µg/m^3, new guideline = 40 µg/m^3).

Station	Civic Centre (Caravan)	Yacht Club
PM_{10} data capture	72.1%	22.4%
PM_{10} average for 2004	25 µg/m^3	23 µg/m^3

5.2 Monthly averages

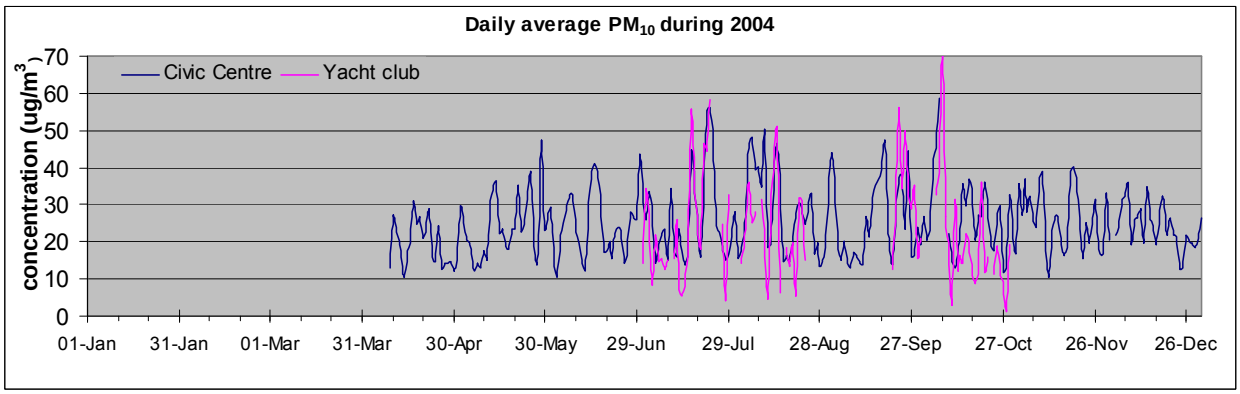
Figure 27: Monthly average PM_{10} during 2004



The trend in monthly average PM_{10} showed a consistency in monthly average PM_{10} concentrations measured at the Caravan (Civic Centre), while an increase was noted at the Yacht club during the winter months.

5.3 Daily averages

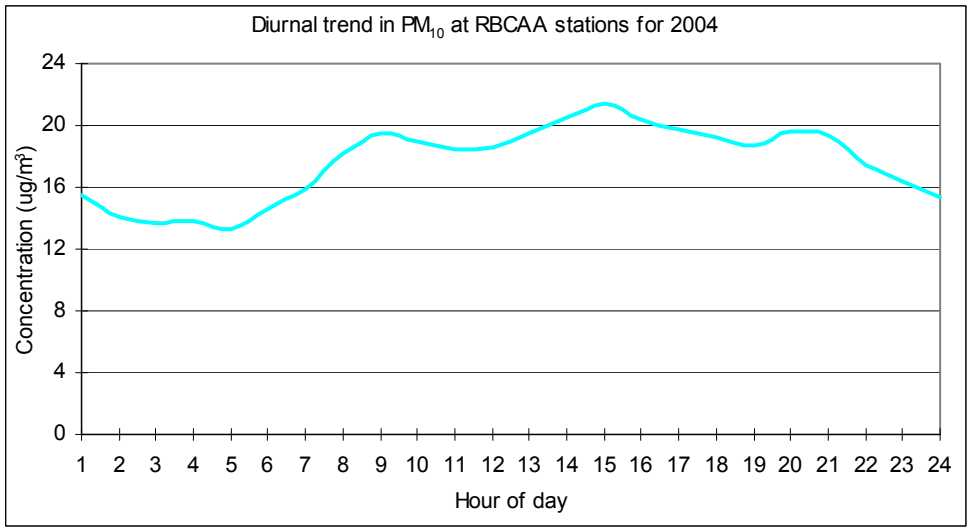
Figure 28: Daily average PM_{10} during 2004



The trend in PM_{10} at the Civic Centre indicates background PM_{10} levels of approximately 10 µg/m^3. Peak daily average concentrations were generally correlated with strong winds, usually from the south-west. There were no exceedances of the old DEAT guideline of 180 µg/m^3 or the new guideline of 75 µg/m^3.

5.4 Diurnal trends

Figure 29: Diurnal trends at the Civic Centre (Caravan)



Diurnal trends are only applied for the Caravan station as this station measures data continuously. PM_{10} concentrations are generally higher during the daytime, associated with higher wind speeds.

5.5 Maximum PM_{10} concentrations

Table 7: Maximum particulate concentrations during 2004

Station	Hourly average		Daily average	
	Concentration	Datetime	Concentration	Date
Civic Centre	157 µg/m^3	17/07/04 14:00	59 µg/m^3	06/10/04
Yacht Club	N/A	N/A	72 µg/m^3	06/10/04

Both stations recorded maximum daily average PM_{10} on the same day, 6 October 2004. Winds were moderate north-easterly, but mixing was limited by a strengthening temperature inversion and hot, dry "Berg wind" conditions were experienced ahead of the arrival of a coastal low on the 7th. Although the maximum daily averages were below the new guideline of 75 µg/m^3, that for the Yacht Club closely approached the guideline value, while the Civic Centre maximum was 79% of the new guideline. When combined with the effect of other pollutants, these levels may present problems in terms of health.

6 QUALITY ASSURANCE REPORT

6.1 Quality Assurance and ISO Accreditation

The Ecoserv quality system, detailing procedures and records for the RBCAA monitoring network was drawn up and implemented in 1997 and 1998. This document formed the basis of the application to the South African National Accreditation Service (SANAS) for ISO guide 25 accreditation. ECOSERV attained accreditation by SANAS during March 1999 for the RBCAA monitoring system. Accreditation is reviewed annually. The system was assessed in February 2004 and accreditation was attained in April 2004.

The quality control scheme (in terms of quality limits and requirements) is presented in Appendix 4. The system is accredited for the measurement of SO_2 only. The accreditation does not include the measurement of O_3, PM_{10} or meteorological variables (e.g. wind, temperature).

6.2 Calibration of equipment

The ambient air monitoring stations are SANAS ISO17025 accredited laboratories. ECOSERV perform analyser span and zero checks, alternated with precision checks, using an external calibrator, on a weekly basis. ESKOM TSI performed quarterly calibrations of the continuous air pollution monitors at all ambient air monitoring stations. Precision checks are performed before and after the calibrations to determine the error of each analyser before the calibration. Results of the pre-calibration checks are given in Table 7.

Table 8: Analyser calibration results for 2004.

Station	30 Mar – 2 Apr 04	6-8 Jul 04	13-15 Oct 04#	25-28 Jan 05
Arboretum	7.2% high	56.0% high*	103% high	16.8% high
Arb Ext.	6.2% low	8.9% low	23% high	11.9% low
Civic Centre	9.2% low	4.6% high	19.1% high	8.7% low
John Ross/ Foskor intersection	6.2% low	0.0%	247% high	3.3% high
Brackenham	20.8% high	23% low	32.6% high	6.7% high

* Cooler replaced prior to calibration

Maintenance performed on analysers prior to calibration

Internal quality specifications allow for a maximum error of 15%. Any adjustments applied to the SO_2 data are detailed in Appendix 6. The Brackenham analyser's pre-calibration response during March was 20.8% low and during July was 23% low and therefore beyond quality assurance. As the previous weekly alternate span and external calibration checks were within specification and no step change was note in the data, no adjustments were applied to the data, apart from minor adjustments around the zero to compensate for a negative database response (refer Appendix 6). The October pre-calibration result for Brackenham was 32.6% high and adjustments were applied to the data based on the Ecoserv external calibration results and the TSI pre-calibration check (Appendix 6). The pre-calibration results for October were out of specification for all analysers due to maintenance that was performed on the instruments (apart from the Brackenham analyser) prior to calibration. The relevant data was invalidated. Adjustments were applied to the SO_2 data from Arboretum after repair of the analyser during November (Appendix 6). The meteorological equipment was calibrated semi-annually by Inteltronics, and does not form part of the SANAS accreditation.

6.3 Data capture

Table 9 lists the overall data capture for the year. The system reliability shows the percentage of the month where the station as a whole was operational, while the SO_2

capture rate indicates the percentage of valid data received from the SO_2 analysers for the month. The breakdown of data capture for each station per month is provided in Appendix 3.

Table 9: RBCAA data capture for the year 2004.

Station	System (%)	SO_2 Capture (%)
Arboretum	98.9	84.2
Arboretum Extension	96.0	95.0
Brackenham	98.7	96.8
Civic Centre	99.1	96.0
John Ross/Foskor intersection	91.0	85.0
Average for year*	**97.3**	**88.4**

* The calculated average is based on overall data capture for the annual period

Overall system reliability was good, however overall SO_2 data capture was marginally below the data capture goal of 90%, due mainly to problems experienced with the analysers at Arboretum and the John Ross/Foskor intersection. The SO_2 data capture was, however, above 80% for all stations, and therefore met quality assurance standards.

6.4 Network Report

6.4.1 Outstations

The RBCAA monitoring network consists of five SO_2 monitoring stations, viz. a mobile Caravan situated near the Civic Centre in the CBD; a station at Arboretum; a station at Arboretum Extension, a station at the Scorpio substation near the intersection of the John Ross Highway and Foskor/West Central Arterial, and at Brackenham. A TEOM particulate monitor was installed at the Civic Centre to measure PM_{10} and data was validated from 1 April 2004.

All the above monitoring stations, apart from the Civic Centre, also record the meteorological variables wind speed and direction and air temperature. In addition, meteorological data are measured at a 70 m tower at Bayside Aluminium, at Richards Bay Minerals (RBM2) and at the airport (RBM1). The Bayside tower measures air temperature at various levels ranging from 2 to 70 m, the information of which gives an indication of air stability. The standard deviation of wind direction in the horizontal and vertical planes (sigma-v and sigma-w), which provides an indication of turbulence, is also measured at the station. Meteorological measurements at the RBM2 tower include rainfall, atmospheric pressure, humidity and solar radiation, in addition to the standard measurements of air temperature and wind. The RBM1 station is mainly used for wind and temperature measurements. All data are transmitted as 5-minute averages by radio telemetry to the base station at the RBCAA offices in the municipal building. Pollen monitoring, under the auspices of Wits University, is conducted at four sites, viz. Brackenham, Meerensee, UVS and Empangeni and analysis is conducted separately to this report and also does not form part of the SANAS accreditation.

6.4.2 Master Station

The master station at the Richards Bay municipal office building functioned satisfactorily during 2004.

6.4.3 Base Station

A problem with the interface on the main datalogger at the base station resulted in incorrect datetime stamping and affected overall data capture during February. The datetime stamp was corrected on 24 February. The base station computer functioned satisfactorily for the remainder of 2004.

7 OBJECTIVES

7.1 Achievement of 2004 objectives

The objectives for 2004 are listed below, along with the attainment status.

2004 Objectives	Attainment
Implementation of dedicated PM_{10} monitoring system.	TEOM installed at Caravan station. Minivol data collected from Yacht Club.
Further refinement of the Hawk model	Expanded use of Hawk for dose maps at various time scales. Modifications ongoing for further improvement.
Maintain SO_2 data capture above 90%	Overall SO_2 data capture of 88% during 2004. All stations exceeded quality assurance limits (80%).
Maintenance of the ISO 17025 accreditation.	SANAS surveillance assessment in February 2004 and system re-accredited.

7.2 Objectives for 2005

The following objectives have been identified by Ecoserv for the year 2005

- Maintain validation of the Hawk model and identify ways to further improve model predictions
- Maintain SO_2 data capture above 90%
- Maintenance of the ISO 17025 accreditation
- Accreditation of PM_{10} monitoring

APPENDIX 1

SANAS Requirements

The SO_2 concentrations reported are determined by a United States Environmental Protection Agency (USEPA) equivalent method. At the Arboretum, Arboretum Extension, Brackenham and John Ross/Foskor intersection stations the equivalent method number is EQSA-0193-092 and at the Civic Centre the equivalent method number is EQSA-0495-100. All measurement results are at standard temperature and pressure. All SO_2 measurements allow for a maximum precision error of 15% of the reported value. A tolerance around the zero point of plus or minus 10 ppb is allowed. All effort is made to reduce the error to a minimum. In terms of quality assurance standards, data collection must be above 80% to be valid for statistical analysis.

Note that the system is accredited for the measurement of SO_2 only. The accreditation does not include the measurement of O_3, PM_{10} or meteorological variables (e.g. wind, temperature). All opinions, interpretations and Hawk model findings detailed in the report do not form part of the accreditation.

APPENDIX 2

Meteorological data

CLIMATE STATISTICS FOR RICHARDS BAY FOR 2004					
	Temperature (°C)	Rainfall (mm)	Pressure (mbar)	Wind speed (m/s)	Relative Humidity (%)
Minimum	7.4		986.5	0.0	28
Maximum	39.7		1040.6	14.7	100
Average	22.1	1411	1015.6	3.1	77
Long-term mean	20.9	1228			75

*Rainfall total from RBM station

Notes: Air pressure and relative humidity are measured at RBM. Wind and temperature are from the Arboretum station. Long-term means are for SA Weather Service meteorological station at Richards Bay Airport.

Average air temperature at Arboretum during 2004 was 1.2ºC higher than the long-term mean measured at the Richards Bay Airport. Rainfall for the year 2004 was 15% higher than normal.

APPENDIX 3

SO_2 data capture: 2004

The data capture rate shows the percentage of valid data received from the SO_2 analysers for each station each month.

	John Ross/Foskor intersection	Arboretum	Civic Centre	Arboretum Ext.	Brackenham	Average
Jan	84	99.8	99.8	99.7	99.5	96.6
Feb	72	56.0	92.8	78.0	73.7	74.5
Mar	96.8	12.9	95.6	86.2	93.6	77.0
Apr	82.1	97.4	99.7	93.3	99.4	94.4
May	83.2	99.5	99.3	90.5	99.0	94.3
Jun	89.3	99.5	99.4	99.6	99.4	97.4
Jul	99.2	98.5	99.0	98.9	99.4	99.0
Aug	99.4	99.6	99.6	99.9	99.5	99.6
Sep	60.1	100	99.4	99.5	99.5	91.7
Oct	55.2	59.3	69.7	99.0	99.2	76.5
Nov	99.6	88.0	98.9	99.2	99.7	97.1
Dec	99.6	99.9	99.3	96.4	99.6	99.0
Average*	85.0	84.2	96.0	95.0	96.8	88.4

* The calculated average is based on overall data capture for the annual period, not an average calculated from the monthly figures

APPENDIX 4

RBCAA data quality control checks

Data Quality Objectives

The Data Quality Assurance Objectives for the monitoring system are summarised below.

Quality Assurance Objectives						
Parameter	**Method**	**Precision (%)**	**Accuracy (%)**	**Completeness (%)**	**Level 1 span**	**Zero (ppb)**
SO2	UV Fluorescence	± 15	± 15	> 80	± 15	± 10

Tolerance Limits and Actions

The following table indicates the required corrective actions after performing a tolerance check on an analyser if the data quality objectives are exceeded. The actions are recorded on the relevant Record Sheet/s.

Tolerance Check	<10ppb from zero	>10ppb from zero	Actions		
			>±5%	>±10%	>±15%
Zero (with reference calibrator)	adjust if >5ppb	multipoint calibration	-	-	-
Level I Span	-	-	adjust	multipoint calibration	multipoint calibration and invalidate data
Multipoint Calibration	-	adjust zero	adjust	adjust	adjust and invalidate
Audit Span	-	-	-	multipoint	multipoint calibration and invalidate data
Precision check					Level I span. If analyser is still out of specification replace or perform a multipoint calibration. Data to be invalidated going back to last valid precision check.
Accuracy check					Replace and repair analyser. Data to be invalidated going back to last valid calibration.
Tolerance Check	Data quality objective		Actions if data quality objective is not achieved		
Completeness	> 80 %		Invalidate time averaged data for which completeness is not 80 %. i.e. hourly averages are to be invalidated if less than 48 minutes of data received and daily averages are to be invalidated if less than 19.2 hours of data available.		

APPENDIX 5

Missing data: 2004

FROM		TO		
DATE	**HR**	**DATE**	**HR**	**REASON/COMMENTS**
All stations				
07-Feb	08:45	08-Feb	08:45	Incorrect date stamping on base station computer
23-Feb	14:00	24-Feb	14:00	Incorrect date stamping on base station computer
Civic Centre				
06-Oct	09:00	15-Oct	15:00	Maintenance followed by calibration
Arboretum				
09-Feb		19-Feb		EPROM card failure on analyser
06-Mar		01-Apr		Analyser removed for repair
06-Oct	15:00	14-Oct	13:00	Maintenance followed by calibration
27-Oct	10:00	04-Nov	14:00	PMT replacement
John Ross/Foskor intersection				
01-Jan	00:00	04-Jan	10:10	Power failure and time for analyser to stabilise
30-Mar	14:00	31-Mar	09:00	Power failure
02-Apr	12:25	07-Apr	15:10	Datalogger failure
13-May	18:00	15-May	08:00	UPS service and datalogger not restarted
12-Jun	05:00	14-Jun	08:00	Power failure
17-Sep	02:00	20-Sep	10:00	Power failure
22-Sep	14:00	14-Oct	19:00	Aircon failure, servicing of analyser followed by calibration
Arboretum Ext				
21-Mar	04:00	23-Mar	10:00	Power failure
04-Jul	00:00	19-Oct	13:00	PMT and UV lamp on analyser required replacement
23-Dec	09:40	24-Dec	09:05	Power failure
Brackenham				
10-Feb	10:45	13-Feb	11:40	Power failure followed by analyser hanging on zero adjust
05-Mar	17:00	24-Mar	10:00	Power supply trip
19-Apr	04:00	21-May	14:00	Data loss after intensive rain on 19 April, after which analyser out of specification

15-Oct	13:00	09-Dec	14:00	Analyser removed to replace that at Arboretum Ext.

APPENDIX 6

SO_2 data adjustments: 2004

DATE FROM	DATE TO	Adjustment	REASON/COMMENTS
Caravan (TLC)			
01-Jan	24-May	- 1 ppb	slightly high database response
25-May	06-Oct	- 0.75 ppb	slightly high database response
15-Oct	31-Dec	+ 0.25 ppb & up 8.7%	slightly low database response & low pre-cal response
Arboretum			
01-Jan	31-Jan	- 0.5 ppb	slightly high database response
01-Feb	09-Feb	- 1 ppb	slightly high database response
21-Feb	21-Feb	+ 4.25 ppb	Low database response
21-Feb	23-Feb	+ 1 ppb	slightly low database response
01-Apr	02-Apr	- 4.5 ppb	Incorrect datalogger output
03-Apr	03-Apr	- 5.5 ppb	Incorrect datalogger output
03-Apr	07-Apr	- 6 ppb	Incorrect datalogger output
01-May	31-Jul	+ 1 ppb	slightly low database response
01-Aug	31-Aug	+ 0.5 ppb	slightly low database response
16-Sep	16-Sep	+ 1 ppb	slightly low database response
21-Sep	21-Sep	+ 0.5 ppb	slightly low database response
28-Sep	23-Oct	+ 1 ppb	slightly low database response
04-Nov	18-Nov	- 1 ppb & down 16.8%	+ve zero % low pre-cal response
18-Nov	31-Dec	- 0.5 ppb & down 16.8%	+ve zero % low pre-cal response
Scorpio			
04-Jan	11-Jan	+ 5.75 ppb	-ve drift of analyser & -ve database response
12-Jan	20-Jan	+ 2.75 ppb	-ve drift of analyser & -ve database response
21-Jan	31-Jan	+ 1 ppb	-ve drift of analyser & -ve database response
01-Feb	01-Feb	+ 2 ppb	-ve drift of analyser & -ve database response
02-Feb	11-Feb	+ 0.5 ppb	-ve drift of analyser & -ve database response
11-Feb	31-Mar	+ 1 ppb	-ve drift of analyser & -ve database response
01-Apr	17-May	+ 2 ppb	-ve drift of analyser & -ve database response
19-May	27-Jul	+ 1 ppb	-ve drift of analyser & -ve database response
28-Jul	03-Aug	+ 2 ppb	-ve drift of analyser & -ve database response
03-Aug	31-Aug	+ 1 ppb	-ve drift of analyser & -ve database response
04-Sep	06-Sep	+ 2.5 ppb	-ve drift of analyser & -ve database response
08-Sep	30-Sep	+ 1.75 ppb	-ve drift of analyser & -ve database response
14-Oct	14-Oct	+ 5.5 ppb	-ve analyser response
15-Oct	16-Oct	+ 3.25 ppb	-ve analyser response
17-Oct	17-Oct	+ 2.75 ppb	-ve analyser response
18-Oct	21-Oct	+ 1.75 ppb	-ve analyser response

21-Oct	27-Oct	+ 1.25 ppb	-ve analyser response
27-Oct	31-Oct	+ 1 ppb	-ve analyser response
01-Nov	30-Nov	+ 1.25 ppb	-ve analyser response
01-Dec	31-Dec	+ 0.5 ppb	-ve analyser response
Arb Ext			
01-Jan	29-Feb	+ 0.5 ppb	slightly low database response
15-Oct	31-Oct	+ 1 ppb & up 11.9%	-ve database response & low analyser response (TSI pre-cal checks)
01-Nov	12-Dec	Up 11.9%	Low analyser response (TSI pre-cal checks)
13-Dec	31-Dec	+ 0.5 ppb & up 11.9%	Low database response & low pre-cal response (TSI)
Brackenham			
01-Jan	08-Jan	- 3.2 ppb & down 46%	Incorrect analog output
01-May	11-Jun	+ 1 ppb	slightly low database response
11-Jun	24-Jun	+ 1.75 ppb	slightly low database response
24-Jun	27-Jun	+ 1 ppb	slightly low database response
08-Jul	30-Jul	+ 1 ppb & down 25%	low database response, high analyser response (ext calibrator)
30-Jul	01-Aug	+ 1 ppb & down 17%	low database response, high analyser response (ext calibrator)
01-Aug	03-Aug	+ 1.5 ppb & down 17%	low database response, high analyser response (ext calibrator)
03-Aug	18-Aug	+ 1.5 ppb & down 22%	low database response, high analyser response (ext calibrator)
18-Aug	31-Aug	+ 1.5 ppb & down 25%	low database response, high analyser response (ext calibrator)
01-Sep	12-Sep	+ 1 ppb & down 32.6%	low database response, high analyser response (TSI pre-cal check)
13-Sep	30-Sep	+ 2 ppb & down 32.6%	low database response, high analyser response (TSI pre-cal check)
01-Oct	06-Oct	+ 3 ppb & down 32.6%	low database response, high analyser response (TSI pre-cal check)
07-Oct	13-Oct	+ 2 ppb & down 32.6%	low database response, high analyser response (TSI pre-cal check)
14-Oct	21-Nov	+ 2 ppb	low database response
22-Nov	30-Nov	+ 1.5 ppb	low database response
01-Dec	31-Dec	+ 2 ppb	low database response

DATE			
FROM	TO	Adjustment	REASON/COMMENTS
Brackenham			
21-Jan	21-Jan	down 16%	analyser +ve drift beyond quality assurance (15%)
22-Jan	22-Jan	down 17.5%	analyser +ve drift beyond quality assurance (15%)
23-Jan	23-Jan	down 19%	analyser +ve drift beyond quality assurance (15%)
24-Jan	27-Jan	down 20.4%	analyser +ve drift beyond quality assurance (15%)
01-Feb	28-Feb	- 1 ppb	slightly high database response
01-Mar	05-Mar	-0.5 ppb	slightly high database response
24-Mar	30-Apr	- 0.5 ppb	slightly high database response
21-May	22-May	down 23.75 ppb & down 36.9%	zero offset & high response of new analyser
23-May	26-May	down 27 ppb & down 36.9%	zero offset & high response of new analyser
27-May	27-May	down 23.75 ppb & down 36.9%	zero offset & high response of new analyser
28-May	31-May	down 28 ppb & down 36.9%	zero offset & high response of new analyser
01-Jun	05-Jun	- 29 ppb	zero offset
27-May	18-Jun	down 36.9%	High response of newly installed analyser
18-Jun	31-Jul	- 0.5 ppb	slightly high database response
01-Aug	30-Sep	- 0.75 ppb	slightly high database response
01-Oct	15-Oct	- 0.8 ppb	slightly high database response
09-Dec	31-Dec	- 4 ppb, down 40%	high dbase response & incorrect datalogger setting

APPENDIX 7

SO_2 guideline exceedances

10-minute average guideline exceedances (191 ppb)					
Station	**Datetime**	**SO2**	**wind direction**	**wind speed**	**Most likely source**
		ppb	**degrees**	**m/s**	
ARBORETUM	14/07/2004 04:25	211.1	231	4.4	Foskor
ARBORETUM	14/07/2004 04:35	287.4	232	4.3	Foskor
ARBORETUM EXT	12/06/2004 21:30	276.5	23	2.9	Undetermined local source
ARBORETUM EXT	12/06/2004 21:40	301.5	20	2	Undetermined local source
ARBORETUM EXT	12/06/2004 22:10	235.0	25	1.9	Undetermined local source
ARBORETUM EXT	12/06/2004 22:30	404.5	15	2.3	Undetermined local source
ARBORETUM EXT	12/06/2004 22:40	291.9	18	2.3	Undetermined local source
ARBORETUM EXT	12/06/2004 22:50	260.8	16	2	Undetermined local source
ARBORETUM EXT	12/06/2004 23:20	228.4	41	1.5	Undetermined local source
ARBORETUM EXT	14/07/2004 04:15	302.9	234	4.8	Foskor
ARBORETUM EXT	14/07/2004 05:15	318.6	243	4.8	Foskor
ARBORETUM EXT	20/07/2004 02:00	496.1	333	1.6	Undetermined local source - winds consistent NNW
ARBORETUM EXT	29/07/2004 05:20	288.3	322	2.6	Undetermined local source - winds consistent NNW
ARBORETUM EXT	29/07/2004 05:30	188.1	317	2.7	Undetermined local source - winds consistent NNW
ARBORETUM EXT	29/07/2004 05:40	223.6	316	2.7	Undetermined local source - winds consistent NNW
ARBORETUM EXT	29/07/2004 09:50	464.9	314	3.3	Undetermined local source - winds consistent NNW
ARBORETUM EXT	29/07/2004 17:10	200.5	114	0.8	Undetermined local source - winds consistent NNW
ARBORETUM EXT	29/07/2004 17:30	712.6	48	0.5	Undetermined local source - winds consistent NNW
ARBORETUM EXT	29/07/2004 17:40	959.3	46	0.4	Undetermined local source - winds consistent NNW
ARBORETUM EXT	29/07/2004 17:50	556.6	18	0.7	Undetermined local source - winds consistent NNW
BRACKENHAM	14/06/2004 23:40	210.9	214	0.7	Mondi
CARAVAN (Civic centre)	03/05/2004 07:20	191.4	237	5	Hillside Aluminium
CARAVAN (Civic centre)	14/05/2004 07:15	191.6	238	4.8	Hillside Aluminium
CARAVAN (Civic centre)	09/06/2004 07:40	196.1	237	5.2	Hillside Aluminium
CARAVAN (Civic centre)	09/06/2004 08:00	205.5	239	5.4	Hillside Aluminium
CARAVAN (Civic centre)	06/07/2004 05:25	193.8	237	5.2	Hillside
CARAVAN (Civic centre)	04/08/2004 19:55	300.0	212	2.8	Foskor
CARAVAN (Civic centre)	25/11/2004 18:50	592.1	221	6.9	Foskor
CARAVAN (Civic centre)	25/11/2004 20:50	220.5	221	6.6	Foskor
CARAVAN (Civic centre)	25/11/2004 21:00	897.3	217	6.8	Foskor

CARAVAN (Civic centre)	25/11/2004 21:10	301.6	216	5.5	Foskor
SCORPIO (JR intersection)	23/01/2004 11:00	866.8	177	0.3	Foskor start-up
SCORPIO (JR intersection)	23/01/2004 11:10	310.3	199	0.4	Foskor start-up
SCORPIO (JR intersection)	06/03/2004 17:20	359.9	201	3.8	Foskor
SCORPIO (JR intersection)	06/03/2004 17:40	236.3	189	3.3	Foskor
SCORPIO (JR intersection)	27/10/2004 22:30	191.0	14	1.6	Hillside Aluminium
SCORPIO (JR intersection)	24/11/2004 04:00	195.5	129	2.5	Foskor

Daily average guideline exceedances (48 ppb)

Station	Datetime	SO2 (ppb)	wind direction	wind speed	Most likely source
SCORPIO (JR intersection)	06/06/2004	56.3	NW-NE	light-moderate	Poor dispersion conditions, Hillside Aluminium
SCORPIO (JR intersection)	14/08/2004	61.0	N-NE	light-mod	Hillside Aluminium
CARAVAN (Civic centre)	06/09/2004	48.6	SW-WSW	mod-strong	Hillside Aluminium