Lower Hunter Ambient Air Quality Review of Available Data

2012

Acknowledgments
The Australian Nuclear Science and Technology Organisation, ConPorts, GrainCorp, Newcastle City Council, BHP Billiton, Hunter Development Corporation, Newcastle Coal Infrastructure Group, Newcastle Port Corporation, OneSteel, Orica, Port Waratah Coal Services and Tomago Aluminium submitted ambient air quality monitoring data for this study.

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1 INTRODUCTION

In response to the August 2011 Orica incident in Newcastle, the NSW Government announced a series of legislative reforms and other initiatives to improve industry's environmental performance and the community's access to information about industrial activities and any incidents that occur at industrial sites. One of these initiatives was the proposal for the establishment of an industry funded environmental monitoring network in the Lower Hunter, with the initial focus on the Newcastle Local Government Area (LGA).

To give effect to this initiative, on 9 October 2011 the Minister for the Environment, Robyn Parker MP, directed the EPA under s295Y of the Protection of the Environment Operations Act 1997, to immediately commence an investigation into the need for an environmental monitoring program in the vicinity of the heavy industrial precincts within the Lower Hunter area, including but not limited to the suburbs of Stockton and Mayfield, where a cluster of industries may be having significant cumulative impact or impacts on populations centres and the environment more generally.

Specifically the EPA must investigate:

- Whether pollution impacts are occurring or have the potential to develop in the area;
- The nature of those impacts (such as cumulative, hot spot or site-specific);
- The type of pollutant(s) that appear to be causing the impacts and in general where they are occurring;
- The need for a program to monitor the identified pollutants; and
- Whether the program should be funded by licence holders or particular classes of licence holders.

In conducting the investigation the EPA must consult with industry and relevant communities and report its findings to the Minister by March 2012.

The Lower Hunter area includes the Local Government Area's of Lake Macquarie, Newcastle, Cessnock, Maitland and Port Stephens.

The initial focus of the investigation will be for an air quality monitoring network (expanding on the existing regional network) in the Newcastle Local Government Area.

This report relates to the investigation of an air monitoring network only. This report is structured as follows:

- **Air Quality Standards and Goals (Section 2).**

This section presents a summary of air quality standards and goals for pollutants where monitoring data is available in the Lower Hunter region of NSW.

- **Summary of Monitoring Stations (Section 3).**

This section presents a summary of ambient air quality monitoring data that is available for the Lower Hunter region following stakeholder consultation in late 2011.

- **OEH Monitoring Data (Section 4).**

This section provides a detailed summary of ambient air quality monitoring data collected and reported by the NSW government since 1995 in the Lower Hunter region. Comparisons between available monitoring data and relevant air quality standards and goals are presented for all pollutants.

- **Other Monitoring Data (Section 5).**

This section provides a detailed summary of ambient air quality monitoring data provided by other entities (than the NSW government) in the Lower Hunter region. Other entities that have performed air quality monitoring in the Lower Hunter region include Australian Nuclear Science and Technology Organisation (ANSTO), BHP Billiton (BHP), Hunter Development Corporation (HDC), Newcastle Coal Infrastructure Group (NCIG), Newcastle Port Corporation (NPC), Newcastle City Council (NCC), OneSteel, Orica, Port Waratah Coal Services (PWCS) and Tomago Aluminium.

- **Summary of Monitoring Data (Section 6).**

This section presents a concise summary of monitoring data presented in Sections 4 and 5 by pollutant and by location.

- **Air Emissions Inventory Data Review (Section 7).**

This section presents a summary of estimated air emissions from all sources in the Newcastle Local Government Area based on the results of the NSW Greater Metropolitan Region air emissions inventory.

- **Facility Prioritisation Analysis (Section 8)**

This section provides a prioritisation of industrial facilities in the Newcastle Local Government Area according to potential short and long term health impacts.

2 AIR QUALITY STANDARDS AND GOALS

Relevant air quality standards and goals for pollutants for which monitoring data exists in the Lower Hunter Region are outlined in the following documents:

- **National Environment Protection (Ambient Air Quality) Measure (Ambient Air Quality NEPM).**

In June 1998, the National Environment Protection Council (NEPC) made the National Environment Protection (Ambient Air Quality) Measure (Ambient Air Quality NEPM) which set uniform national ambient air quality standards for six air pollutants: carbon monoxide; lead; sulfur dioxide; nitrogen dioxide; ozone and particles with an aerodynamic equivalent diameter less than 10 μm (PM_{10}) [1]. In August 2003, the Ambient Air Quality NEPM was varied to add an advisory reporting standard for particles with an aerodynamic equivalent diameter less than 2.5 μm ($PM_{2.5}$).

- **National Environment Protection (Air Toxics) Measure (Air Toxics NEPM).**

The NEPC made the National Environment Protection (Air Toxics) Measure (Air Toxics NEPM) in 2004. The purpose of the Air Toxics NEPM is to improve the information base regarding ambient air toxics within the Australian environment in order to facilitate the development of standards. The Air Toxics NEPM sets monitoring investigation levels, measurement methods and sampling methodologies to levels around sites where significantly elevated concentrations of one or more of these air toxics are likely to occur and where the potential for significant population exposure to air toxics exists. The Air Toxics NEPM includes five air pollutants: benzene; benzo(a)pyrene (as a marker for polycyclic aromatic hydrocarbons (PAHs); formaldehyde; toluene; and xylenes (as total of ortho, meta and para isomers).

- **Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW DEC, (2005)).**

The EPA first published the Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales (Approved Methods) in August 2001. The Approved Methods contain impact assessment criteria for a range of air pollutants.

Relevant air quality criteria for this study are listed in Table 2.1.

[1] Clause 13(2) of the Ambient Air Quality NEPM specifies that monitoring is undertaken at locations which are representative of air quality experienced by the general population in a region. The monitoring data reported here do not necessarily meet those criteria.

Table 2.1: Ambient Air Quality Criteria

Pollutant	Averaging period	Maximum concentration	Maximum allowable exceedences	Source of Ambient Air Quality Criteria
Benzene	1 year	0.003 ppm	Monitoring investigation level - goal is to gather sufficient data nationally to facilitate development of a standard	Air Toxics NEPM
Benzo(a)pyrene as a marker for Polycyclic Aromatic Hydrocarbons	1 year	0.3 ng/m^3	Monitoring investigation level - goal is to gather sufficient data nationally to facilitate a development of a standard	Air Toxics NEPM
Carbon monoxide	8 hours	9.0 ppm	1 day a year	Ambient Air Quality NEPM
Nitrogen dioxide	1 hour	0.12 ppm	1 day a year	Ambient Air Quality NEPM
	1 year	0.03 ppm	none	
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year	Ambient Air Quality NEPM
	1 year	30 µg/m^3	none	NSW DEC (2005)
Particles as $PM_{2.5}$	1 day	25 µg/m^3	Goal is to gather sufficient data nationally to facilitate a review of the Advisory Reporting Standards.	Ambient Air Quality NEPM
	1 year	8 µg/m^3		
Photochemical oxidants (as ozone)	1 hour	0.10 ppm	1 day a year	Ambient Air Quality NEPM
	4 hours	0.08 ppm	1 day a year	
Sulfur dioxide	1 hour	0.20 ppm	1 day a year	Ambient Air Quality NEPM
	1 day	0.08 ppm	1 day a year	
	1 year	0.02 ppm	none	
Toluene	24 hours	1 ppm	Monitoring investigation level - goal is to gather sufficient data nationally to facilitate a development of a standard	Air Toxics NEPM
	1 year	0.1 ppm		
Total suspended particulate (TSP)	1 year	90 µg/m^3	none	NSW DEC (2005)
Xylenes	24 hours	0.25 ppm	Monitoring investigation level - goal is to gather sufficient data nationally to facilitate a development of a standard	Air Toxics NEPM
	1 year	0.2 ppm		

3 SUMMARY OF MONITORING STATIONS

Ambient air quality monitoring stations located in the Lower Hunter region are reported and/or operated by:

- Office of Environment & Heritage (OEH);
- Newcastle City Council (NCC);
- Australian Nuclear Science and Technology Organisation (ANSTO); and
- Industry including:
  - BHP Billiton (BHP);
  - ConPorts;
  - GrainCorp;
  - Hunter Development Corporation (HDC);
  - Newcastle Coal Infrastructure Group (NCIG);
  - Newcastle Port Corporation (NPC);
  - OneSteel;
  - Orica;
  - Port Waratah Coal Services (PWCS); and
  - Tomago Aluminium.

Industry also operates a number of dust deposition monitors which have not been included in this summary of ambient air quality data.

OEH operate regional ambient air quality monitoring stations to characterise regional air quality. These are summarised in Table 3.1.

Table 3.1: Summary of OEH Monitoring Stations in the Lower Hunter Region

Monitoring Site		MGA X (km)	MGA Y (km)	O_3	NO NO_2 NO_x	TEOM-PM_{10}	TEOM-$PM_{2.5}$	SO_2	CO
Beresfield	Francis Greenway High School	374.534	6370.275	⊕	⊕	⊕	⊕	⊕	
Newcastle	Athletics Field	383.917	6355.512	⊕	⊕	⊕		⊕	⊕
Wallsend	Swimming Pool	375.529	6359.445	⊕	⊕	⊕	⊕	⊕	

⊕ indicates that the pollutant is monitored at the monitoring station

Where: MGA: Map Grid of Australia (GDA94); O_3: ozone; NO: nitric oxide; NO_2: nitrogen dioxide; NO_x: oxides of nitrogen; PM_{10}: particles less than 10 micrometres in diameter measured using a high-volume sampler; TEOM-PM_{10}: particles less than 10 micrometres in diameter measured using a tapered element oscillating microbalance; TEOM-$PM_{2.5}$: particles less than 2.5 micrometres in diameter measured using a tapered element oscillating microbalance; SO_2: sulfur dioxide; CO: carbon monoxide

Beresfield

The Beresfield air quality monitoring site is located in Francis Greenway High School, on Lawson Avenue, Beresfield. It is situated in a residential area north-west of Newcastle and is at an elevation of 14 metres. The Beresfield site was commissioned in May 1993.

Newcastle

The Newcastle air quality monitoring site is located in the Newcastle Sportsground, off Dumaresq Street, Newcastle. It is situated in a residential area close to the commercial centre of Newcastle and is at an elevation of 5 metres. The Newcastle site was commissioned in November 1992.

Wallsend

The Wallsend air quality monitoring site is located in the Newcastle City Council Swimming Pool, off Frances Street, Wallsend. It is situated in a residential area south-west of Newcastle and is at an elevation of 8 metres. The Wallsend site was commissioned in November 1992.

Locations of OEH and ambient air monitoring stations are shown in Figure 3.2.

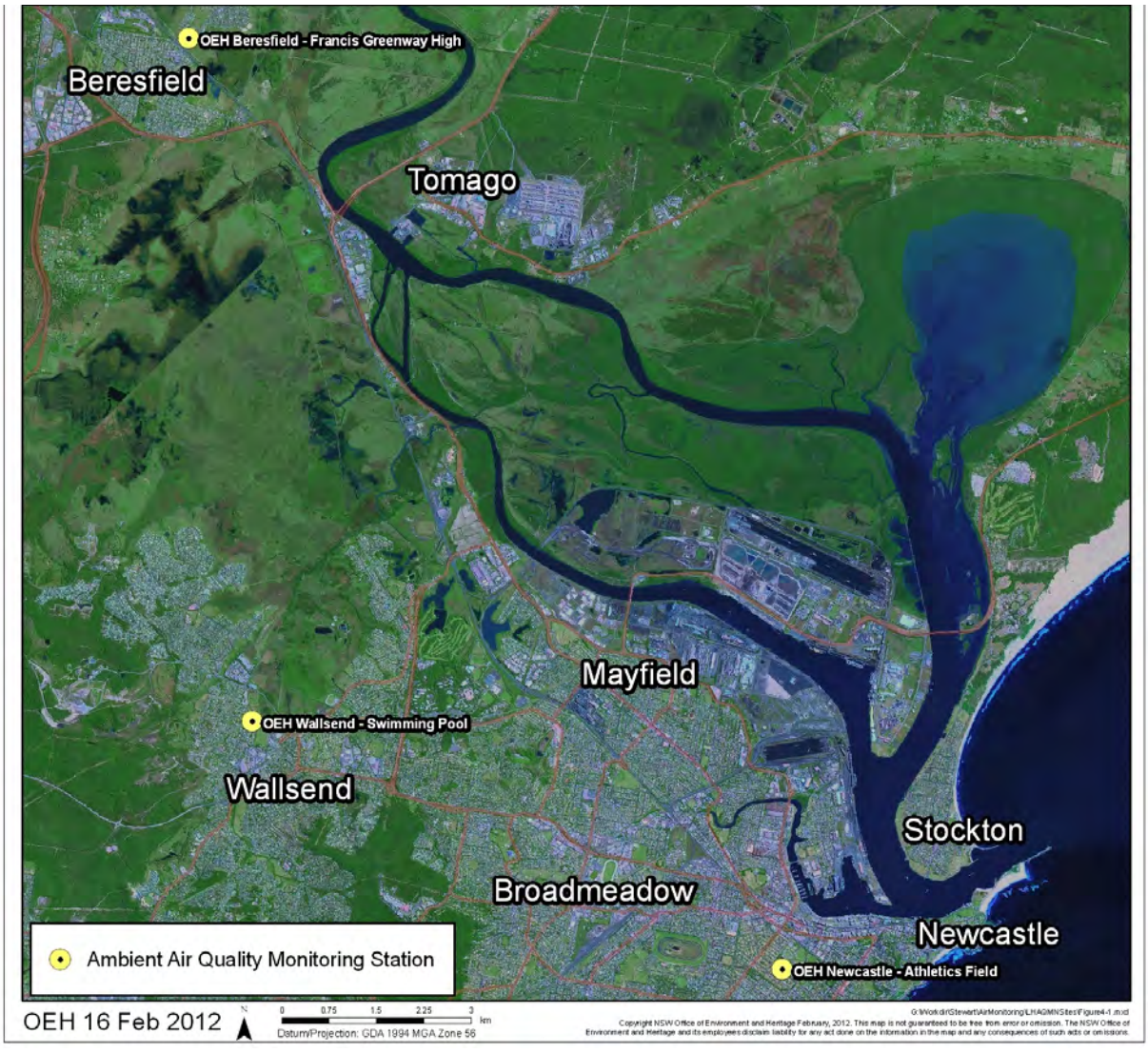

Figure 3.1: Location of OEH Ambient Monitoring Stations

Monitoring stations operated by other entities are summarised in Table 3.2. These are generally neighbourhood monitoring stations located close to particular sources of air pollution.

Table 3.2: Summary of Other Monitoring Stations in the Lower Hunter Region

Site ID	Site Name/Location	MGA X (km)	MGA Y (km)	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	Organics	Reporting Organisation
1	Mayfield -ASP	382.784	6359.697				⊕			ANSTO
2	ConPorts - North	385.136	6357.534		⊕					ConPorts
3	ConPorts - South	385.198	6357.364		⊕					
4	Mayfield	382.781	6359.700		⊕	⊕			⊕	BHP, HDC, NCIG
5	Smart St	384.630	6356.880		⊕					GrainCorp
6	Rail Yard	384.739	6357.047		⊕					
7	R + D Darval St	384.588	6357.027		⊕					
8	Steel River	380.614	6360.965	⊕	⊕	⊕		⊕		NCIG
9	Stockton	386.338	6358.981		⊕	⊕				Orica
10	NCC Wallsend	375.529	6359.445		⊕					NCC
11	Fern Bay	387.448	6362.005		⊕	⊕				PWCS
12	Mayfield 4 Berth	384.595	6359.83			⊕				NPC
13	East Drain	381.018	6359.258		⊕					OneSteel
14	West Car Park	380.525	6359.692		⊕					
15	Fullerton Rd - Stockton	386.336	6358.990		⊕	⊕				Orica
16	Roxburgh St - Stockton	386.311	6358.656	⊕						
17	C1 Stockton	385.846	6358.220		⊕					PWCS
18	C2 Mayfield East	383.306	6359.155		⊕					
19	Farm	381.364	6366.705					⊕		Tomago Aluminium
20	Highway	379.357	6369.102					⊕		
21	Laverick	378.884	6367.290					⊕		
22	Met	381.194	6368.221					⊕		
23	SchoolDrv	381.419	6367.117					⊕		

⊕ indicates that the pollutant is monitored at the monitoring station

⊕ indicates that the pollutant is monitored however monitoring data were not supplied to OEH

Where: MGA: Map Grid of Australia (GDA94); NO_x: oxides of nitrogen; TSP: total suspended particulates; PM_{10}: particles less than 10 micrometres in diameter; $PM_{2.5}$: particles less than 2.5 micrometres in diameter; SO_2: sulfur dioxide; CO: carbon monoxide; Organics includes benzene, ethylbenzene, toluene, isomers of xylenes and polycyclic aromatic hydrocarbons (PAHs).

[a] The reporting organisation indicates the organisation that provided the monitoring data to the EPA for use in this study. The reporting organisation is not necessarily the organisation that manages and maintains the monitoring station

Locations of industry ambient air monitoring stations are shown in Figure 3.2

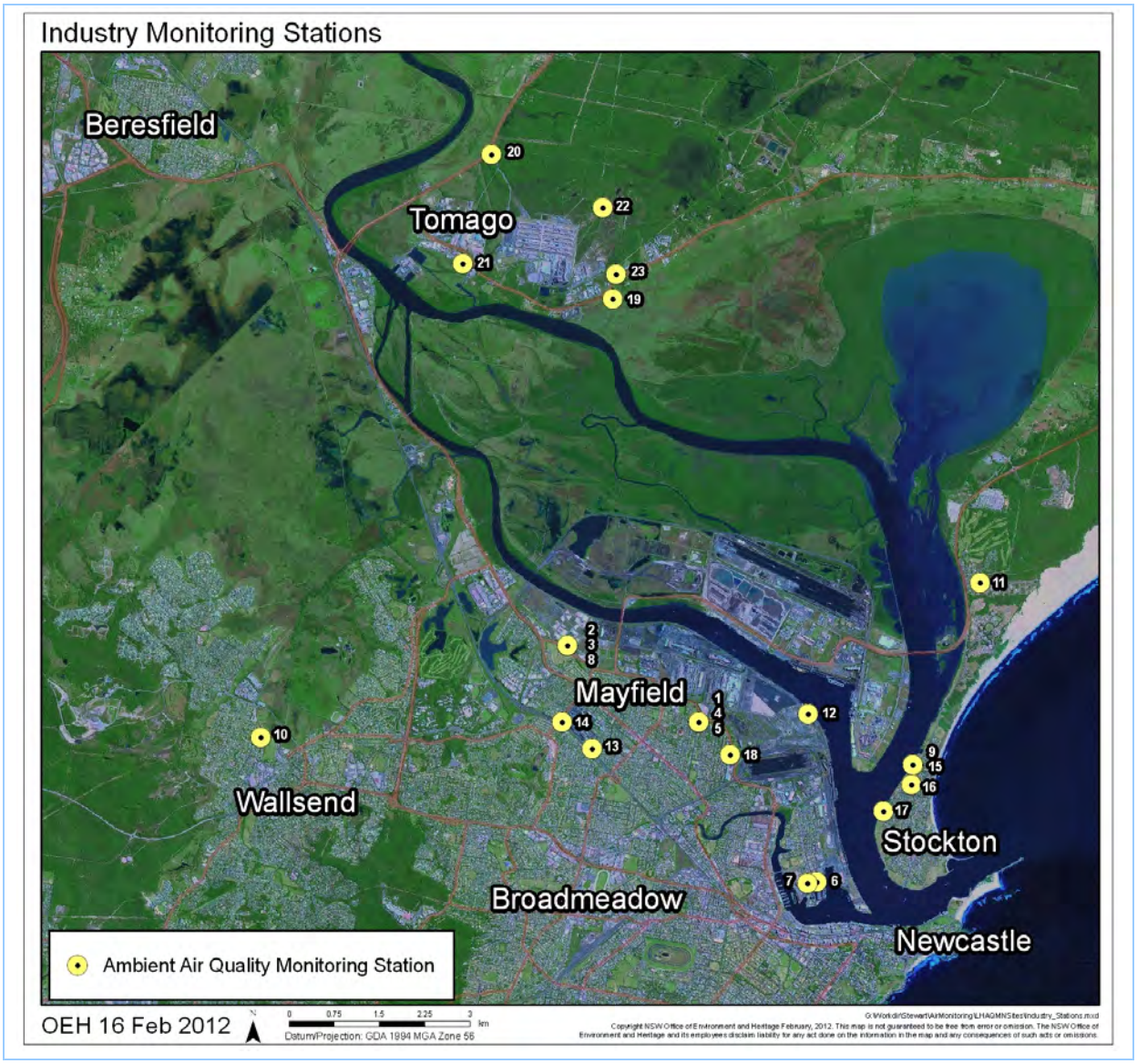

Figure 3.2: Location of Industry Ambient Monitoring Stations

4 OEH MONITORING DATA

Summary statistics are presented for each OEH monitoring station and pollutant in this section. Explanatory notes for interpreting the summary statistics are as follows:

1. For all pollutants and averaging periods, each table lists the year monitoring took place, percent of total possible data captured, pollutant concentration and the number of days the concentration is above the relevant criteria. In addition to these parameters, the first to sixth highest concentrations are listed for 1 hour and/or 24-hour averaging periods.

2. The values in **Green** indicate that all recorded concentrations are below the relevant criteria. The values in **Yellow** indicate recorded concentrations were above the relevant criteria for five days or less per year for 24-hour average PM_{10} and $PM_{2.5,}$ one day per year for $NO_{2,}$ $SO_{2,}$ ozone and CO . The values in **Orange** indicate recorded concentrations were above the relevant criteria for more than five days per year for 24-hour average PM_{10} and $PM_{2.5,}$ or more than one day per year for NO_2, $SO_{2,}$ ozone and CO.

3. The 24-hour average values presented for continuous monitor methods (AM-12, AM-20 and AM-22) are the arithmetic average of concentrations recorded for one calendar day. Where there are missing records in a calendar day, the arithmetic average of the recorded values is deemed to be the 24-hour value. When no data records were recorded for the calendar day, the 24-hour value was not calculated.

4. The percent data coverage parameter corresponds to the total percent of data recorded for the reporting period (1 year).

5. Results should be interpreted with reference to the percent of total possible data captured. If this parameter is less than 100%, concentrations could potentially have been higher than those listed.

4.1 PM_{10} Concentrations

4.1.1 Beresfield

24-hour average PM_{10} data are presented for the Beresfield Monitoring Station in Figure 4.1. Summary statistics for the maximum recorded 24-hour PM_{10} concentrations measured at the Beresfield Monitoring Station are presented in Table 4.1.

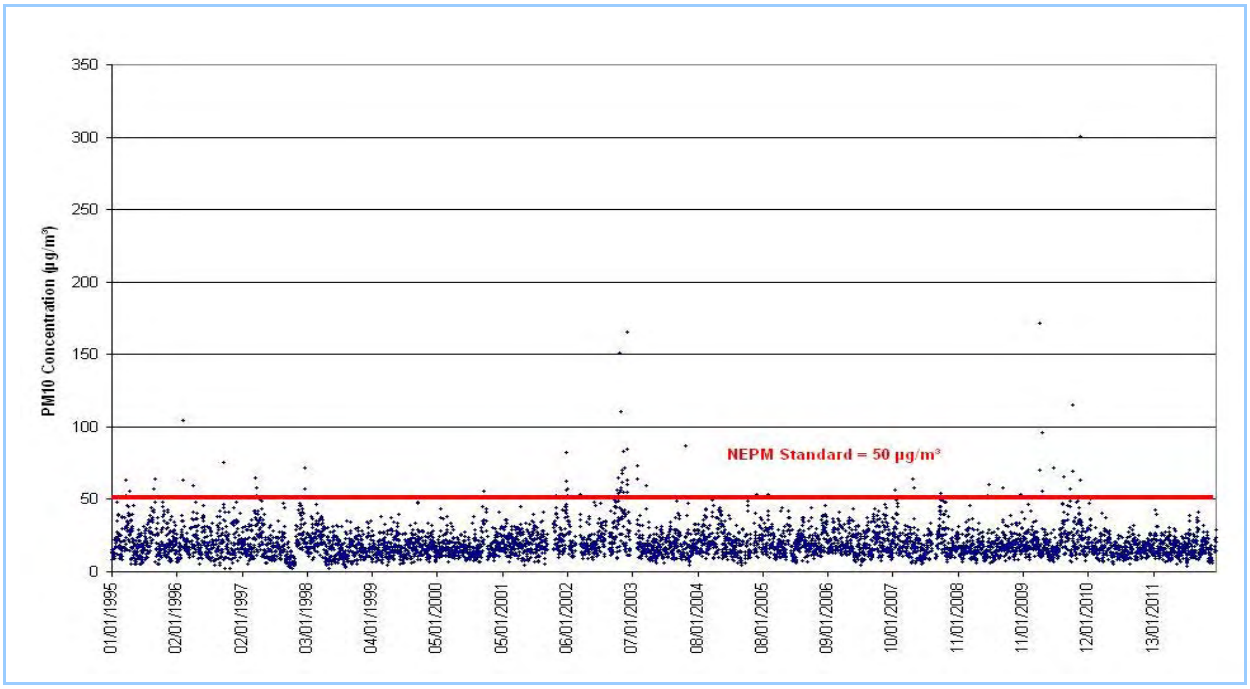

Figure 4.1: Beresfield Air Monitoring Station – TEOM – 24-hour PM_{10} Concentrations [2]

Table 4.1: Beresfield Air Monitoring Station – TEOM – PM_{10} – 24-hour Averages

Year	Concentration (µg/m3)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	95%	63.8	63.5	56.9	55.8	52.5	52.2	8
1996	92%	104.3	75.7	63.4	59.1	51.5	51.3	6
1997	98%	71.6	64.9	58.2	57.2	52.9	49.8	5
1998	100%	46.7	40.7	38.4	38.0	37.6	36.4	0
1999	99%	48.2	46.9	39.8	37.9	37.6	34.6	0
2000	90%	55.7	45.0	43.5	43.3	41.1	41.0	1
2001	90%	82.0	62.6	52.3	51.1	46.4	45.1	4
2002#	81%	165.6	150.7	110.6	84.6	83.0	71.5	25
2003	91%	87.0	72.9	63.7	59.3	51.9	49.1	5
2004	87%	53.1	49.3	48.5	46.0	45.8	44.6	1
2005	96%	53.1	45.9	44.6	44.2	42.0	42.0	1
2006	96%	51.9	51.4	46.3	44.2	44.0	43.8	2
2007	90%	64.0	57.9	56.2	54.5	52.0	49.5	5
2008	95%	59.9	57.6	53.1	52.4	51.8	45.5	5
2009*	99%	1999.0	300.6	211.4	171.8	115.2	96.2	15
2010	97%	50.0	47.2	40.6	37.3	36.5	36.1	0
2011	95%	42.8	41.4	41.0	39.6	38.7	37.2	0

\# Bushfires in 2002 resulted in elevated particle concentrations

* Dust storms in 2009 resulted in significantly elevated particle concentrations

[2] For clarity chart excludes the result for 23/09/2009 of 1999 µg/m³

Annual average PM_{10} monitoring data are presented for the Beresfield Monitoring Station in Figure 4.2. Summary statistics for the annual average PM_{10} concentrations are presented in Table 4.2.

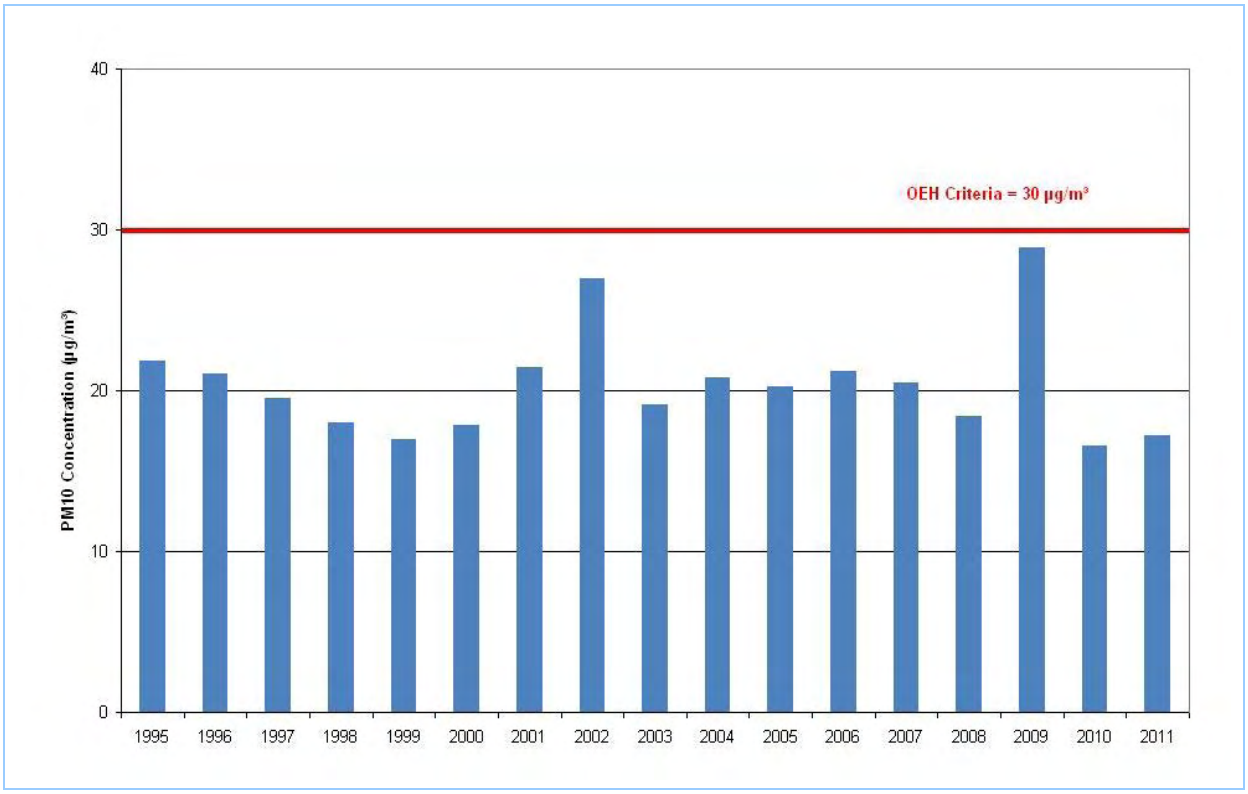

Figure 4.2: Beresfield Air Monitoring Station – TEOM – Annual Average PM_{10} Concentrations

Table 4.2: Beresfield Air Monitoring Station -TEOM- Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
1995	95%	**21.9**
1996	92%	**21.0**
1997	98%	**19.5**
1998	100%	**18.0**
1999	99%	**16.9**
2000	90%	**17.8**
2001	90%	**21.4**
2002	81%	**27.0**
2003	91%	**19.1**
2004	87%	**20.8**
2005	96%	**20.3**
2006	96%	**21.2**
2007	90%	**20.4**
2008	95%	**18.4**
2009	98%	**28.9**
2010	97%	**16.6**
2011	95%	**17.2**

4.1.2 Newcastle

24-hour average PM_{10} data are presented for the Newcastle Monitoring Station in Figure 4.3. Summary statistics for the maximum recorded 24-hour PM_{10} concentration measured at the Newcastle Monitoring Station are presented in Table 4.3.

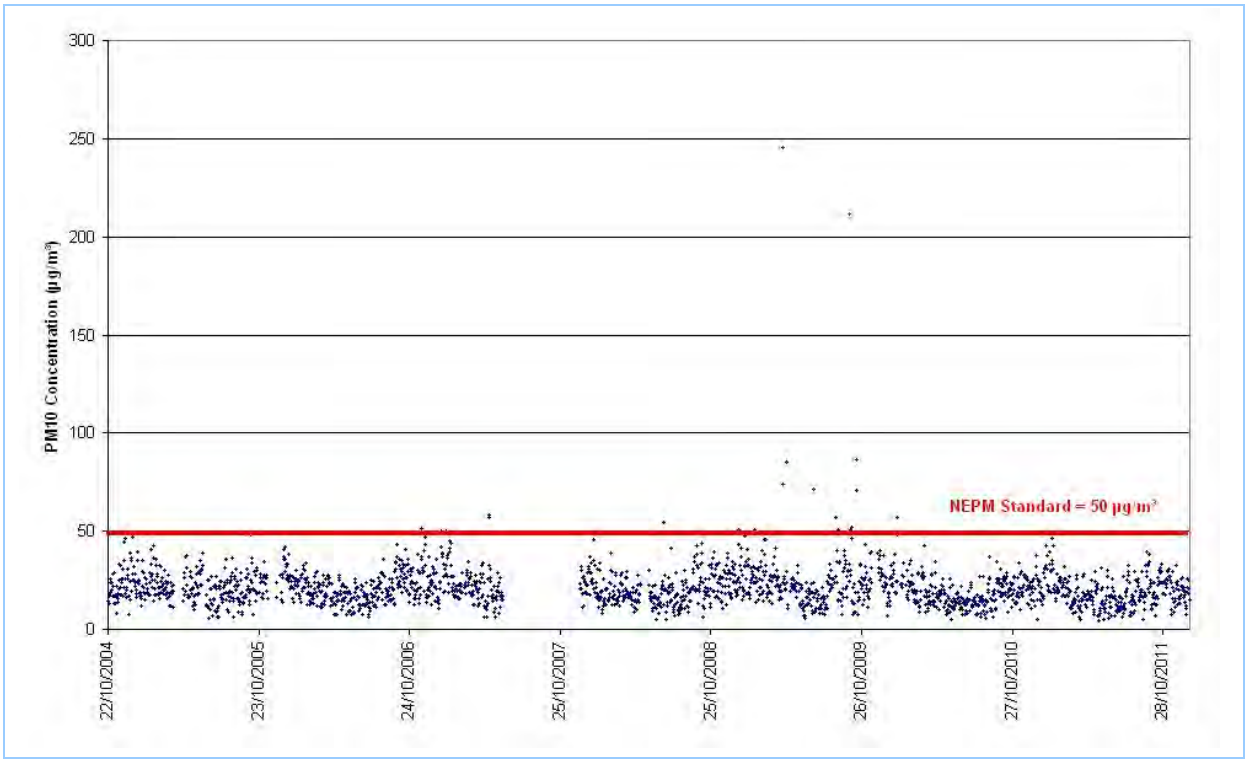

Figure 4.3: Newcastle Air Monitoring Station – TEOM – 24-hour PM_{10} Concentrations [3]

Table 4.3: Newcastle Air Monitoring Station – TEOM – PM_{10} – 24-hour Averages

Year	Concentration (µg/m³)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2004	19% [a]	46.7	46.6	44.5	38.8	36.6	35.3	0
2005	82%	48.3	42.8	42.2	40.6	40.5	39.5	0
2006	97%	51.2	47.2	43.3	43.2	40.9	40.2	1
2007	47%	58.1	57.2	50.4	49.8	45.1	43.6	3
2008	93%	54.4	50.6	45.6	43.7	42.3	41.2	2
2009*	93%	2426.8	245.4	211.6	86.6	85.1	73.9	13
2010	96%	57.1	48.3	42.5	38	37.4	37.1	1
2011	99%	49.2	46.3	42.6	42.6	42.6	39.6	0

[a] TEOM operated for part of the year only in the first year of operation.
* dust storms in 2009 resulted in significantly elevated particle concentrations

[3] chart excludes result for the 23/09/2009 of 2426 µg/m³

PM_{10} monitoring data averaged annually are presented for the Newcastle Monitoring Station in Figure 4.4. Summary statistics for the annual average PM_{10} concentrations are presented in Table 4.4.

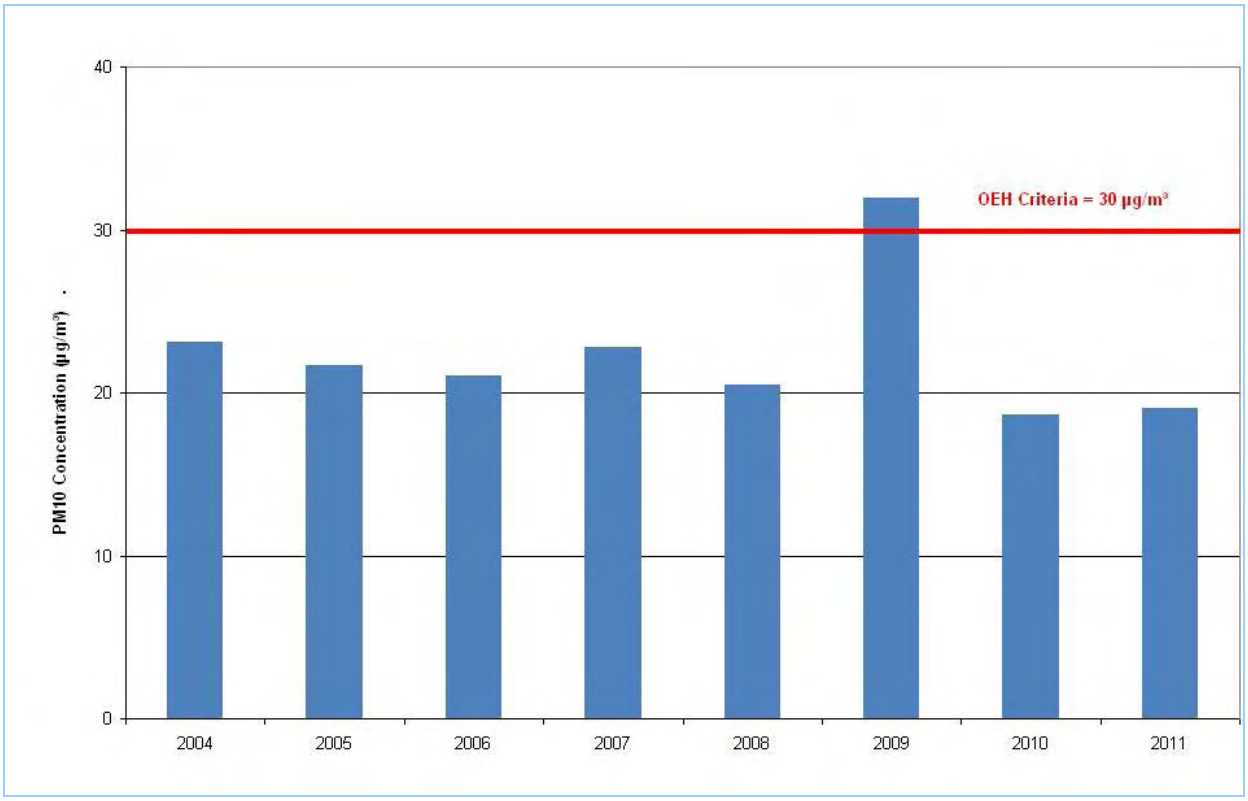

Figure 4.4: Newcastle Air Monitoring Station – TEOM – Annual Average PM_{10} Concentrations

Table 4.4: Newcastle Air Monitoring Station - TEOM - Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
2004	19%[a]	23.1
2005	82%	21.7
2006	97%	21.1
2007	47%	22.8
2008	93%	20.5
2009	93%	31.9
2010	96%	18.6
2011	99%	19.1

[a] TEOM operated for part of the year only in the first year of operation.

4.1.3 Wallsend

24-hour average PM_{10} data are presented for the Wallsend Monitoring Station in Figure 4.5. Summary statistics for the maximum recorded 24-hour PM_{10} concentration measured at the Newcastle Monitoring Station are presented in Table 4.5.

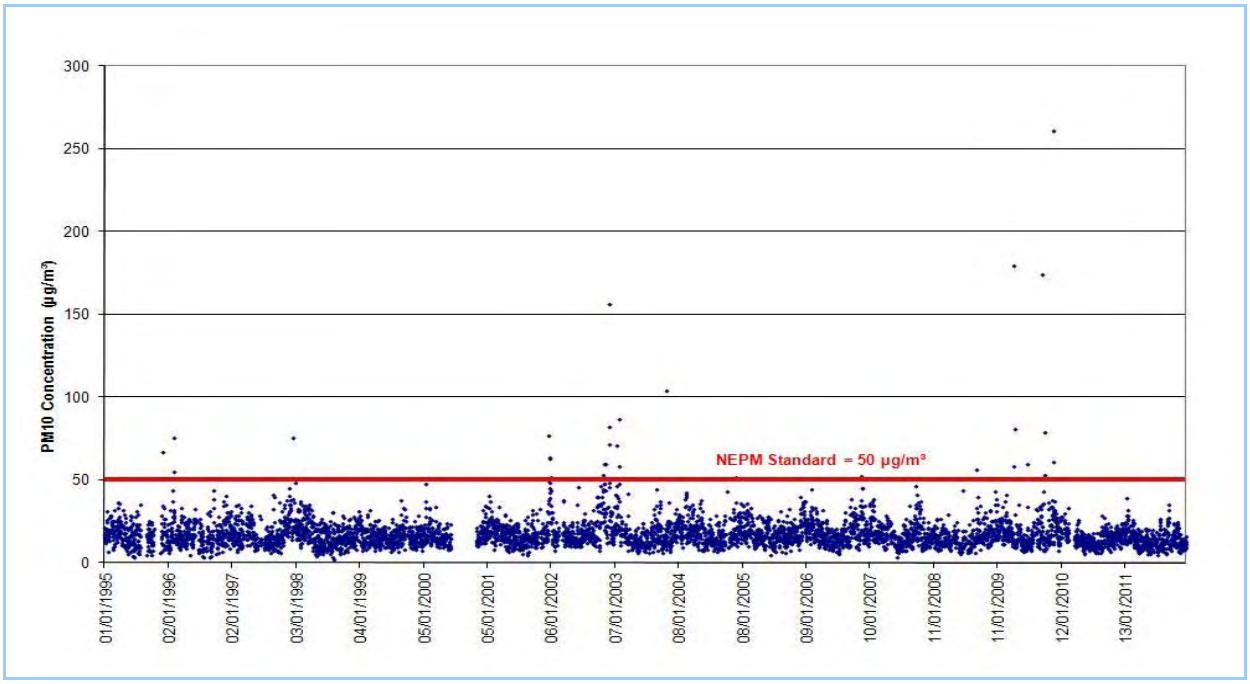

Figure 4.5: Wallsend Air Monitoring Station – TEOM – 24-hour PM_{10} Concentrations [4]

Table 4.5: Wallsend Air Monitoring Station – TEOM – PM_{10} – 24-hour Averages

Year	Concentration (µg/m³)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	74%	67.2	36.6	35.8	35.4	34.6	33.3	1
1996	86%	75.4	54.7	43.6	43.5	40.4	38.3	2
1997	84%	75.6	44.9	41.2	40.2	39.6	38.4	1
1998	97%	48.1	36.8	36.0	35.4	34.5	34.2	0
1999	91%	37.7	33.3	32.2	32.0	29.1	29.0	0
2000	57%	47.6	36.9	34.2	34.1	33.2	33.1	0
2001	91%	76.5	62.9	49.5	48.6	42.4	40.6	2
2002#	81%	156.2	82.1	71.6	63.9	59.5	59.5	9
2003	90%	104.3	86.8	70.7	58.5	48.0	46.6	4
2004	89%	51.8	42.8	42.5	41.1	39.9	38.3	1
2005	95%	50.7	39.5	37.2	36.6	35.6	35.6	1
2006	98%	52.0	45.3	45.1	44.2	38.2	37.6	1
2007	93%	50.9	50.8	46.5	41.1	38.4	37.3	2
2008	83%	56.5	43.6	43.0	40.0	34.3	33.4	1
2009*	92%	2150.3	260.8	179.5	173.9	81.1	78.9	10
2010	87%	32.8	29.5	28.6	28.0	27.8	27.3	0
2011	99%	38.9	35.2	32.1	31.5	28.5	28.4	0

\# Bushfires in 2002 resulted in elevated particle concentrations

* Dust storms in 2009 resulted in significantly elevated particle concentrations

[4] chart excludes result for the 23/09/2009 of 2,150 µg/m³

PM_{10} monitoring data averaged annually are presented for the Wallsend Monitoring Station in Figure 4.6. Summary statistics for the annual average PM_{10} concentrations are presented in Table 4.6.

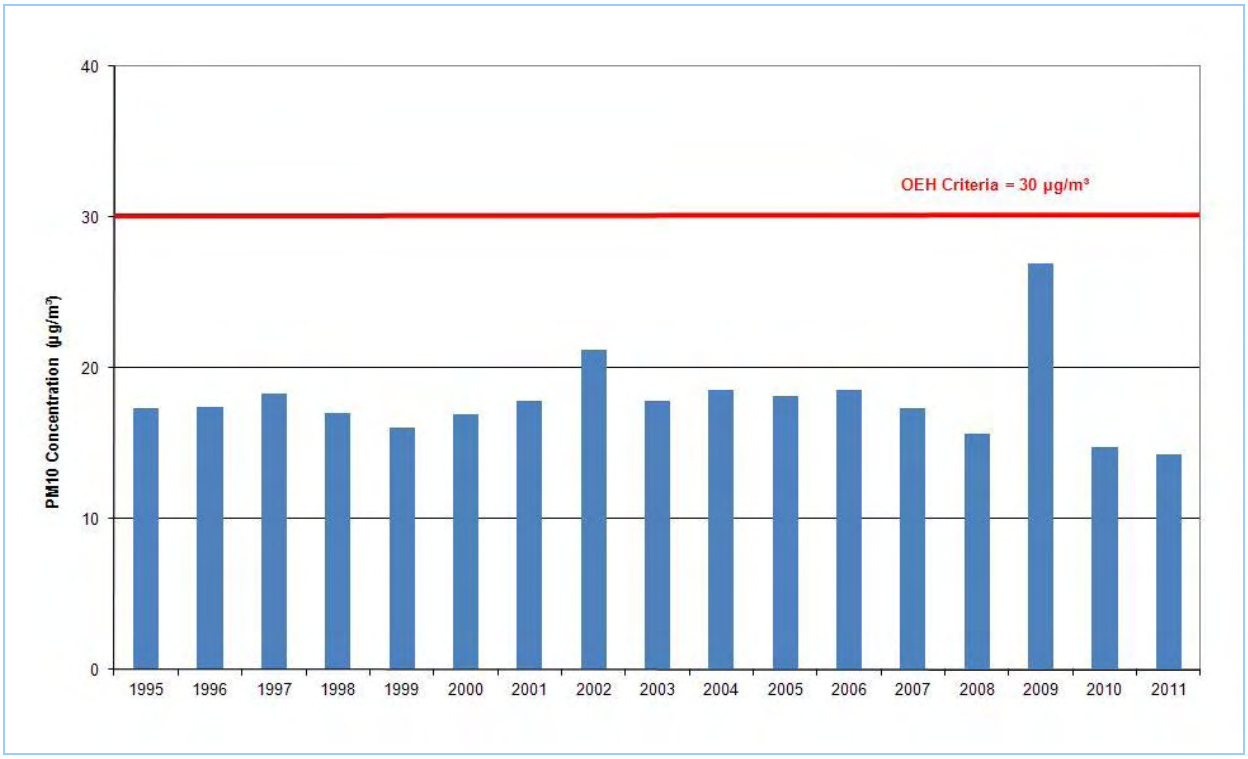

Figure 4.6: Wallsend Air Monitoring Station – TEOM – Annual Average PM_{10} Concentrations

Table 4.6: Wallsend Air Monitoring Station – TEOM - Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
1995	74%	17.3
1996	86%	17.4
1997	84%	18.3
1998	97%	17.0
1999	91%	16.0
2000	57%	16.9
2001	91%	17.8
2002	81%	21.2
2003	90%	17.8
2004	89%	18.5
2005	95%	18.2
2006	98%	18.6
2007	93%	17.4
2008	83%	15.7
2009	92%	26.9
2010	87%	14.7
2011	99%	14.2

4.2 $PM_{2.5}$ Concentrations

4.2.1 Beresfield

24-hour average $PM_{2.5}$ monitoring data are presented for the Beresfield Monitoring Station in Figure 4.7. Summary statistics for the maximum recorded 24-hour $PM_{2.5}$ concentration measured at the Beresfield Monitoring Station are presented in Table 4.7.

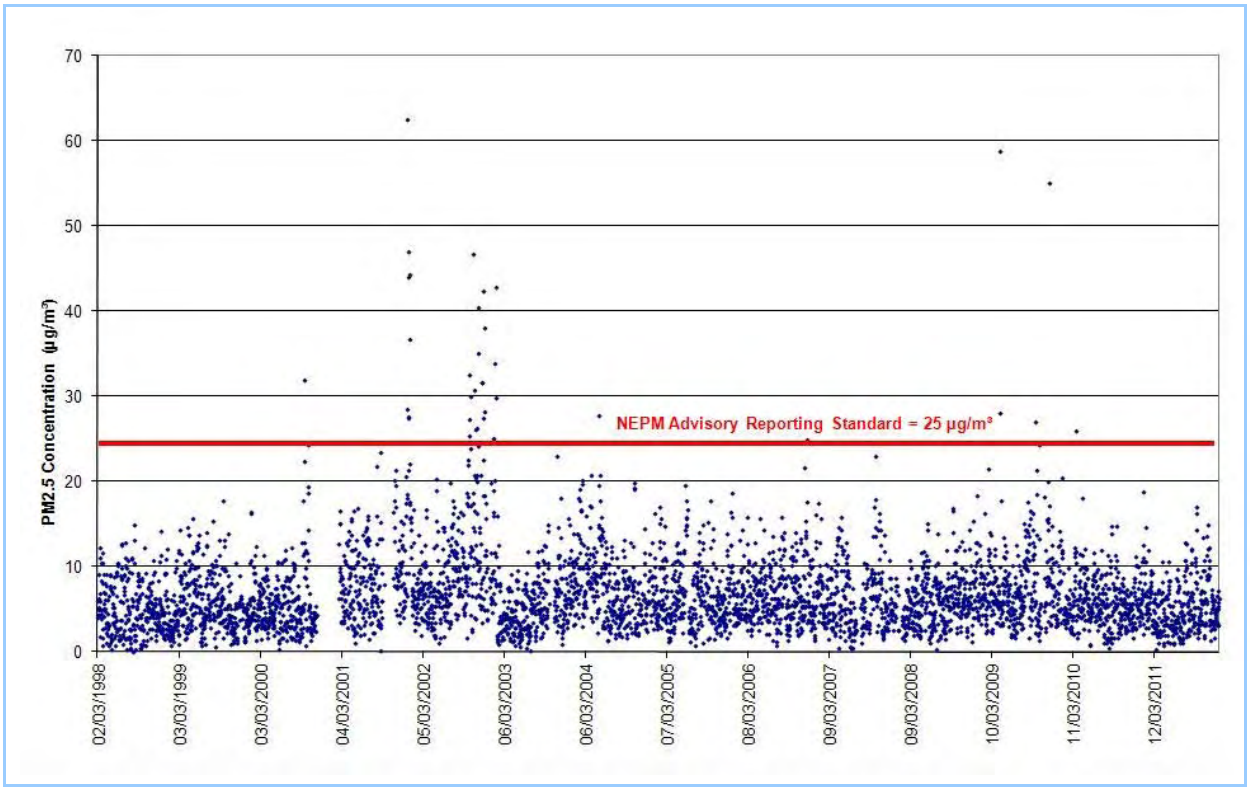

Figure 4.7: Beresfield Air Monitoring Station – TEOM – 24-hour $PM_{2.5}$ Concentrations [5]

[5] chart excludes result for the 23/09/2009 of 231 µg/m³

Table 4.7: Beresfield Air Monitoring Station – TEOM – $PM_{2.5}$ – 24-hour Averages

Year	Concentration (µg/m³)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1998	80%	14.9	14.2	13.1	12.9	12.7	12.6	0
1999	95%	17.8	15.6	15.4	14.7	14.4	14.1	0
2000	85%	31.9	24.4	22.4	19.4	18.6	17.8	1
2001	69%	62.5	44.0	28.5	27.6	27.4	23.5	5
2002#	95%	47.0	46.7	44.4	42.4	40.4	38.1	19
2003	90%	42.9	33.9	29.9	25.0	23.0	20.1	3
2004	90%	27.8	20.7	20.7	20.1	19.8	19.7	1
2005	94%	19.5	18.7	17.8	17.7	17.0	16.7	0
2006	99%	24.9	24.7	21.6	17.6	15.8	15.8	0
2007	86%	23.0	17.9	17.5	17.0	16.3	16.1	0
2008	92%	16.9	16.6	15.4	15.0	14.4	14.3	0
2009*	94%	230.8	58.8	55.0	28.1	27.0	24.3	5
2010	97%	25.9	20.4	18.0	14.8	14.8	14.2	1
2011	99%	18.8	17.0	16.2	14.9	14.6	14.3	0

\# Bushfires in 2002 resulted in elevated particle concentrations

* Dust storms in 2009 resulted in significantly elevated particle concentrations

$PM_{2.5}$ monitoring data averaged annually are presented for the Beresfield Monitoring Station in Figure 4.8. Summary statistics for the annual average $PM_{2.5}$ concentrations are presented in Table 4.8.

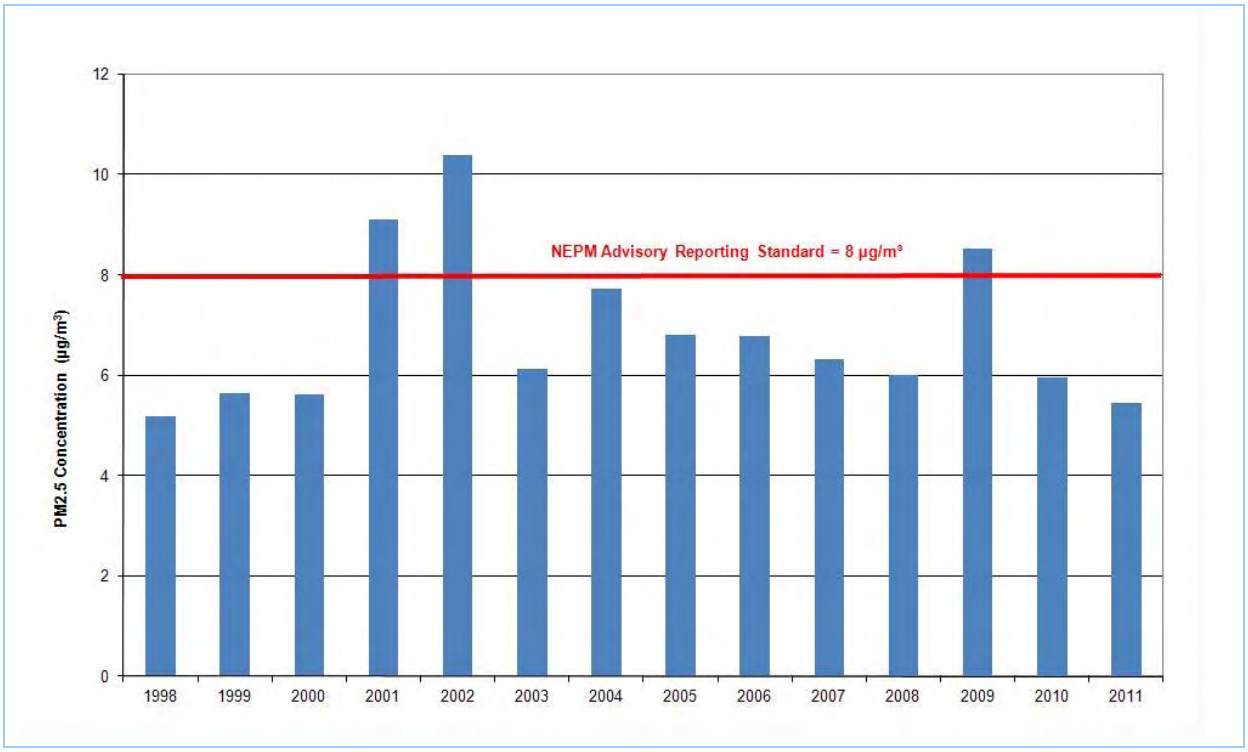

Figure 4.8: Beresfield Air Monitoring Station – TEOM – Annual Average $PM_{2.5}$ Concentrations

Table 4.8: Beresfield Air Monitoring Station - Annual Average $PM_{2.5}$

Year	Percent Data Coverage	Concentration (µg/m³)
1998	80%	5.2
1999	95%	5.6
2000	85%	5.6
2001	69%	9.1
2002	95%	10.4
2003	90%	6.1
2004	90%	7.7
2005	94%	6.8
2006	99%	6.8
2007	86%	6.3
2008	92%	6.0
2009	94%	8.5
2010	97%	6.0
2011	99%	5.5

4.2.2 Wallsend

$PM_{2.5}$ monitoring data averaged over 24 hours are presented for the Beresfield Monitoring Station in Figure 4.9. Summary statistics for the maximum recorded 24-hour $PM_{2.5}$ concentration measured at the Beresfield Monitoring Station are presented in Table 4.9.

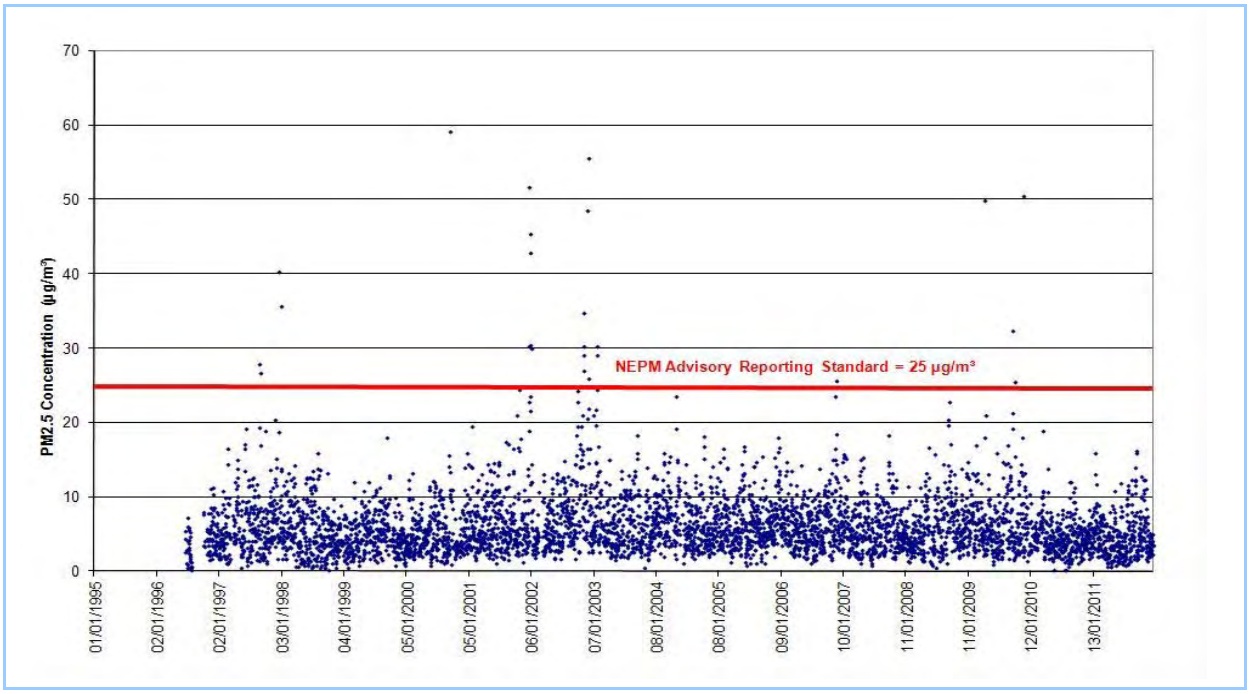

Figure 4.9: Wallsend Air Monitoring Station – TEOM – 24-hour $PM_{2.5}$ Concentrations [6]

Table 4.9: Wallsend Air Monitoring Station – TEOM – $PM_{2.5}$ – 24-hour Averages

Year	Concentration (µg/m³)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1996	27%[a]	11.2	11.1	10.3	8.6	8.6	8.5	0
1997	85%	40.2	27.8	26.7	20.3	19.3	19.2	3
1998	92%	35.6	15.9	14.2	13.7	13.7	13.6	1
1999	88%	18.0	12.9	12.5	11.9	11.9	11.3	0
2000	89%	59.1	15.9	15.5	14.1	13.9	13.3	1
2001	94%	51.7	42.8	30.4	30.3	24.4	23.5	4
2002	85%	55.6	48.5	45.4	34.7	30.3	30.0	9
2003	88%	30.2	29.0	24.4	21.7	21.0	19.6	2
2004	87%	23.5	19.1	18.1	16.7	15.8	15.4	0
2005	95%	18.0	16.8	16.6	16.5	16.1	16.0	0
2006	99%	25.6	23.5	18.4	16.5	14.9	14.9	1
2007	92%	18.2	15.7	15.4	15.2	15.2	15.1	0
2008	87%	22.8	20.3	19.6	17.1	16.6	15.7	0
2009	89%	415.6	50.5	49.8	32.3	25.5	21.2	5
2010	92%	18.8	13.7	12.0	11.9	11.3	10.8	0
2011	100%	16.2	15.8	15.8	13.9	13.0	12.7	0

[a] TEOM operated for part of the year only in the first year of operation.

Bushfires in 2002 resulted in elevated particle concentrations

* Dust storms in 2009 resulted in significantly elevated particle concentrations

[6] chart excludes result for the 23/09/2009 of 416 µg/m³

$PM_{2.5}$ monitoring data averaged annually are presented for the Wallsend Monitoring Station in Figure 4.10. Summary statistics for the annual average $PM_{2.5}$ concentrations are presented in Table 4.10.

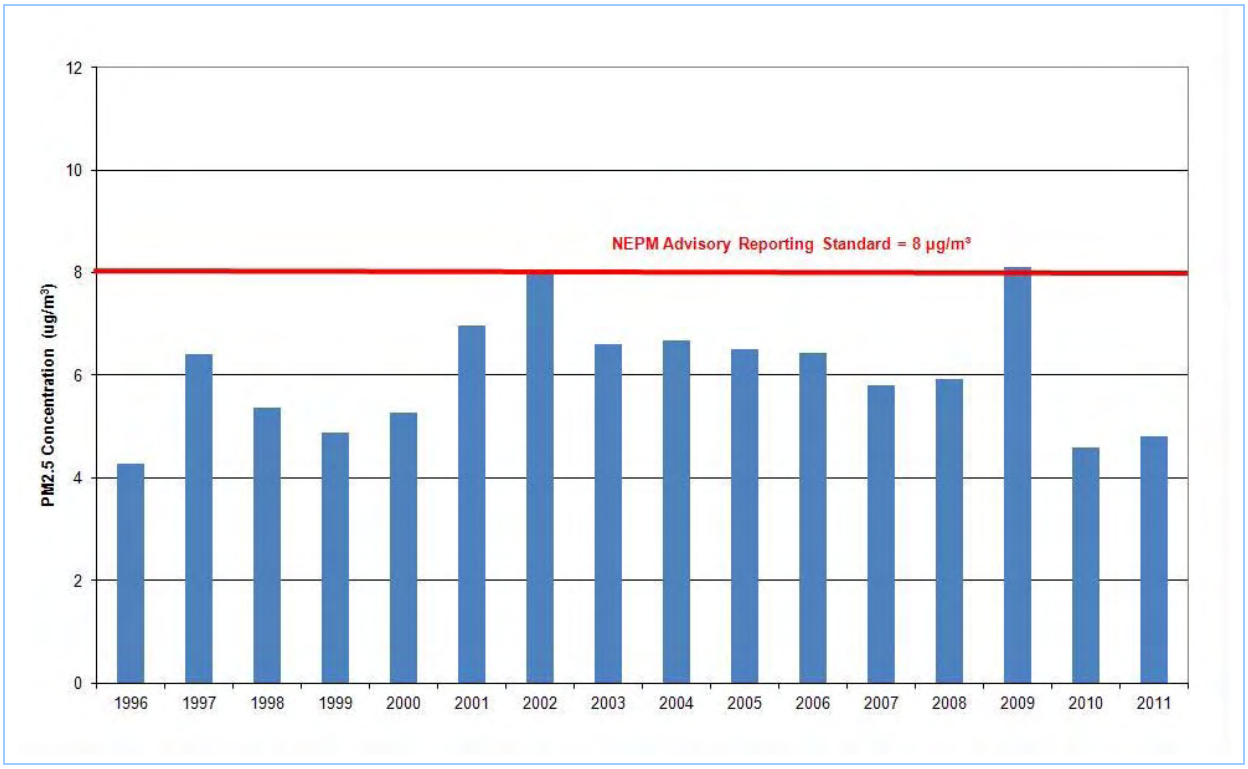

Figure 4.10: Wallsend Air Monitoring Station – TEOM – Annual Average $PM_{2.5}$ Concentrations

Table 4.10: Wallsend Air Monitoring Station - Annual Average $PM_{2.5}$

Year	Percent Data Coverage	Concentration (µg/m³)
1996	27% [a]	4.3
1997	85%	6.4
1998	92%	5.4
1999	88%	4.9
2000	89%	5.3
2001	94%	7.0
2002	85%	8.1
2003	88%	6.6
2004	87%	6.7
2005	95%	6.5
2006	99%	6.4
2007	92%	5.8
2008	87%	5.9
2009	89%	8.1
2010	92%	4.6
2011	100%	4.8

[a] TEOM operated for part of the year only in the first year of operation.

4.3 NO_2 Concentrations

4.3.1 Beresfield

NO_2 monitoring data averaged over 1 hour are presented for the Beresfield Monitoring Station in Figure 4.11. Data presented in Figure 4.11 are the daily maximum 1 hour average NO_2 concentration. Summary statistics for the maximum recorded daily 1 hour average NO_2 concentration measured at the Beresfield Monitoring Station are presented in Table 4.11.

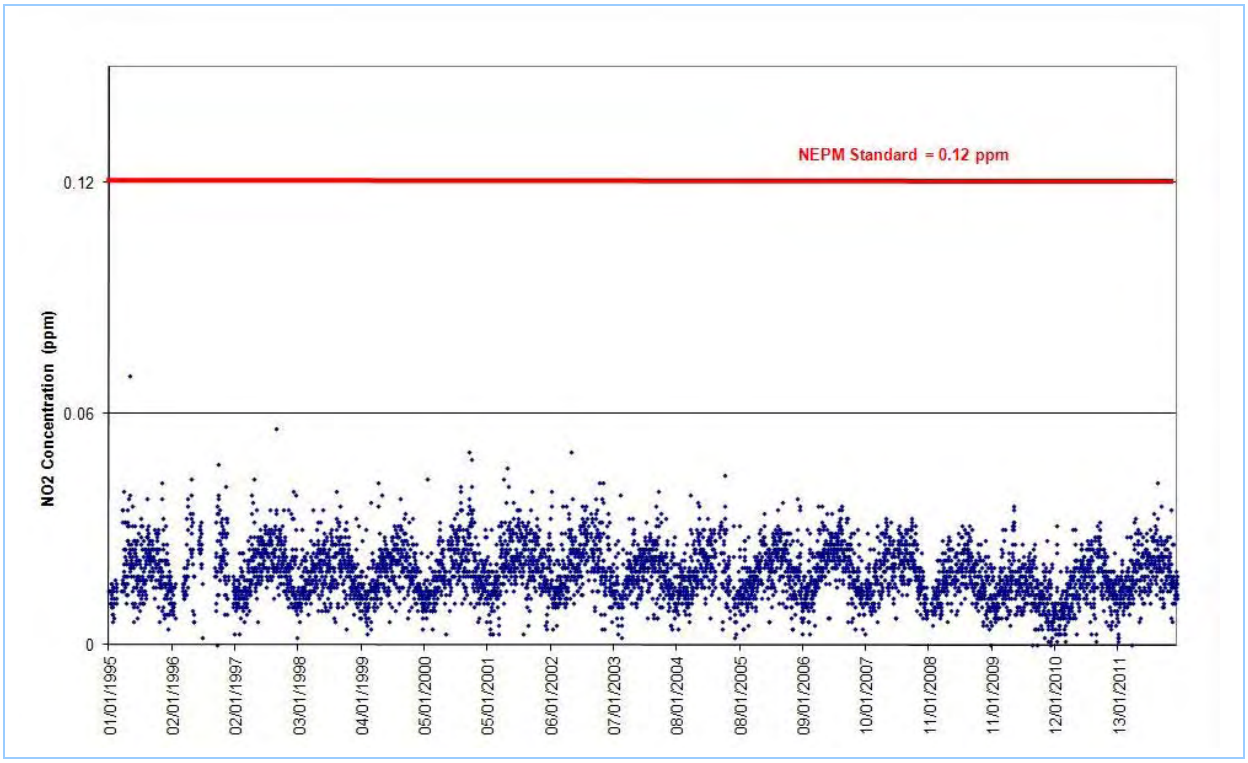

Figure 4.11: Beresfield Air Monitoring Station – AM-12 – 1 Hour Daily Maximum NO_2 Concentrations

Table 4.11: Beresfield Air Monitoring Station –AM-12 – NO_2 – 1 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	85%	0.070	0.042	0.040	0.039	0.038	0.038	0
1996	45%	0.047	0.043	0.041	0.039	0.039	0.038	0
1997	100%	0.056	0.043	0.040	0.039	0.039	0.037	0
1998	99%	0.040	0.036	0.035	0.035	0.033	0.033	0
1999	96%	0.042	0.039	0.038	0.037	0.036	0.034	0
2000	95%	0.050	0.048	0.043	0.041	0.041	0.040	0
2001	98%	0.046	0.043	0.041	0.040	0.037	0.037	0
2002	94%	0.050	0.042	0.042	0.040	0.038	0.038	0
2003	95%	0.040	0.039	0.036	0.034	0.033	0.033	0
2004	85%	0.044	0.039	0.037	0.036	0.036	0.033	0
2005	97%	0.038	0.037	0.036	0.035	0.035	0.034	0
2006	94%	0.036	0.036	0.036	0.035	0.035	0.034	0
2007	92%	0.033	0.033	0.032	0.032	0.032	0.031	0
2008	87%	0.031	0.031	0.030	0.030	0.029	0.029	0
2009	99%	0.036	0.035	0.032	0.032	0.031	0.031	0
2010	96%	0.032	0.031	0.031	0.030	0.030	0.030	0
2011	95%	0.042	0.036	0.035	0.034	0.033	0.033	0

NO_2 monitoring data averaged annually are presented for the Beresfield Monitoring Station in Figure 4.12. Summary statistics for the annual average NO_2 concentrations are presented in Table 4.12.

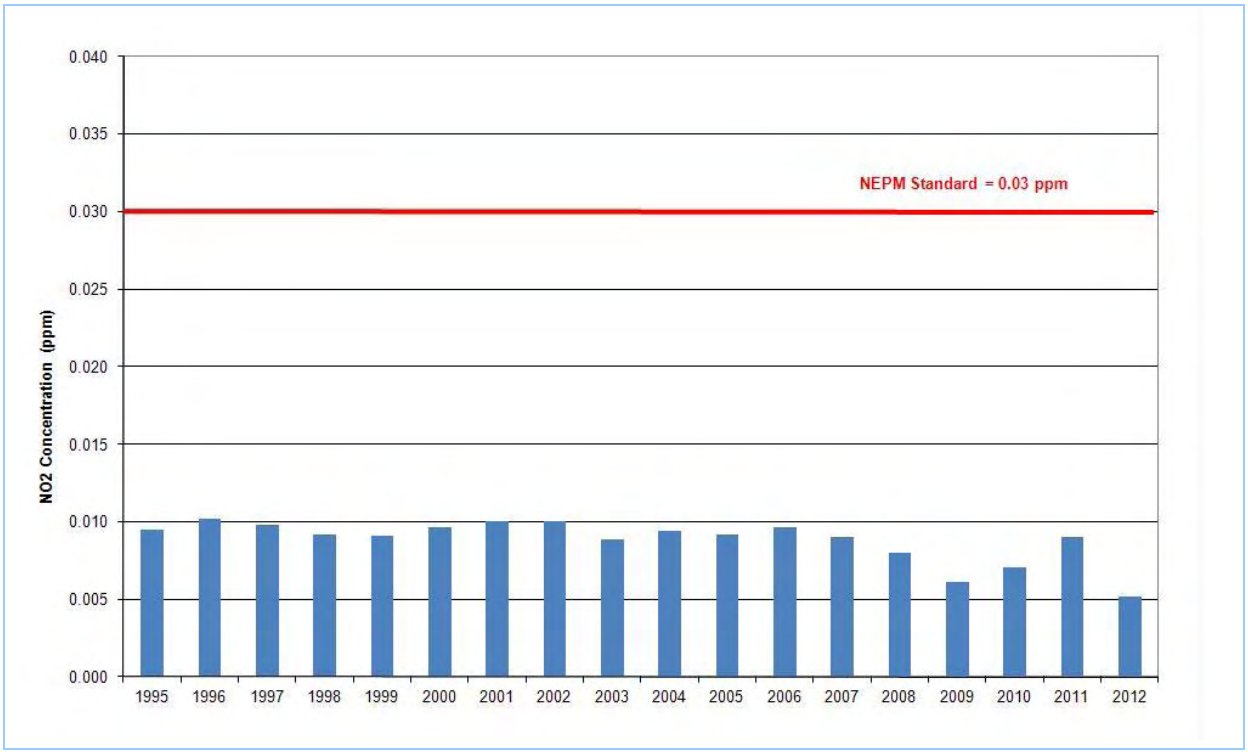

Figure 4.12: Beresfield Air Monitoring Station – Annual Average NO_2 Concentrations

Table 4.12: Beresfield Air Monitoring Station - Annual Average NO_2

Year	Percent Data Coverage	Concentration (ppm)
1995	85%	0.0095
1996	45%	0.0102
1997	100%	0.0098
1998	99%	0.0091
1999	96%	0.0091
2000	95%	0.0096
2001	98%	0.0101
2002	94%	0.0100
2003	95%	0.0088
2004	85%	0.0094
2005	97%	0.0091
2006	94%	0.0096
2007	92%	0.0090
2008	87%	0.0080
2009	99%	0.0061
2010	96%	0.0071
2011	95%	0.0090

4.3.2 Newcastle

NO_2 monitoring data averaged over 1 hour are presented for the Newcastle Monitoring Station in Figure 4.13. Data presented in Figure 4.13 are the daily maximum 1 hour average NO_2 concentration. Summary statistics for the maximum recorded daily 1 hour average NO_2 concentration measured at the Newcastle Monitoring Station are presented in Table 4.13.

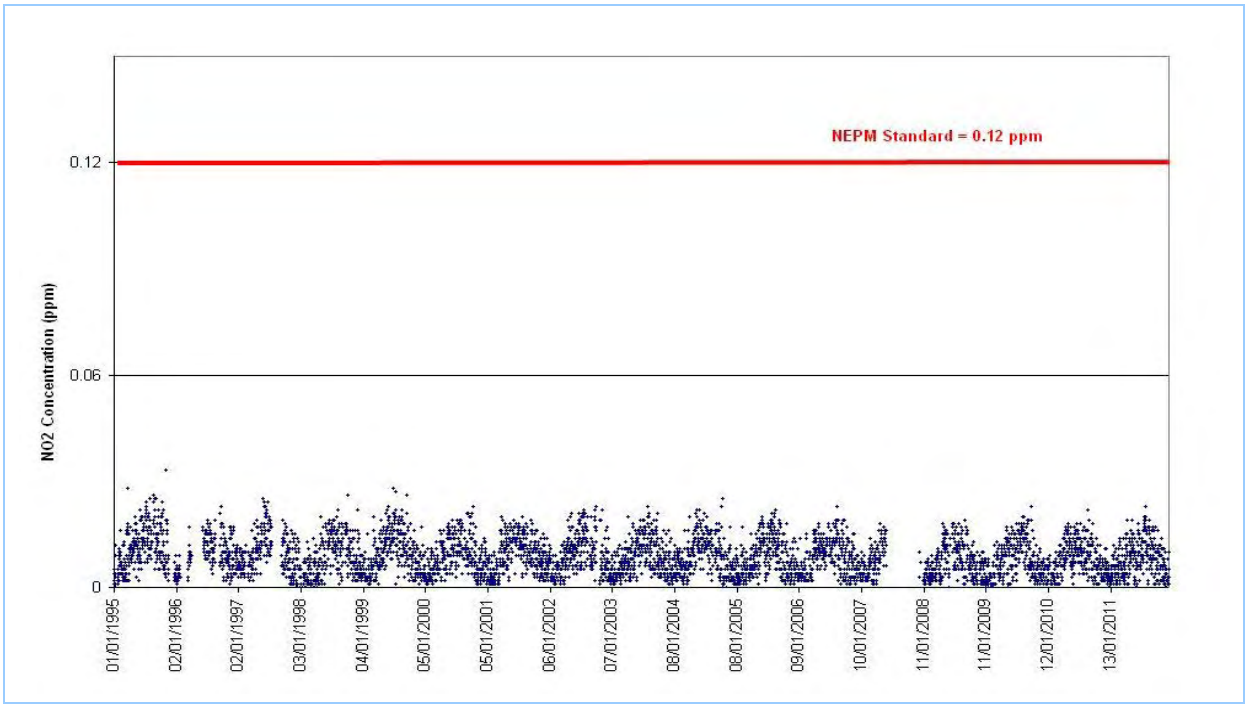

Figure 4.13: Newcastle Air Monitoring Station – AM-12 – 1 Hour Daily Maximum NO_2 Concentrations

Table 4.13: Newcastle Air Monitoring Station –AM-12 – NO_2 – 1 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	85%	0.070	0.042	0.040	0.039	0.038	0.038	0
1996	45%	0.047	0.043	0.041	0.039	0.039	0.038	0
1997	100%	0.056	0.043	0.040	0.039	0.039	0.037	0
1998	99%	0.040	0.036	0.035	0.035	0.033	0.033	0
1999	96%	0.042	0.039	0.038	0.037	0.036	0.034	0
2000	95%	0.050	0.048	0.043	0.041	0.041	0.040	0
2001	98%	0.046	0.043	0.041	0.040	0.037	0.037	0
2002	94%	0.050	0.042	0.042	0.040	0.038	0.038	0
2003	95%	0.040	0.039	0.036	0.034	0.033	0.033	0
2004	85%	0.044	0.039	0.037	0.036	0.036	0.033	0
2005	97%	0.038	0.037	0.036	0.035	0.035	0.034	0
2006	94%	0.036	0.036	0.036	0.035	0.035	0.034	0
2007	92%	0.033	0.033	0.032	0.032	0.032	0.031	0
2008	87%	0.031	0.031	0.030	0.030	0.029	0.029	0
2009	99%	0.036	0.035	0.032	0.032	0.031	0.031	0
2010	96%	0.032	0.031	0.031	0.030	0.030	0.030	0
2011	95%	0.042	0.036	0.035	0.034	0.033	0.033	0

NO_2 monitoring data averaged annually are presented for the Newcastle Monitoring Station in Figure 4.14. Summary statistics for the annual average NO_2 concentrations are presented in Table 4.14.

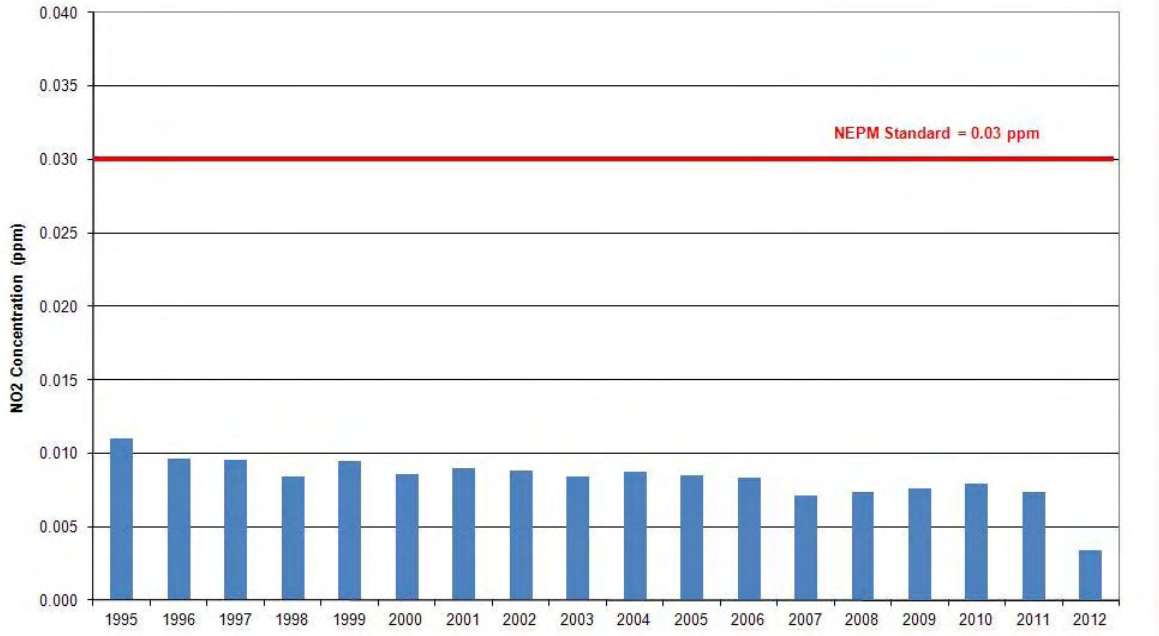

Figure 4.14: Newcastle Air Monitoring Station – Annual Average NO_2 Concentrations

Table 4.14: Newcastle Air Monitoring Station - Annual Average NO_2

Year	Percent Data Coverage	Concentration (ppm)
1995	85%	0.0110
1996	45%	0.0096
1997	100%	0.0095
1998	99%	0.0084
1999	96%	0.0095
2000	95%	0.0086
2001	98%	0.0090
2002	94%	0.0088
2003	95%	0.0084
2004	85%	0.0087
2005	97%	0.0085
2006	94%	0.0084
2007	92%	0.0071
2008	87%	0.0073
2009	99%	0.0076
2010	96%	0.0079
2011	95%	0.0074

4.3.3 Wallsend

NO_2 monitoring data averaged over 1 hour are presented for the Wallsend Monitoring Station in Figure 4.15. Data presented in Figure 4.15 are the daily maximum 1 hour average NO_2 concentration.

Summary statistics for the maximum recorded daily 1 hour average NO_2 concentration measured at the Wallsend Monitoring Station are presented in Table 4.15.

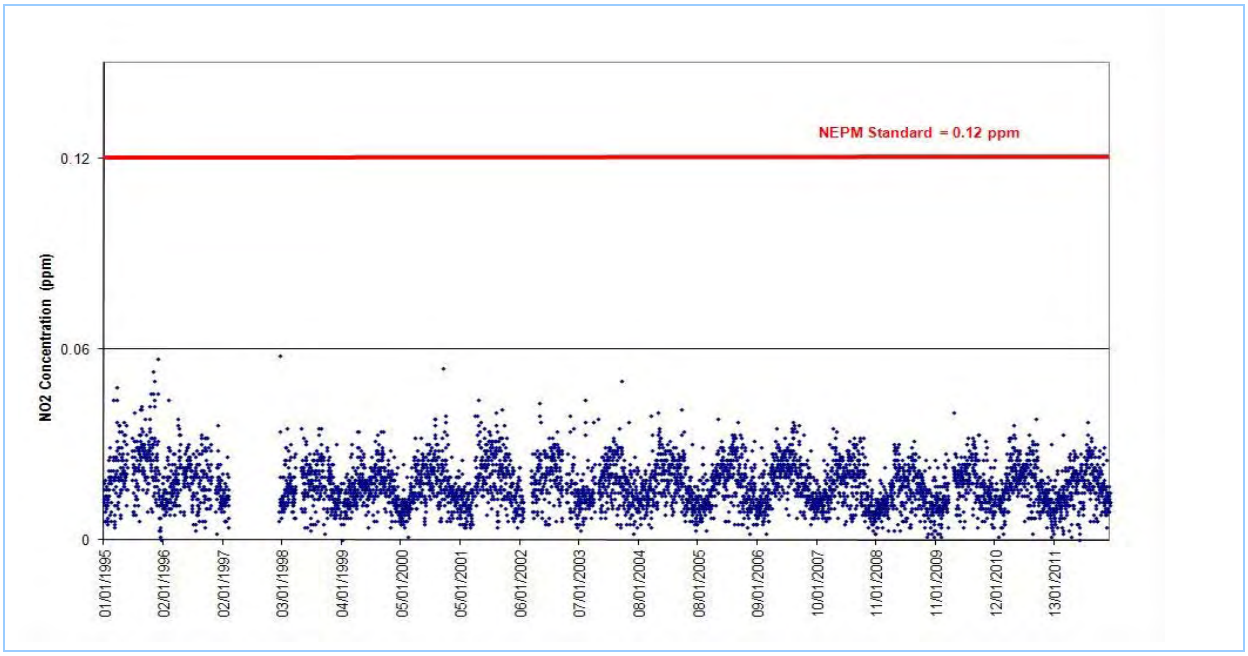

Figure 4.15: Wallsend Air Monitoring Station – AM-12 – 1 Hour Daily Maximum NO_2 Concentrations

Table 4.15: Wallsend Air Monitoring Station –AM-12 – NO_2 – 1 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	88%	0.057	0.053	0.050	0.048	0.046	0.046	0
1996	85%	0.044	0.038	0.036	0.036	0.035	0.033	0
1997	13%	0.058	0.034	0.026	0.021	0.020	0.020	0
1998	87%	0.035	0.035	0.035	0.035	0.033	0.032	0
1999	95%	0.034	0.034	0.034	0.034	0.033	0.031	0
2000	99%	0.054	0.039	0.038	0.038	0.037	0.036	0
2001	95%	0.044	0.041	0.040	0.039	0.039	0.037	0
2002	70%	0.043	0.039	0.039	0.037	0.035	0.034	0
2003	91%	0.050	0.044	0.038	0.037	0.037	0.037	0
2004	99%	0.041	0.040	0.039	0.035	0.034	0.034	0
2005	98%	0.038	0.037	0.033	0.033	0.033	0.032	0
2006	97%	0.037	0.036	0.036	0.035	0.035	0.035	0
2007	100%	0.035	0.034	0.032	0.032	0.032	0.032	0
2008	95%	0.031	0.030	0.030	0.029	0.029	0.029	0
2009	90%	0.040	0.033	0.033	0.032	0.032	0.031	0
2010	96%	0.038	0.036	0.033	0.033	0.032	0.032	0
2011	96%	0.037	0.033	0.033	0.032	0.031	0.030	0

NO_2 monitoring data averaged annually are presented for the Wallsend Monitoring Station in Figure 4.16. Summary statistics for the annual average NO_2 concentrations are presented in Table 4.16.

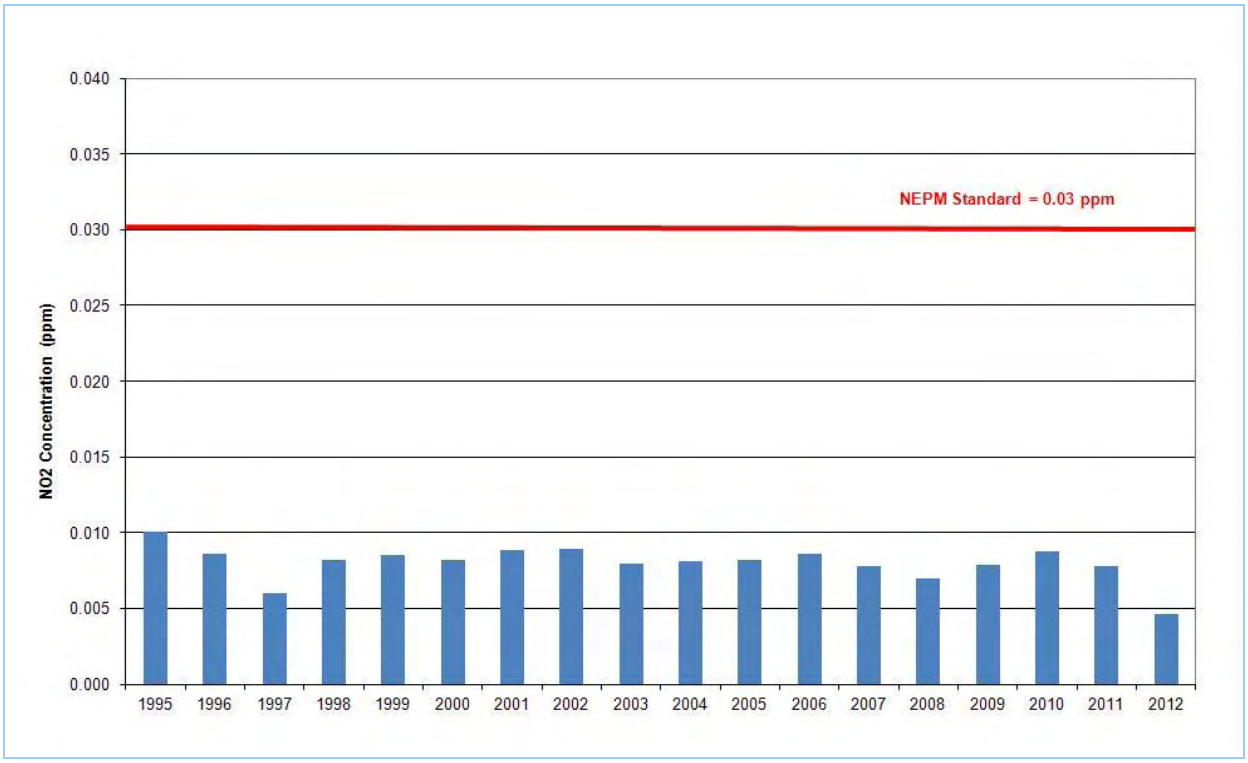

Figure 4.16: Wallsend Air Monitoring Station – Annual Average NO_2 Concentrations

Table 4.16: Wallsend Air Monitoring Station - Annual Average NO_2

Year	Percent Data Coverage	Concentration (ppm)
1995	88%	0.0101
1996	85%	0.0086
1997	13%	0.0060
1998	87%	0.0082
1999	95%	0.0086
2000	99%	0.0082
2001	95%	0.0088
2002	70%	0.0089
2003	91%	0.0080
2004	99%	0.0081
2005	98%	0.0082
2006	97%	0.0086
2007	100%	0.0078
2008	95%	0.0070
2009	90%	0.0079
2010	96%	0.0088
2011	96%	0.0078

4.4 SO_2 Concentrations

4.4.1 Beresfield

SO_2 monitoring data averaged over 1 hour are presented for the Beresfield Monitoring Station in Figure 4.17. Data presented in Figure 4.17 are the daily maximum 1 hour average SO_2 concentration. Summary statistics for the maximum recorded daily 1 hour average SO_2 concentration measured at the Beresfield Monitoring Station are presented in Table 4.17.

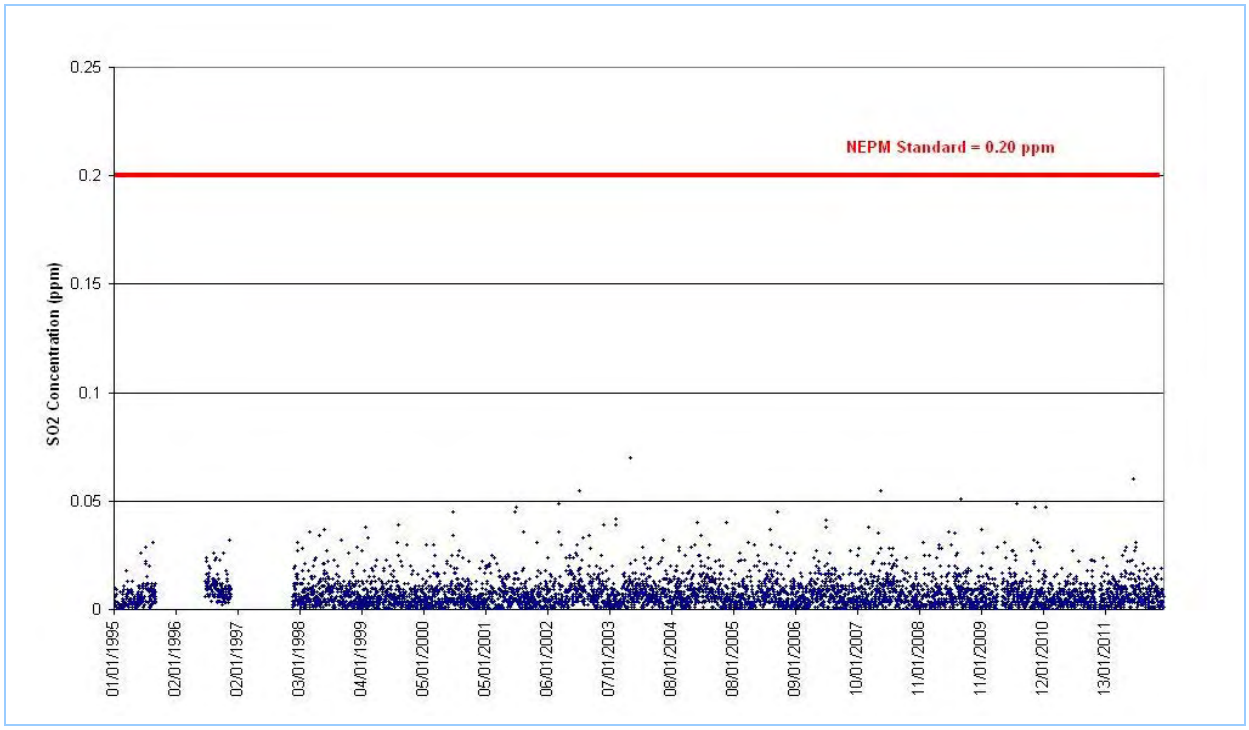

Figure 4.17: Beresfield Air Monitoring Station – AM-20 – 1 Hour Daily Maximum SO_2 Concentrations

Table 4.17: Beresfield Air Monitoring Station –AM-20 – SO_2 – 1 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	58%	0.031	0.029	0.026	0.022	0.021	0.020	0
1996	39%	0.032	0.026	0.026	0.024	0.024	0.023	0
1997	12%	0.031	0.027	0.020	0.019	0.016	0.016	0
1998	98%	0.037	0.036	0.034	0.032	0.029	0.028	0
1999	97%	0.039	0.038	0.033	0.031	0.030	0.027	0
2000	98%	0.045	0.034	0.030	0.030	0.027	0.025	0
2001	97%	0.047	0.045	0.036	0.031	0.025	0.024	0
2002	94%	0.055	0.049	0.039	0.036	0.034	0.033	0
2003	100%	0.070	0.042	0.039	0.032	0.029	0.024	0
2004	96%	0.040	0.040	0.034	0.030	0.030	0.029	0
2005	94%	0.045	0.037	0.031	0.030	0.030	0.029	0
2006	99%	0.041	0.038	0.027	0.027	0.026	0.024	0
2007	94%	0.055	0.038	0.035	0.028	0.028	0.028	0
2008	92%	0.051	0.036	0.035	0.031	0.030	0.030	0
2009	93%	0.049	0.047	0.037	0.032	0.031	0.031	0
2010	94%	0.047	0.027	0.024	0.023	0.023	0.022	0
2011	97%	0.060	0.031	0.029	0.029	0.027	0.027	0

SO_2 monitoring data averaged over 24 hours are presented for the Beresfield Monitoring Station in Figure 4.18. Summary statistics for the maximum recorded 24-hour SO_2 concentration measured at the Beresfield Monitoring Station are presented in Table 4.18.

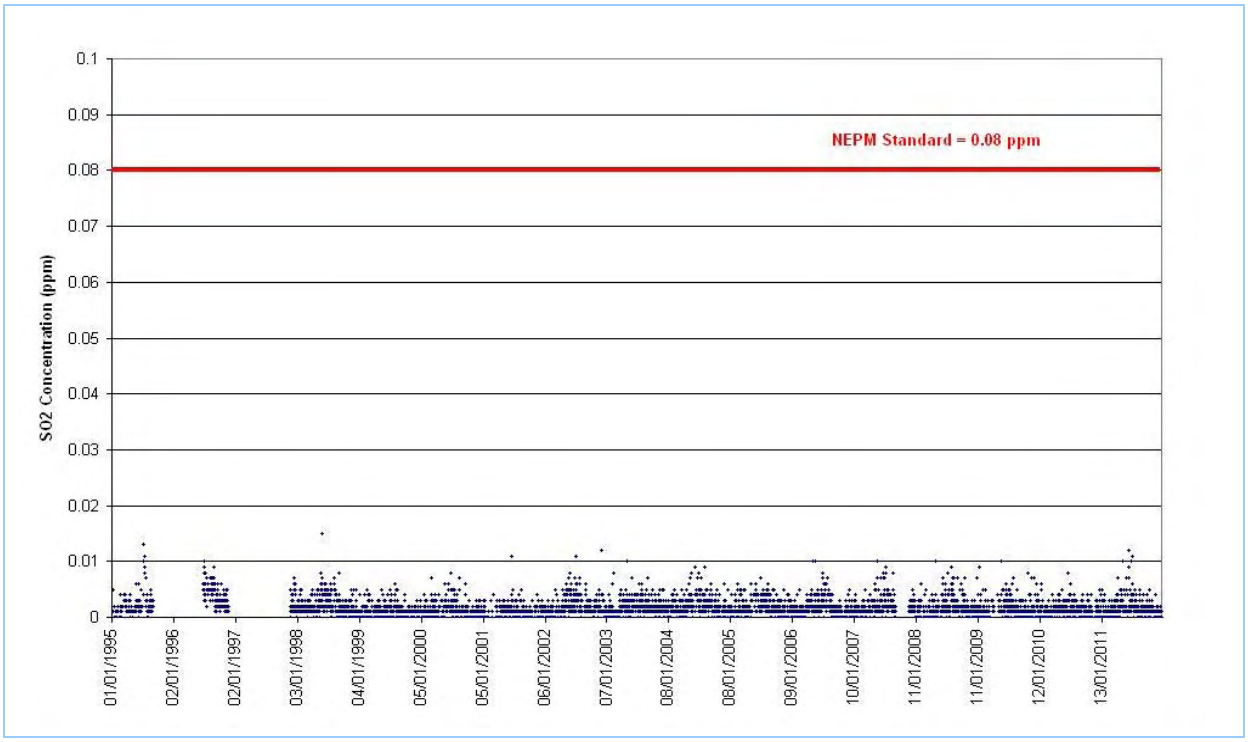

Figure 4.18: Beresfield Air Monitoring Station – AM-20 – 24-hour SO_2 Concentrations

Table 4.18: Beresfield Air Monitoring Station –AM-20 – SO_2 – 24 Hour Averages

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	42%	0.013	0.013	0.013	0.011	0.010	0.009	0
1996	37%	0.010	0.009	0.009	0.008	0.008	0.008	0
1997	11%	0.007	0.006	0.006	0.005	0.005	0.005	0
1998	96%	0.015	0.008	0.008	0.007	0.007	0.006	0
1999	93%	0.006	0.005	0.005	0.005	0.005	0.005	0
2000	95%	0.008	0.007	0.007	0.006	0.006	0.006	0
2001	80%	0.011	0.005	0.005	0.004	0.004	0.004	0
2002	92%	0.012	0.011	0.008	0.007	0.007	0.007	0
2003	99%	0.010	0.008	0.007	0.007	0.006	0.006	0
2004	92%	0.009	0.009	0.008	0.008	0.007	0.007	0
2005	89%	0.007	0.006	0.006	0.006	0.006	0.005	0
2006	96%	0.010	0.010	0.008	0.007	0.007	0.006	0
2007	73%	0.010	0.009	0.008	0.008	0.008	0.007	0
2008	88%	0.010	0.009	0.008	0.007	0.007	0.007	0
2009	91%	0.010	0.009	0.008	0.007	0.007	0.007	0
2010	91%	0.008	0.006	0.006	0.005	0.005	0.005	0
2011	98%	0.012	0.011	0.010	0.010	0.009	0.007	0

SO_2 monitoring data averaged annually are presented for the Beresfield Monitoring Station in Figure 4.19. Summary statistics for the annual average SO_2 concentrations are presented in Table 4.19.

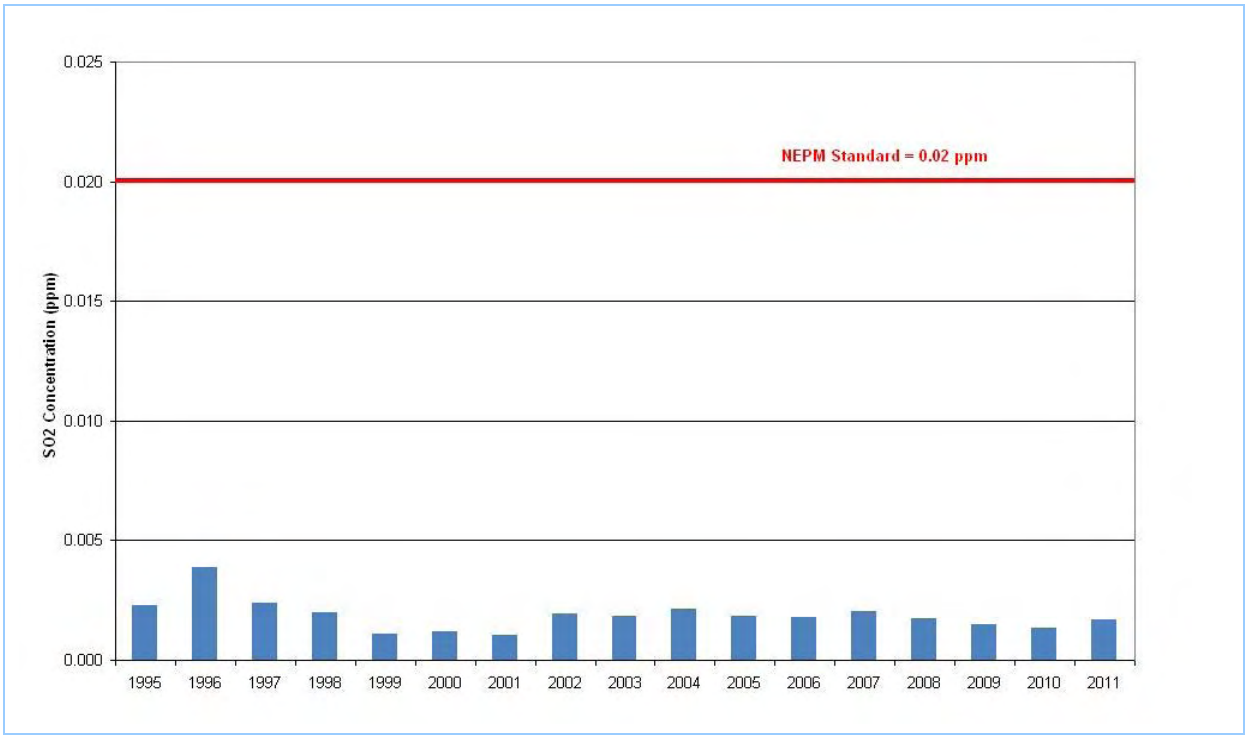

Figure 4.19: Beresfield Air Monitoring Station – Annual Average SO_2 Concentrations

Table 4.19: Beresfield Air Monitoring Station - Annual Average SO_2

Year	Percent Data Coverage	Concentration (ppm)
1995	42%	0.0023
1996	37%	0.0039
1997	11%	0.0024
1998	96%	0.0020
1999	93%	0.0011
2000	95%	0.0012
2001	80%	0.0010
2002	92%	0.0019
2003	99%	0.0018
2004	92%	0.0021
2005	89%	0.0018
2006	96%	0.0018
2007	73%	0.0020
2008	88%	0.0017
2009	91%	0.0015
2010	91%	0.0013
2011	98%	0.0017

4.4.2 Newcastle

SO_2 monitoring data averaged over 1 hour are presented for the Newcastle Monitoring Station in Figure 4.20. Data presented in Figure 4.20 are the daily maximum 1 hour average SO_2 concentration. Summary statistics for the maximum recorded daily 1 hour average SO_2 concentration measured at the Newcastle Monitoring Station are presented in Table 4.20.

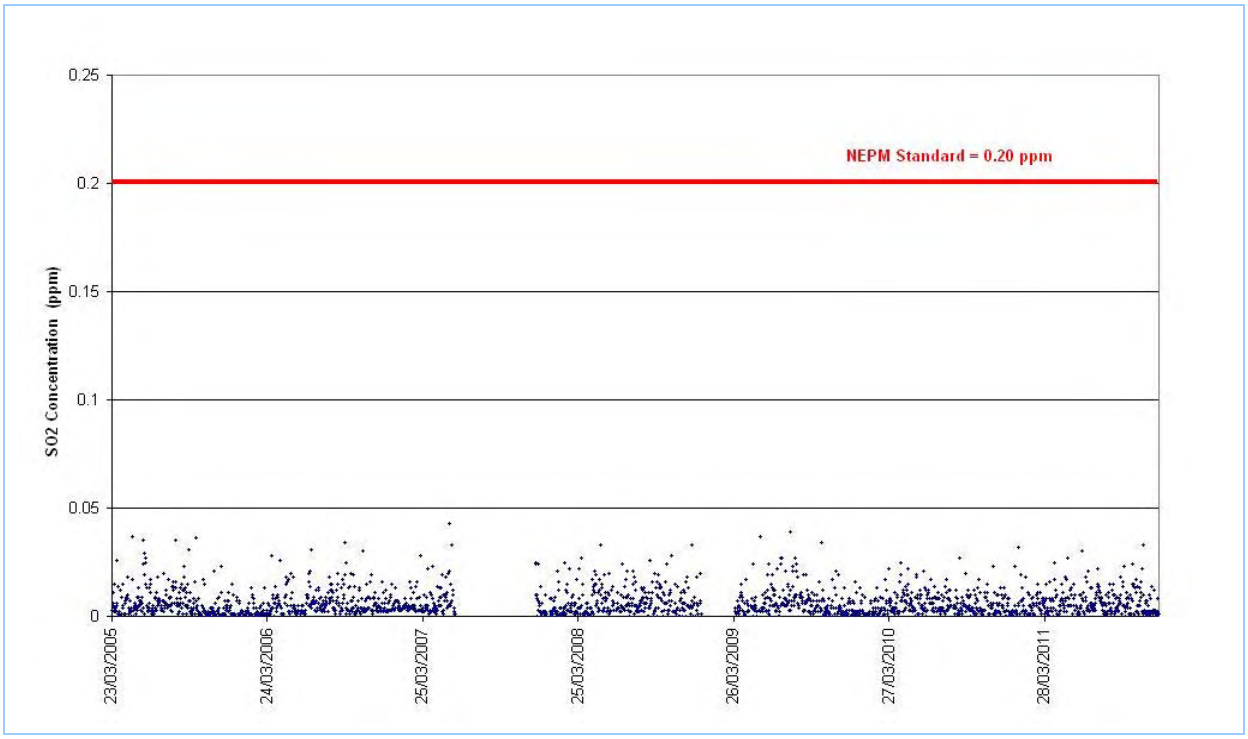

Figure 4.20: Newcastle Air Monitoring Station – AM-20 – 1 Hour Daily Maximum SO_2 Concentrations

Table 4.20: Newcastle Air Monitoring Station –AM-20– SO_2 – 1 Hour Daily Maximum

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2005	77%	0.037	0.036	0.035	0.035	0.031	0.029	0
2006	99%	0.034	0.031	0.030	0.028	0.026	0.025	0
2007	48%	0.043	0.033	0.028	0.025	0.024	0.024	0
2008	95%	0.033	0.033	0.028	0.027	0.026	0.025	0
2009	76%	0.039	0.037	0.034	0.027	0.027	0.027	0
2010	97%	0.027	0.025	0.023	0.022	0.022	0.021	0
2011	97%	0.033	0.032	0.030	0.027	0.025	0.024	0

SO_2 monitoring data averaged over 24 hours are presented for the Newcastle Monitoring Station in Figure 4.21. Summary statistics for the maximum recorded 24-hour SO_2 concentration measured at the Newcastle Monitoring Station are presented in Table 4.21.

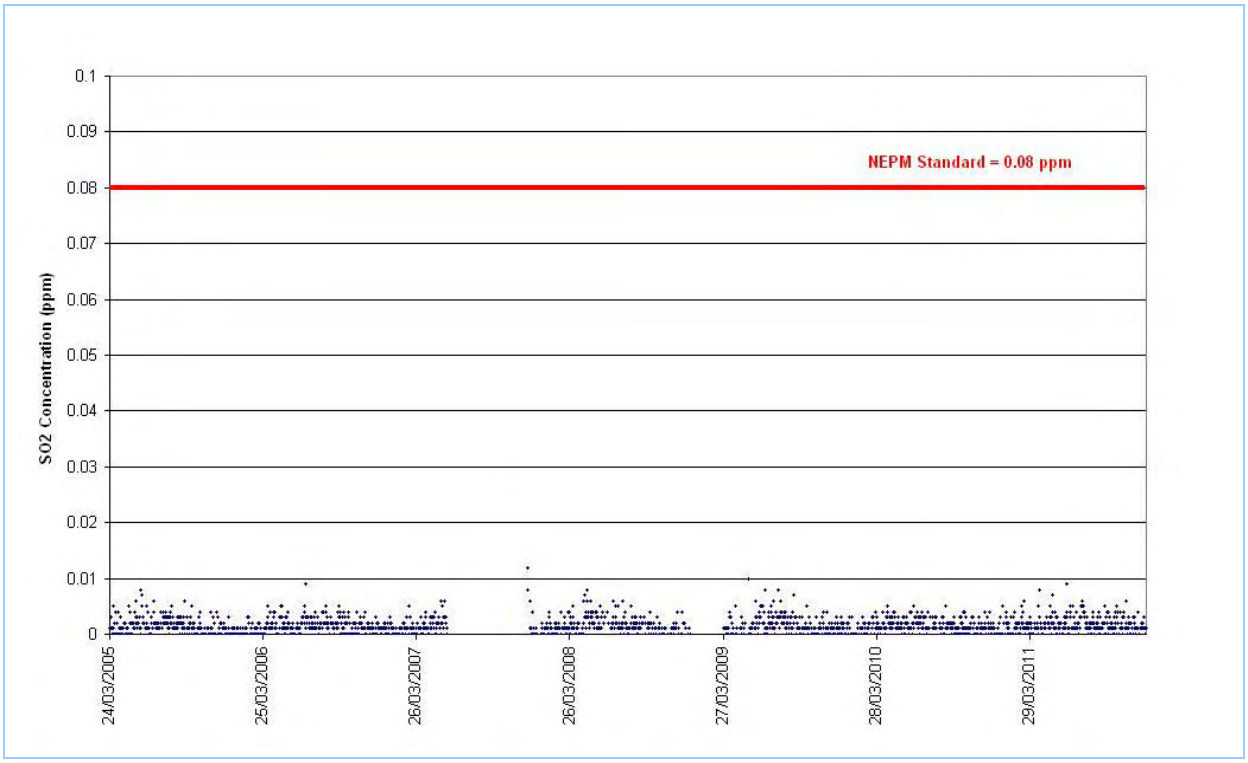

Figure 4.21: Newcastle Air Monitoring Station – AM-20 – 24-hour SO_2 Concentrations

Table 4.21: Newcastle Air Monitoring Station –AM-20 – SO_2 – 24-hour Averages

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2005	75%	0.008	0.007	0.006	0.006	0.006	0.005	0
2006	97%	0.009	0.005	0.005	0.005	0.005	0.005	0
2007	46%	0.012	0.012	0.008	0.006	0.006	0.006	0
2008	90%	0.008	0.007	0.006	0.006	0.006	0.006	0
2009	73%	0.010	0.008	0.008	0.007	0.006	0.006	0
2010	92%	0.005	0.005	0.005	0.004	0.004	0.004	0
2011	99%	0.009	0.008	0.007	0.006	0.006	0.006	0

SO_2 monitoring data averaged annually are presented for the Newcastle Monitoring Station in Figure 4.22. Summary statistics for the annual average SO_2 concentrations are presented in Table 4.22.

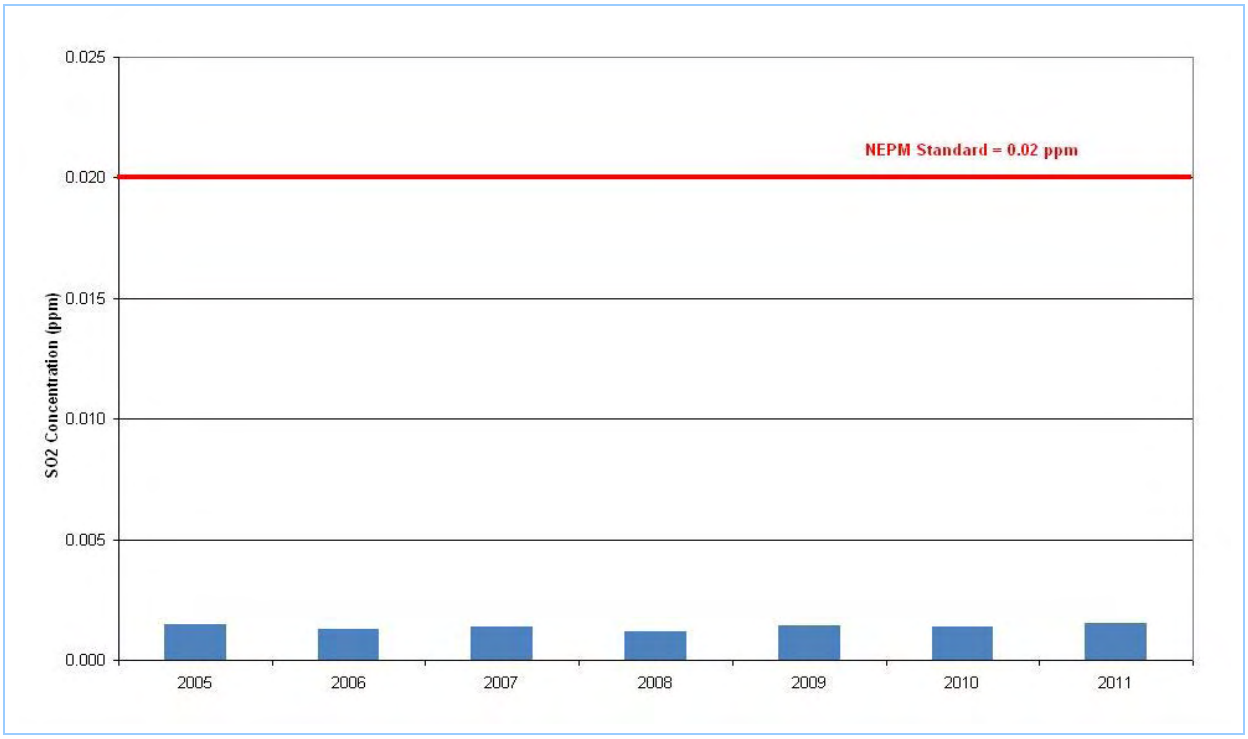

Figure 4.22: Newcastle Air Monitoring Station – Annual Average SO_2 Concentrations

Table 4.22: Newcastle Air Monitoring Station - Annual Average SO_2

Year	Percent Data Coverage	Concentration (ppm)
2005	75%	0.0015
2006	97%	0.0013
2007	46%	0.0014
2008	90%	0.0012
2009	73%	0.0014
2010	92%	0.0014
2011	99%	0.0015

4.4.3 Wallsend

SO_2 monitoring data averaged over 1 hour are presented for the Wallsend Monitoring Station in Figure 4.23. Data presented in Figure 4.23 are the daily maximum 1 hour average SO_2 concentration. Summary statistics for the maximum recorded daily 1 hour average SO_2 concentration measured at the Wallsend Monitoring Station are presented in Table 4.23.

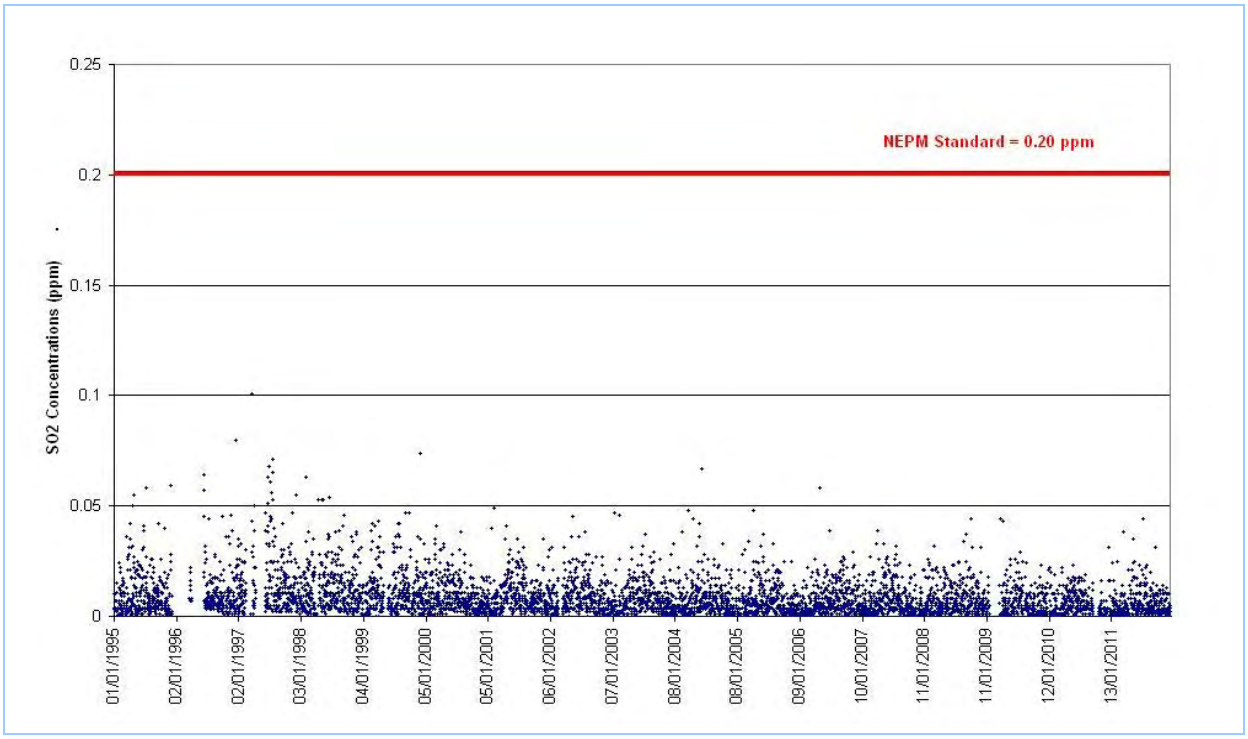

Figure 4.23: Wallsend Air Monitoring Station – AM-20 – 1 Hour Daily Maximum SO_2 Concentrations

Table 4.23: Wallsend Air Monitoring Station –AM-20– SO_2 – 1 Hour Daily Maximum

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	90%	0.059	0.058	0.055	0.050	0.042	0.042	0
1996	56%	0.080	0.064	0.057	0.057	0.046	0.045	0
1997	76%	0.101	0.071	0.071	0.068	0.065	0.063	0
1998	93%	0.063	0.054	0.053	0.053	0.053	0.046	0
1999	89%	0.074	0.047	0.047	0.043	0.042	0.042	0
2000	99%	0.041	0.038	0.035	0.033	0.033	0.031	0
2001	94%	0.049	0.041	0.040	0.035	0.035	0.035	0
2002	89%	0.045	0.038	0.036	0.036	0.031	0.031	0
2003	96%	0.047	0.046	0.037	0.033	0.032	0.031	0
2004	97%	0.067	0.048	0.044	0.042	0.038	0.036	0
2005	98%	0.048	0.037	0.034	0.033	0.032	0.030	0
2006	99%	0.058	0.039	0.029	0.027	0.026	0.026	0
2007	96%	0.039	0.033	0.033	0.032	0.028	0.027	0
2008	99%	0.044	0.037	0.034	0.032	0.031	0.031	0
2009	78%	0.044	0.043	0.029	0.026	0.026	0.025	0
2010	81%	0.031	0.023	0.022	0.022	0.021	0.020	0
2011	97%	0.044	0.038	0.035	0.031	0.025	0.025	0

SO_2 monitoring data averaged over 24 hours are presented for the Wallsend Monitoring Station in Figure 4.24. Summary statistics for the maximum recorded 24-hour SO_2 concentration measured at the Wallsend Monitoring Station are presented in Table 4.24.

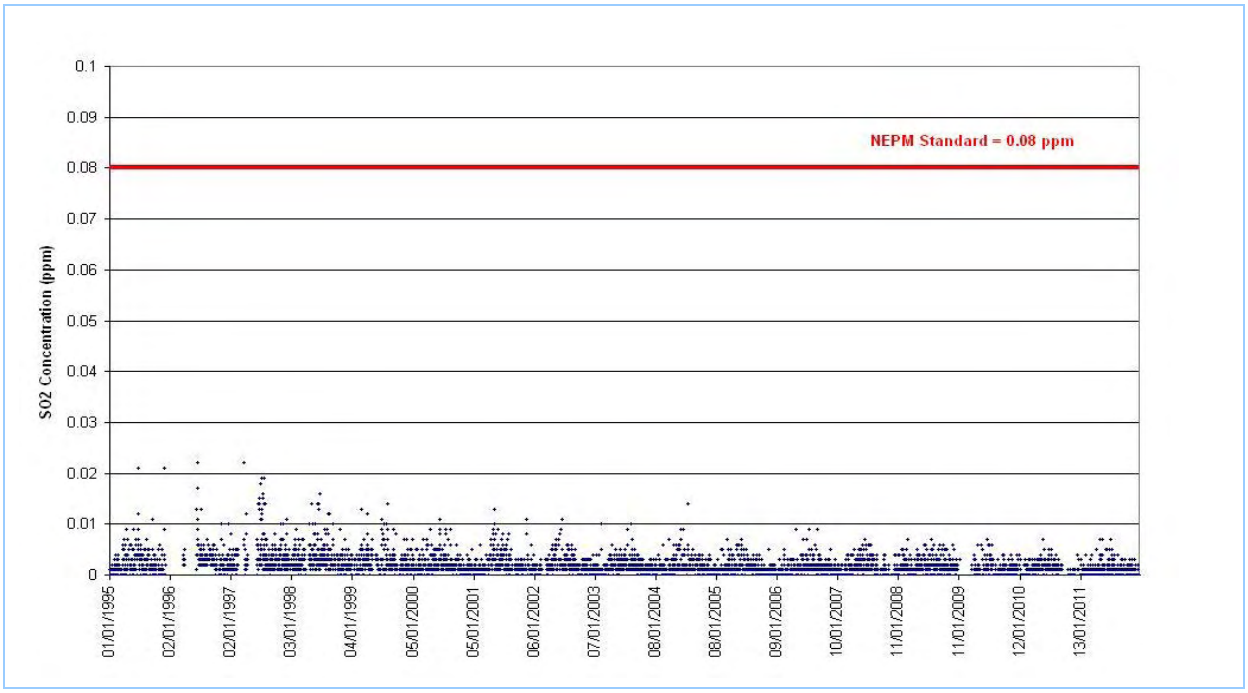

Figure 4.24: Wallsend Air Monitoring Station – AM-20 – 24-hour SO_2 Concentrations

Table 4.24: Wallsend Air Monitoring Station –AM-20 – SO_2 – 24-hour Averages

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	78%	0.021	0.021	0.012	0.011	0.009	0.009	0
1996	54%	0.022	0.017	0.013	0.013	0.011	0.010	0
1997	73%	0.022	0.019	0.019	0.018	0.016	0.015	0
1998	91%	0.016	0.014	0.014	0.014	0.013	0.012	0
1999	86%	0.014	0.013	0.012	0.011	0.010	0.010	0
2000	95%	0.011	0.009	0.009	0.009	0.009	0.008	0
2001	90%	0.013	0.011	0.010	0.009	0.009	0.008	0
2002	82%	0.011	0.009	0.008	0.007	0.007	0.007	0
2003	94%	0.010	0.010	0.009	0.007	0.006	0.006	0
2004	93%	0.014	0.009	0.009	0.007	0.007	0.006	0
2005	98%	0.007	0.007	0.006	0.006	0.006	0.006	0
2006	99%	0.009	0.009	0.009	0.007	0.007	0.006	0
2007	84%	0.007	0.006	0.006	0.006	0.006	0.006	0
2008	95%	0.007	0.007	0.006	0.006	0.006	0.006	0
2009	68%	0.007	0.006	0.006	0.006	0.006	0.006	0
2010	74%	0.007	0.005	0.005	0.005	0.004	0.004	0
2011	99%	0.007	0.007	0.007	0.005	0.005	0.005	0

SO_2 monitoring data averaged annually are presented for the Wallsend Monitoring Station in Figure 4.25. Summary statistics for the annual average SO_2 concentrations are presented in Table 4.25.

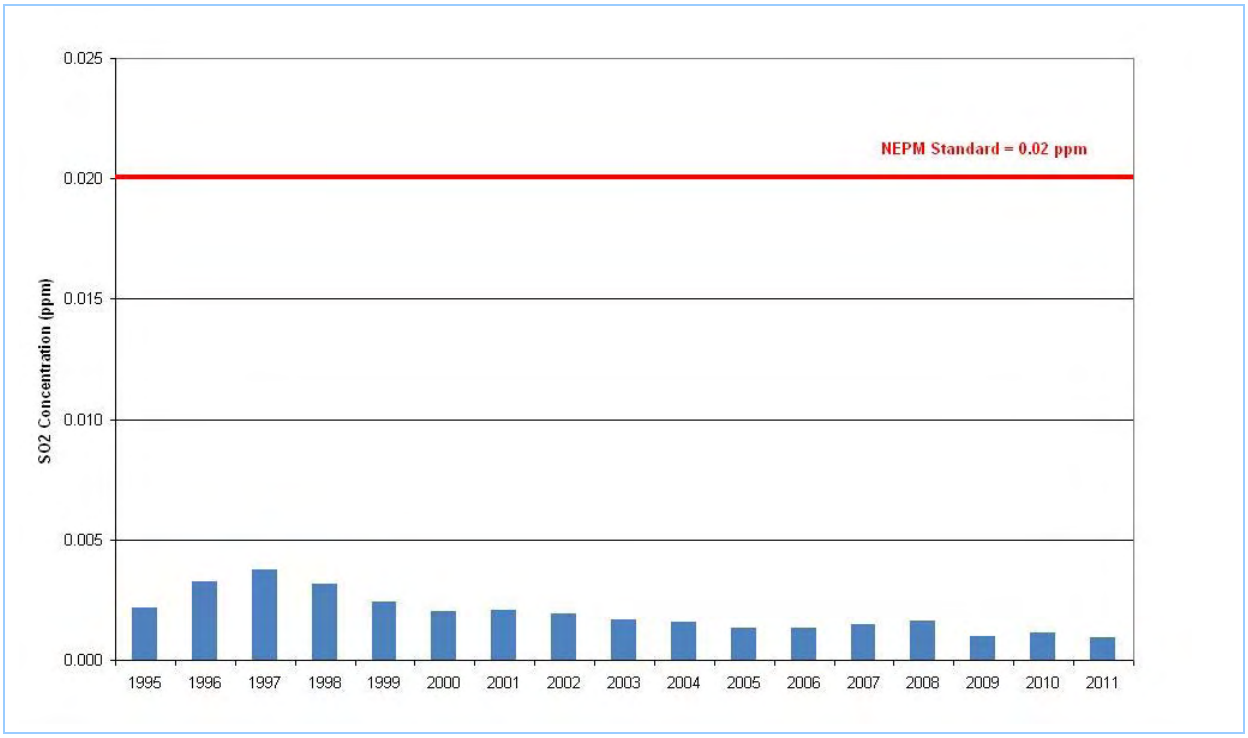

Figure 4.25: Wallsend Air Monitoring Station – Annual Average SO_2 Concentrations

Table 4.25: Wallsend Air Monitoring Station - Annual Average SO_2

Year	Percent Data Coverage	Concentration (ppm)
1995	78%	0.0022
1996	54%	0.0032
1997	73%	0.0038
1998	91%	0.0031
1999	86%	0.0024
2000	95%	0.0020
2001	90%	0.0021
2002	82%	0.0019
2003	94%	0.0017
2004	93%	0.0016
2005	98%	0.0013
2006	99%	0.0013
2007	84%	0.0015
2008	95%	0.0016
2009	68%	0.0010
2010	74%	0.0012
2011	99%	0.0009

4.5 Ozone Concentrations

4.5.1 Beresfield

Ozone monitoring data averaged over 1 hour are presented for the Beresfield Monitoring Station in Figure 4.26. Data presented in Figure 4.26 are the daily maximum 1 hour average ozone concentration. Summary statistics for the maximum recorded daily 1 hour average ozone concentration measured at the Beresfield Monitoring Station are presented in Table 4.26.

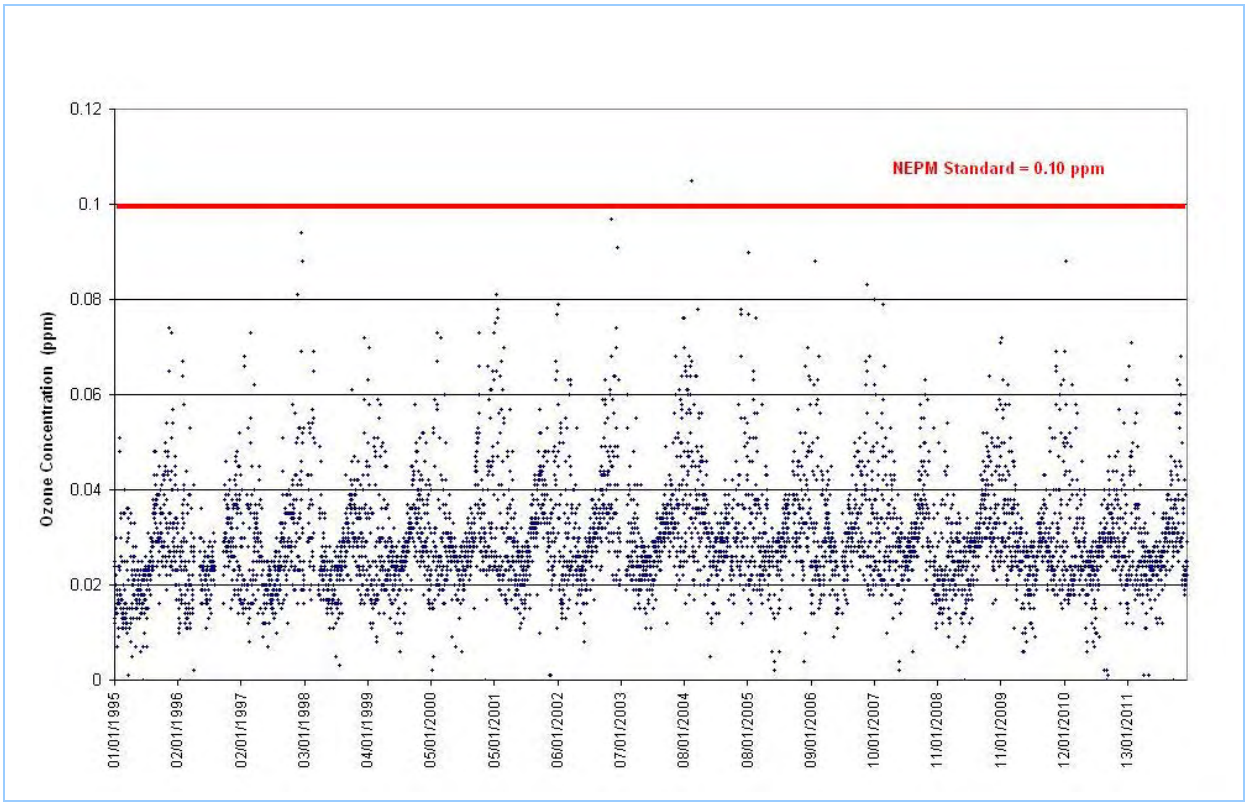

Figure 4.26: Beresfield Air Monitoring Station – AM-13 – 1 Hour Daily Maximum Ozone Concentrations

Table 4.26: Beresfield Air Monitoring Station –AM-13 – Ozone – 1 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	99%	0.074	0.073	0.065	0.057	0.054	0.054	0
1996	77%	0.067	0.064	0.058	0.053	0.052	0.048	0
1997	96%	0.094	0.088	0.081	0.073	0.069	0.068	0
1998	88%	0.072	0.069	0.065	0.061	0.059	0.057	0
1999	100%	0.070	0.063	0.059	0.058	0.058	0.058	0
2000	98%	0.073	0.073	0.072	0.067	0.066	0.066	0
2001	96%	0.081	0.078	0.076	0.075	0.073	0.070	0
2002	96%	0.097	0.091	0.079	0.077	0.074	0.070	0
2003	91%	0.076	0.068	0.064	0.061	0.060	0.060	0
2004	93%	0.105	0.078	0.078	0.077	0.076	0.070	1
2005	92%	0.090	0.077	0.076	0.070	0.066	0.065	0
2006	90%	0.088	0.083	0.068	0.068	0.067	0.065	0
2007	92%	0.080	0.079	0.066	0.063	0.062	0.060	0
2008	97%	0.064	0.059	0.057	0.054	0.052	0.052	0
2009	100%	0.072	0.071	0.069	0.066	0.065	0.063	0
2010	97%	0.088	0.069	0.063	0.062	0.058	0.058	0
2011	95%	0.071	0.068	0.066	0.063	0.063	0.062	0

Ozone monitoring data averaged over 4 hours are presented for the Beresfield Monitoring Station in Figure 4.27. Data presented in Figure 4.27 are the daily maximum 4 hour average ozone concentration. Summary statistics for the maximum recorded daily 4 hour average ozone concentration measured at the Beresfield Monitoring Station are presented in Table 4.27.

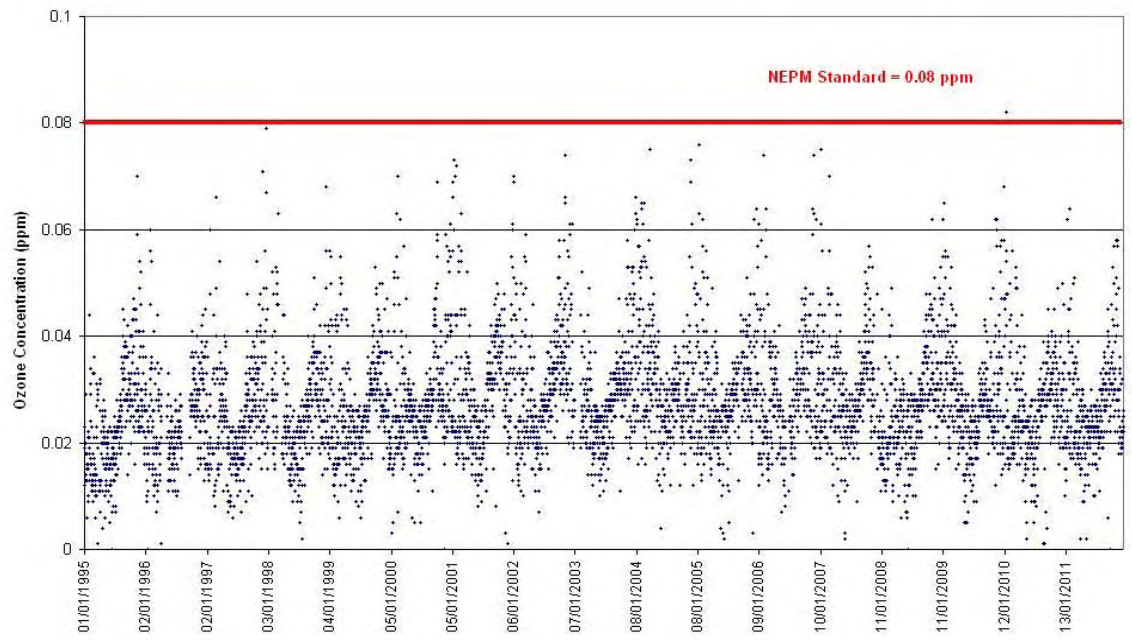

Figure 4.27: Beresfield Air Monitoring Station – AM-13 – 4 Hour Daily Maximum Ozone Concentrations

Table 4.27: Beresfield Air Monitoring Station –AM-13 – Ozone – 4 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	99%	0.070	0.059	0.054	0.052	0.049	0.047	0
1996	77%	0.060	0.056	0.054	0.046	0.045	0.044	0
1997	96%	0.079	0.071	0.067	0.066	0.060	0.056	0
1998	88%	0.068	0.063	0.056	0.053	0.052	0.052	0
1999	100%	0.056	0.055	0.055	0.053	0.051	0.050	0
2000	98%	0.070	0.069	0.063	0.062	0.061	0.059	0
2001	96%	0.073	0.072	0.070	0.069	0.066	0.063	0
2002	96%	0.080	0.074	0.070	0.069	0.066	0.065	0
2003	91%	0.063	0.060	0.058	0.053	0.053	0.053	0
2004	93%	0.075	0.073	0.069	0.066	0.065	0.065	0
2005	92%	0.076	0.064	0.063	0.062	0.062	0.057	0
2006	90%	0.074	0.074	0.064	0.064	0.063	0.062	0
2007	92%	0.075	0.070	0.061	0.057	0.056	0.056	0
2008	97%	0.062	0.053	0.051	0.049	0.049	0.048	0
2009	100%	0.065	0.062	0.062	0.062	0.060	0.058	0
2010	97%	0.082	0.068	0.058	0.056	0.056	0.054	1
2011	96%	0.064	0.062	0.058	0.058	0.057	0.057	0

4.5.2 Newcastle

Ozone monitoring data averaged over 1 hour are presented for the Newcastle Monitoring Station in Figure 4.28. Data presented in Figure 4.28 are the daily maximum 1 hour average ozone concentration. Summary statistics for the maximum recorded daily 1 hour average ozone concentration measured at the Newcastle Monitoring Station are presented in Table 4.28.

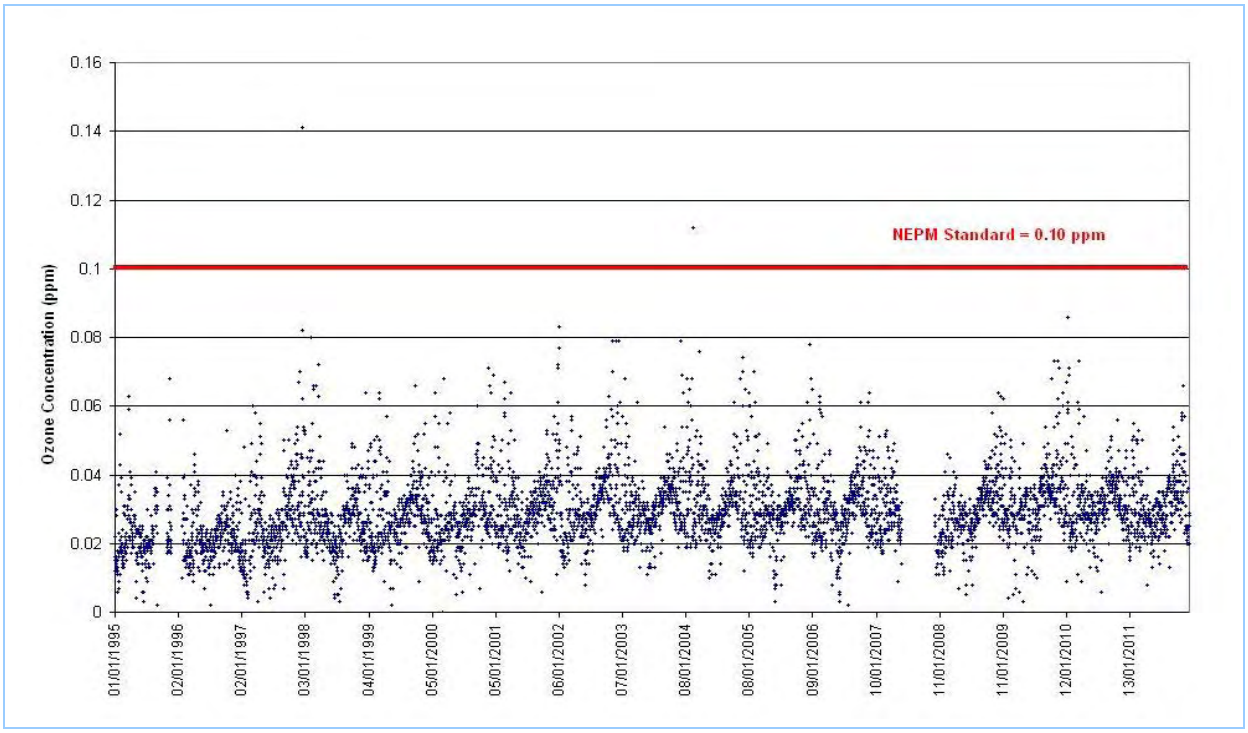

Figure 4.28: Newcastle Air Monitoring Station – AM-13 – 1 Hour Daily Maximum Ozone Concentrations

Table 4.28: Newcastle Air Monitoring Station –AM-13 – Ozone – 1 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	72%	0.068	0.063	0.059	0.056	0.052	0.043	0
1996	93%	0.056	0.053	0.046	0.043	0.041	0.040	0
1997	97%	0.141	0.082	0.070	0.067	0.062	0.060	1
1998	100%	0.080	0.072	0.066	0.066	0.065	0.064	0
1999	98%	0.066	0.064	0.062	0.057	0.055	0.052	0
2000	95%	0.071	0.069	0.068	0.066	0.064	0.064	0
2001	98%	0.072	0.071	0.067	0.064	0.062	0.061	0
2002	99%	0.083	0.079	0.079	0.079	0.077	0.070	0
2003	97%	0.079	0.069	0.068	0.064	0.061	0.057	0
2004	98%	0.112	0.076	0.074	0.070	0.068	0.068	1
2005	98%	0.078	0.070	0.064	0.061	0.061	0.060	0
2006	99%	0.068	0.065	0.064	0.063	0.061	0.061	0
2007	47%	0.053	0.052	0.051	0.051	0.049	0.048	0
2008	96%	0.064	0.058	0.054	0.053	0.052	0.051	0
2009	95%	0.073	0.073	0.071	0.068	0.064	0.063	0
2010	99%	0.086	0.073	0.071	0.069	0.067	0.061	0
2011	97%	0.066	0.058	0.057	0.057	0.056	0.055	0

Ozone monitoring data averaged over 4 hours are presented for the Newcastle Monitoring Station in Figure 4.29. Data presented in Figure 4.29 are the daily maximum 4 hour average ozone concentration. Summary statistics for the maximum recorded daily 4 hour average ozone concentration measured at the Newcastle Monitoring Station are presented in Table 4.29.

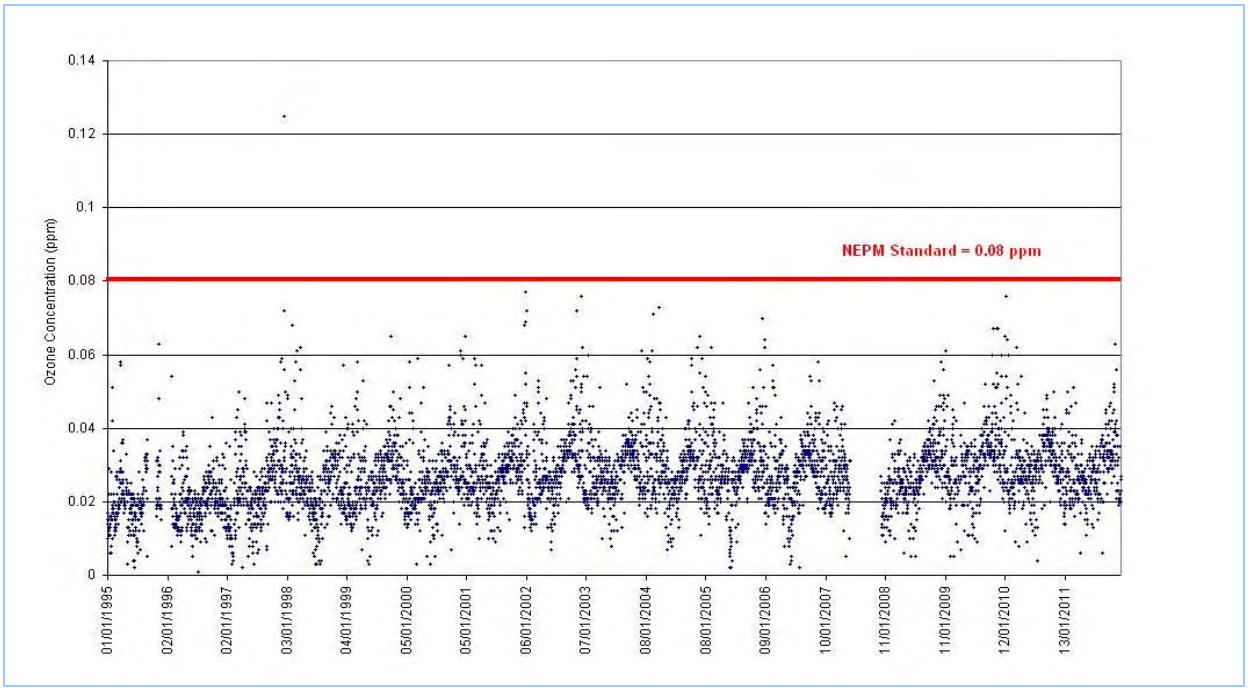

Figure 4.29: Newcastle Air Monitoring Station – AM-13 – 4 Hour Daily Maximum Ozone Concentrations

Table 4.29: Newcastle Air Monitoring Station –AM-13 – Ozone – 4 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	72%	0.063	0.058	0.057	0.051	0.048	0.042	0
1996	93%	0.054	0.043	0.039	0.038	0.036	0.035	0
1997	97%	0.125	0.072	0.059	0.058	0.056	0.050	1
1998	100%	0.068	0.062	0.061	0.058	0.057	0.056	0
1999	97%	0.065	0.058	0.053	0.050	0.050	0.048	0
2000	95%	0.065	0.061	0.060	0.059	0.059	0.058	0
2001	98%	0.069	0.068	0.059	0.057	0.057	0.055	0
2002	99%	0.077	0.076	0.072	0.072	0.062	0.059	0
2003	97%	0.061	0.061	0.060	0.054	0.052	0.051	0
2004	98%	0.073	0.071	0.065	0.062	0.061	0.059	0
2005	98%	0.070	0.062	0.056	0.054	0.051	0.051	0
2006	99%	0.064	0.062	0.058	0.057	0.054	0.053	0
2007	47%	0.047	0.046	0.046	0.045	0.045	0.043	0
2008	96%	0.058	0.053	0.049	0.049	0.047	0.046	0
2009	95%	0.067	0.067	0.067	0.061	0.060	0.060	0
2010	99%	0.076	0.065	0.064	0.062	0.060	0.054	0
2011	97%	0.063	0.056	0.052	0.051	0.051	0.050	0

4.5.3 Wallsend

Ozone monitoring data averaged over 1 hour are presented for the Wallsend Monitoring Station in Figure 4.30. Data presented in Figure 4.30 are the daily maximum 1 hour average ozone concentration. Summary statistics for the maximum recorded daily 1 hour average ozone concentration measured at the Newcastle Monitoring Station are presented in Table 4.30.

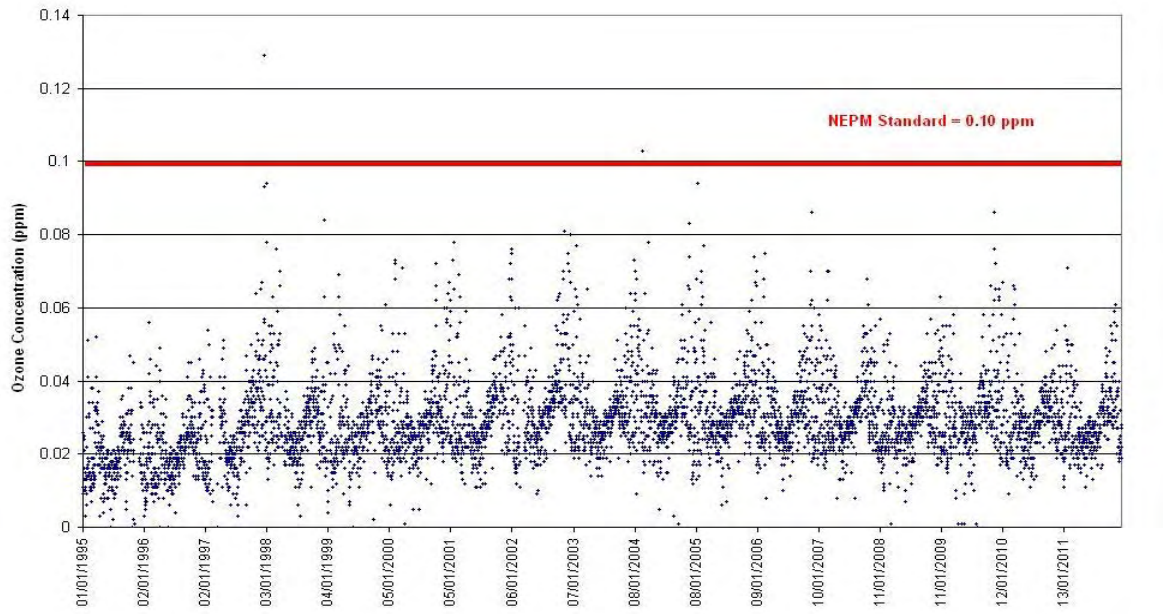

Figure 4.30: Wallsend Air Monitoring Station – AM-13 – 1 Hour Daily Maximum Ozone Concentrations

Table 4.30: Wallsend Air Monitoring Station –AM-13 – Ozone – 1 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	89%	0.052	0.051	0.047	0.045	0.041	0.041	0
1996	98%	0.056	0.049	0.046	0.046	0.045	0.045	0
1997	86%	0.129	0.093	0.067	0.065	0.065	0.064	1
1998	92%	0.094	0.084	0.078	0.076	0.070	0.066	0
1999	90%	0.069	0.063	0.061	0.058	0.055	0.055	0
2000	97%	0.073	0.072	0.072	0.071	0.068	0.067	0
2001	94%	0.078	0.076	0.073	0.072	0.069	0.068	0
2002	88%	0.081	0.080	0.075	0.075	0.072	0.070	0
2003	97%	0.077	0.073	0.065	0.065	0.064	0.063	0
2004	95%	0.103	0.083	0.078	0.074	0.070	0.068	1
2005	97%	0.094	0.077	0.074	0.070	0.068	0.067	0
2006	98%	0.086	0.075	0.070	0.070	0.068	0.066	0
2007	98%	0.070	0.070	0.068	0.062	0.061	0.058	0
2008	99%	0.057	0.057	0.054	0.054	0.053	0.053	0
2009	93%	0.086	0.076	0.072	0.066	0.065	0.065	0
2010	97%	0.067	0.067	0.066	0.065	0.061	0.058	0
2011	97%	0.071	0.061	0.059	0.056	0.056	0.056	0

Ozone monitoring data averaged over 4 hours are presented for the Wallsend Monitoring Station in Figure 4.31. Data presented in Figure 4.31 are the daily maximum 4 hour average ozone concentration. Summary statistics for the maximum recorded daily 4 hour average ozone concentration measured at the Newcastle Monitoring Station are presented in Table 4.31.

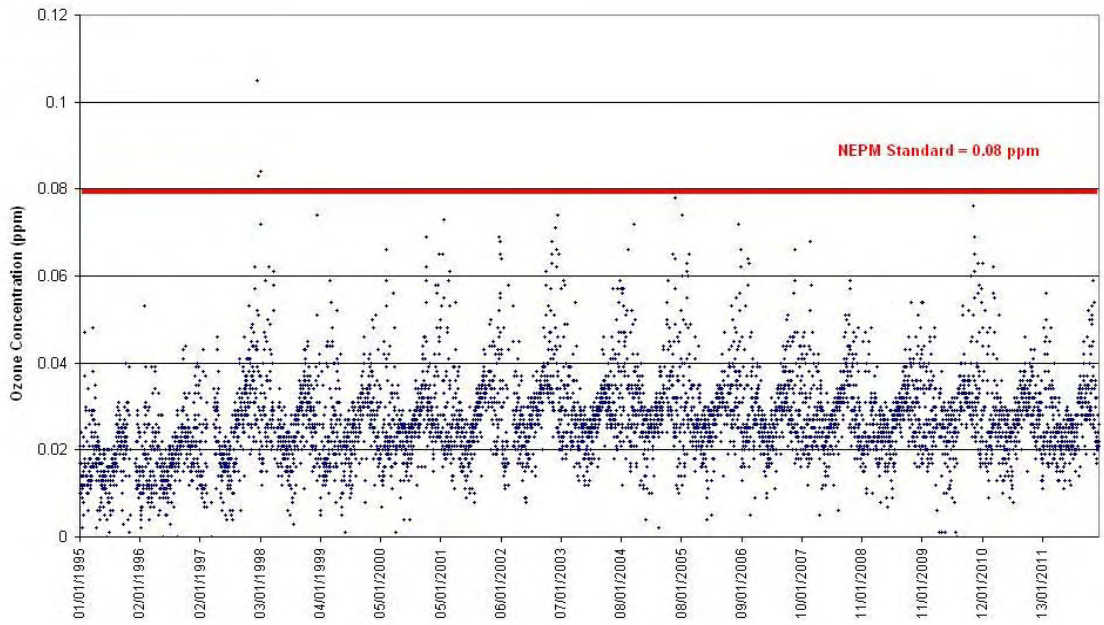

Figure 4.31: Wallsend Air Monitoring Station – AM-13 – 4 Hour Daily Maximum Ozone Concentrations

Table 4.31: Wallsend Air Monitoring Station –AM-13 – Ozone – 4 Hour Daily Maximums

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	89%	0.048	0.047	0.040	0.039	0.038	0.037	0
1996	98%	0.053	0.044	0.043	0.041	0.040	0.039	0
1997	86%	0.105	0.083	0.062	0.057	0.053	0.052	2
1998	92%	0.084	0.074	0.072	0.062	0.061	0.059	1
1999	90%	0.059	0.054	0.052	0.051	0.050	0.048	0
2000	97%	0.069	0.066	0.065	0.062	0.059	0.059	0
2001	94%	0.073	0.069	0.065	0.065	0.061	0.059	0
2002	88%	0.074	0.071	0.068	0.068	0.066	0.065	0
2003	97%	0.059	0.059	0.058	0.058	0.057	0.057	0
2004	95%	0.078	0.072	0.066	0.065	0.064	0.059	0
2005	97%	0.074	0.072	0.065	0.063	0.061	0.060	0
2006	98%	0.066	0.066	0.064	0.063	0.062	0.059	0
2007	98%	0.068	0.059	0.058	0.057	0.052	0.051	0
2008	99%	0.054	0.051	0.048	0.048	0.047	0.046	0
2009	93%	0.076	0.069	0.065	0.063	0.061	0.060	0
2010	97%	0.063	0.062	0.057	0.056	0.055	0.054	0
2011	97%	0.059	0.056	0.054	0.053	0.052	0.051	0

4.6 CO Concentrations

CO monitoring data averaged over 8 hours are presented for the Newcastle Monitoring Station in Figure 4.32. Summary statistics for the maximum recorded 8 hour CO concentrations measured at the Newcastle Monitoring Station are presented in Table 4.32.

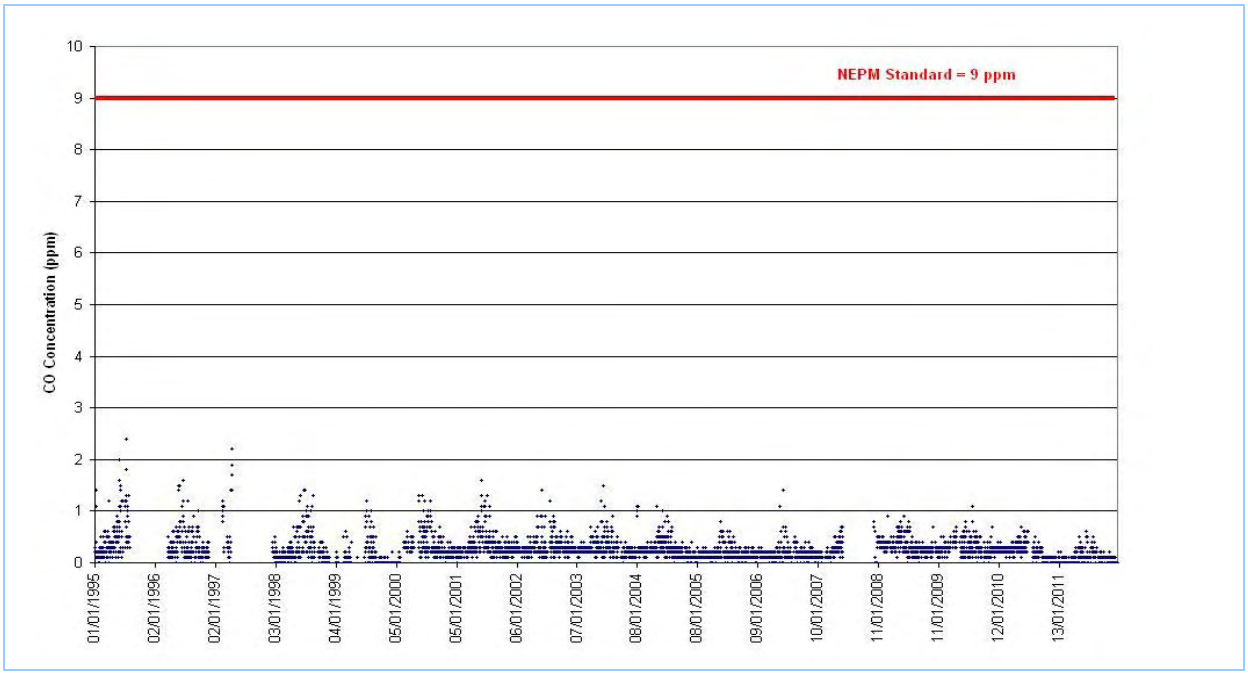

Figure 4.32: Newcastle Air Monitoring Station – AM-6 – 8 Hour Rolling Average CO Concentrations

Table 4.32: Newcastle Air Monitoring Station –AM-6 – Carbon Monoxide – 8 Hour Average

Year	Concentration (ppm)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
1995	54%	2.4	2.0	1.8	1.6	1.5	1.4	0
1996	51%	1.6	1.5	1.5	1.4	1.2	1.2	0
1997	16%	2.2	1.9	1.9	1.9	1.7	1.4	0
1998	75%	1.4	1.4	1.3	1.3	1.2	1.1	0
1999	68%	1.2	1.2	1.0	1.0	1.0	0.9	0
2000	82%	1.3	1.3	1.2	1.2	1.2	1.0	0
2001	96%	1.6	1.3	1.3	1.2	1.1	1.1	0
2002	95%	1.4	1.2	0.9	0.9	0.9	0.9	0
2003	93%	1.5	1.2	1.1	0.9	0.8	0.8	0
2004	97%	1.1	1.1	1.1	1.0	1.0	0.9	0
2005	95%	0.8	0.6	0.6	0.6	0.6	0.6	0
2006	94%	1.4	1.1	0.7	0.7	0.6	0.6	0
2007	44%	0.8	0.7	0.7	0.7	0.6	0.6	0
2008	96%	0.9	0.9	0.8	0.8	0.8	0.7	0
2009	84%	1.1	0.8	0.8	0.7	0.7	0.7	0
2010	87%	0.7	0.6	0.6	0.6	0.6	0.5	0
2011	99%	0.6	0.6	0.5	0.5	0.5	0.5	0

5 OTHER MONITORING DATA

Other monitoring data was provided to OEH from the following organisations:

- Newcastle City Council (NCC);
- Australian Nuclear Science and Technology Organisation (ANSTO); and
- Industry including:
  - BHP Billiton (BHP);
  - ConPorts;
  - GrainCorp;
  - Hunter Development Corporation (HDC);
  - Newcastle Coal Infrastructure Group (NCIG);
  - Newcastle Port Corporation (NPC);
  - OneSteel;
  - Orica;
  - Port Waratah Coal Services (PWCS); and
  - Tomago Aluminium.

Summary statistics are presented for each monitoring station and pollutant in this section. Explanatory notes for interpreting the summary statistics are as follows:

1. For all pollutants and averaging periods, each table lists the year monitoring took place, percent of total possible data captured, pollutant concentration and the number of days the concentration is above the NEPM level. In addition to these parameters first to sixth highest concentrations are listed for 1 hour and/or 24-hour averaging periods.

2. The values in **Green** indicate that all recorded concentrations are below the relevant criteria. The values in **Yellow** indicate recorded concentrations were above the relevant criteria for five days or less per year for 24-hour average PM_{10} and $PM_{2.5,}$ one day per year for $NO_{2,}$ $SO_{2,}$ ozone and CO . The values in **Orange** indicate recorded concentrations were above the relevant criteria for more than five days per year for 24-hour average PM_{10} and $PM_{2.5,}$ or more than one day per year for NO_2, $SO_{2,}$ ozone and CO.

3 The 24-hour average values presented for continuous monitor methods (AM-12, AM-20 and AM-22) are the arithmetic average of concentrations recorded for one (1) calendar day. Where there are missing records in a calendar day, the arithmetic average of the recorded values is deemed to be the 24-hour value. When no data records were recorded for the calendar day, the 24-hour value was not calculated.

4. The percent data coverage parameter corresponds to the total percent of data recorded for the reporting period (1 year). The percent data coverage is calculated based on the minimum time step that the monitored records were analysed for each site. For example, the percent data coverage in a standard year where there are 365 days and 8760 hours is calculated as follows:

   a. hourly data records = number of records / 8760 × 100.

   b. 1 in 6 day sampling cycle (e.g. AM-18 PM_{10}) = number of records / (365/6) × 100.

5. Results should be interpreted with reference to the percent of total possible data captured. If this parameter is less than 100%, concentrations could potentially have been higher than those listed. This is especially the case for monitoring frequency other than continuous (e.g. AM-18 one in six day cycle).

6. In several instances, the earliest reporting year listed in the tables has very low data coverage. This is often due to data records starting part way through the year. When this has occurred, it is noted in the relevant table(s).

7. OEH has not performed any data validation or quality assurance as part of the review.

5.1 TSP Concentrations

Data from fifteen HVAS Total Suspended Particulate (TSP) monitoring sites were available. Details of each TSP monitoring station are provided in Table 5.1.

Table 5.1: TSP Monitoring Stations Details

TSP Site ID	Site Name/Location	Method	MGA X (km)	MGA Y (km)
SITE 2	CONPORTS – NORTH	AM-18	385.136	6357.534
SITE 3	CONPORTS - SOUTH	AM-18	385.198	6357.364
SITE 5	SMART ST	AM-18	384.630	6356.880
SITE 6	RAIL YARD	AM-18	384.739	6357.047
SITE 7	R + D – DARVAL ST	AM-18	384.588	6357.027
SITE 8	STEEL RIVER ESTATE	AM-18	380.614	6360.965
SITE 4	MAYFIELD	AM-18	382.784	6359.697
SITE 9	STOCKTON	AM-18	386.338	6358.981
SITE 10	NCC WALLSEND	AM-18	375.529	6359.445
SITE 14	WEST CAR PARK	AM-18	380.525	6359.692
SITE 13	EAST DRAIN	AM-18	381.018	6359.258
SITE 15	FULLERTON RD - STOCKTON	AM-18	386.336	6358.990
SITE 17	C1 STOCKTON	AM-18	385.846	6358.220
SITE 18	C2 MAYFIELD EAST	AM-18	383.306	6359.155
SITE 11	FERN BAY	AM-18	387.445	6362.010

The locations of industry monitoring stations for TSP are shown in Figure 5.1.

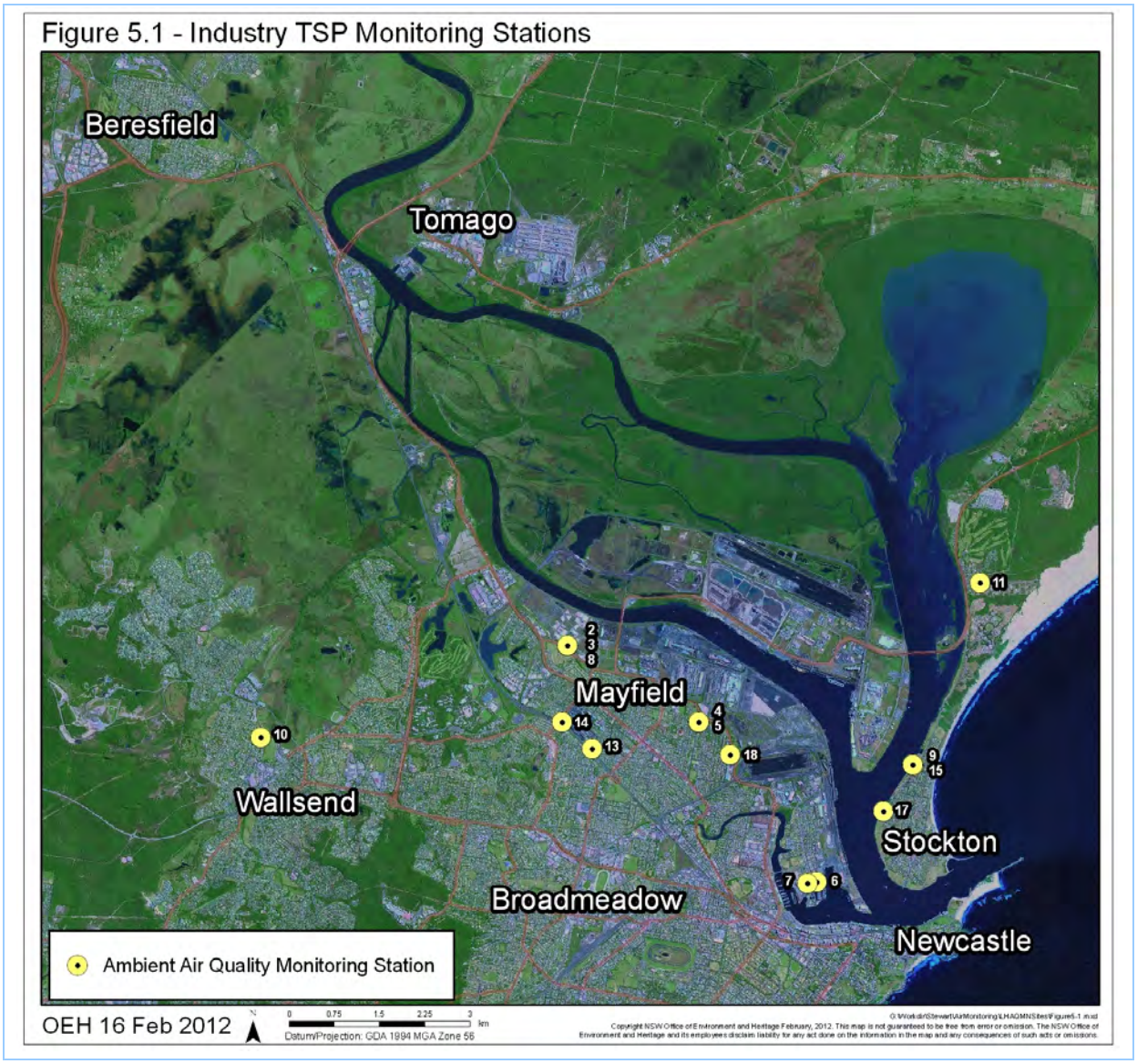

Figure 5.1: Location of Industry TSP Monitoring Stations

5.1.1 ConPorts – North

TSP monitoring data averaged annually are presented for the ConPorts – North site in Figure 5.2. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.2.

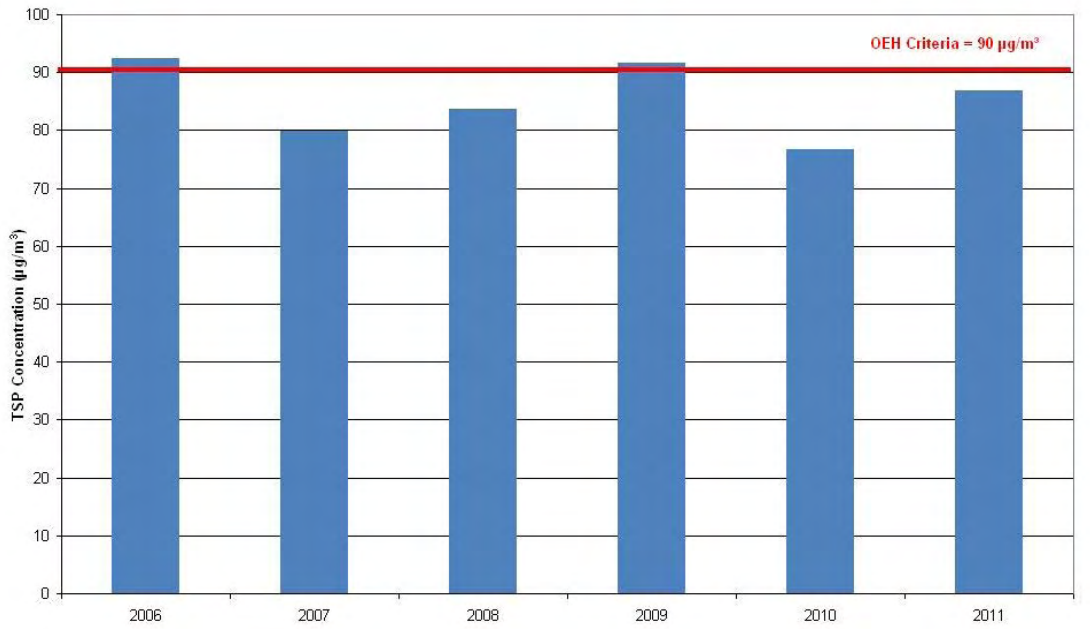

Figure 5.2: ConPorts – North Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.2: ConPorts - North Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	7%	92.3
2007	16%	79.9
2008	16%	83.7
2009	16%	91.5
2010	17%	76.7
2011	8%	86.8

5.1.2 ConPorts – South

TSP monitoring data averaged annually are presented for the ConPorts – South site in Figure 5.3. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.3.

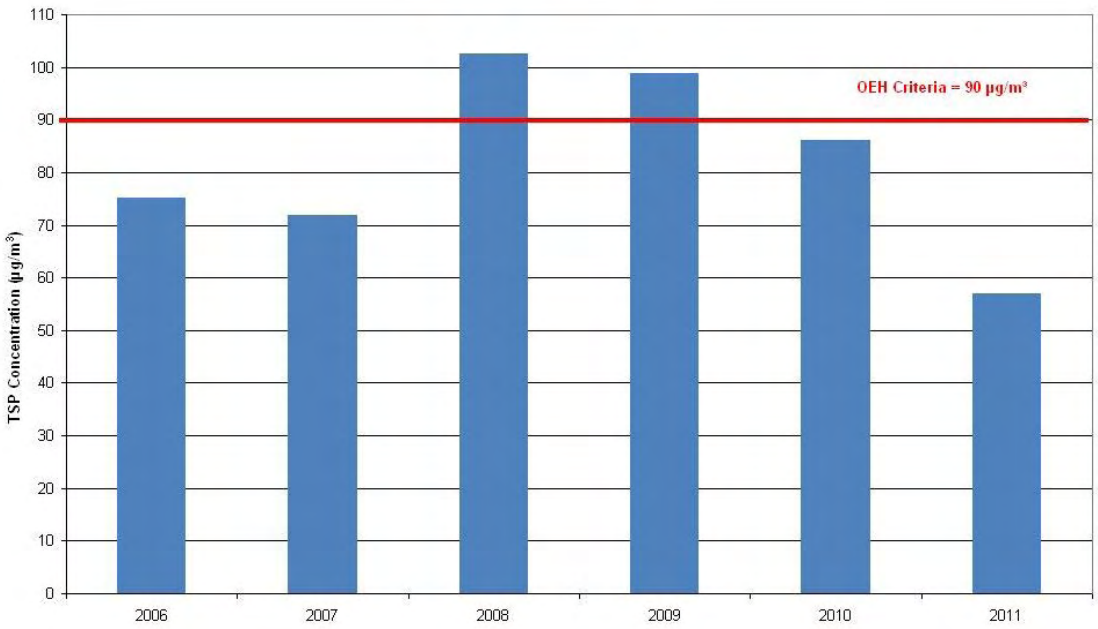

Figure 5.3: ConPorts – South Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.3: ConPorts - South Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	8%	75.2
2007	15%	72.0
2008	17%	102.5
2009	16%	98.8
2010	17%	86.2
2011	8%	56.9

5.1.3 Smart St

TSP monitoring data averaged annually are presented for the Smart St site in Figure 5.4. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.4.

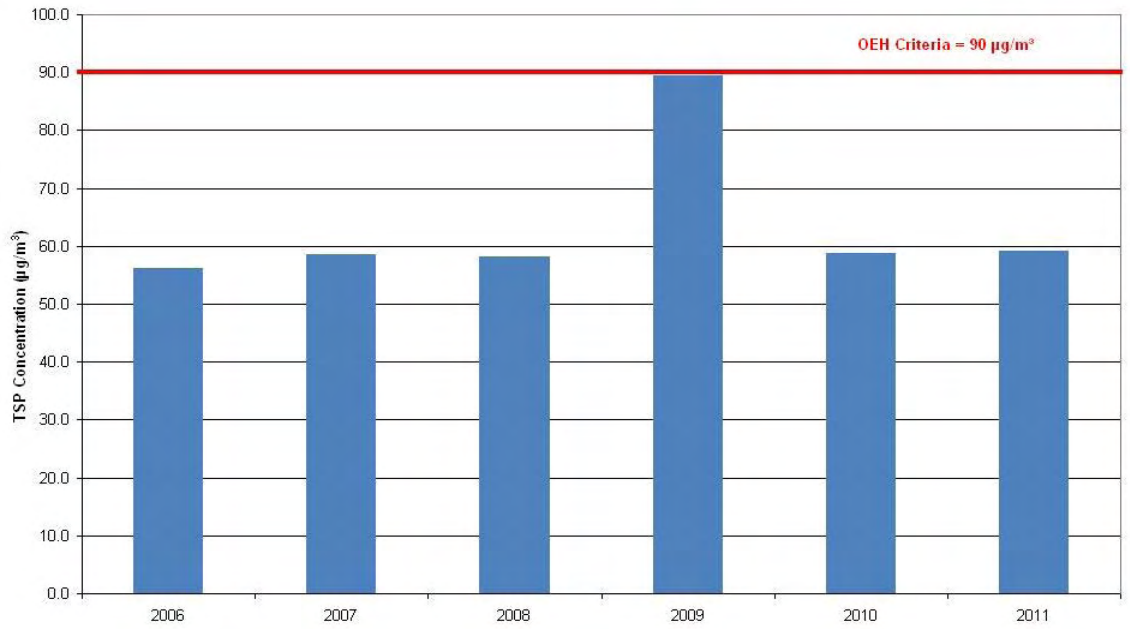

Figure 5.4: Smart St Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.4: Smart St Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	16%	56.1
2007	16%	58.6
2008	16%	58.1
2009	16%	89.4
2010	16%	58.8
2011	13%	59.3

5.1.4 Rail Yard

TSP monitoring data averaged annually are presented for the Rail Yard site in Figure 5.5. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.5.

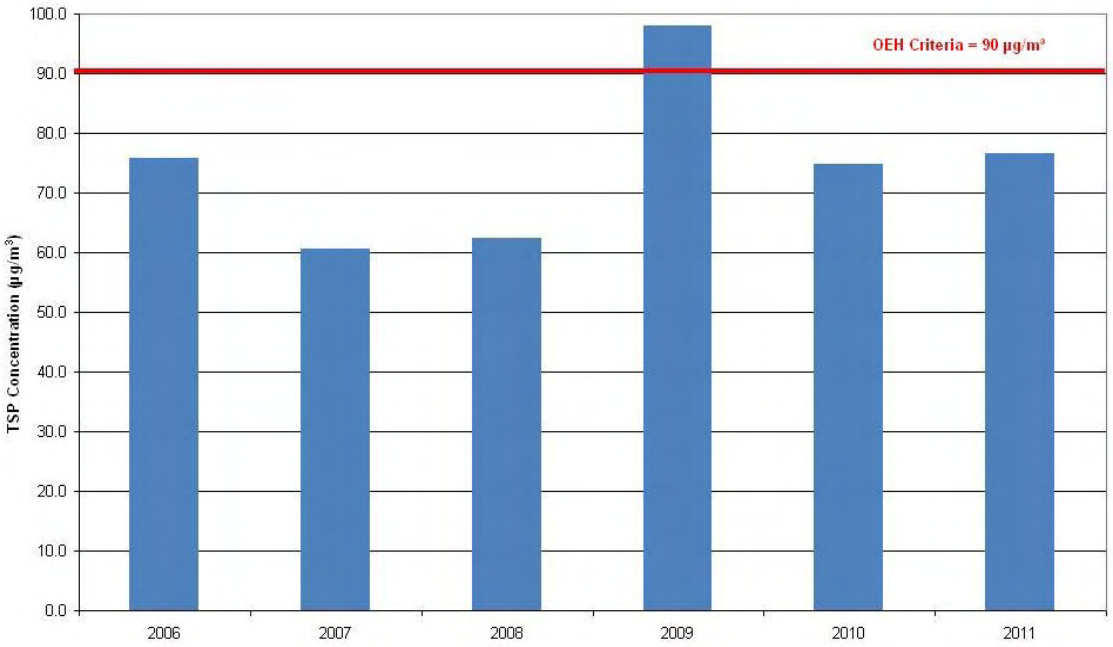

Figure 5.5: Rail Yard Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.5: Rail Yard Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	16%	75.8
2007	16%	60.7
2008	17%	62.4
2009	16%	98.0
2010	16%	74.8
2011	12%	76.6

5.1.5 R + D - Darval St

TSP monitoring data averaged annually are presented for the R+D Darval St site in Figure 5.6. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.6.

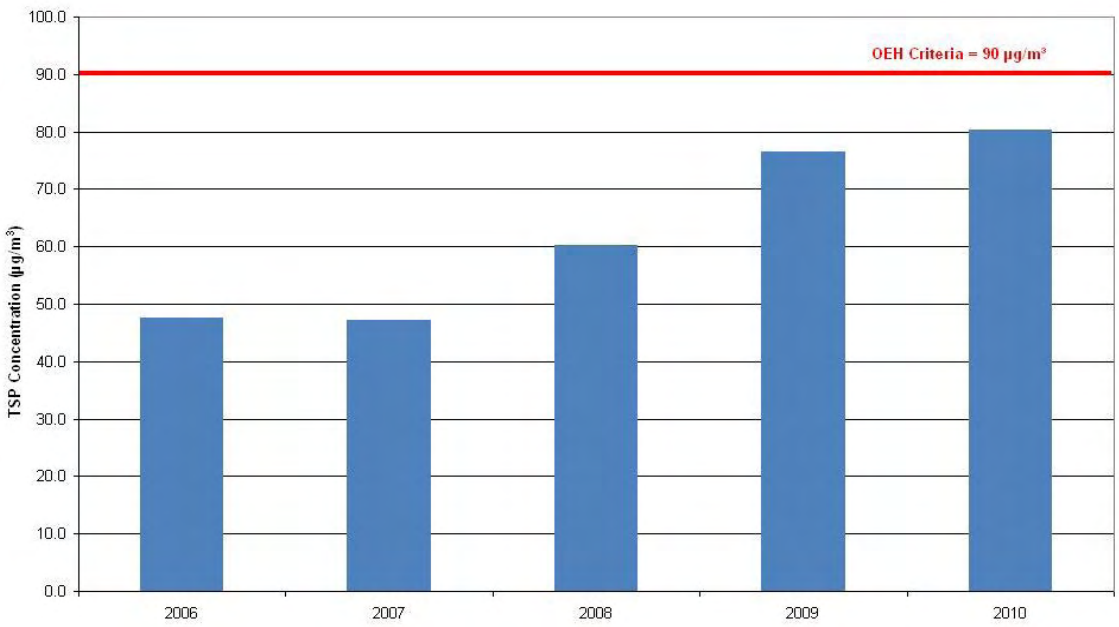

Figure 5.6: R+D Darval St Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.6: R+D Darval St Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	16%	47.6
2007	16%	47.2
2008	16%	60.3
2009	16%	76.5
2010	4%	80.4

5.1.6 Steel River Estate

TSP monitoring data averaged annually are presented for the Steel River Estate Monitoring Station in Figure 5.7. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.7.

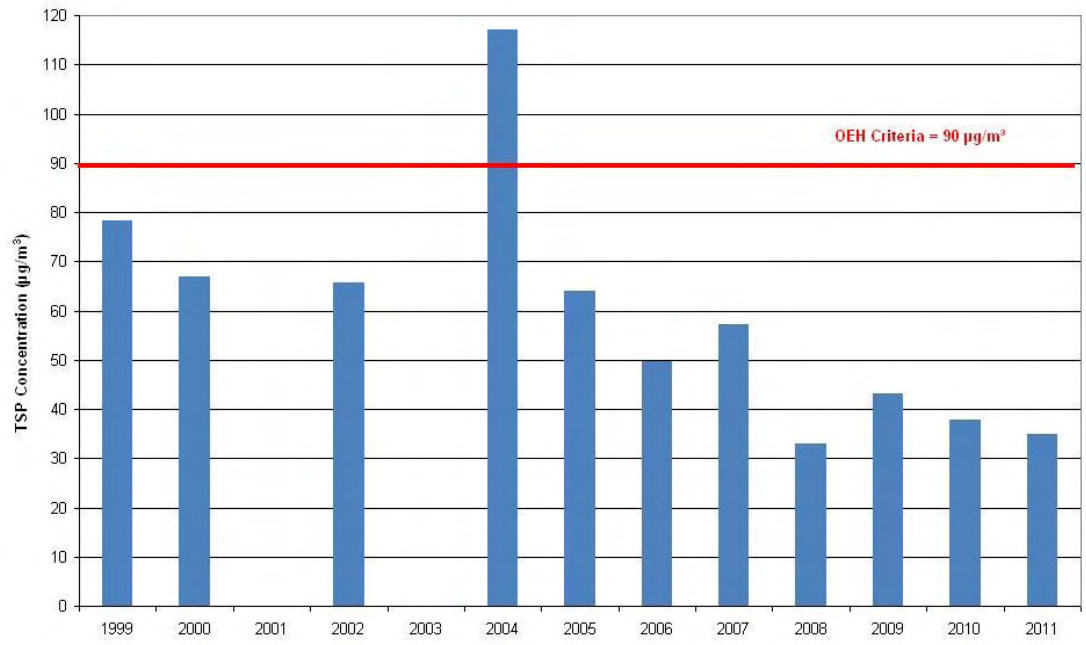

Figure 5.7: Steel River Estate Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.7: Steel River Estate Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
1999	17%	78.2
2000	17%	66.8
2001	ND	**ND**
2002	17%	65.8
2003	ND	**ND**
2004	17%	117.1
2005	17%	64.0
2006	17%	49.6
2007	16%	57.2
2008	12%	33.0
2009	16%	43.1
2010	16%	37.9
2011	12%	34.9

5.1.7 Mayfield

TSP monitoring data averaged annually are presented for the Mayfield Monitoring Station in Figure 5.8. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.8.

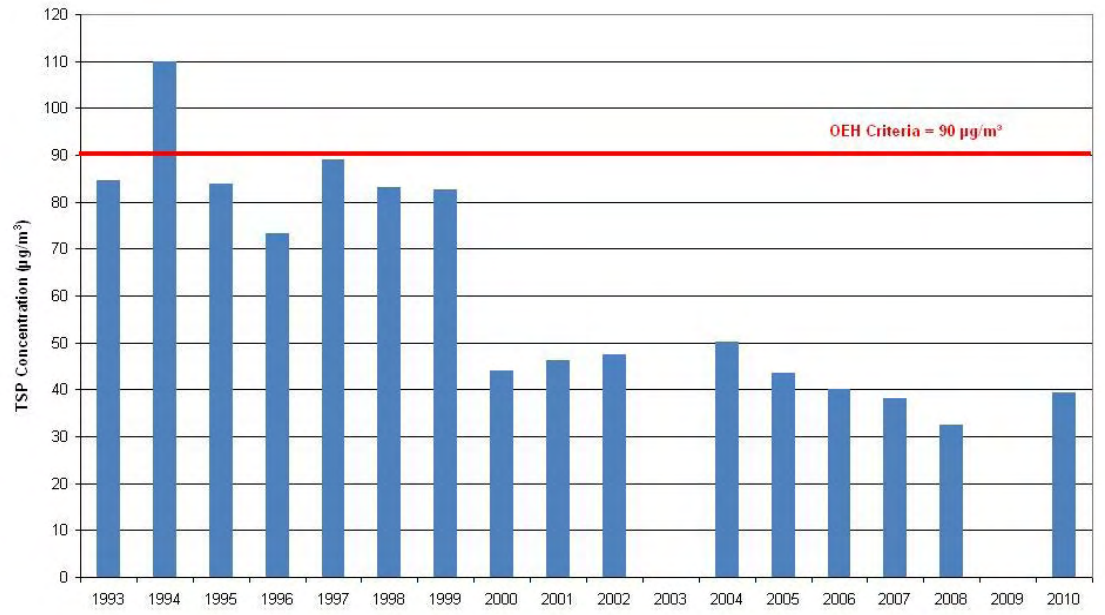

Figure 5.8: Mayfield Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.8: Mayfield Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
1993	16%	84.7
1994	17%	109.9
1995	17%	83.7
1996	17%	73.3
1997	17%	88.9
1998	17%	83.2
1999	17%	82.7
2000	17%	44.0
2001	16%	46.2
2002	17%	47.5
2003	ND	**ND**
2004	17%	50.2
2005	17%	43.4
2006	17%	40.1
2007	16%	38.1
2008	12%	32.5
2009	ND	**ND**
2010	17%	39.5

5.1.8 Stockton

TSP monitoring data averaged annually are presented for the Stockton Monitoring Station in Figure 5.9. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.9.

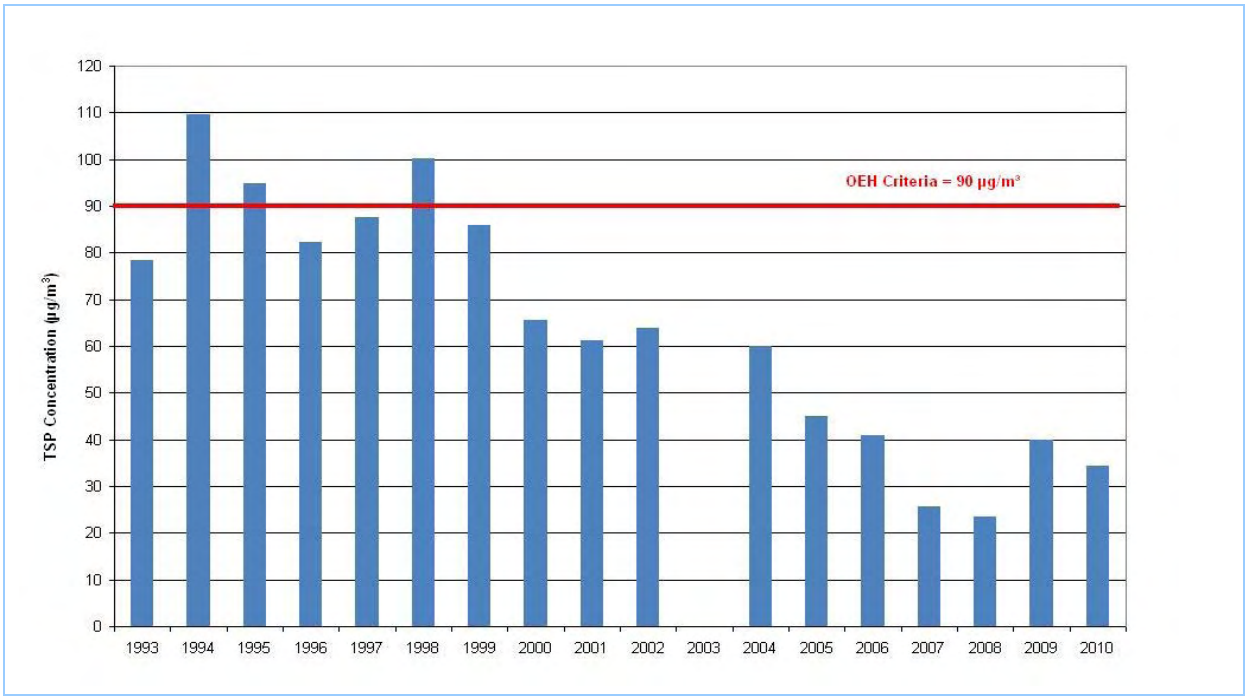

Figure 5.9: Stockton Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.9: Stockton Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
1993	16%	78.3
1994	17%	109.7
1995	17%	94.8
1996	17%	82.4
1997	17%	87.6
1998	17%	100.1
1999	17%	85.8
2000	17%	65.6
2001	16%	61.3
2002	17%	63.9
2003	ND	ND
2004	17%	60.0
2005	17%	44.9
2006	17%	40.8
2007	16%	25.6
2008	12%	23.6
2009	16%	39.8
2010	17%	34.2

5.1.9 NCC Wallsend

TSP monitoring data averaged annually are presented for the NCC Wallsend Monitoring Station in Figure 5.10. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.10.

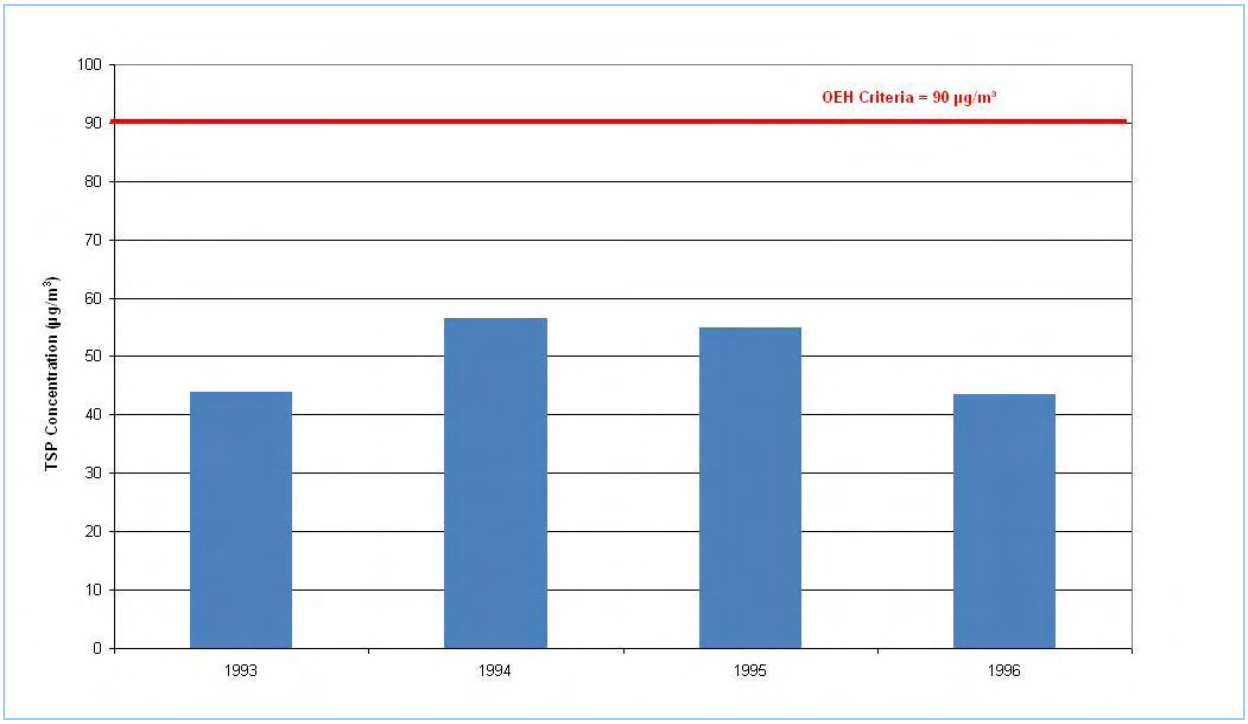

Figure 5.10: NCC Wallsend Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.10: NCC Wallsend Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
1993	16%	43.9
1994	17%	56.5
1995	17%	54.8
1996	17%	43.6

5.1.10 West Car Park

TSP monitoring data averaged annually are presented for the West Car Park Monitoring Station in Figure 5.11. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.11.

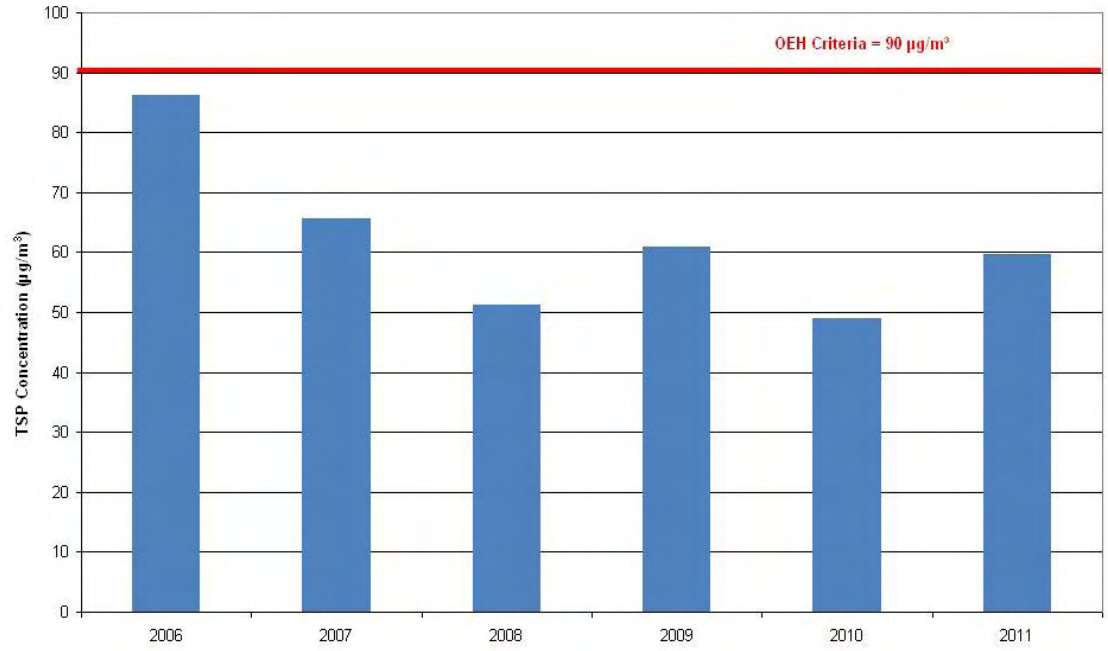

Figure 5.11: West Car Park Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.11: West Car Park Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	8%	86.2
2007	16%	65.7
2008	17%	51.2
2009	14%	60.8
2010	12%	49.0
2011	8%	59.8

5.1.11 East Drain

TSP monitoring data averaged annually are presented for the East Drain Monitoring Point 4 in Figure 5.12. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.12.

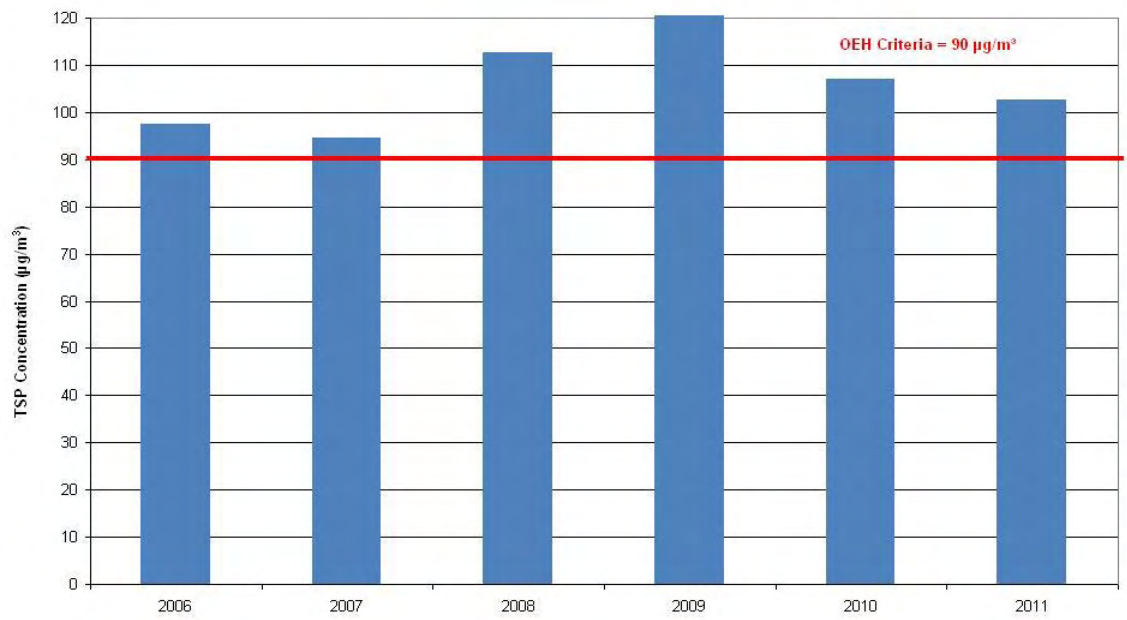

Figure 5.12: East Drain Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.12: East Drain Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	8%	97.5
2007	17%	94.6
2008	17%	112.7
2009	13%	144.2
2010	18%	107.1
2011	8%	102.6

5.1.12 Fullerton Rd – Stockton

TSP monitoring data averaged annually are presented for the Fullerton Rd – Stockton Monitoring Station in Figure 5.13. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.12.

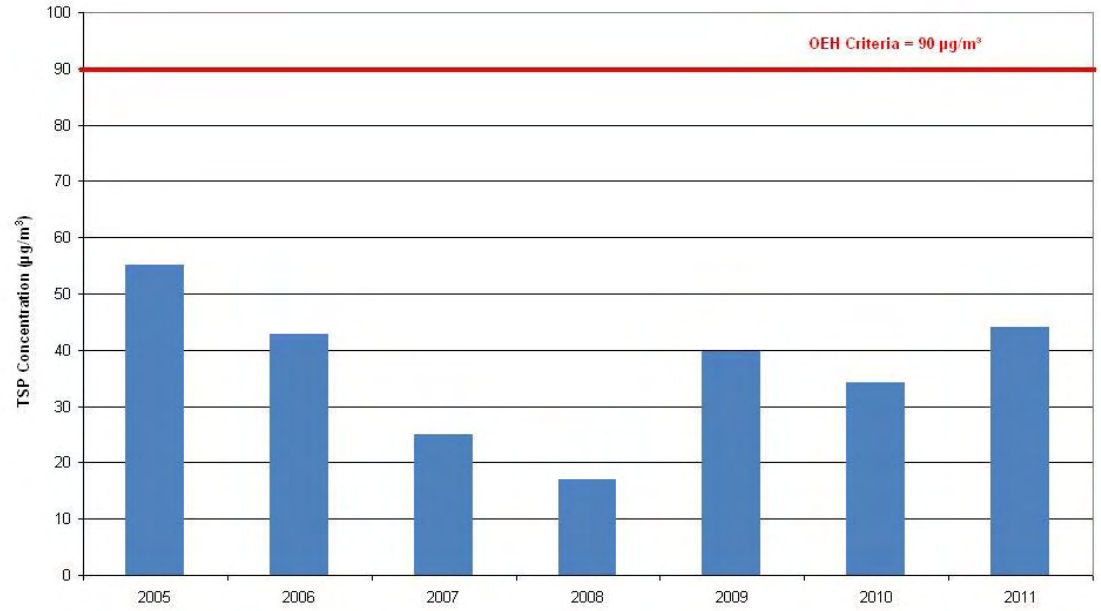

Figure 5.13: Fullerton Rd - Stockton Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.13: Fullerton Rd - Stockton Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2005	13%	55.1
2006	17%	42.9
2007	17%	25.0
2008	17%	17.0
2009	16%	39.7
2010	17%	34.2
2011	13%	44.0

5.1.13 C1 Stockton

TSP monitoring data averaged annually are presented for the C1 Stockton Monitoring Station in Figure 5.14. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.14.

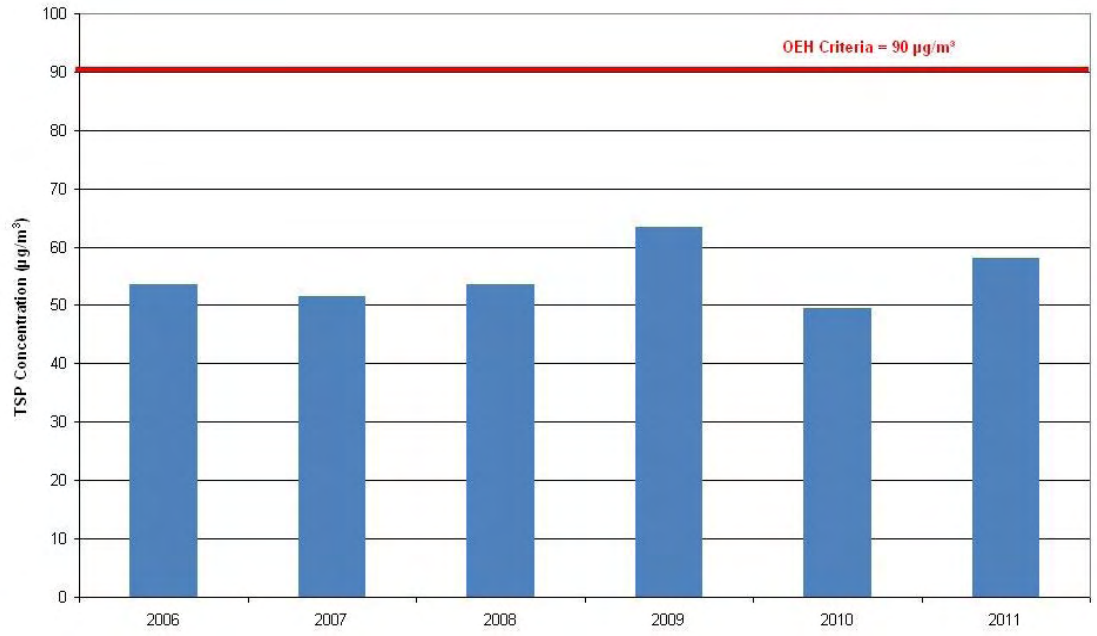

Figure 5.14: C1 Stockton Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.14: C1-Stockton Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	17%	53.5
2007	16%	51.6
2008	16%	53.6
2009	16%	63.4
2010	17%	49.4
2011	12%	58.0

5.1.14 C2 Mayfield East

TSP monitoring data averaged annually are presented for the C2-Mayfield East Monitoring Station in Figure 5.15. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.15.

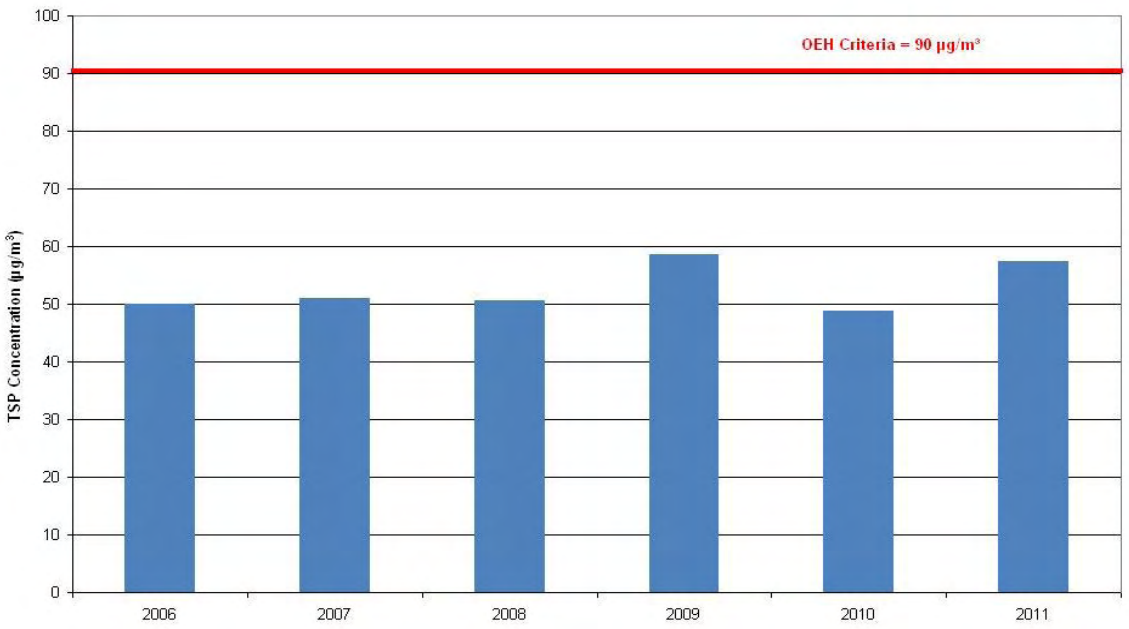

Figure 5.15: C2 Mayfield East Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.15: C2-Mayfield East Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	17%	49.9
2007	17%	51.0
2008	17%	50.6
2009	16%	58.7
2010	17%	48.7
2011	12%	57.4

5.1.15 Fern Bay

TSP monitoring data averaged annually are presented for the Fern Bay Monitoring Station in Figure 5.16. TSP concentrations are measured once every six days using a HVAS. Summary statistics for the annual average TSP concentrations are presented in Table 5.16.

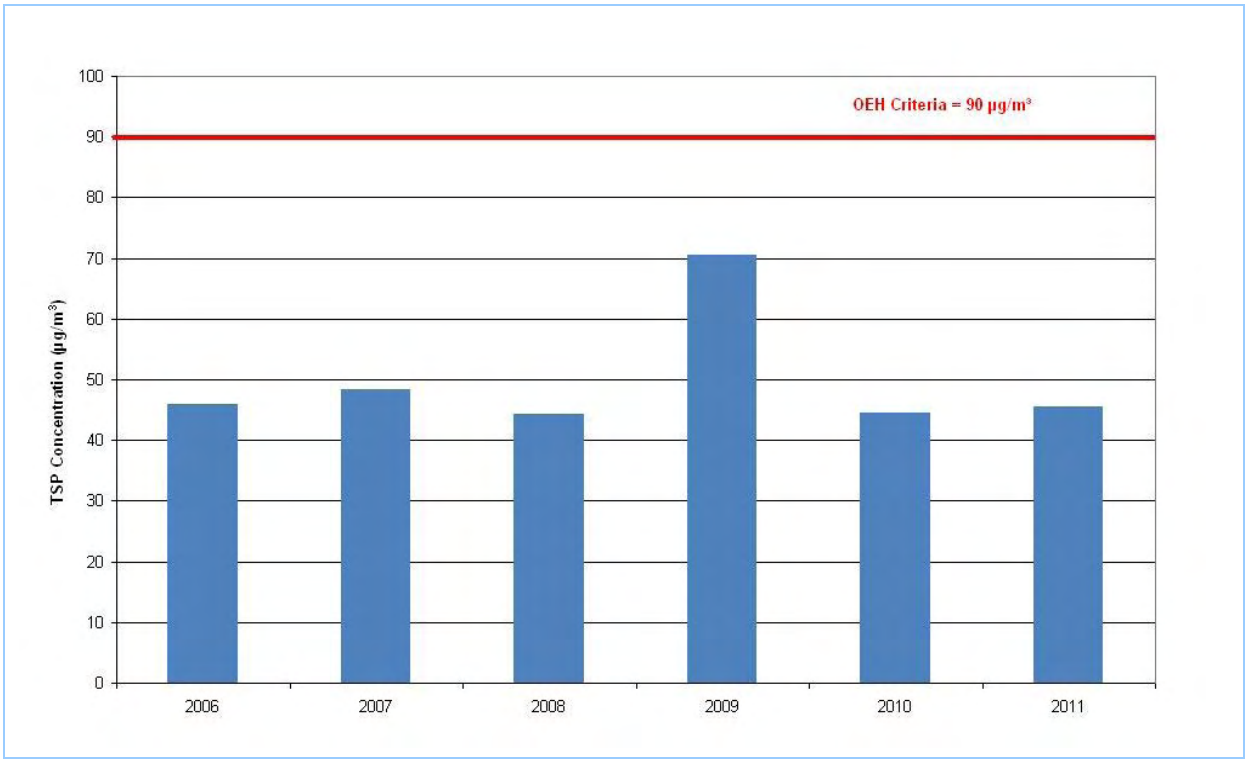

Figure 5.16: Fern Bay Air Monitoring Station – HVAS – Annual Average TSP Concentrations

Table 5.16: Fern Bay Air Monitoring Station – HVAS - Annual Average TSP

Year	Percent Data Coverage	Concentration (µg/m³)
2006	17%	46.0
2007	17%	48.4
2008	17%	44.3
2009	16%	70.5
2010	17%	44.6
2011	12%	45.6

5.2 PM_{10} Concentrations

Data from six HVAS PM_{10} monitoring sites were available. Details of each PM_{10} monitoring station are provided in Table 5.17.

Table 5.17: PM_{10} Monitoring Stations Details

PM_{10} Site ID	Site Name/Location	Method	MGA X (km)	MGA Y (km)
SITE 8	STEEL RIVER	AM-18	380.614	6360.965
SITE 4	MAYFIELD	AM-18	382.784	6359.697
SITE 9	STOCKTON	AM-18	386.338	6358.981
SITE 11	FERN BAY	AM-18	387.448	6362.005
SITE 12	MAYFIELD 4 BERTH	AM-18	384.595	6359.830
SITE 15	FULLERTON RD - STOCKTON	AM-18	386.336	6358.990

The locations of industry monitoring stations for PM_{10} are shown in Figure 5.17.

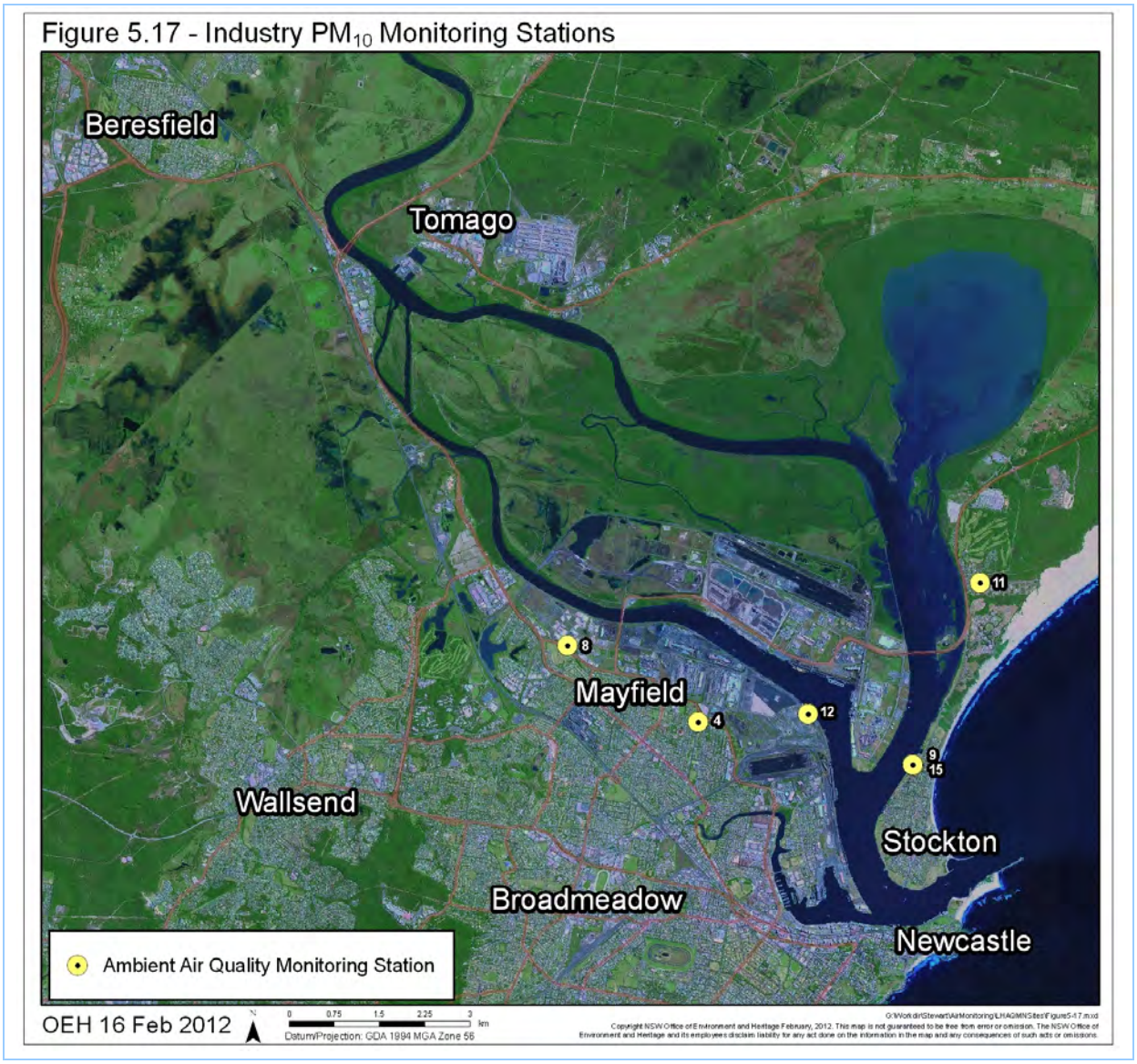

Figure 5.17: Location of Industry PM_{10} Monitoring Stations

5.2.1 Steel River Estate

24-hour average PM_{10} data are presented for the Steel River Estate Monitoring Station in Figure 5.18. PM_{10} concentrations are measured once every six days using a HVAS. Summary statistics for the maximum recorded 24-hour PM_{10} concentration measured at the Steel River Estate Monitoring Station are presented in Table 5.18.

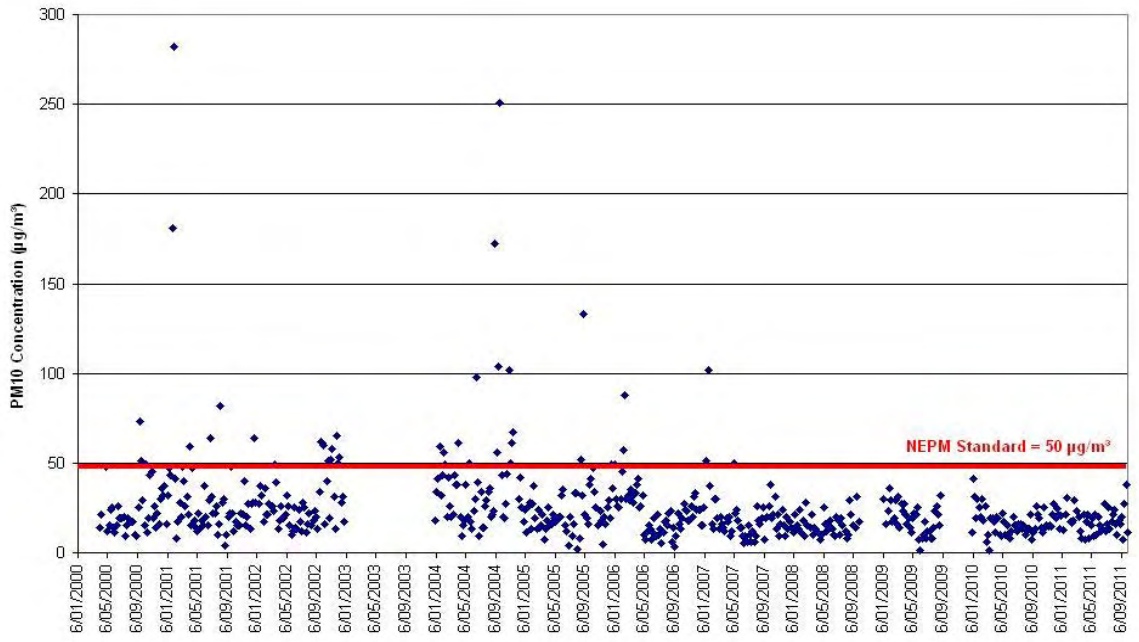

Figure 5.18: Steel River Estate Monitoring Station –HVAS – 24-hour PM_{10} Concentrations

Table 5.18: Steel River Estate - Air Monitoring Station – PM_{10} – HVAS

Year	Concentration (µg/m3)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2000	11%	73.0	51.0	49.0	48.0	45.0	43.0	2
2001	16%	282.0	181.0	82.0	64.0	64.0	59.0	6
2002	16%	65.0	62.0	61.0	60.0	58.0	53.0	6
2003	ND	ND	ND	ND	ND	ND	ND	ND
2004	16%	251.0	172.0	104.0	102.0	98.0	67.0	6
2005	16%	133.0	52.0	49.0	47.0	41.0	38.0	2
2006	17%	88.0	57.0	49.0	45.0	41.0	38.0	2
2007	16%	102.0	51.0	50.0	49.0	38.0	37.0	2
2008	11%	31.0	29.0	28.0	25.0	24.0	21.0	0
2009	11%	36.0	32.0	31.0	30.0	29.0	29.0	0
2010	17%	41.0	31.0	30.0	30.0	27.3	26.0	0
2011	12%	38.0	30.6	29.0	27.0	27.0	25.0	0

PM_{10} monitoring data averaged annually are presented for the Steel River Estate Monitoring Station in Figure 5.19. PM_{10} concentrations are measured once every six days using a HVAS. Summary statistics for the annual average PM_{10} concentrations are presented in Table 5.19.

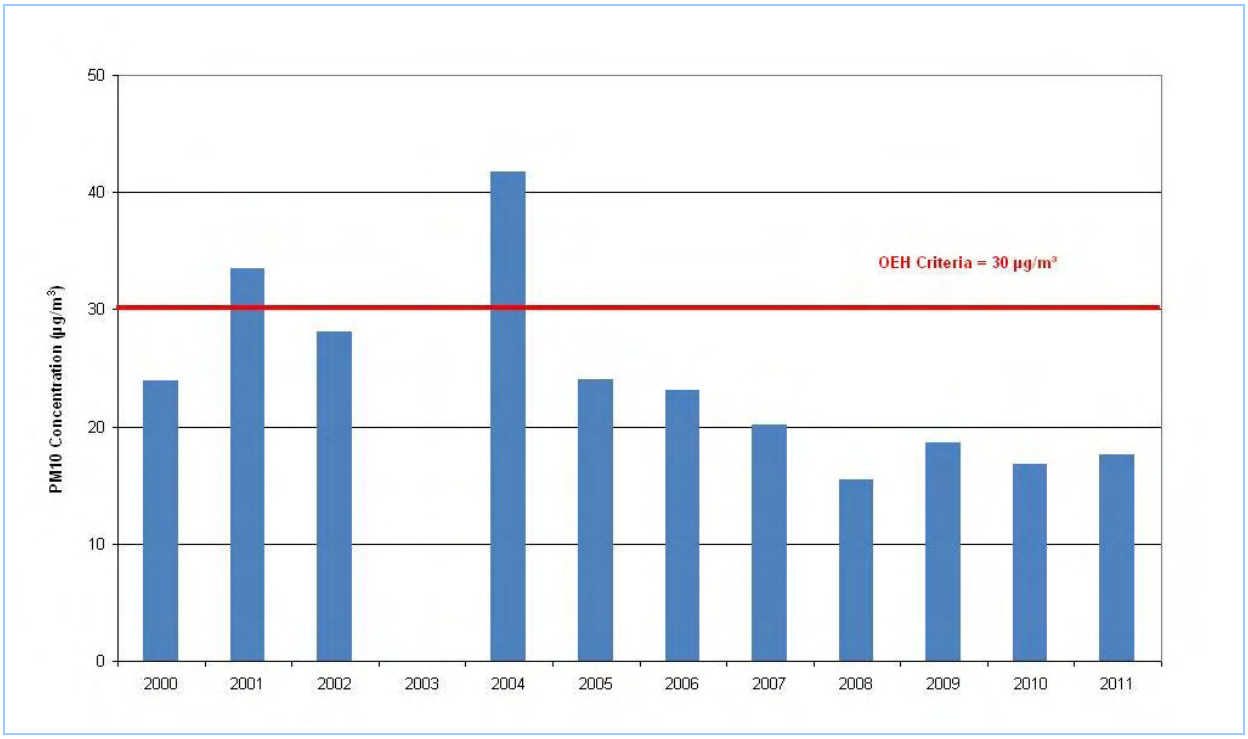

Figure 5.19: Steel River Estate Air Monitoring Station – HVAS – Annual Average PM_{10} Concentrations

Table 5.19: Steel River Estate Air Monitoring Station – HVAS - Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
2000	11%	24.0
2001	16%	33.5
2002	16%	28.1
2003	ND	ND
2004	16%	41.7
2005	16%	24.0
2006	17%	23.1
2007	16%	20.2
2008	11%	15.5
2009	11%	18.6
2010	17%	16.8
2011	12%	17.6

5.2.2 Mayfield

24-hour average PM_{10} data are presented for the Mayfield Monitoring Station in Figure 5.20. PM_{10} concentrations are measured once every six days using a HVAS. Summary statistics for the maximum recorded 24-hour PM_{10} concentration measured at the Mayfield Monitoring Station are presented in Table 5.20.

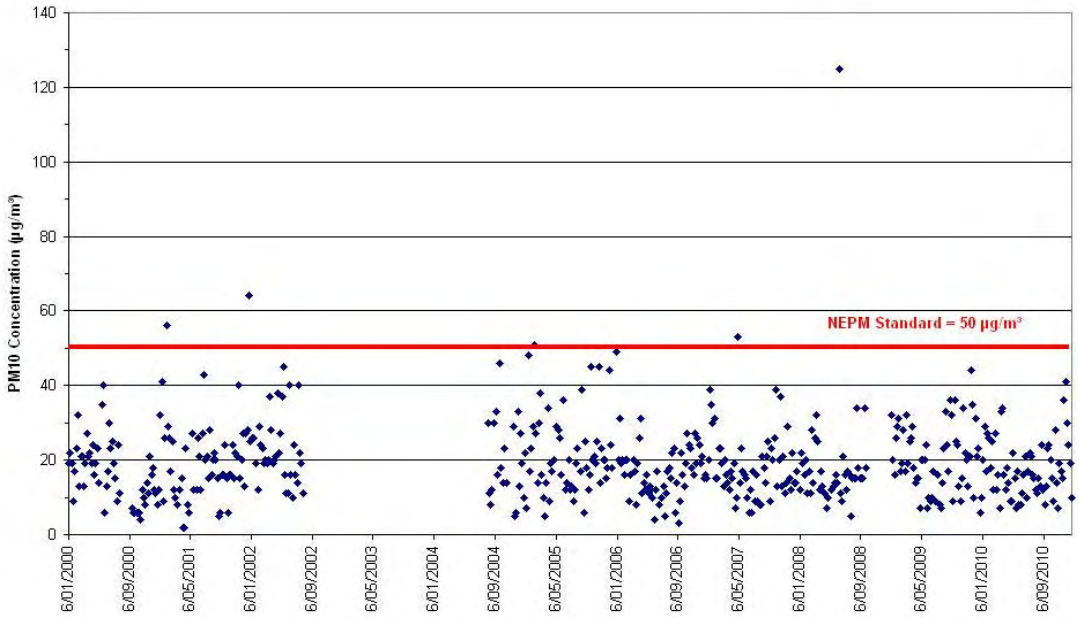

Figure 5.20: Mayfield Monitoring Station –HVAS – 24-hour PM_{10} Concentrations

Table 5.20: Mayfield - Air Monitoring Station – HVAS

Year	Concentration (µg/m3)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2000	14%	40.0	35.0	32.0	30.0	27.0	25.0	0
2001	16%	64.0	56.0	43.0	41.0	40.0	32.0	2
2002	10%	45.0	40.0	40.0	38.0	37.0	37.0	0
2003	ND	ND	ND	ND	ND	ND	ND	ND
2004	5%	46.0	33.0	33.0	30.0	30.0	29.0	0
2005	15%	51.0	48.0	45.0	45.0	44.0	39.0	1
2006	16%	49.0	31.0	31.0	27.0	27.0	26.0	0
2007	16%	53.0	39.0	39.0	37.0	35.0	31.0	1
2008	12%	125.0	34.0	34.0	32.0	28.0	26.0	1
2009	16%	44.0	36.0	36.0	35.0	34.0	33.0	0
2010	17%	41.0	36.0	34.0	33.0	30.0	29.0	0

PM_{10} monitoring data averaged annually are presented for the Mayfield Monitoring Station in Figure 5.21. PM_{10} concentrations are measured once every six days using a HVAS. Summary statistics for the annual average PM_{10} concentrations are presented in Table 5.21.

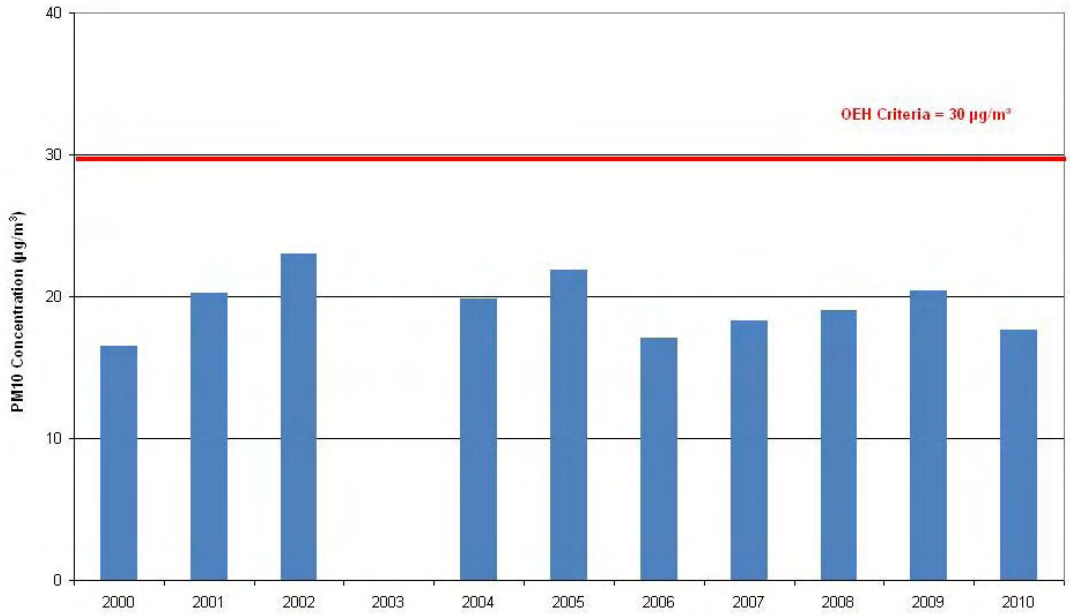

Figure 5.21: Mayfield Air Monitoring Station – HVAS – Annual Average PM_{10} Concentrations

Table 5.21: Mayfield Air Monitoring Station – HVAS - Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
2000	14%	**16.5**
2f001	16%	**20.2**
2002	10%	**23.0**
2003	ND	**ND**
2004	5%	**19.9**
2005	15%	**21.8**
2006	16%	**17.1**
2007	16%	**18.3**
2008	12%	**19.0**
2009	16%	**20.4**

5.2.3 Stockton

24-hour average PM_{10} data are presented for the Stockton Monitoring Station in Figure 5.22. PM_{10} concentrations are measured once every six days using a HVAS.

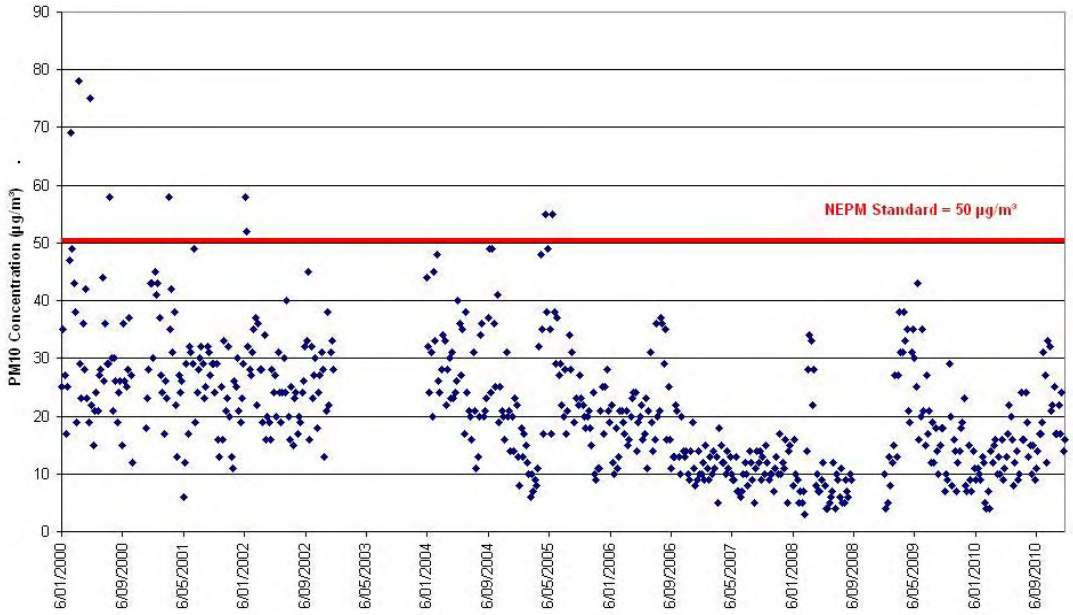

Figure 5.22: Stockton Monitoring Station –HVAS – 24-hour PM_{10} Concentrations

Summary statistics for the maximum recorded 24-hour PM_{10} concentration measured at the Stockton Monitoring Station are presented in Table 5.22.

Table 5.22: Stockton - Air Monitoring Station – HVAS

Year	Concentration (µg/m3)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2000	14%	78.0	75.0	69.0	58.0	49.0	47.0	4
2001	16%	58.0	49.0	45.0	43.0	42.0	41.0	1
2002	17%	58.0	52.0	45.0	40.0	38.0	37.0	2
2003	ND	ND	ND	ND	ND	ND	ND	ND
2004	17%	49.0	49.0	48.0	45.0	44.0	41.0	0
2005	16%	55.0	55.0	49.0	48.0	38.0	38.0	2
2006	17%	37.0	36.0	36.0	35.0	31.0	29.0	0
2007	16%	18.0	17.0	16.0	15.0	15.0	15.0	0
2008	11%	34.0	33.0	28.0	28.0	22.0	16.0	0
2009	16%	43.0	38.0	38.0	35.0	35.0	35.0	0
2010	17%	33.0	32.0	31.0	27.0	25.0	24.0	0

PM_{10} monitoring data averaged annually are presented for the Stockton Monitoring Station in Figure 5.23. PM_{10} concentrations are measured once every six days using a HVAS. Summary statistics for the annual average PM_{10} concentrations are presented in Table 5.23.

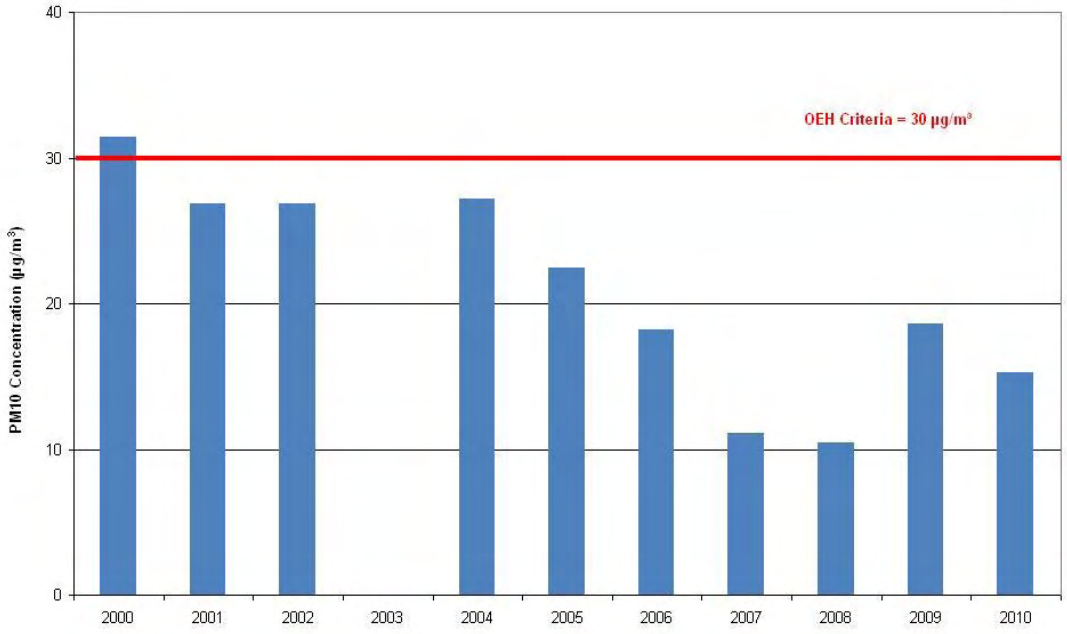

Figure 5.23: Stockton Air Monitoring Station – HVAS – Annual Average PM_{10} Concentrations

Table 5.23: Stockton Air Monitoring Station – HVAS - Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
2000	14%	31.4
2001	16%	26.9
2002	17%	26.9
2003	ND	ND
2004	17%	27.2
2005	16%	22.5
2006	17%	18.2
2007	16%	11.1
2008	11%	10.5
2009	16%	18.6

5.2.4 Fern Bay

24-hour average PM_{10} data are presented for the Fern Bay Monitoring Station in Figure 5.24. PM_{10} concentrations are measured once every six days using a HVAS.

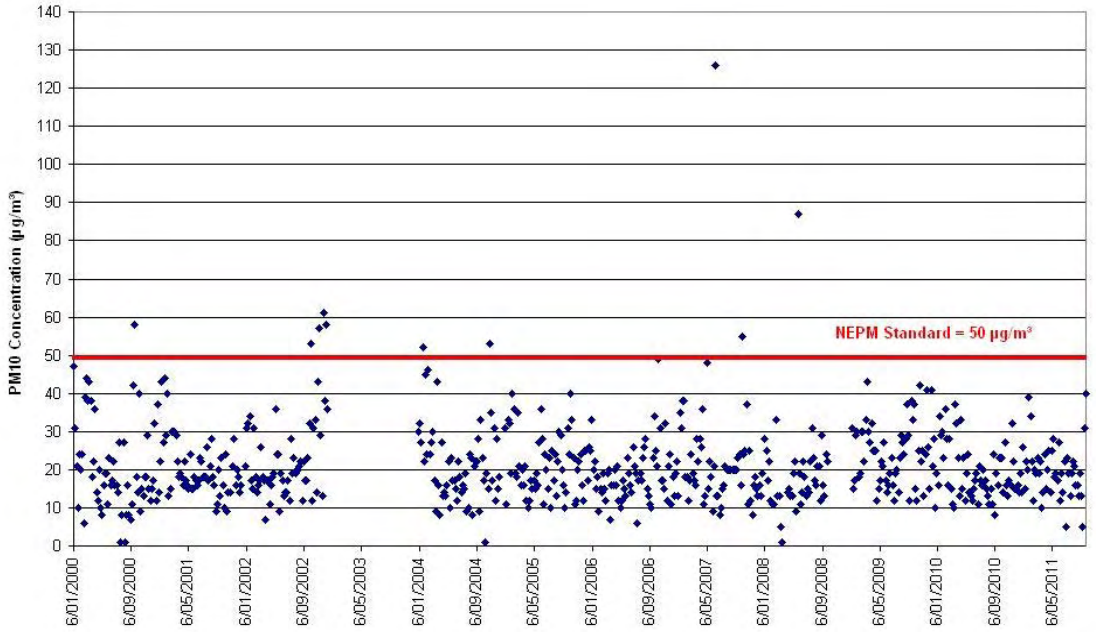

Figure 5.24: Fern Bay Monitoring Station –HVAS – 24-hour PM_{10} Concentrations

Summary statistics for the maximum recorded 24-hour PM_{10} concentration measured at the Fern Bay Monitoring Station are presented in Table 5.24.

Table 5.24: Fern Bay - Air Monitoring Station – HVAS

Year	Concentration (µg/m3)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2000	17%	58.0	47.0	44.0	43.0	42.0	40.0	1
2001	16%	44.0	43.0	40.0	30.0	30.0	30.0	0
2002	16%	61.0	58.0	57.0	53.0	43.0	38.0	4
2003	ND	ND	ND	ND	ND	ND	ND	ND
2004	16%	53.0	52.0	46.0	45.0	43.0	35.0	2
2005	17%	40.0	40.0	36.0	36.0	35.0	33.0	0
2006	17%	49.0	34.0	33.0	32.0	31.0	28.0	0
2007	16%	126.0	55.0	48.0	38.0	38.0	37.0	2
2008	11%	87.0	33.0	31.0	29.0	28.0	25.0	1
2009	16%	43.0	42.0	41.0	41.0	38.0	37.0	0
2010	17%	37.0	36.0	34.0	33.0	32.0	32.0	0
2011	12%	40.0	39.0	34.0	31.0	28.0	27.0	0

PM_{10} monitoring data averaged annually are presented for the Fern Bay Monitoring Station in Figure 5.25. PM_{10} concentrations are measured once every six days using a HVAS. Summary statistics for the annual average PM_{10} concentrations are presented in Table 5.25.

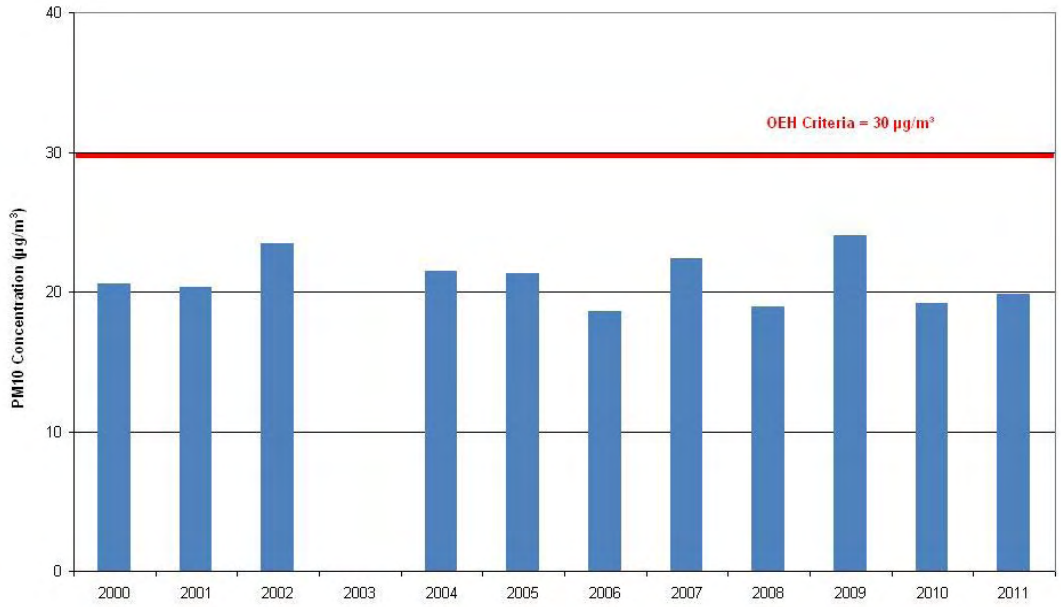

Figure 5.25: Fern Bay Air Monitoring Station – HVAS – Annual Average PM_{10} Concentrations

Table 5.25: Fern Bay Air Monitoring Station – HVAS - Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
2000	17%	20.6
2001	16%	20.3
2002	16%	23.5
2003	ND	ND
2004	16%	21.5
2005	17%	21.3
2006	17%	18.6
2007	16%	22.4
2008	11%	18.9
2009	16%	24.0
2010	17%	19.2
2011	12%	19.8

5.2.5 Mayfield 4 Berth

24-hour average PM_{10} data are presented for the Mayfield 4 Berth Monitoring Station in Figure 5.26. PM_{10} concentrations are measured once every six days using a HVAS.

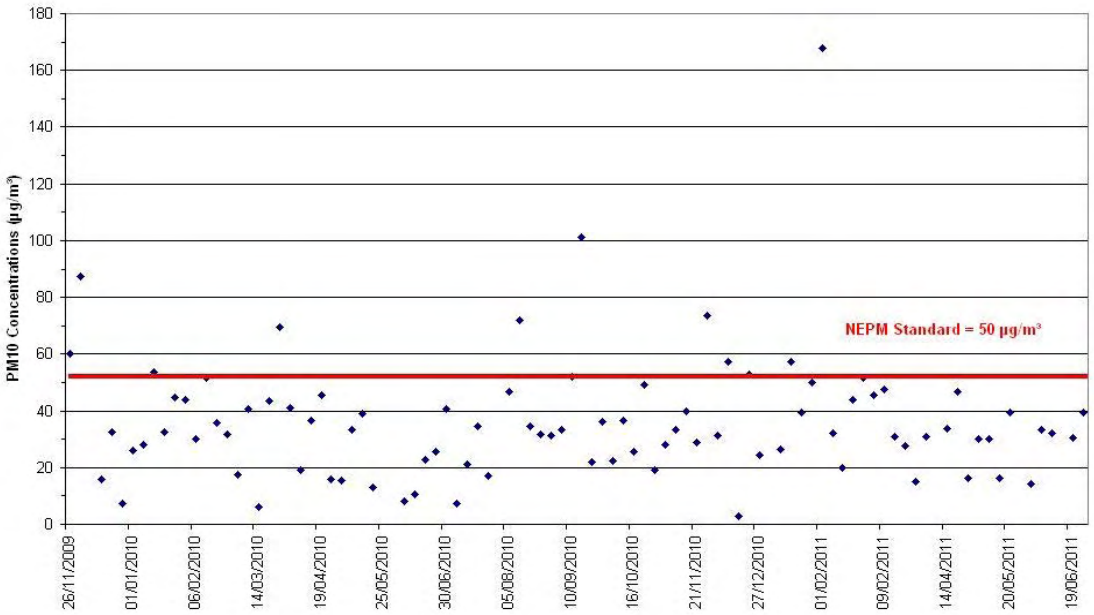

Figure 5.26: Mayfield 4 Berth Monitoring Station –HVAS – 24-hour PM_{10} Concentrations

Summary statistics for the maximum recorded 24-hour PM_{10} concentration measured at the Mayfield 4 Berth Monitoring Station are presented in Table 5.26.

Table 5.26: Mayfield 4 Berth - Air Monitoring Station – HVAS

Year	Concentration (µg/m3)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2009	1%	87.4	60.1	32.6	15.9	7.4	ND	2
2010	16%	101.0	73.5	71.8	69.6	57.4	53.8	6
2011	7%	168.0	57.1	51.4	49.9	47.5	46.9	3

PM_{10} monitoring data averaged annually are presented for the Mayfield 4 Berth Monitoring Station in Figure 5.27. PM_{10} concentrations are measured once every six days using a HVAS. Summary statistics for the annual average PM_{10} concentrations are presented in Table 5.27.

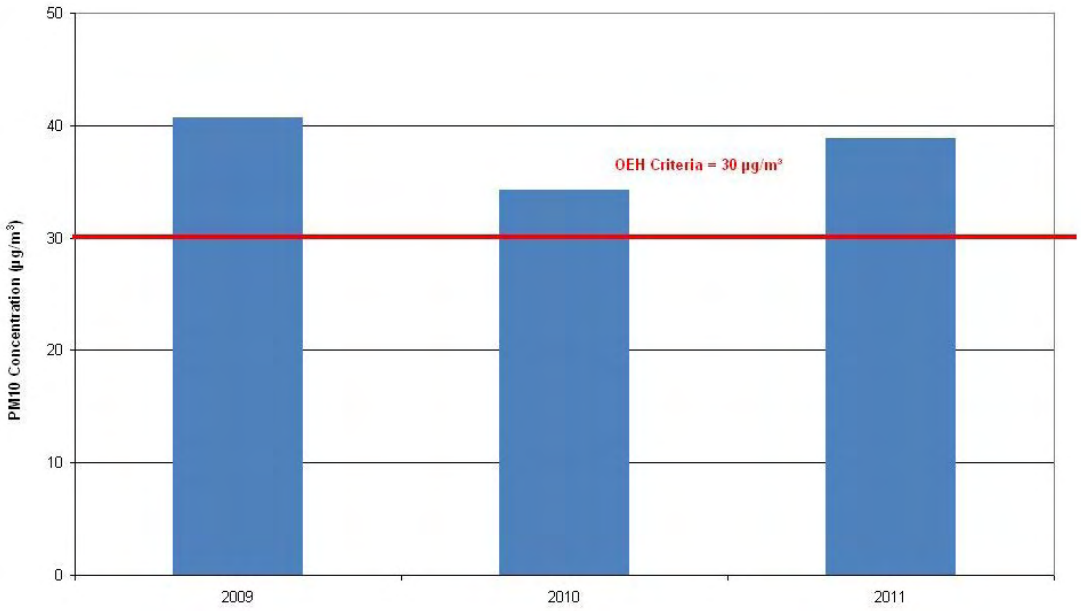

Figure 5.27: Mayfield 4 Berth Air Monitoring Station – HVAS – Annual Average PM_{10} Concentrations

Table 5.27: Mayfield 4 Berth Air Monitoring Station – HVAS - Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
2009	1%	40.7
2010	16%	34.3
2011	7%	38.8

5.2.6 Fullerton Rd Stockton

24-hour average PM_{10} data are presented for the Fullerton Road Stockton Monitoring Station in Figure 5.28. PM_{10} concentrations are measured once every six days using a HVAS.

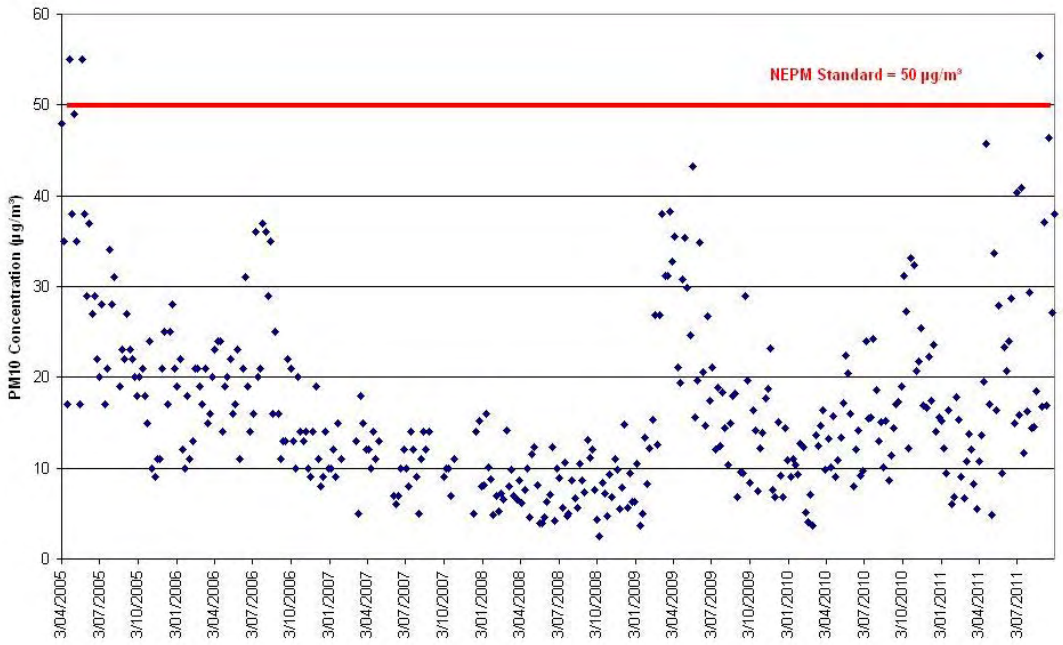

Figure 5.28: Fullerton Road Stockton Monitoring Station –HVAS – 24-hour PM_{10} Concentrations

Summary statistics for the maximum recorded 24-hour PM_{10} concentration measured at the Fullerton Road Stockton Monitoring Station are presented in Table 5.28.

Table 5.28: Fullerton Road Stockton - Air Monitoring Station – HVAS

Year	Concentration (µg/m3)							Number of Days Above NEPM Level
	% Data Coverage	1st Highest	2nd Highest	3rd Highest	4th Highest	5th Highest	6th Highest	
2005	12%	55.0	55.0	49.0	48.0	38.0	38.0	2
2006	17%	37.0	36.0	36.0	35.0	31.0	29.0	0
2007	11%	18.0	15.1	15.0	15.0	14.1	14.0	0
2008	17%	16.0	14.8	14.1	13.1	12.3	12.3	0
2009	16%	43.3	38.3	37.9	35.5	35.4	34.8	0
2010	17%	33.1	32.3	31.2	27.3	25.4	24.2	0
2011	13%	55.5	46.4	45.7	40.8	40.4	38.0	1

PM_{10} monitoring data averaged annually are presented for the Fullerton Road Monitoring Station in Figure 5.29. PM_{10} concentrations are measured once every six days using a HVAS. Summary statistics for the annual average PM_{10} concentrations are presented in Table 5.29.

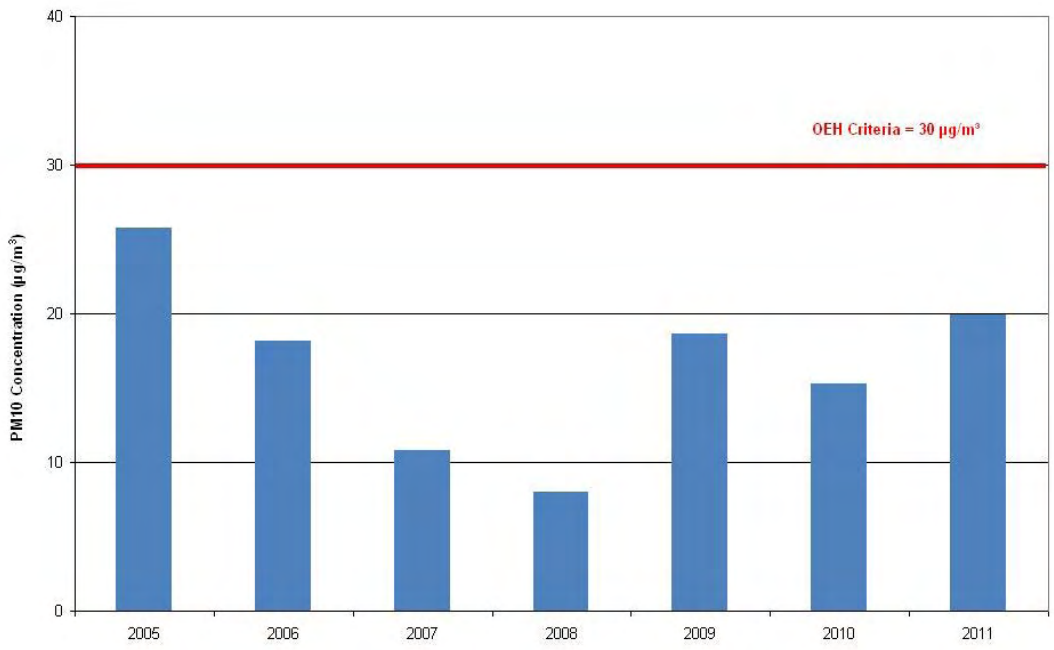

Figure 5.29: Fullerton Rd Stockton Air Monitoring Station – HVAS – Annual Average PM_{10} Concentrations

Table 5.29: Fullerton Rd Stockton Air Monitoring Station – HVAS - Annual Average PM_{10}

Year	Percent Data Coverage	Concentration (µg/m³)
2005	12%	**25.8**
2006	17%	**18.2**
2007	11%	**10.8**
2008	17%	**8.0**
2009	16%	**18.7**
2010	17%	**15.3**
2011	13%	**19.9**

5.3 $PM_{2.5}$ Concentrations

Data from one $PM_{2.5}$ monitoring site were available from the Australian Nuclear Science and Technology Organisation (ANSTO) in the Lower Hunter region. Details of the $PM_{2.5}$ monitoring station are provided in Table 5.30.

Table 5.30: $PM_{2.5}$ Monitoring Stations Details

$PM_{2.5}$ Site ID	Site Name/Location	Method	MGA X (km)	MGA Y (km)
SITE 1	Mayfield -ASP	ASP	382.784	6359.697

The location the industry monitoring stations for $PM_{2.5}$ is shown in Figure 5.30.

Figure 5.30: Location of Industry $PM_{2.5}$ Monitoring Station

ANSTO has conducted a long term $PM_{2.5}$ monitoring campaign at a number of locations along the east coast of Australia (ANSTO, 2008). One monitoring station is located at Mayfield. For sampling conducted at Mayfield between 2000 and 2010, ANSTO have reported the annual average recorded concentrations and provided data on the composition of the recorded $PM_{2.5}$ concentrations.

Results from the ANSTO study indicate that Mayfield experiences annual average concentrations at around the NEPM advisory reporting goal of 8 $\mu g/m^3$.

Long-term annual average $PM_{2.5}$ concentration data from the ANSTO monitoring at Mayfield were obtained from Newcastle City Council.

Figure 5.31: Annual Average $PM_{2.5}$ Concentrations recorded at Mayfield

Major chemical components of $PM_{2.5}$ are sea spray, wind blown soil, sooty or black carbon, ammonium sulphate and organics (ANSTO, 2010). Sources of black carbon include primarily carbon generated from combustion processes (soot), but could also include carbon from coal dust (Nelson et al., 2007). The contribution of coal dust derived from mechanical attrition processes reduces for smaller sizes, and is likely to be insignificant for the less than 1 µg component of fine particles. (Nelson et al., 2007).

Inter-annual trends in the major chemical components of $PM_{2.5}$ are illustrated in Figure 5.32.

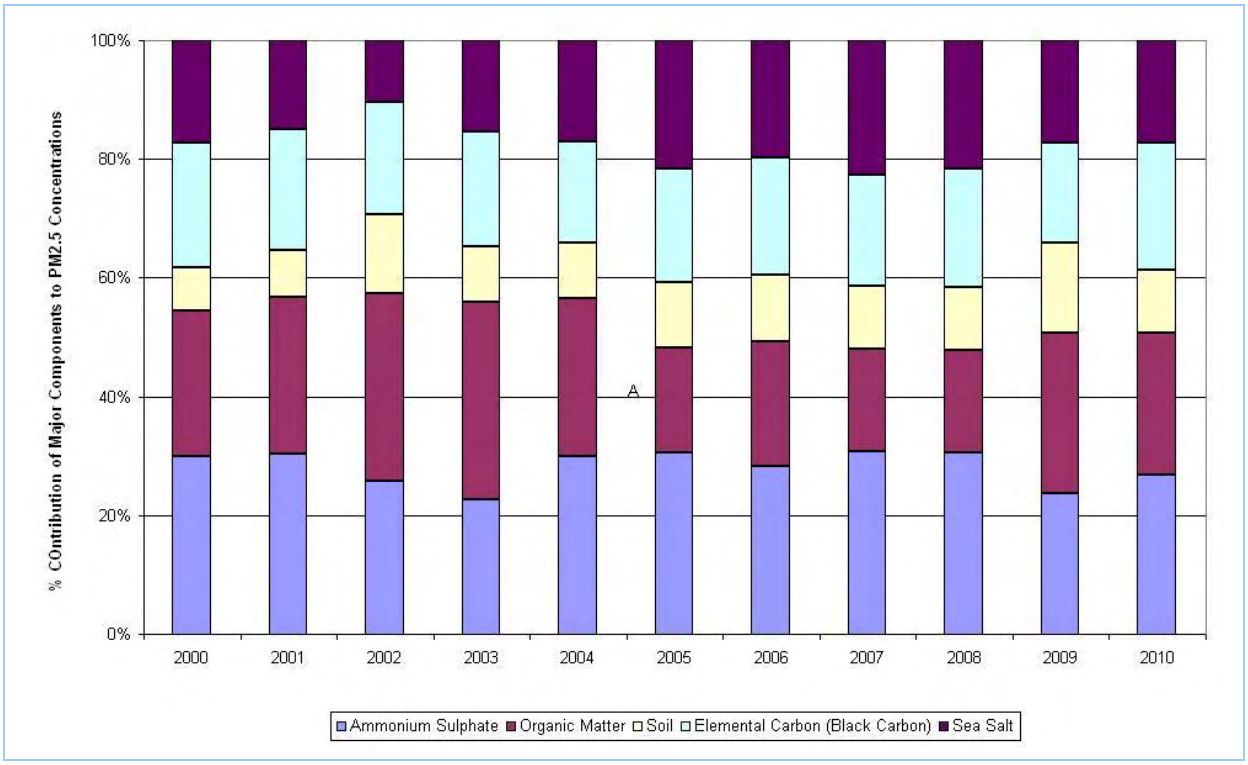

Figure 5.32: Temporal Trends in $PM_{2.5}$ Composition at Mayfield, 2000 - 2010

ANSTO (2010) undertook receptor modelling based on the $PM_{2.5}$ samples collected at the Mayfield station over the 1998 to 2009 period. Source 'fingerprints' were assigned and source contributions to $PM_{2.5}$ concentrations predicted, as shown in Figure 5.33. Combustion related sources, secondary particles (sulphate) and sea salt were predicted to contribute significantly to fine particle concentrations.

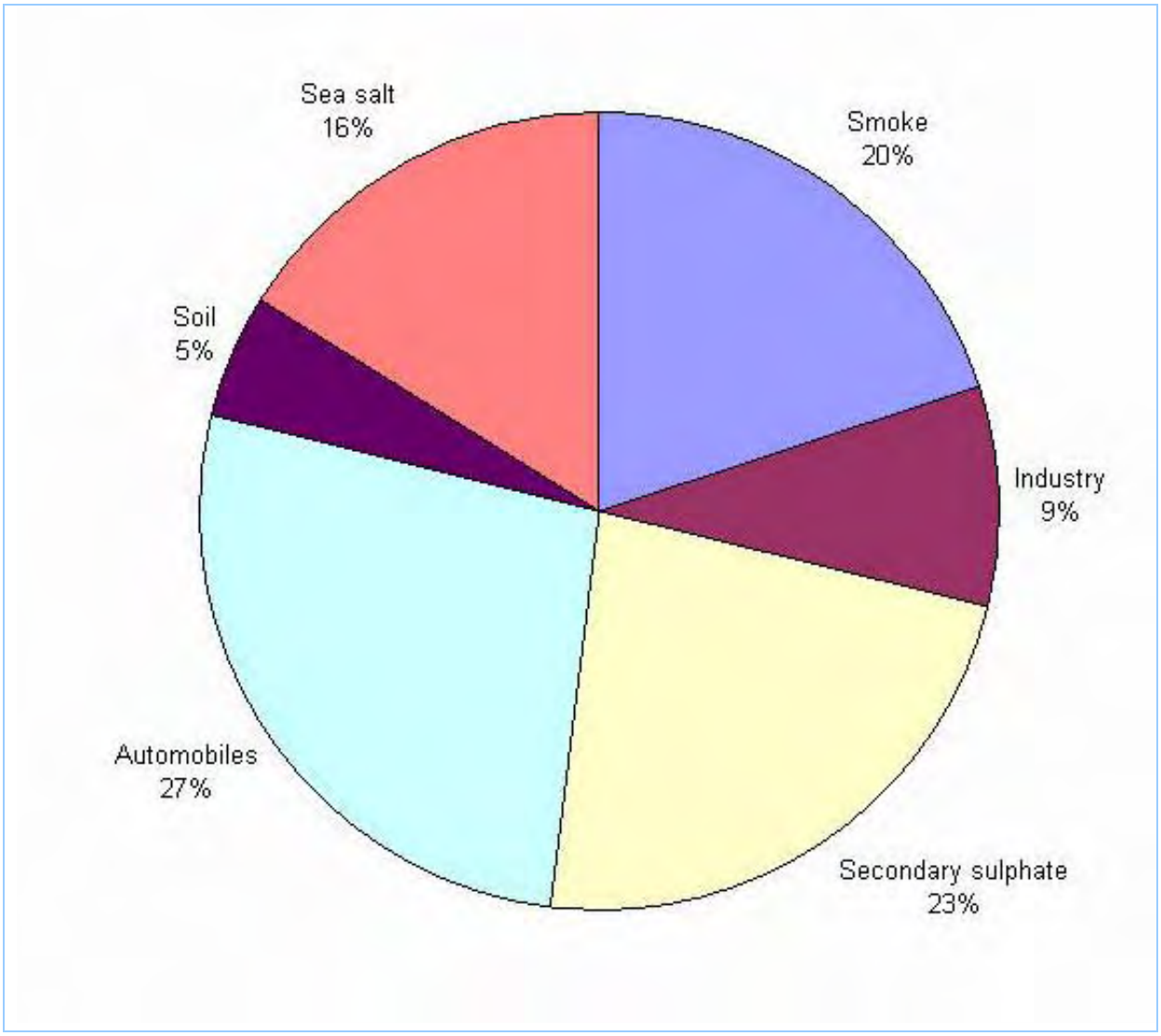

Figure 5.33: Percentage Source Contribution to $PM_{2.5}$ Concentrations Recorded at Mayfield, 1998 – 2009 (ANSTO, 2010)

5.4 NO_2 Concentrations

Data from one NO_2 monitoring site were available from Orica in the Lower Hunter region. Details of the NO_2 monitoring station are provided in Table 5.31.

Table 5.31: NO_2 Monitoring Stations Details

NO_x Site ID	Site Name/Location	Method	MGA X (km)	MGA Y (km)
SITE 16	Roxburgh St - Stockton	AM-18	386.311	6358.656

The location of the industry monitoring stations for NO_2 is shown in Figure 5.34.

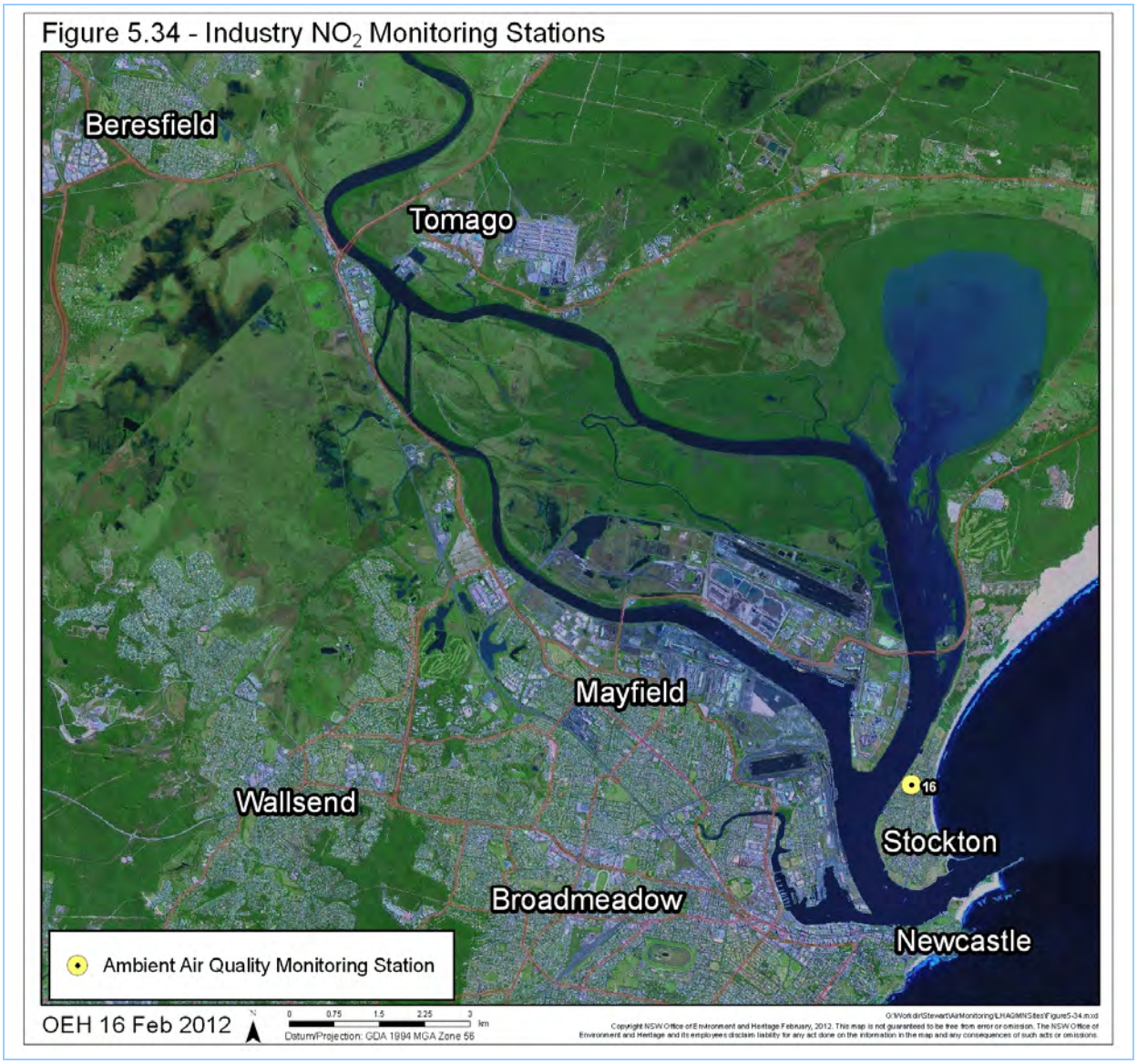

Figure 5.34: Location of Industry NO_2 Monitoring Station

NO_2 monitoring data averaged hourly and annually are presented for the Orica Roxburgh St - Stockton Monitoring Station in Figure 5.35 and Figure 5.36. NO_2 concentrations are monitored continuously using AM-18. Summary statistics for the maximum recorded 1 hour average and annual average NO_2 concentrations are presented in Table 5.32and Table 5.33 respectively.

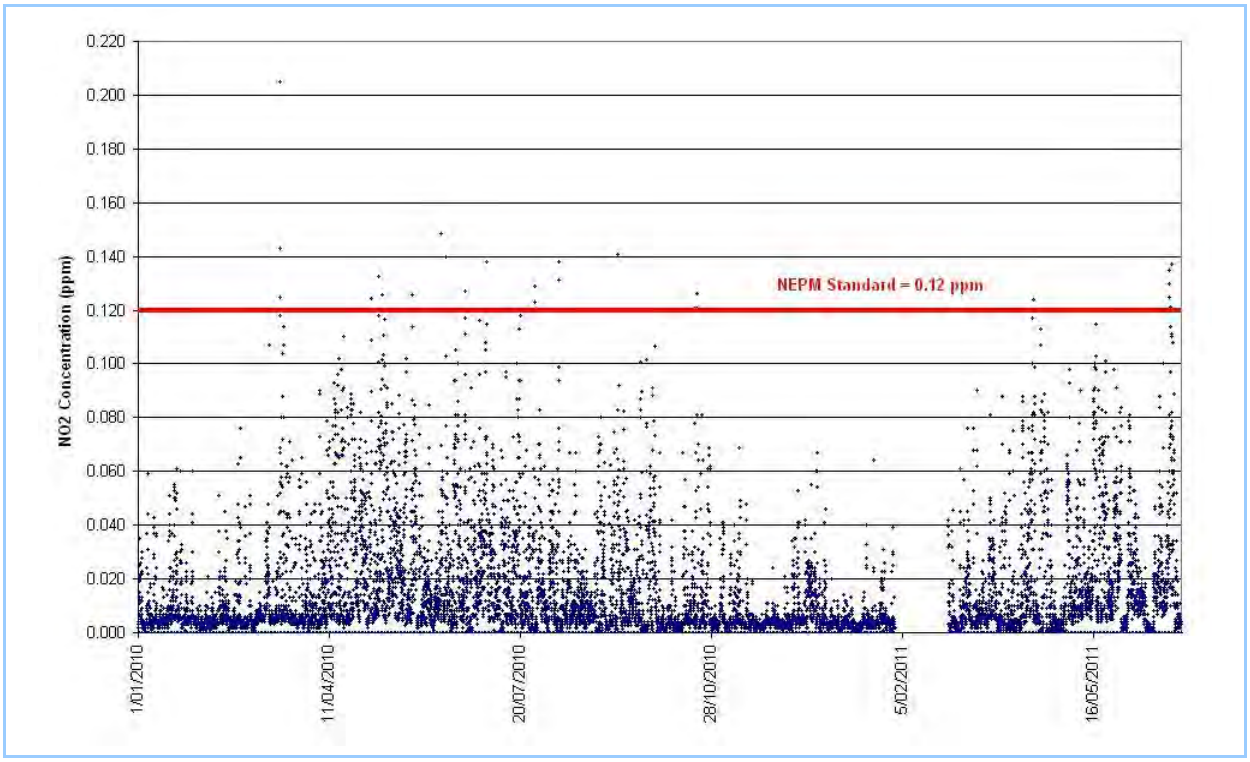

Figure 5.35: Roxburgh St - Stockton – AM-18 – 1 Hour NO_2 Concentrations

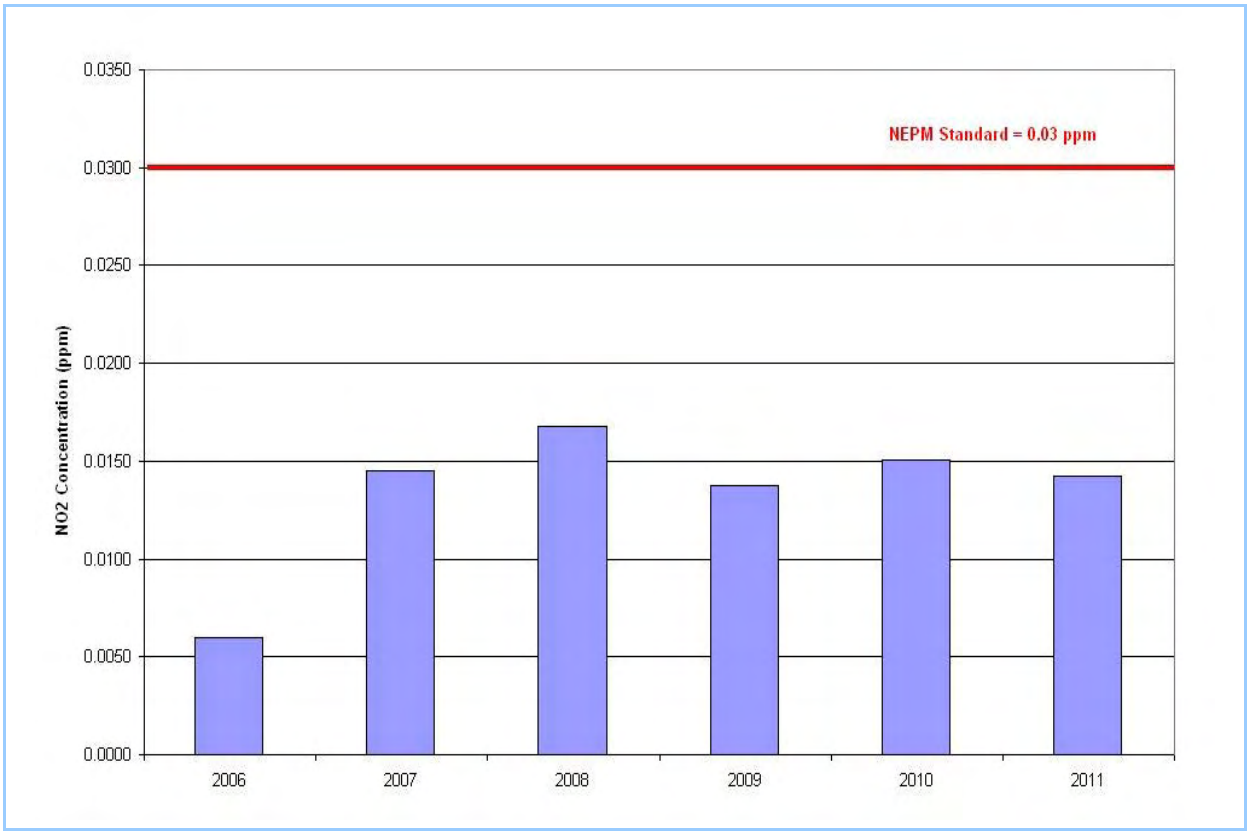

Figure 5.36: Roxburgh St - Stockton – AM-18 – Annual Average NO_2 Concentrations

Table 5.32: 1 Hour Average NO_2 – Roxburgh St - Stockton

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2006	43%	0.112	0.104	0
2007	85%	0.204	0.166	8
2008	91%	0.159	0.159	8
2009	95%	0.172	0.165	6
2010	95%	0.205	0.148	13
2011	46%	0.137	0.137	4

Table 5.33: Annual Average NO_2 –Roxburgh St - Stockton

Year	Percent Data Coverage	Concentration (ppm)
2006	43%	0.0060
2007	85%	0.0145
2008	91%	0.0168
2009	95%	0.0138
2010	95%	0.0151
2011	46%	0.0142

5.5 SO_2 Concentrations

Data from five SO_2 monitoring sites were available from Tomago Aluminium in the Lower Hunter region. Details of the SO_2 monitoring stations are provided in Table 5.34.

Table 5.34: SO_2 Monitoring Stations Details

SO_2 Site ID	Site Name/Location	Method	MGA X (km)	MGA Y (km)
SITE 22	Met	AM-20	381.194	6368.221
SITE 19	Farm	AM-20	381.364	6366.705
SITE 20	Highway	AM-20	379.357	6369.102
SITE 21	Laverick	AM-20	378.884	6367.290
SITE 23	SchoolDrv	AM-20	381.419	6367.117

The locations of industry monitoring stations for SO_2 are shown in Figure 5.37.

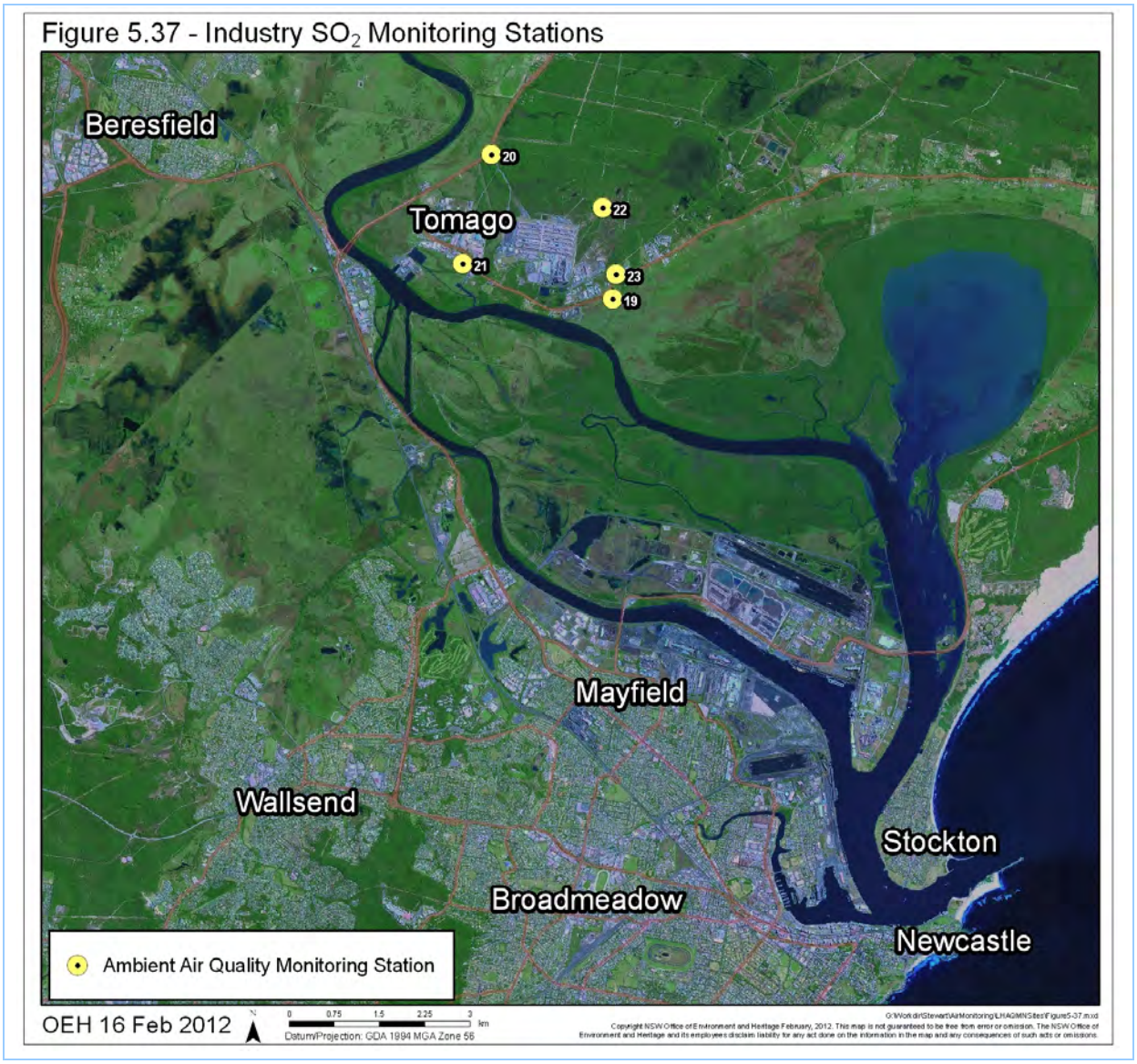

Figure 5.37: Location of Industry SO_2 Monitoring Stations

5.5.1 Met

SO_2 monitoring data averaged over 24 hours and annually are presented for the Tomago Aluminium Met Monitoring Station in Figure 5.38 and Figure 5.39 respectively. SO_2 concentrations are monitored continuously using AM-20. Summary statistics for the maximum recorded 1 hour, 24-hour and annual average SO_2 concentration are presented in Table 5.35, Table 5.36 and Table 5.37 respectively.

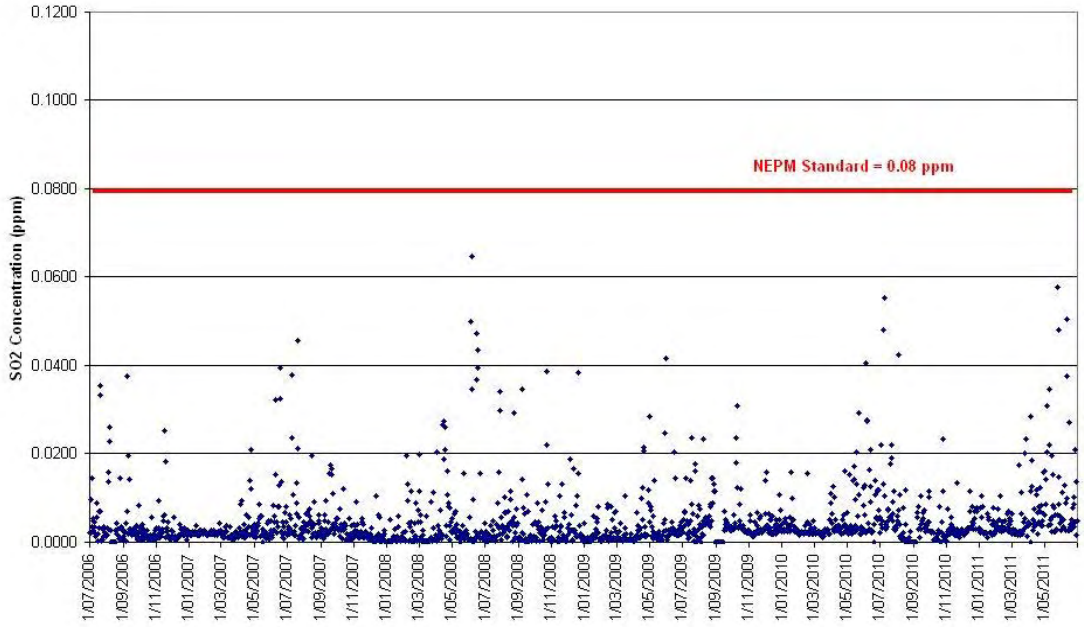

Figure 5.38: Met – AM-20 – 24-hour SO_2 Concentrations

Table 5.35: 1 Hour Average SO_2 – Met

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2006	47%	0.084	0.078	0
2007	99%	0.100	0.085	0
2008	96%	0.094	0.093	0
2009	85%	0.086	0.086	0
2010	89%	0.103	0.101	0
2011	48%	0.114	0.108	0

Table 5.36: 24-hour Average SO_2 – Met

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2006	47%	0.038	0.035	0
2007	99%	0.046	0.039	0
2008	96%	0.065	0.050	0
2009	85%	0.042	0.031	0
2010	89%	0.055	0.048	0
2011	48%	0.058	0.050	0

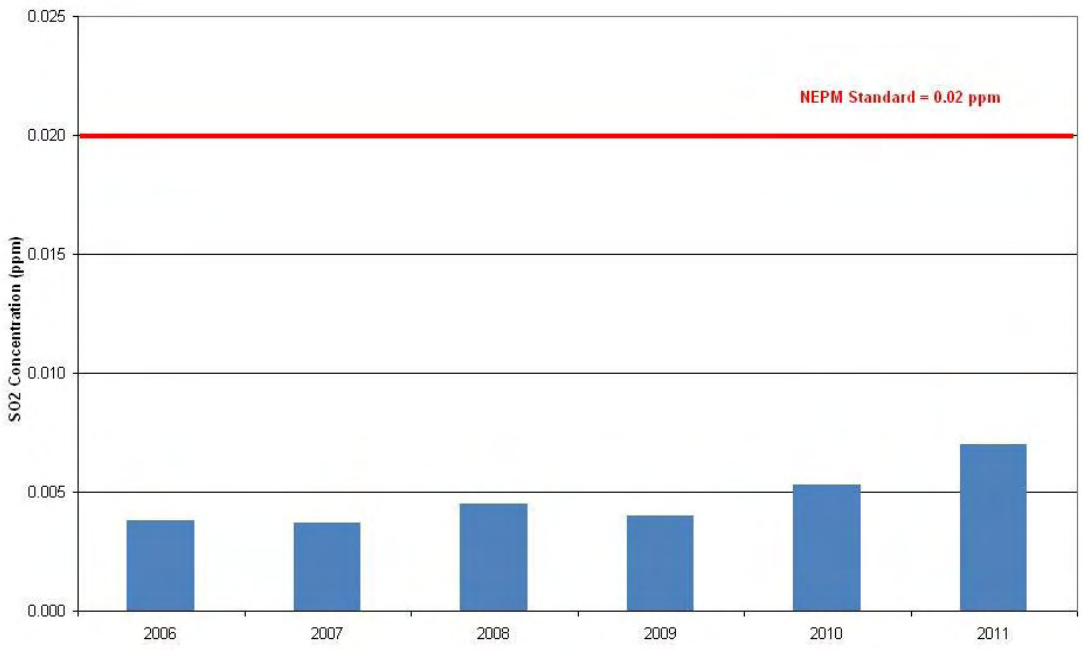

Figure 5.39: Met – AM-20 – Annual Average SO_2 Concentrations

Table 5.37: Annual Average SO_2 – Met

Year	Percent Data Coverage	Concentration (ppm)
2006	47%	0.0038
2007	99%	0.0037
2008	96%	0.0045
2009	85%	0.0040
2010	89%	0.0053
2011	48%	0.0070

5.5.2 Farm

SO_2 monitoring data averaged over 24 hours and annually are presented for the Tomago Aluminium Farm Monitoring Station in Figure 5.40 and Figure 5.41 respectively. SO_2 concentrations are monitored continuously using AM-20. Summary statistics for the maximum recorded 1 hour, 24-hour and annual average SO_2 concentrations are presented in Table 5.38, Table 5.39 and Table 5.40 respectively.

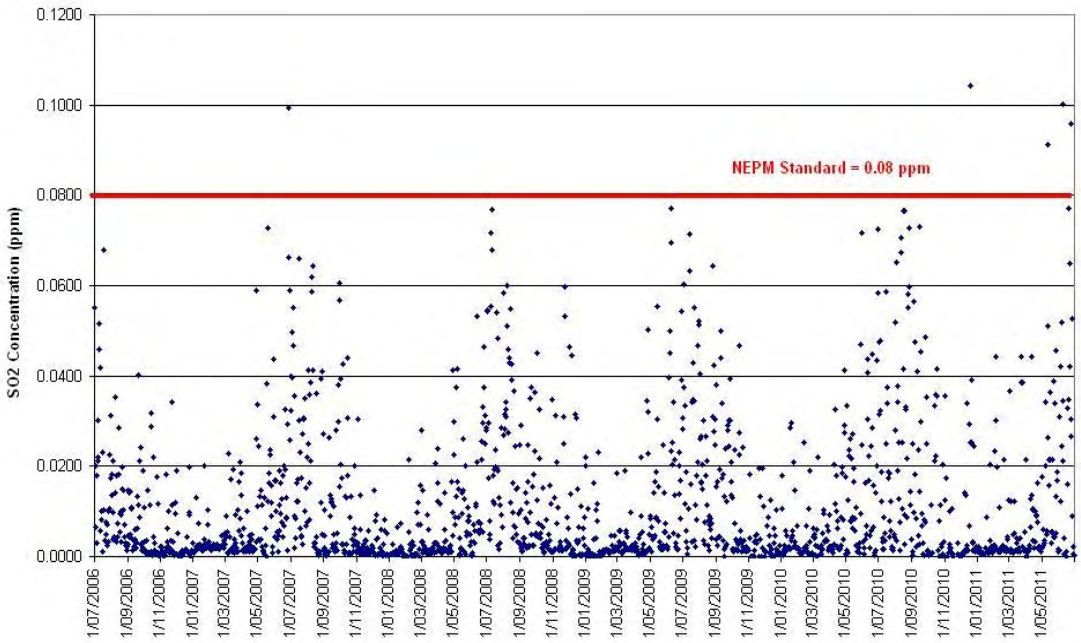

Figure 5.40: Farm – AM-20 – 24-hour SO_2 Concentrations

Table 5.38: 1 Hour Average SO_2 – Farm

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2006	49%	0.126	0.120	0
2007	99%	0.147	0.139	0
2008	96%	0.302	0.237	3
2009	94%	0.231	0.175	1
2010	90%	0.171	0.164	0
2011	48%	0.155	0.151	0

Table 5.39: 24-hour Average SO_2 – Farm

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2006	49%	0.068	0.055	0
2007	99%	0.099	0.073	0
2008	96%	0.077	0.072	0
2009	94%	0.077	0.071	0
2010	90%	0.104	0.077	1
2011	48%	0.100	0.096	3

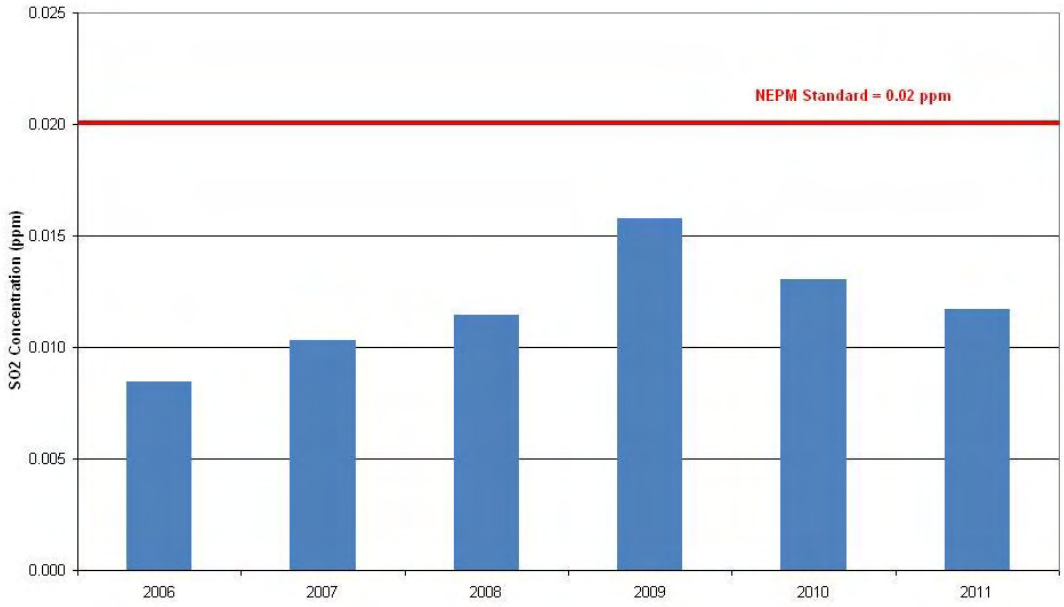

Figure 5.41: Farm – AM-20 – Annual Average SO_2 Concentrations

Table 5.40: Annual Average SO_2 – Farm

Year	Percent Data Coverage	Concentration (ppm)
2006	49%	0.0084
2007	99%	0.0103
2008	96%	0.0115
2009	94%	0.0158
2010	90%	0.0130
2011	48%	0.0117

5.5.3 Highway

SO_2 monitoring data averaged over 24 hours and annually are presented for the Tomago Aluminium Highway Monitoring Station in Figure 5.42 and Figure 5.43 respectively. SO_2 concentrations are monitored continuously using AM-20. Summary statistics for the maximum recorded 1 hour, 24-hour and annual average SO_2 concentrations are presented in Table 5.41, Table 5.42 and Table 5.43 respectively.

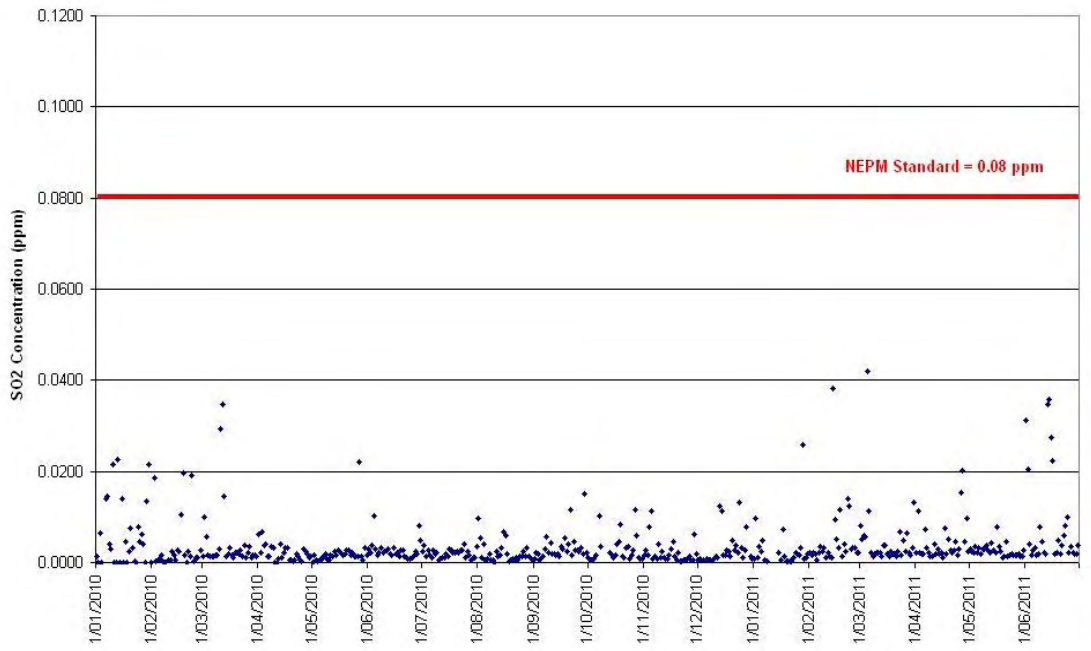

Figure 5.42: Highway – AM-20 – 24-hour SO_2 Concentrations

Table 5.41: 1 Hour Average SO_2 – Highway

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2010	86%	0.074	0.070	0
2011	48%	0.096	0.091	0

Table 5.42: 24-hour Average SO_2 – Highway

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2010	86%	0.035	0.029	0
2011	48%	0.042	0.038	0

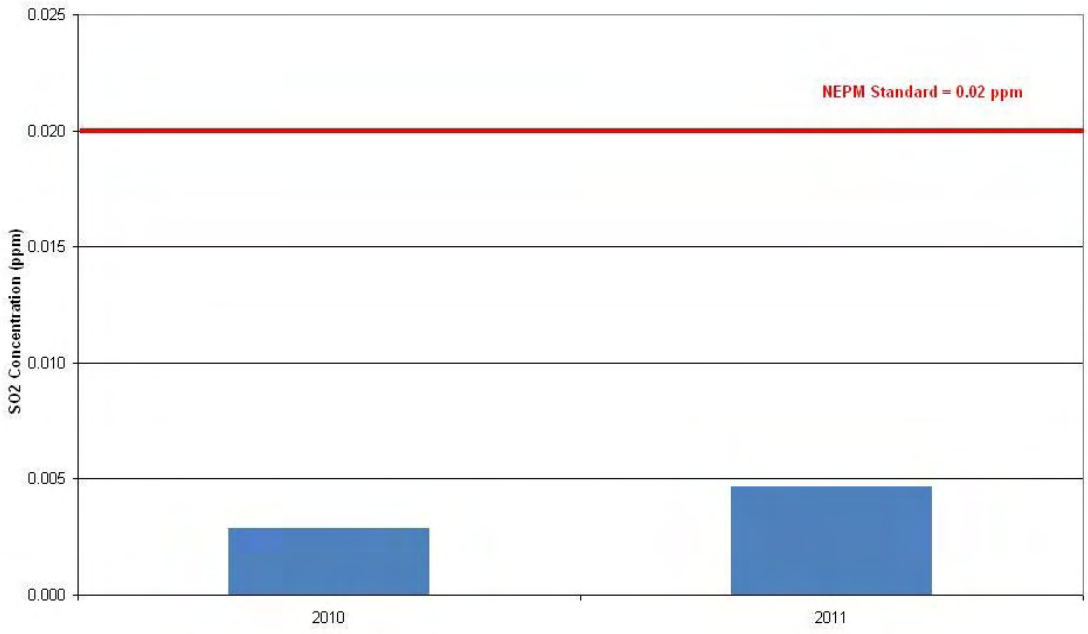

Figure 5.43: Highway – AM-20 – Annual Average SO_2 Concentrations

Table 5.43: Annual Average SO_2 – Highway

Year	Percent Data Coverage	Concentration (ppm)
2010	86%	0.0029
2011	48%	0.0047

5.5.4 Laverick

SO_2 monitoring data averaged over 24 hours and annually are presented for the Tomago Aluminium Laverick Monitoring Station in Figure 5.44 and Figure 5.45. SO_2 concentrations are monitored continuously using AM-20. Summary statistics for the maximum recorded 1 hour, 24-hour and annual average SO_2 concentrations are presented in Table 5.44, Table 5.45 and Table 5.46 respectively.

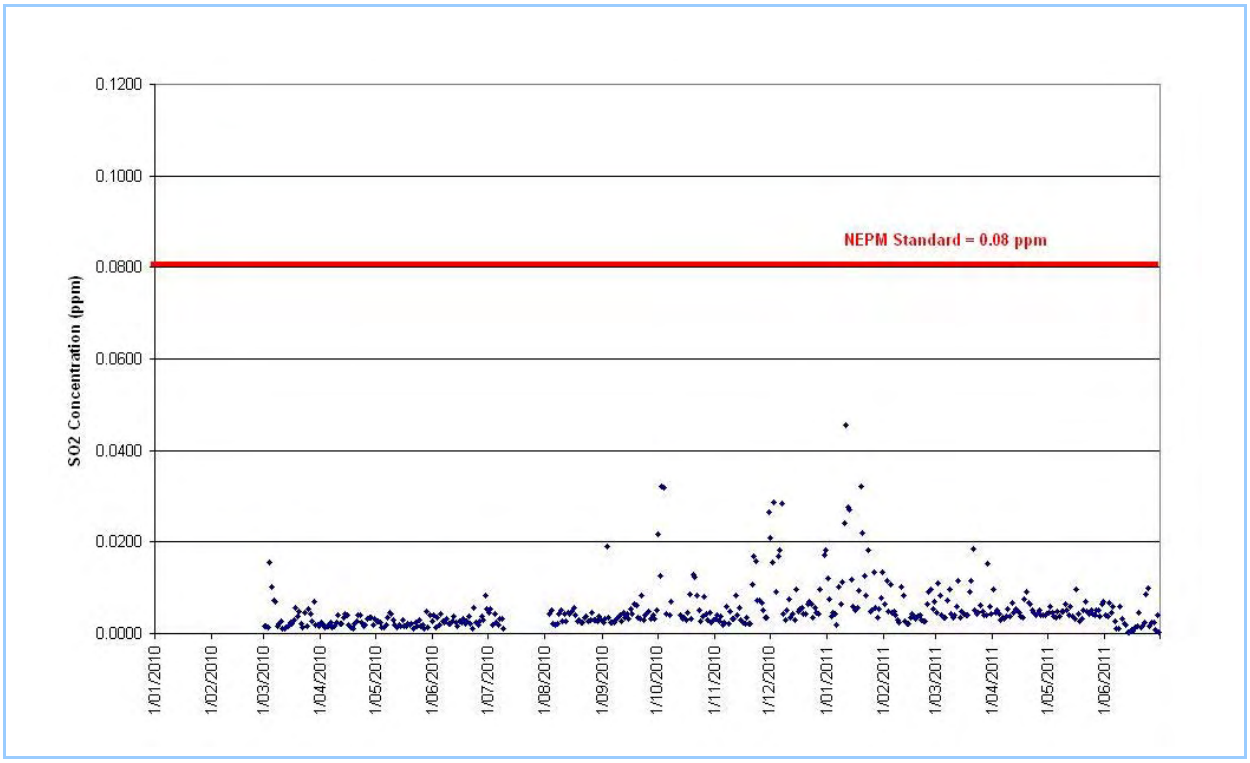

Figure 5.44: Laverick – AM-20 – 24-hour SO_2 Concentrations

Table 5.44: 1 Hour Average SO_2 – Laverick

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2010	76%	0.086	0.085	0
2011	49%	0.090	0.087	0

Table 5.45: 24-hour Average SO_2 – Laverick

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2010	76%	0.032	0.032	0
2011	49%	0.045	0.032	0

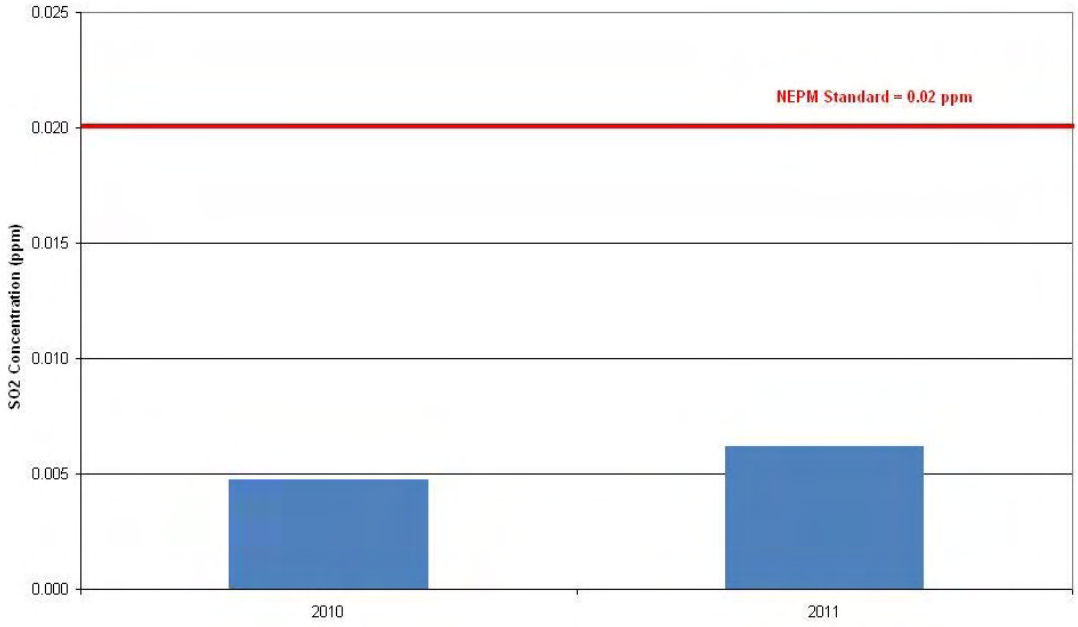

Figure 5.45: Laverick – AM-20 – Annual Average SO_2 Concentrations

Table 5.46: Annual Average SO_2 – Laverick

Year	Percent Data Coverage	Concentration (ppm)
2010	76%	0.0047
2011	49%	0.0062

5.5.5 SchoolDrv

SO_2 monitoring data averaged over 24 hours and annually are presented for the Tomago Aluminium SchoolDrv Monitoring Station in Figure 5.46 and Figure 5.47. SO_2 concentrations are monitored continuously using AM-20. Summary statistics for the maximum recorded 1 hour, 24-hour and annual average SO_2 concentrations are presented in Table 5.47, Table 5.48 and Table 5.49 respectively.

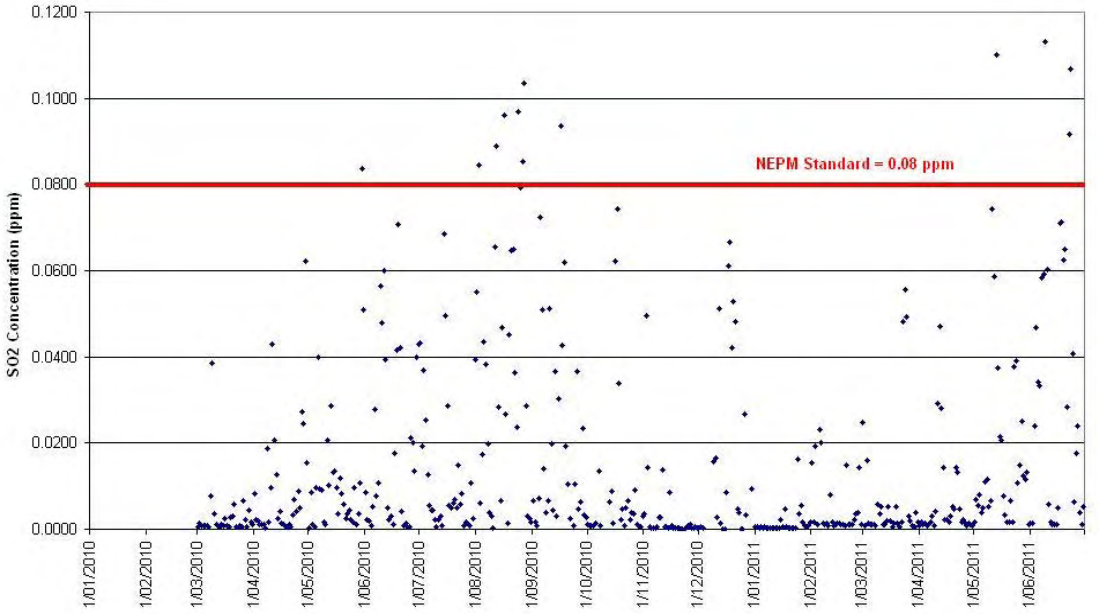

Figure 5.46: SchoolDrv – AM-20 – 24-hour SO_2 Concentrations

Table 5.47: 1 Hour Average SO_2 – SchoolDrv

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2010	76%	0.149	0.148	0
2011	49%	0.166	0.158	0

Table 5.48: 24-hour Average SO_2 – SchoolDrv

Year	Concentration (ppm)			Number of Days Above NEPM Level
	Percent Data Coverage	1st Highest	2nd Highest	
2010	76%	0.104	0.097	4
2011	49%	0.113	0.110	8

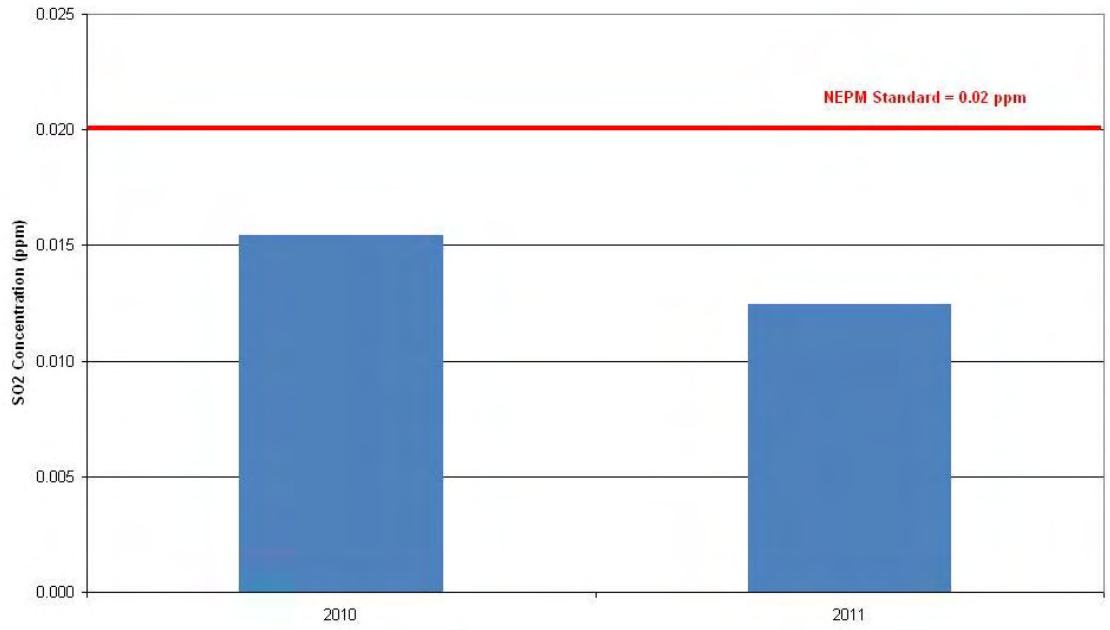

Figure 5.47: SchoolDrv – AM-20 – Annual Average SO_2 Concentrations

Table 5.49: Annual Average SO_2 – SchoolDrv

Year	Percent Data Coverage	Concentration (ppm)
2010	76%	0.0154
2011	49%	0.0124

5.6 Organic Concentrations

Organic monitoring has been performed at one monitoring station, the Mayfield Air Monitoring Station in the Lower Hunter Region by Hunter Development Corporation (HDC). The monitoring campaign was conducted over a period of approximately 11 months between 18 February 2010 and 11 January 2011. The monitoring campaign covered the following five organic pollutants:

- Benzene;
- Ethylbenzene
- Toluene;
- Polycyclic aromatic hydrocarbons (PAHs); and
- Xylenes (all isomers).

The benzene, toluene, ethylbenzene and xylene (BTEX) components of the organic monitoring was conducted using charcoal sorbent tubes attached to a low flow sample tube holder and personal sampling pump. The sample was collected over a period of approximately eight hours on a six day cycle.

Sampling and analysis was carried out in accordance with the National Institute for Occupational Safety Health (NIOSH) method: *1501: Hydrocarbons, Aromatic. Issue 3, May 2003, NIOSH, Manual of Analytical Methods (NMAM), Fourth Edition.*

The PAH component of the organic monitoring was conducted using a PUF 2100 High Volume Air Sampler containing a Polyurethane filter for monitoring of PAH. The method complies with US EPA Method TO-13A Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS).

5.6.1 Benzene

Over the sampling period 18 February 2010 to 26 January 2011, 58 ambient air samples were tested for benzene concentrations. Only two samples returned a result at greater than the analytical level of detection of 0.5 µg per sample. These samples were taken on the 27 April 2010 and 3 May 2010. Following these positive test results the sample amount was increased to reduce the level of detection when expressing the results as concentrations (reducing the level of detection from 0.010 ppm to 0.001 ppm).

The results from the benzene ambient monitoring campaign are shown in Figure 5.48. Note that only two results are positive readings from the sampling program and all other results show half the analytical level of detection.

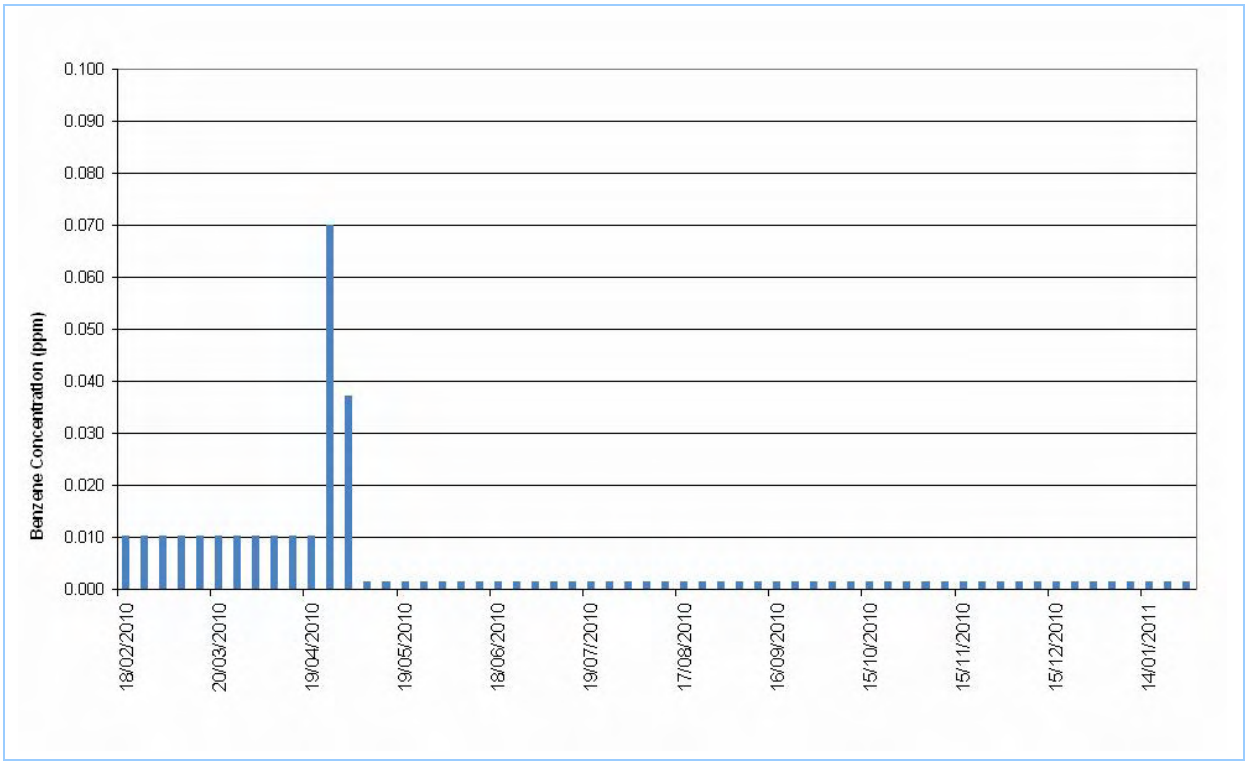

Figure 5.48: Mayfield Air Monitoring Station – Benzene Sample Results

Annual average benzene concentrations are presented in Figure 5.49. Minimum, maximum and 'average' annual averaged benzene concentrations are presented in Figure 5.49. For the purposes of averaging these are calculated as follows:

Average concentration (annual)

Samples that were below the level of detection were assumed to contain concentrations at half the level of detection.

Minimum concentration (annual)

Samples that were below the level of detection were assumed to contain zero concentration of contaminant (i.e. annual average consists of only samples that returned a result at greater the level of detection).

Maximum concentration (annual)

Samples that were below the level of detection were assumed to contain concentrations at the level of detection.

When the results are averaged over an annual reporting period, the monitoring program results in an annual average concentration that is greater than the NEPM monitoring investigation level (MIL) for benzene. It is noted that early in the program half the level of detection (0.010 ppm) was much greater than the NEPM monitoring investigation level (MIL) of 0.003 ppm. Once this was realised the volume of sample was increased to lower the level of detection for the monitoring program. It is noted that the NEPM MIL level has not been recorded since the volume of sample was increased even on a short term basis.

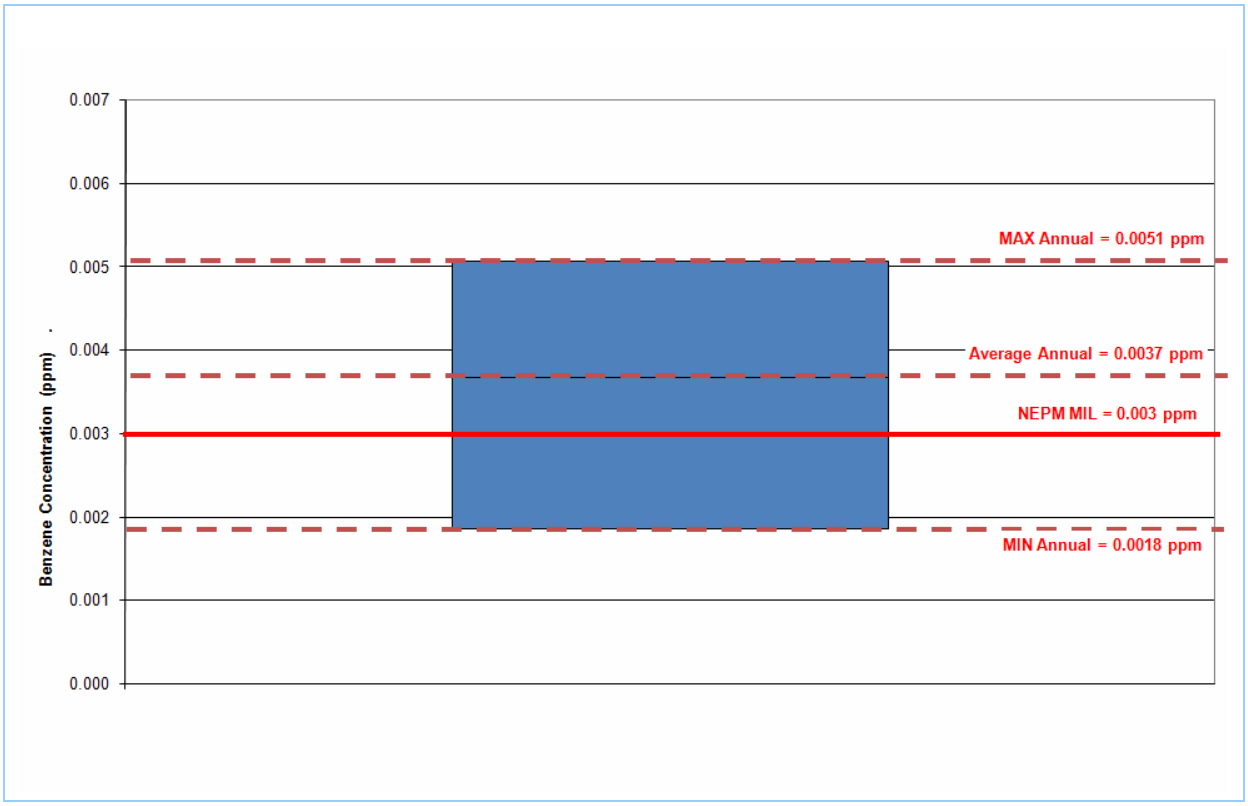

Figure 5.49: Mayfield Air Monitoring Station – Annual Average Benzene Concentration

5.6.2 Ethylbenzene

Over the sampling period 18 February 2010 to 26 January 2011, 58 ambient air samples were tested for ethylbenzene concentrations. None of the samples returned a result greater than analytical level of detection. The analytical level of detection for the program was 0.0022 ppm. This is much less than the 1 hour design impact assessment criteria of 1.8 ppm outlined in the Approved Methods.

5.6.3 Toluene

Over the sampling period 18 February 2010 to 26 January 2011, 58 ambient air samples were tested for toluene concentrations. Ten samples returned a result at greater than the analytical level of detection of 0.5 µg per sample. As noted, following 3 May 2010, the sample amount was increased to reduce the level of detection when expressing the results as concentrations (reducing the level of detection from 0.017 ppm to 0.002 ppm).

The results from the toluene ambient monitoring campaign are shown in Figure 5.50. Note that only ten results are positive readings from the sampling program and all other results show half the analytical level of detection.

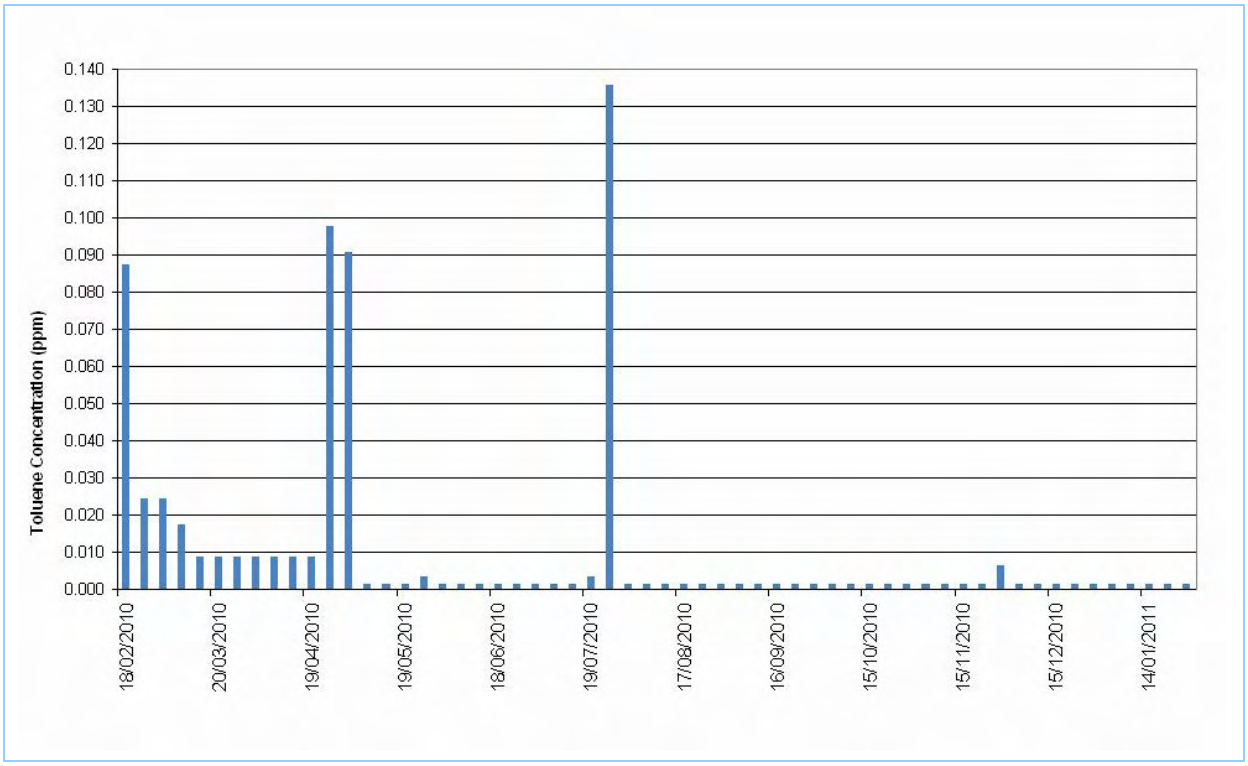

Figure 5.50: Mayfield Air Monitoring Station – Toluene Sample Results

The annual average toluene concentration is presented in Figure 5.51.

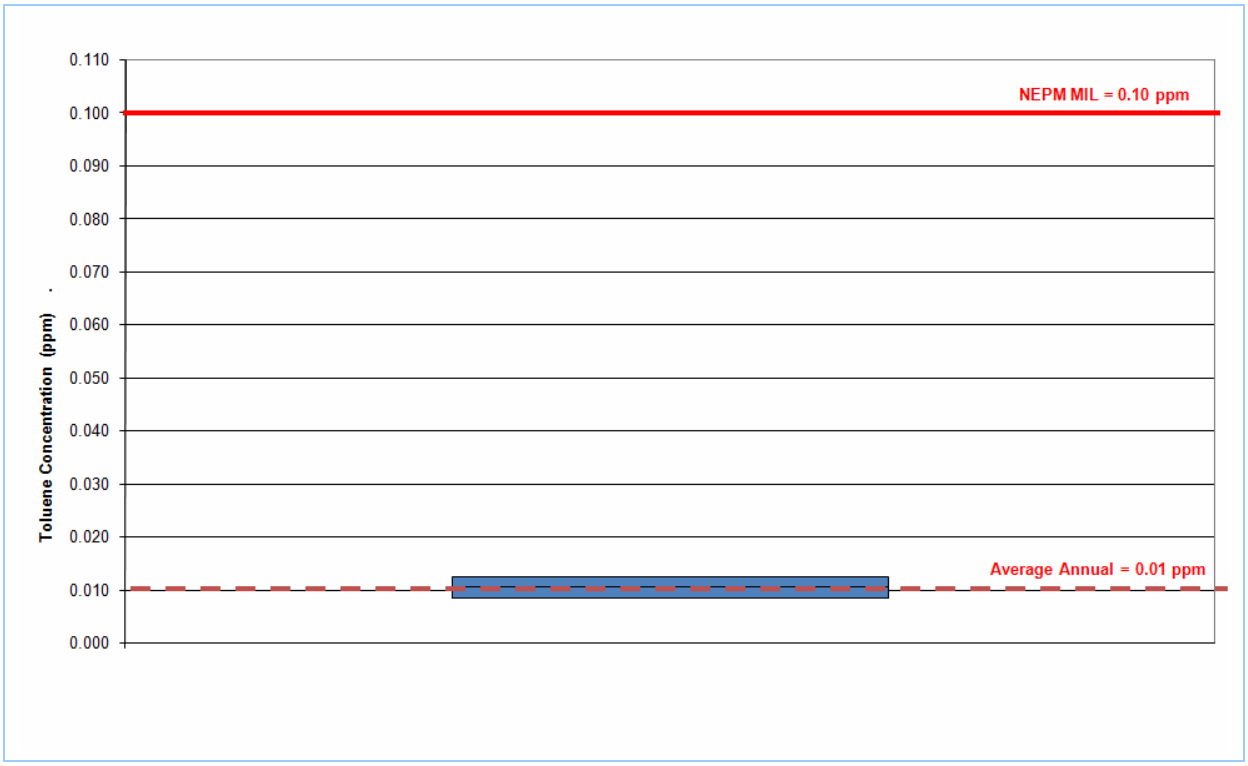

Figure 5.51: Mayfield Air Monitoring Station – Annual Average Toluene Concentration

5.6.4 Polycyclic aromatic hydrocarbons (PAHs)

Over the sampling period 2 March 2010 to 26 January 2011, 56 ambient air samples were tested for benzo(a)pyrene concentrations. None of the samples returned a result greater than analytical level of detection. The analytical level of detection for the program was 0.0772 ng/m^3. This is much less than the annual average monitoring investigation level of 0.3 ng/m^3 outlined in the Air Toxics NEPM.

5.6.5 Xylenes

Over the sampling period 18 February 2010 to 26 January 2011, 58 ambient air samples were tested for xylene (all isomers) concentrations. Only one sample returned a result at greater than the analytical level of detection of 0.5 µg per sample (19/07/2011). As noted, following 3 May 2010, the sample amount was increased to reduce the level of detection when expressing the results as concentrations (reducing the level of detection from 0.045 ppm to 0.006 ppm).

The results from the xylene ambient monitoring campaign are shown in Figure 5.52. Note that only one result is a positive reading from the sampling program (19/07/2011) and all other results show half the analytical level of detection.

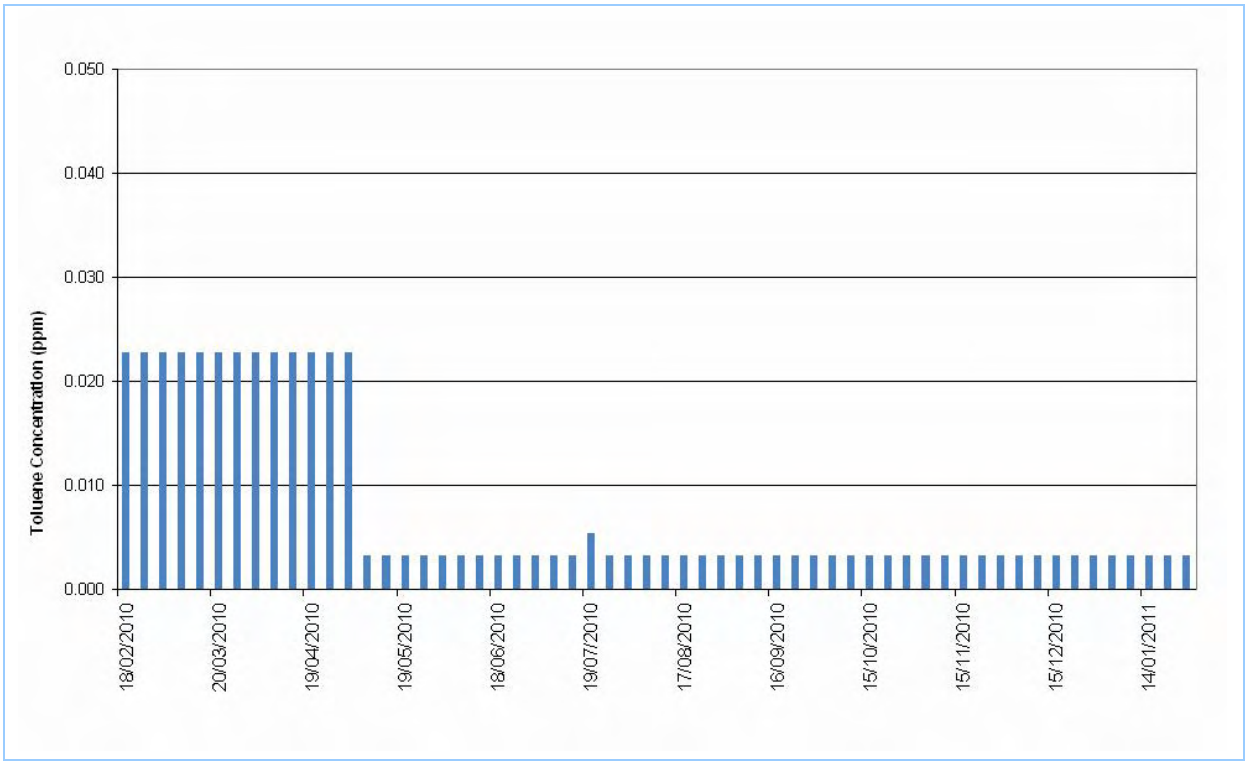

Figure 5.52: Mayfield Air Monitoring Station – Total Xylene (all isomers) Sample Results

The annual average total xylene concentration is presented in Figure 5.53.

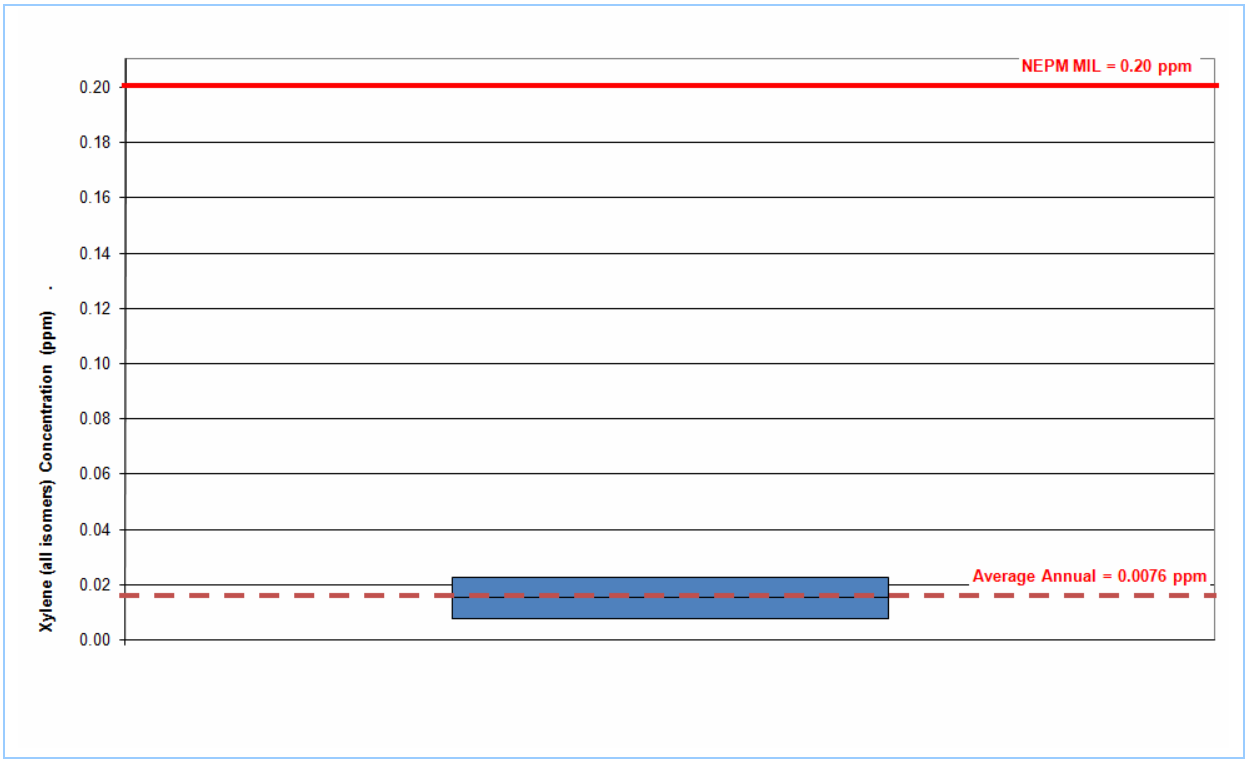

Figure 5.53: Mayfield Air Monitoring Station – Annual Average Total Xylene (all isomers) Concentration

6 SUMMARY OF MONITORING DATA

6.1 Summary by pollutant

Monitoring data is summarised using colour coding as indicators for the level of compliance with relevant ambient air quality goals.

Colour coding indicators for each pollutant in Table 6.1 are categorised as follows:

Green	indicates that the all monitoring stations consistently recorded levels less than relevant air quality criteria
Yellow	indicates that only one monitoring station infrequently recorded levels above relevant air quality criteria (taking recent years into account)
Orange	indicates that either: • more than one monitoring station infrequently recorded levels above relevant air quality criteria (taking recent years into account); or • at least one monitoring station occasionally recorded levels above relevant air quality criteria
White	indicates not monitored

Table 6.1: Summary by Pollutant

Substance	Regional (OEH)	Neighbourhood (Other)	Comments
Carbon monoxide	⊕		Carbon monoxide levels are well below the Ambient Air Quality NEPM goal.
Ozone	⊕		Regional ozone levels comply with the Ambient Air Quality NEPM goal.
Nitrogen dioxide	⊕	⊕	Regional nitrogen dioxide levels comply with Ambient Air Quality NEPM goal. Local nitrogen dioxide levels at Roxburgh St Stockton exceed the Ambient Air Quality NEPM goal on occasion.
Particulate matter less than 10 microns (PM_{10})	⊕	⊕	Regional PM_{10} concentrations generally comply with the Ambient Air Quality NEPM goal. PM_{10} concentrations at the OEH Beresfield, Newcastle and Wallsend sites are consistent with other urban areas in NSW. Local PM_{10} levels are generally consistent with regional levels. The exception is elevated PM_{10} at Mayfield 4 berth.
Particulate matter less than 2.5 microns ($PM_{2.5}$)	⊕	⊕	Regional $PM_{2.5}$ concentrations generally comply with the Ambient Air Quality NEPM advisory reporting standard. $PM_{2.5}$ concentrations at the OEH Beresfield and Wallsend sites are consistent with other urban areas in NSW. Local $PM_{2.5}$ levels at Mayfield ASP are consistent with regional levels.
Total suspended particulates (TSP)		⊕	TSP levels were occasionally above the nuisance criteria at the East Drain monitoring location, and infrequently above the nuisance criteria at ConPorts North ConPorts South and the Railyard monitoring locations. Total suspended particulates (TSP) measures all the particles suspended in the air. Health impacts are associated with particles less than 10 microns (PM_{10}). TSP monitoring provides an indication of potential nuisance dust levels, rather than health impacts.
Sulfur dioxide	⊕	⊕	Sulfur dioxide levels exceed the Ambient Air Quality NEPM goals at the School Drive monitoring site in the vicinity of the Tomago Aluminum Smelter. There are occasional exceedances of the sulfur dioxide Air NEPM goals at the Farm monitoring location in the vicinity of the Tomago Aluminum Smelter.
Organics		⊕	Organic monitoring at Mayfield is generally in compliance with the Air Toxics NEPM monitoring and investigation level. Two benzene samples exceeded the analytical level of detection on 27 April 2010 and 3 May 2010. Following these results, the analytical method was improved, with a lower level of detection. Benzene has not been detected in the ambient air at Mayfield since 3 May 2010.

⊕ indicates that the pollutant is monitored at the monitoring stations

Colour coding indicators for each monitoring station and pollutant in Figures 6.1 to 6.8 are categorised as follows:

Green	indicates that the monitoring station consistently recorded levels less than relevant air quality criteria
Yellow	indicates that the monitoring station infrequently recorded levels above relevant air quality criteria (taking recent years into account)
Orange	indicates that the monitoring station occasionally recorded levels above relevant air quality criteria

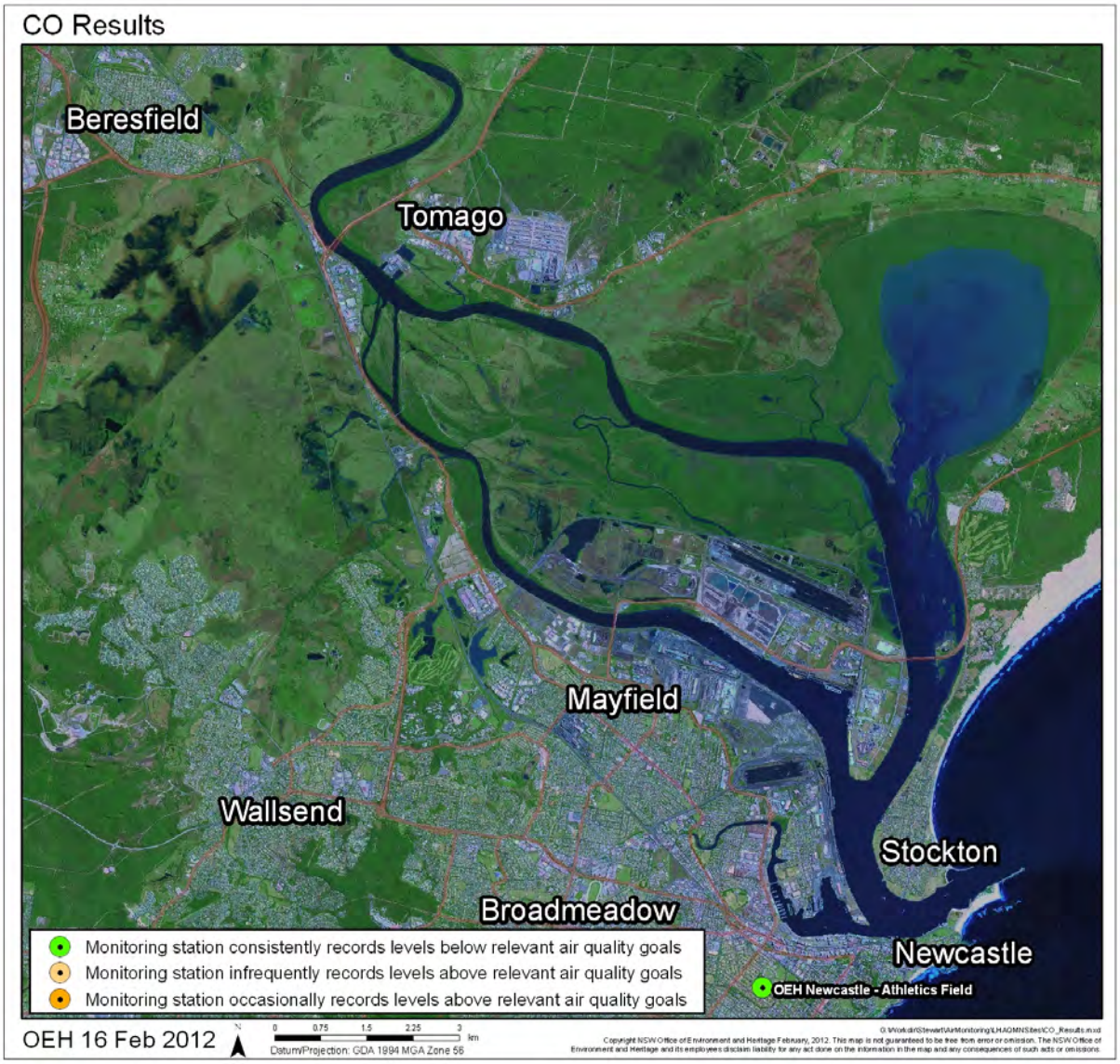

Figure 6.1: Summary of monitored carbon monoxide levels

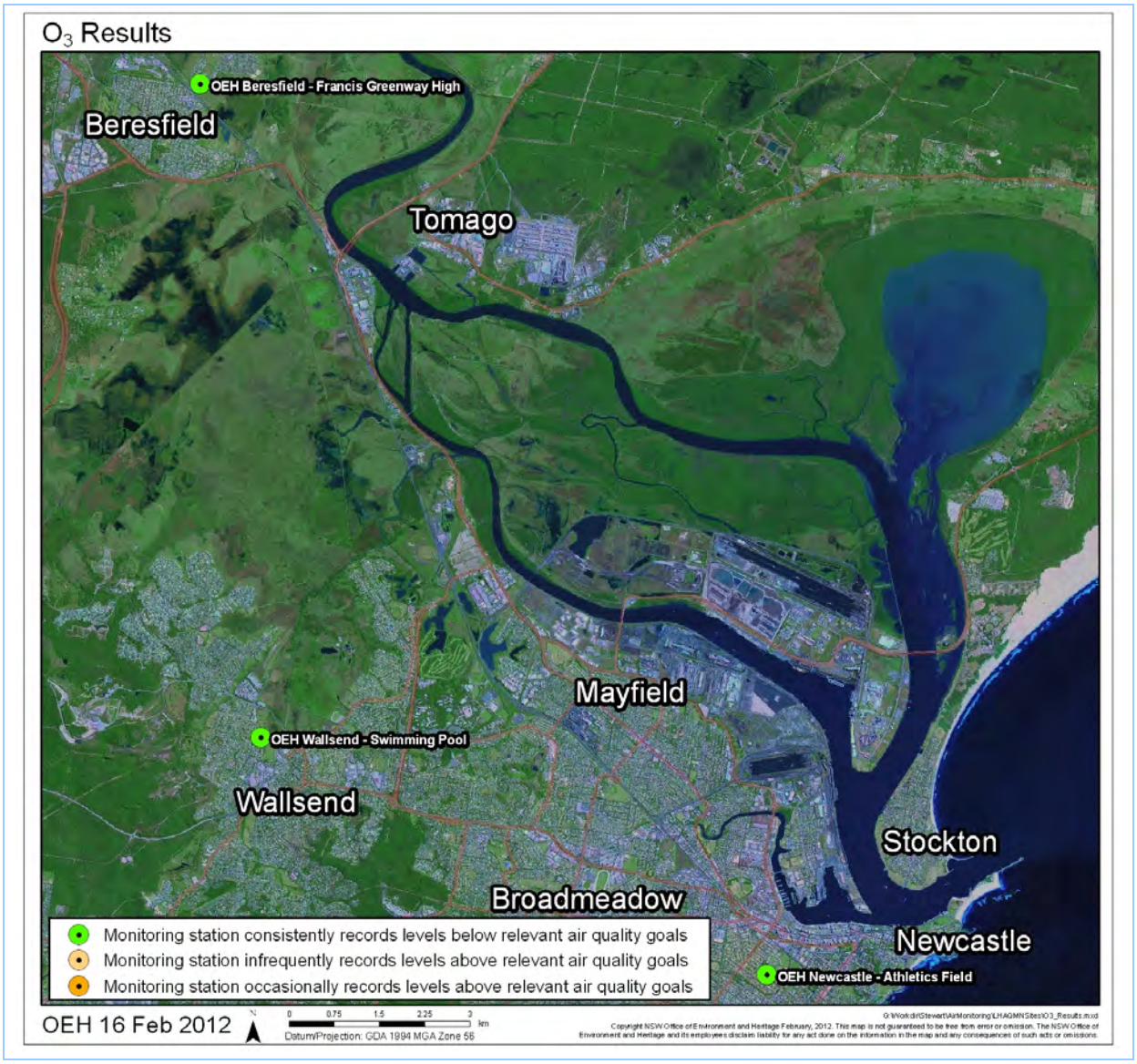

Figure 6.2: Summary of monitored ozone levels

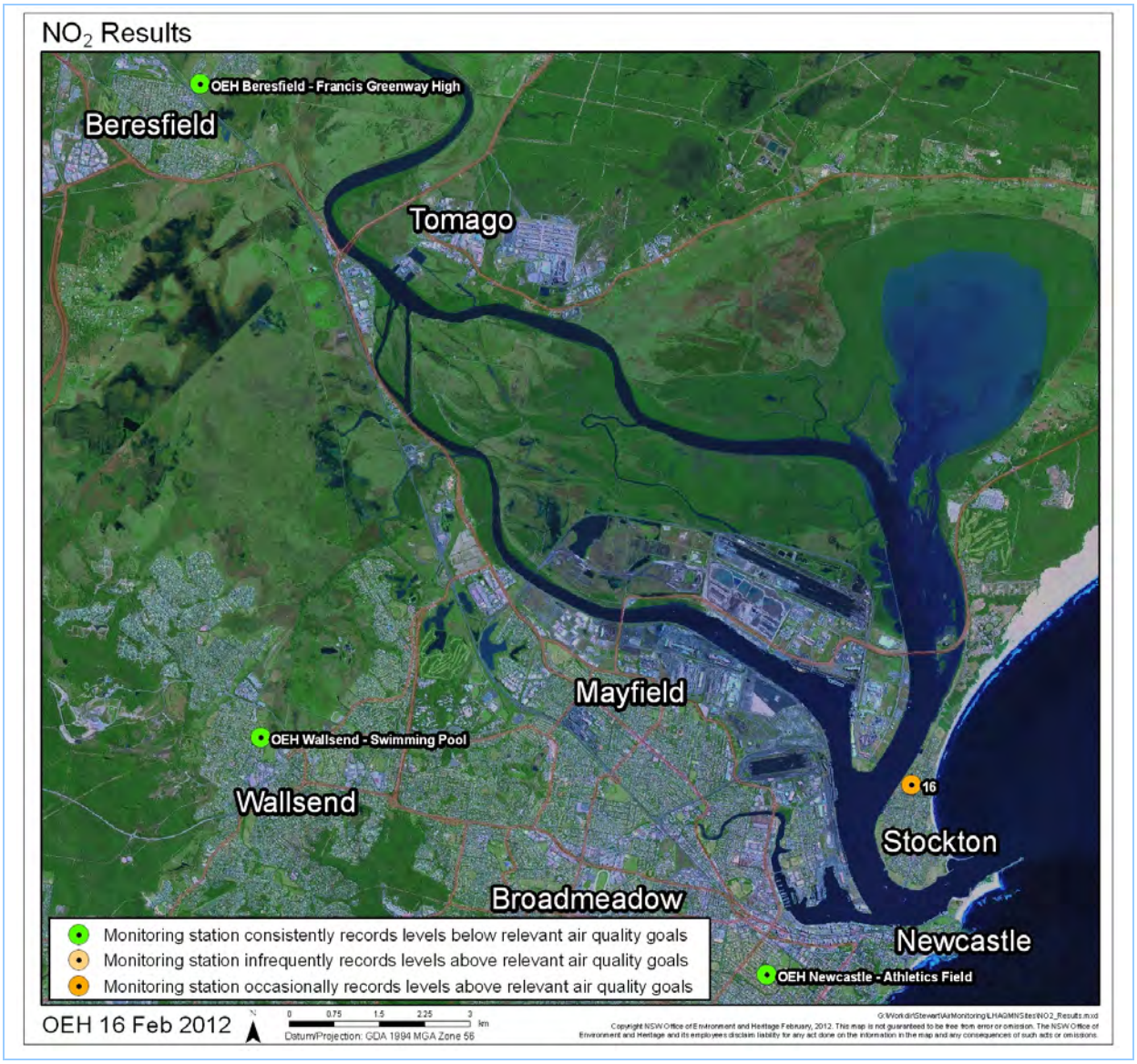

Figure 6.3: Summary of monitored nitrogen dioxide levels

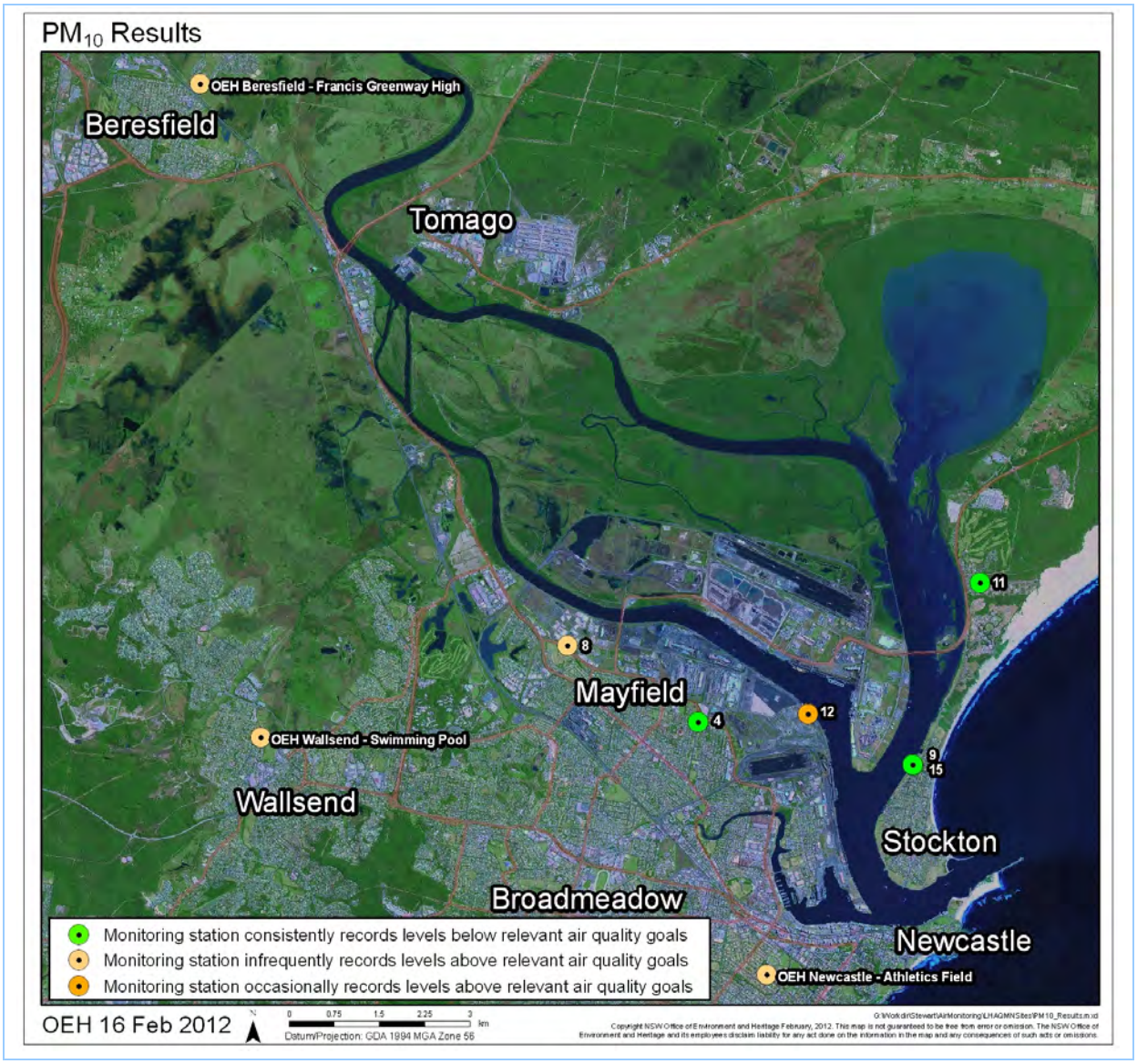

Figure 6.4: Summary of monitored PM_{10} levels

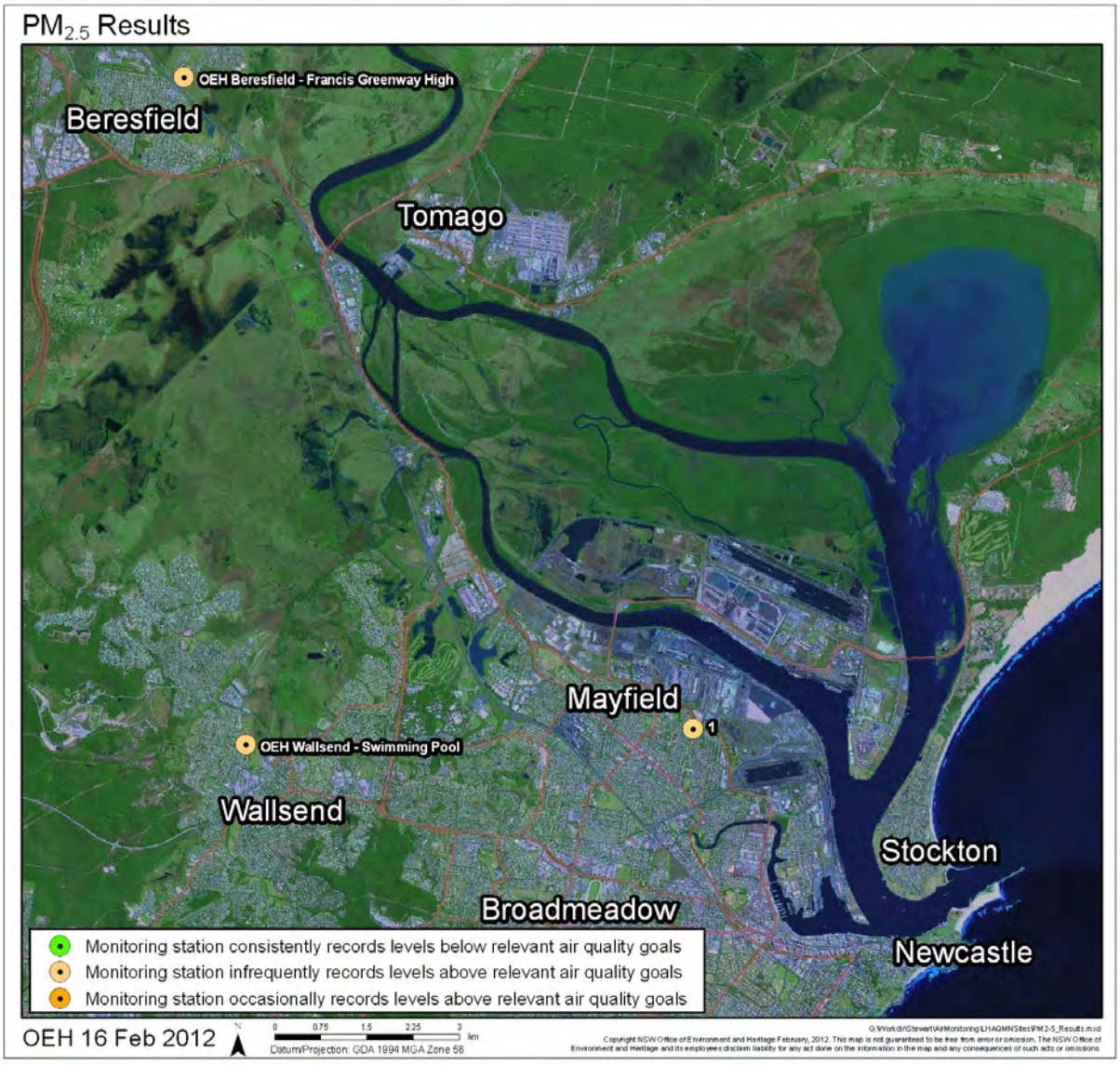

Figure 6.5: Summary of monitored $PM_{2.5}$ levels

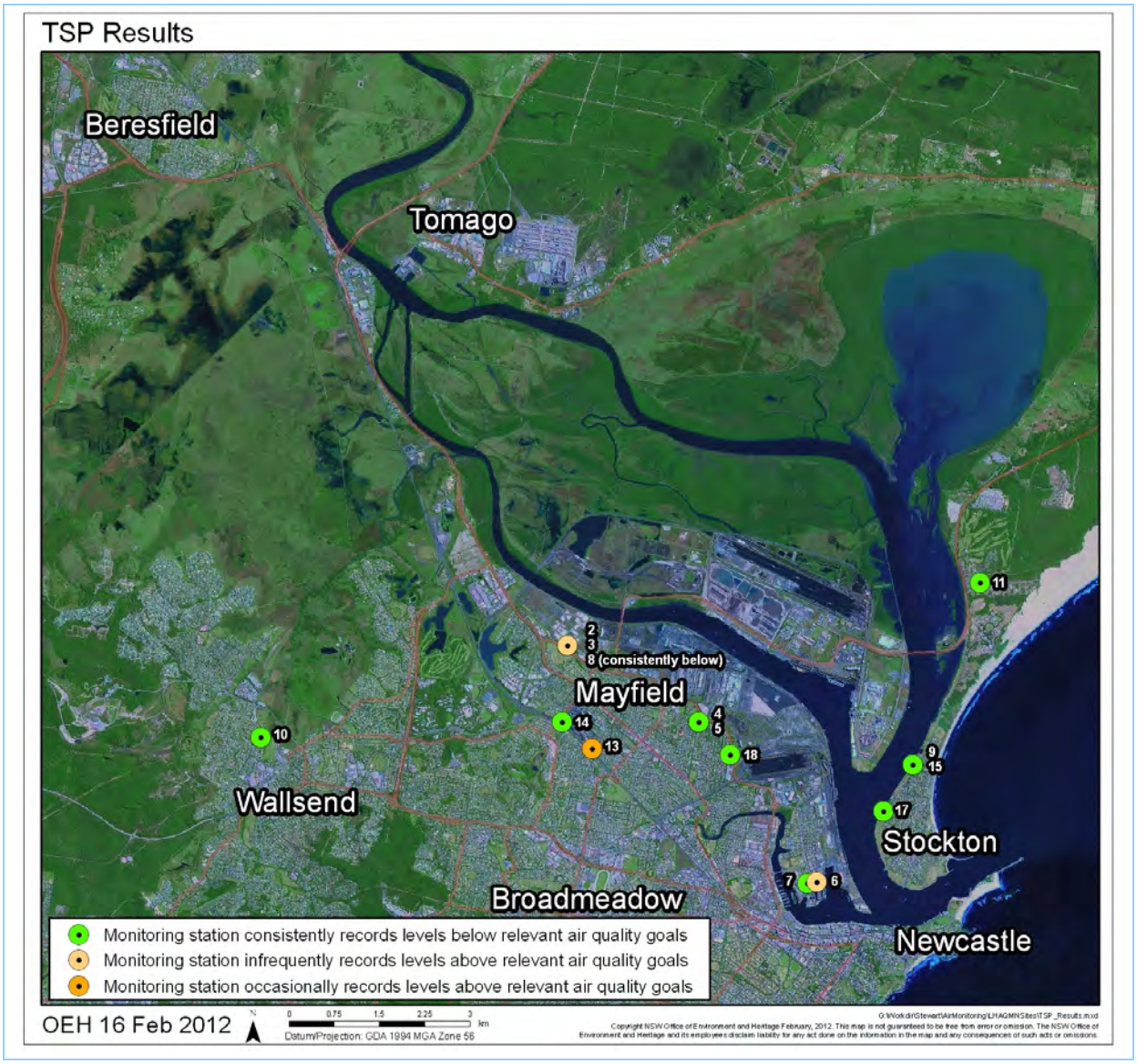

Figure 6.6: Summary of monitored TSP levels

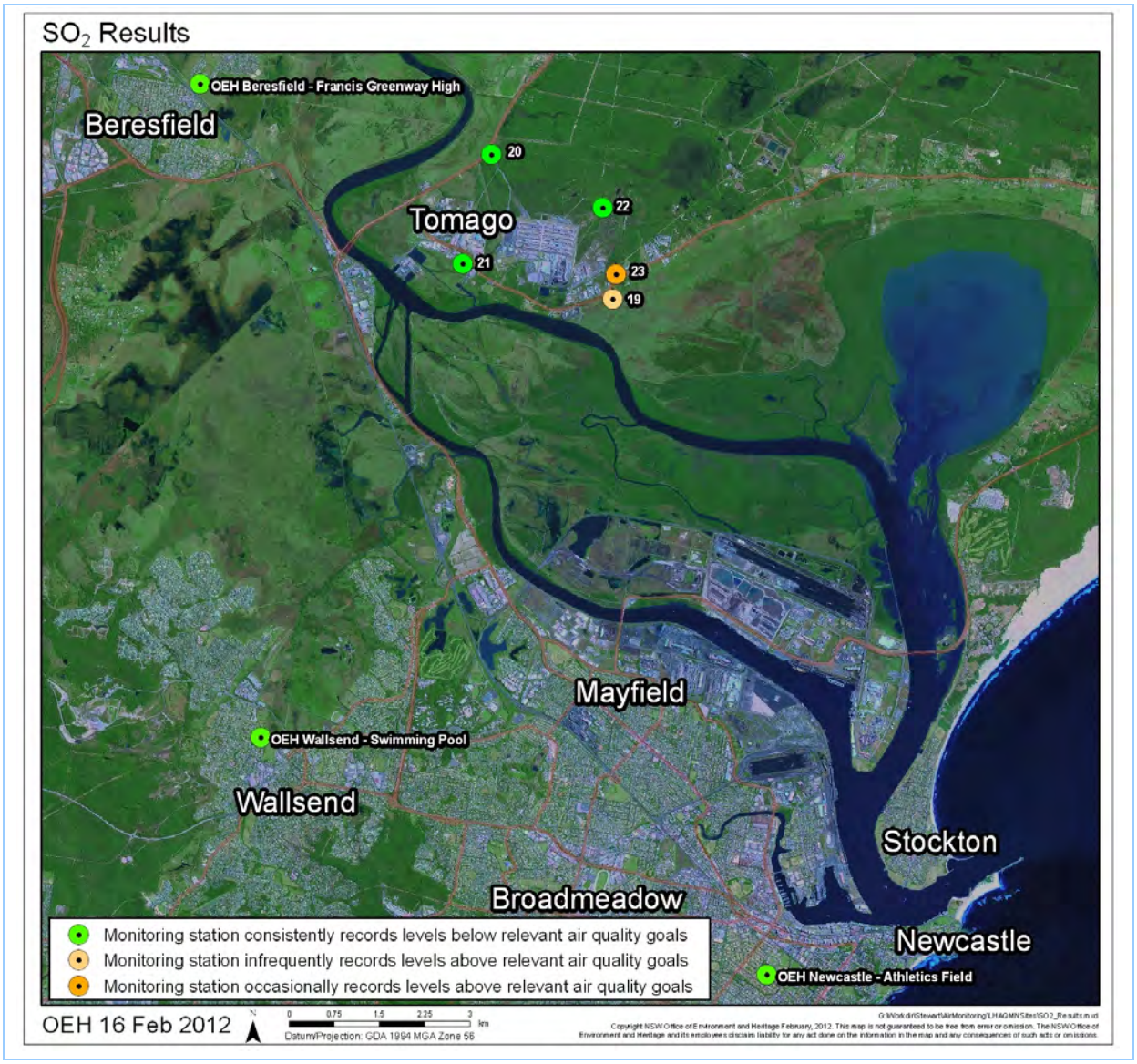

Figure 6.7: Summary of monitored SO_2 levels

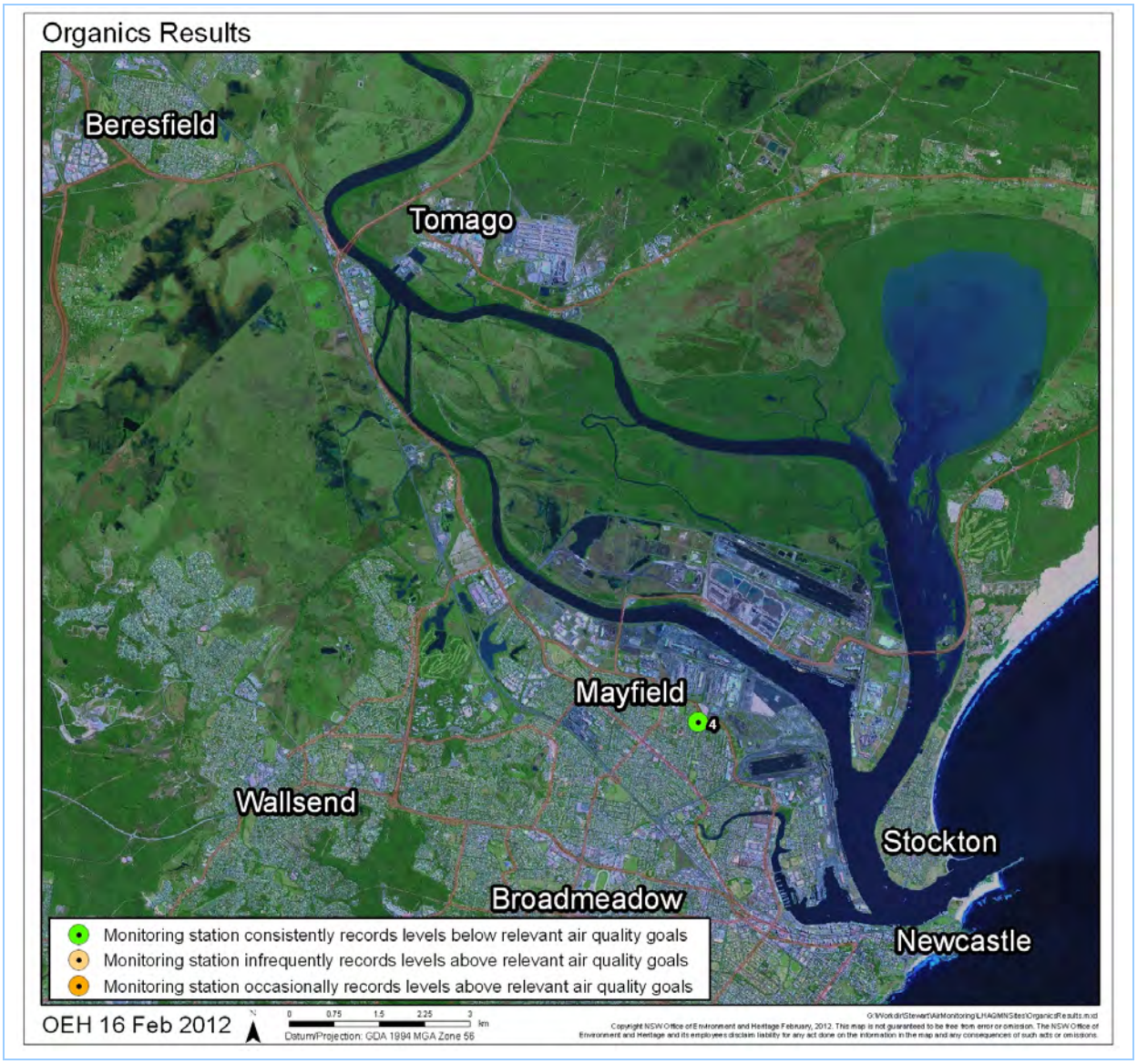

Figure 6.8: Summary of monitored organics levels

6.2 Summary by location

Monitoring data is summarised using colour coding as indicators for the level of compliance with relevant ambient air quality goals. Colour coding indicators for each monitoring station and pollutant are categorised as follows:

Green	indicates that the monitoring station consistently recorded levels less than relevant air quality criteria
Yellow	indicates that the monitoring station infrequently recorded levels above relevant air quality criteria (taking recent years into account)
Orange	indicates that the monitoring station occasionally recorded levels above relevant air quality criteria
White	indicates not monitored

OEH ambient air quality monitoring stations are summarised in Table 6.2.

Table 6.2: Summary of OEH Monitoring Stations in the Lower Hunter Region

Monitoring Site		MGA X (km)	MGA Y (km)	O_3	NO NO_2 NO_x	TEOM PM_{10}	TEOM $PM_{2.5}$	SO_2	CO
Beresfield	Francis Greenway High School	374.534	6370.275	⊕	⊕	⊕	⊕	⊕	
Newcastle	Athletics Field	383.917	6355.512	⊕	⊕	⊕		⊕	⊕
Wallsend	Swimming Pool	375.529	6359.445	⊕	⊕	⊕	⊕	⊕	

⊕ indicates that the pollutant is monitored at the monitoring station

Where: MGA: Map Grid of Australia (GDA94); O_3: ozone; NO: nitric oxide; NO_2: nitrogen dioxide; NO_x: oxides of nitrogen; PM_{10}: particles less than 10 micrometres in diameter measured using a high-volume sampler; TEOM-PM_{10}: particles less than 10 micrometres in diameter measured using a tapered element oscillating microbalance; TEOM-$PM_{2.5}$: particles less than 2.5 micrometres in diameter measured using a tapered element oscillating microbalance; SO_2: sulfur dioxide; CO: carbon monoxide

Monitoring stations operated by other entities are summarised in Table 6.3.

Table 6.3: Summary of Other Monitoring Stations in the Lower Hunter Region

Site ID	Site Name/Location	MGA X (km)	MGA Y (km)	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	Organics	Reporting Organisation
1	Mayfield -ASP	382.784	6359.697				⊕			ANSTO
2	ConPorts - North	385.136	6357.534		⊕					ConPorts
3	ConPorts - South	385.198	6357.364		⊕					
4	Mayfield	382.781	6359.700		⊕	⊕			⊕	BHP, HDC, NCIG
5	Smart St	384.630	6356.880		⊕					GrainCorp
6	Rail Yard	384.739	6357.047		⊕					
7	R + D Darval St	384.588	6357.027		⊕					
8	Steel River	380.614	6360.965	⊕	⊕	⊕		⊕		NCIG
9	Stockton	386.338	6358.981		⊕	⊕				Orica
10	NCC Wallsend	375.529	6359.445		⊕					NCC
11	Fern Bay	387.448	6362.005		⊕	⊕				PWCS
12	Mayfield 4 Berth	384.595	6359.83			⊕				NPC
13	East Drain	381.018	6359.258		⊕					OneSteel
14	West Car Park	380.525	6359.692		⊕					
15	Fullerton Rd - Stockton	386.336	6358.990		⊕	⊕				Orica
16	Roxburgh St - Stockton	386.311	6358.656	⊕						
17	C1 Stockton	385.846	6358.220		⊕					PWCS
18	C2 Mayfield East	383.306	6359.155		⊕					
19	Farm	381.364	6366.705					⊕		Tomago Aluminium
20	Highway	379.357	6369.102					⊕		
21	Laverick	378.884	6367.290					⊕		
22	Met	381.194	6368.221					⊕		
23	SchoolDrv	381.419	6367.117					⊕		

⊕ indicates that the pollutant is monitored at the monitoring station

⊕ indicates that the pollutant is monitored however monitoring data were not supplied to OEH

Where: MGA: Map Grid of Australia (GDA94); NO_x: oxides of nitrogen; TSP: total suspended particulates; PM_{10}: particles less than 10 micrometres in diameter; $PM_{2.5}$: particles less than 2.5 micrometres in diameter; SO_2: sulfur dioxide; CO: carbon monoxide; Organics includes benzene, ethylbenzene, toluene, isomers of xylenes and polycyclic aromatic hydrocarbons (PAHs).

[a] The reporting organisation indicates the organisation that provided the monitoring data to the EPA for use in this study. The reporting organisation does not necessarily denote the organisation that manages and maintains the monitoring station

6.3 Comparison of OEH Lower Hunter Regional monitoring with Sydney and the Illawarra

OEH operates an air quality monitoring network throughout the state, focussed on the main population centres of Sydney, the lower Hunter, and the Illawarra. The monitoring network in Lower Hunter, Sydney and Illawarra Regions is shown in Figure 6.9.

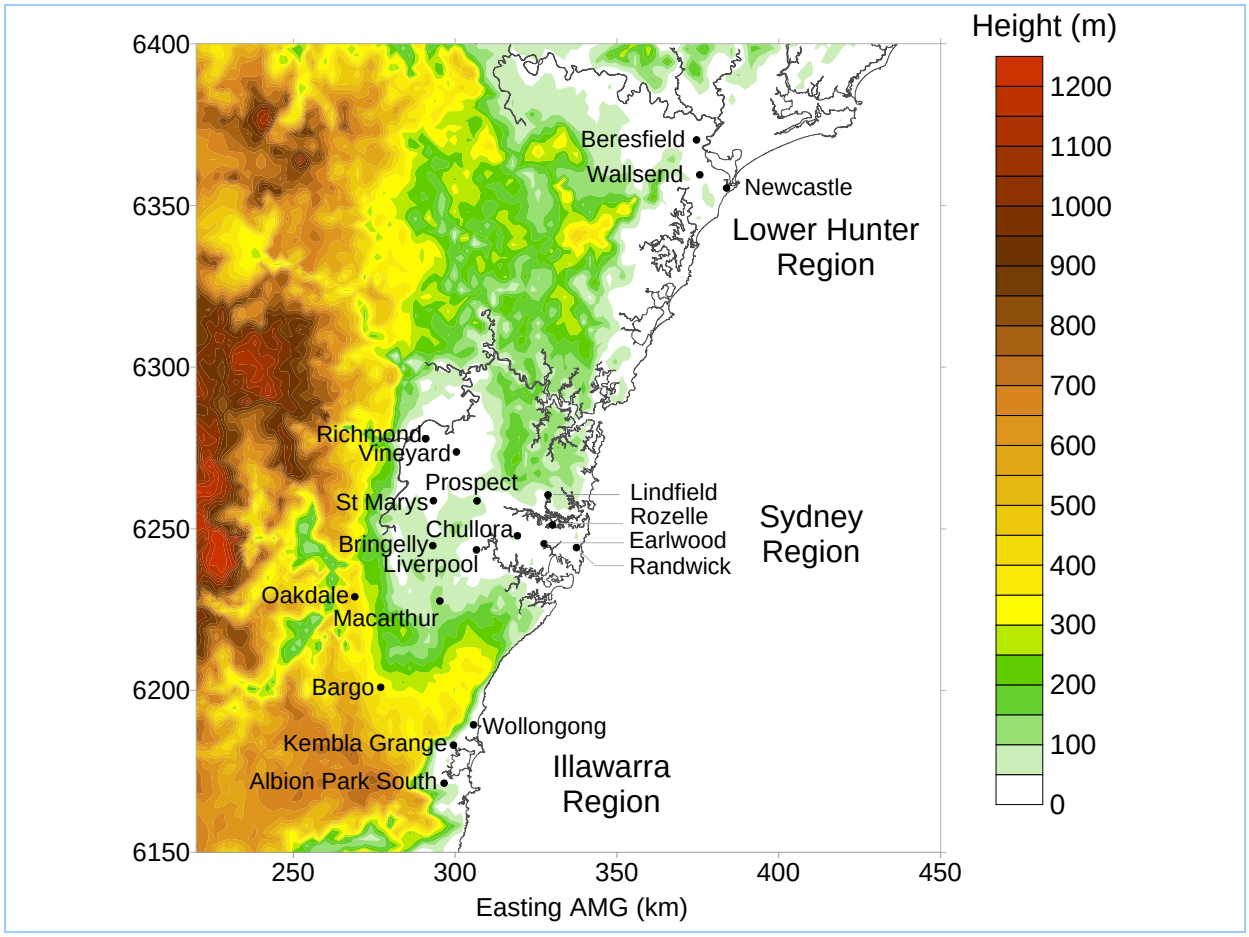

Figure 6.9: OEH Lower Hunter, Sydney and Illawarra Monitoring Network

Data from the three OEH monitoring sites at Beresfield, Newcastle and Wallsend is compared to OEH data from Sydney and the Illawarra in Figures 6.10 to 6.15 (DECCW 2010).

It can be seen from the data presented in each of these figures that regional air quality in the Lower Hunter is typically as good – or better than – air quality in Sydney and the Illawarra.

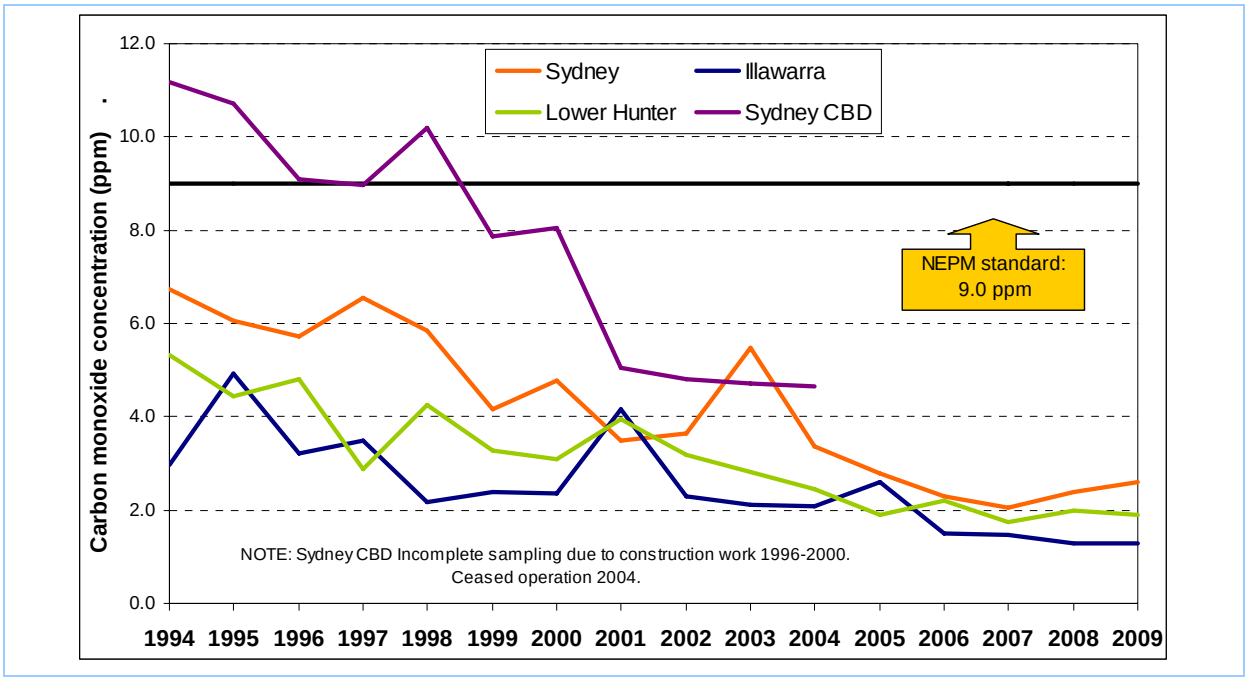

Figure 6.10: Carbon Monoxide Concentrations in NSW

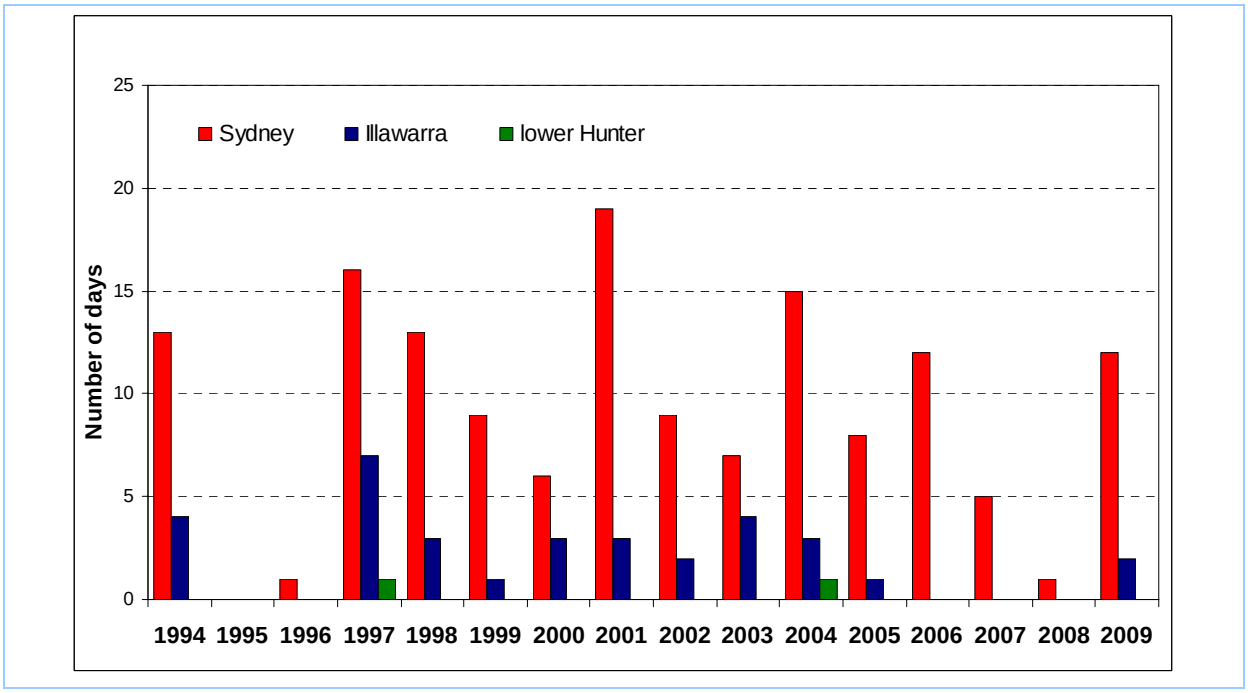

Figure 6.11: Exceedences of the one-hour ozone standard by year

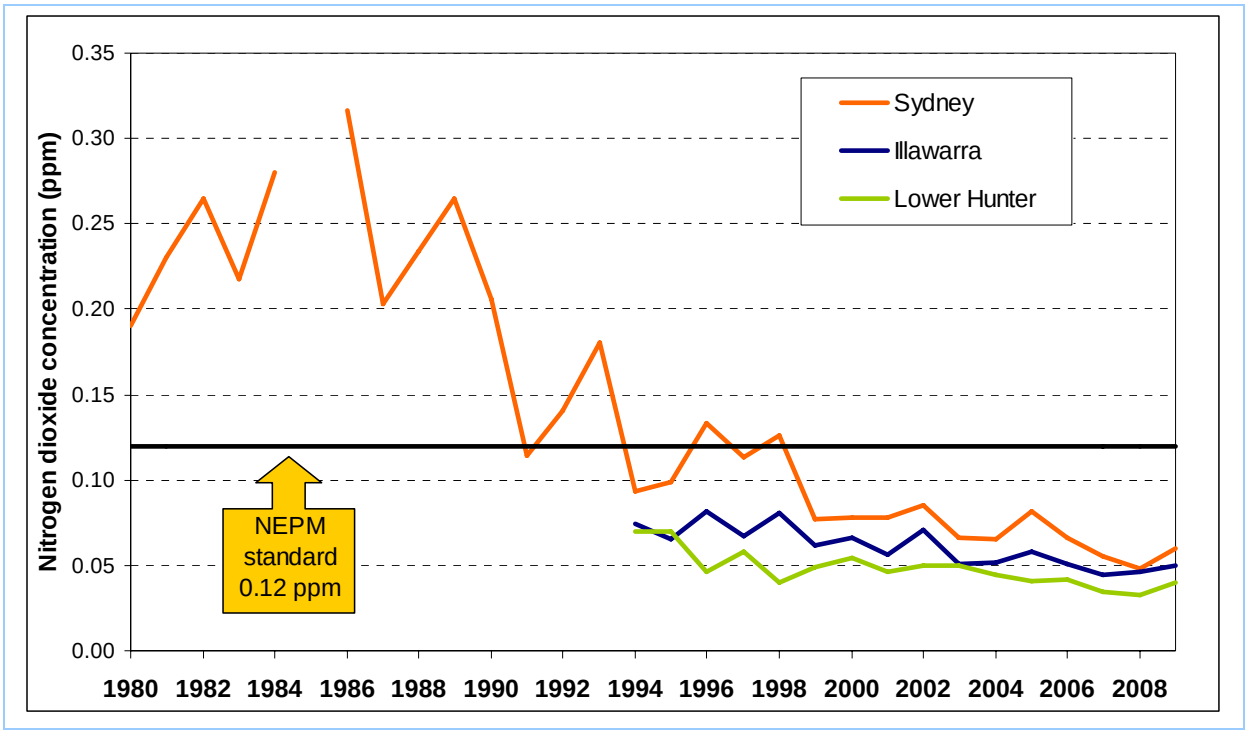

Figure 6.12: Maximum 1-hr average NO_2 concentrations in NSW

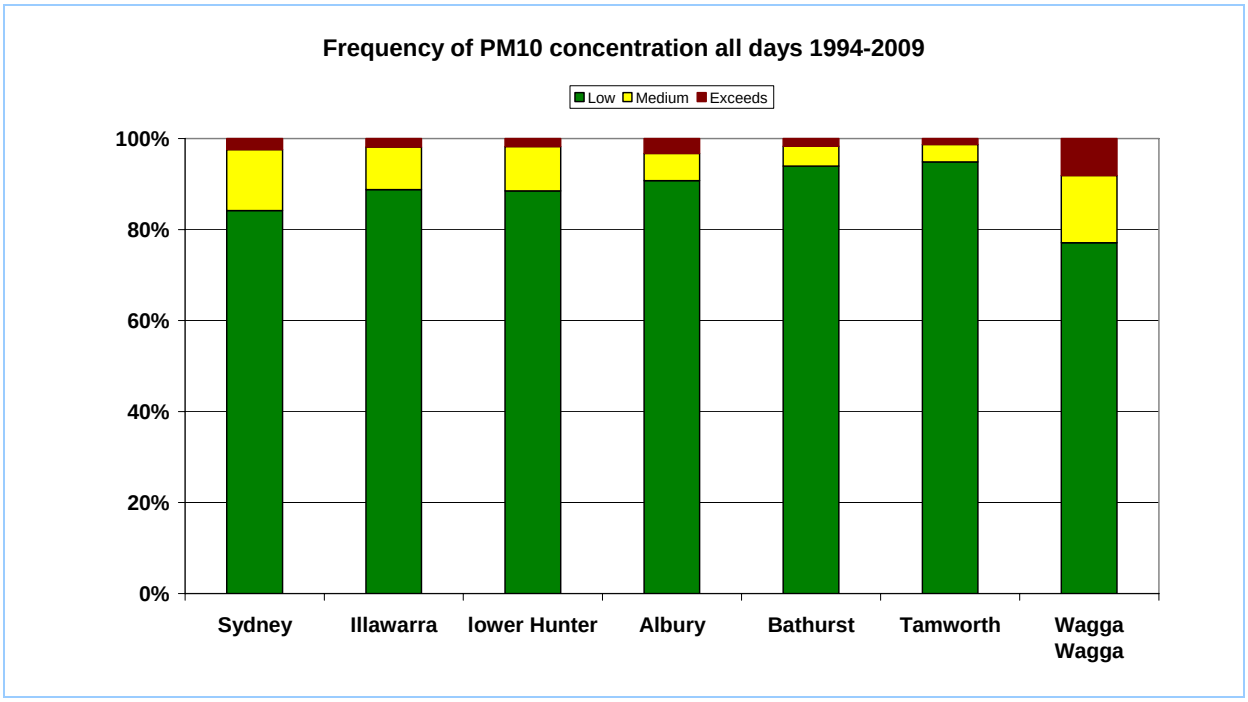

Figure 6.13: Distribution of PM_{10} concentration in New South Wales, 1994-2009
"low" are concentrations up to 33 µg/m³; "medium" are concentrations between 33 and 50 µg/m³; "exceeds" are concentrations of 50 µg/m³ or more

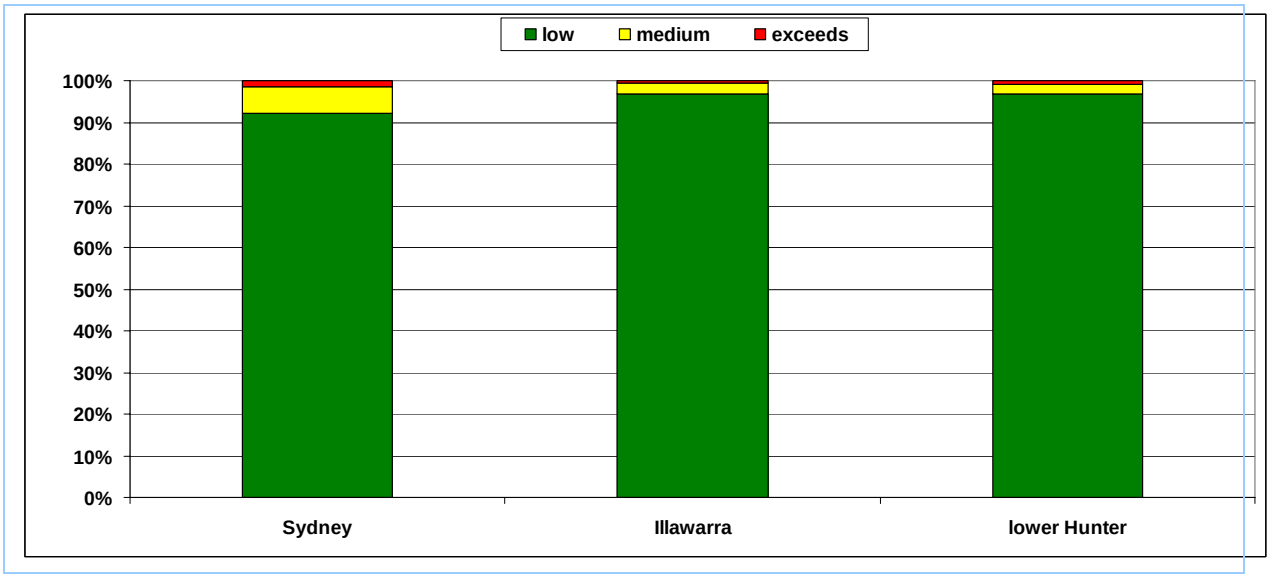

Figure 6.14: Distribution of $PM_{2.5}$ concentration in New South Wales, 1994-2009
"low" are concentrations up to 16.5 µg/m³; "medium" are concentrations between 16.5 and 25 µg/m³; "exceeds" are concentrations of 25 µg/m³ or more

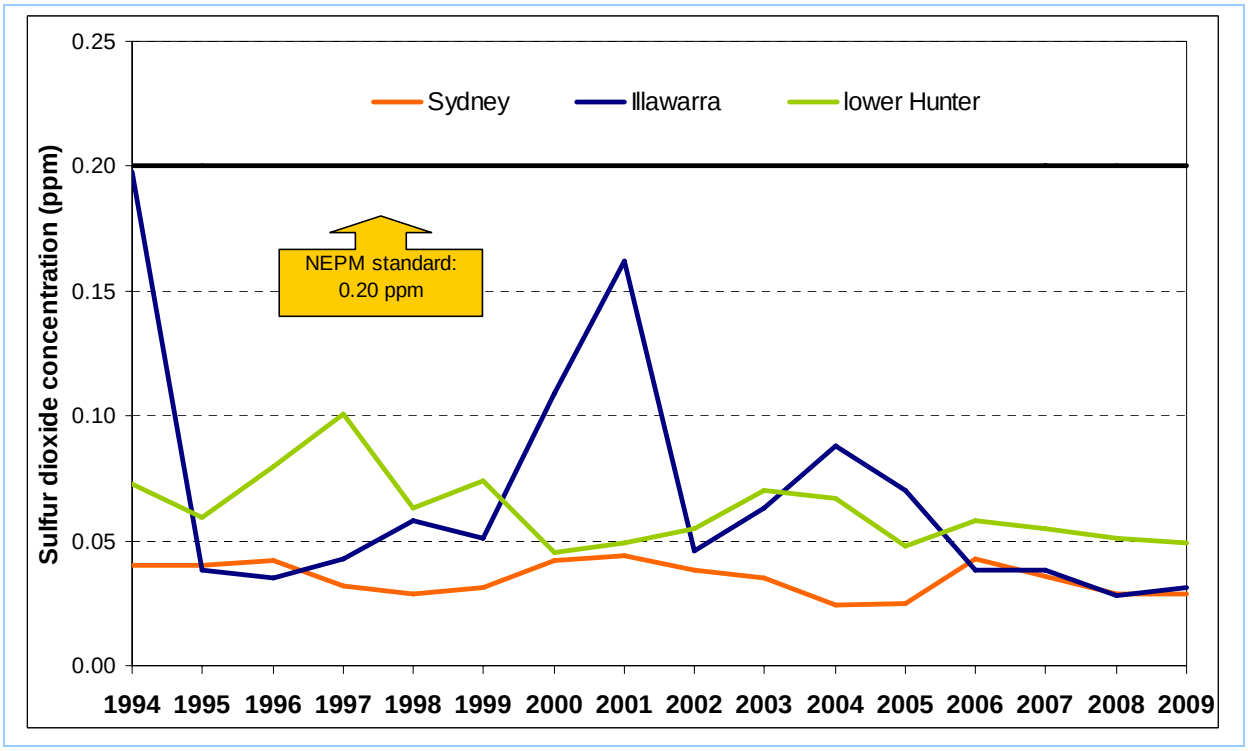

Figure 6.15: Maximum 1-hour average sulfur dioxide concentrations in NSW

7 AIR EMISSIONS INVENTORY DATA REVIEW

In 2007, the Department of Environment and Climate Change published the Air Emissions Inventory for the Greater Metropolitan Region in NSW (DECC, 2007a)[7]. The air emissions inventory is a detailed listing of pollutants discharged into the atmosphere by each source type during a given time period and at a specific location. The study area covers 57,330 km^2, which includes the greater Sydney, Newcastle and Wollongong regions. The inventory includes emissions from biogenic (i.e. natural) and anthropogenic (i.e. human) derived sources as outlined below:

- Biogenic (e.g. bushfires, trees and windborne dust)
- Commercial businesses (e.g. quarries, service stations and smash repairers)
- Domestic activities (e.g. house painting, lawn mowing and wood heaters)
- Industrial premises (e.g. oil refineries, power stations and steelworks)
- Off-road mobile (e.g. aircraft, railways and recreational boats)
- On-road mobile (e.g. buses, cars and trucks).

The inventory includes over 90 air pollutants as outlined below:

- Criteria Pollutants (i.e. carbon monoxide (CO), lead, oxides of nitrogen (NO_x), PM_{10}, $PM_{2.5}$, sulfur dioxide (SO_2) and volatile organic compounds (VOCs))
- Metal air toxics (e.g. antimony, arsenic, beryllium, chromium and nickel)
- Organic air toxics (e.g. benzene, formaldehyde, polycyclic aromatic hydrocarbons (PAHs), toluene and xylenes).

The major sources for each pollutant in the Newcastle Local Government Area are summarised in Table 7.1 and Table 7.2. The location of the Newcastle Local Government Area is shown in Figure 7.1.

[7] For a detailed description of the NSW GMR air emissions inventory please refer to DECC, 2007a

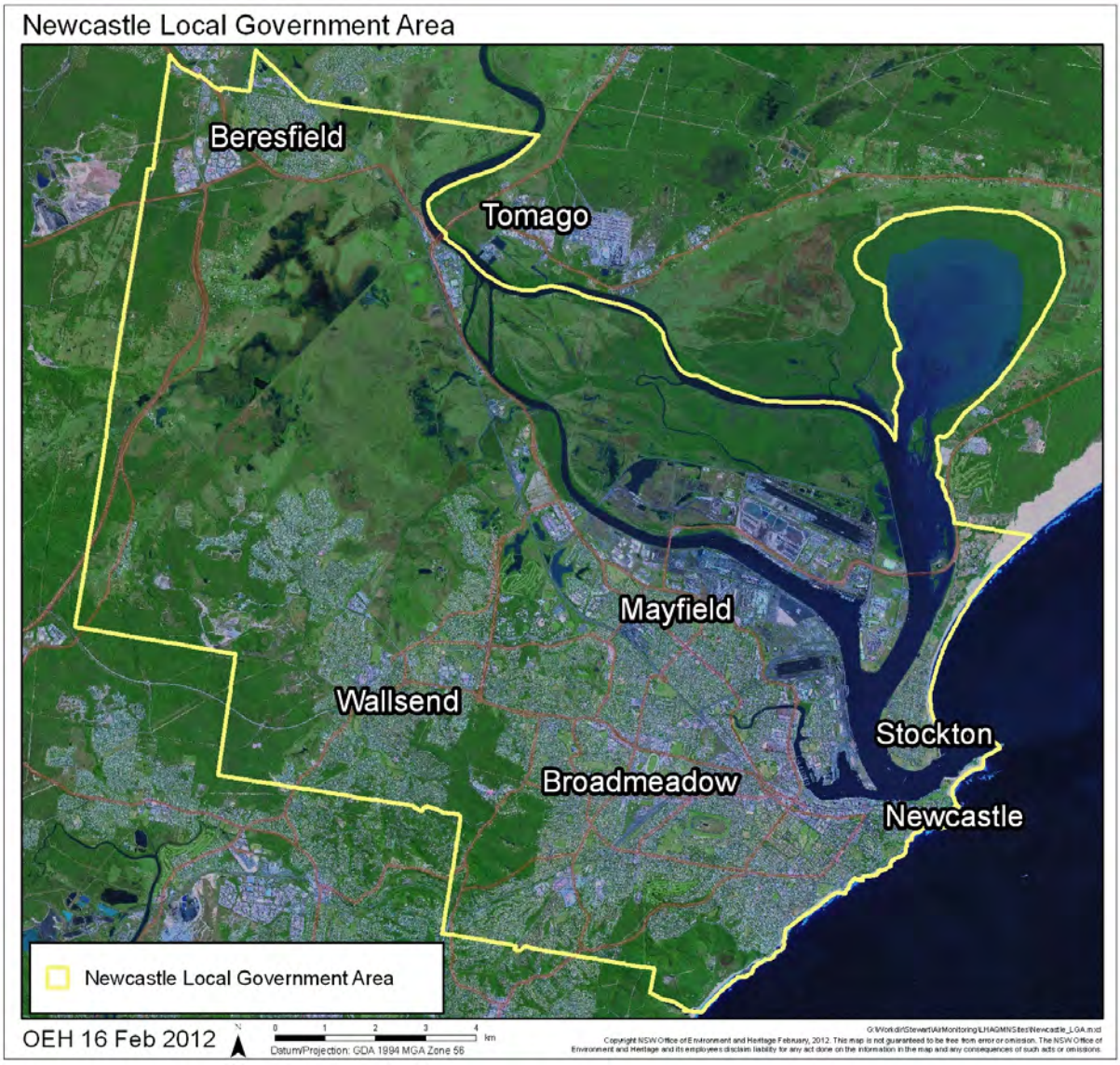

Figure 7.1: Newcastle Local Government Area

Table 7.1: Major Sources of Criteria Air Pollutants in Newcastle Local Government Area

Category	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	TOTAL VOCS
Industrial	13%	23%	47%	48%	14%	20%
On-Road Mobile	71%	43%	7%	9%	5%	31%
Off-Road Mobile	2%	31%	19%	15%	81%	2%
Commercial	0%	1%	8%	3%	0%	7%
Domestic	13%	1%	17%	24%	0%	34%
Biogenic	1%	0%	2%	2%	0%	5%

Where: NO_x: oxides of nitrogen; PM_{10}: particles less than 10 micrometres in diameter; $PM_{2.5}$: particles less than 2.5 micrometres in diameter; SO_2: sulfur dioxide; CO: carbon monoxide; Total VOCs: total volatile organic compounds.

Industrial emissions are a significant source of all pollutants, and the dominant source of Particulate Matter < 10 µm and Particulate Matter < 2.5 µm.

Table 7.2: Major Sources of Criteria Air Pollutants in Newcastle Local Government Area

Pollutant	Major Emission Sources
Carbon monoxide	On-road mobile (71%) Secondary iron or steel production (11%)
Oxides of nitrogen	On-road mobile (43%) Commercial ships (27%) Industrial – ammonium nitrate production (18%)
Particulate matter < 10 µm	Solid fuel burning (domestic) (16%) Industrial – ammonium nitrate production (15%) Off-road industrial vehicles (13%)
Particulate matter < 2.5 µm	Solid fuel burning (domestic) (22%) Industrial – ammonium nitrate production (21%) Industrial – bitumen pre-mix or hot-mix production (11%)
Sulfur dioxide	Commercial ships (79%)
Total VOCs	On-road mobile (31%) Aerosols and solvents (12%) Soil fuel burning (domestic) (7%)

Motor vehicles are the dominant source of carbon monoxide, nitrogen oxide and VOC emissions.

Orica is a significant source of Particulate Matter < 10 µm and Particulate Matter < 2.5 µm, comparable to emissions from woodheaters in the Newcastle Local Government Area.

Commercial ships are the dominant source of sulphur dioxide emissions. It should be noted that as the inventory analysis is for the Newcastle Local Government Area, it does not include emissions from the Tomago Aluminium Smelter.

Total estimated emissions to air of primary pollutants by source in the Newcastle Local Government Area are summarised in Table 7.3.

Estimated emissions to air in the Newcastle Local Government Area to air by source are presented graphically for:

- Carbon monoxide (Figure 7.2);
- Oxides of nitrogen (Figure 7.3);
- Particulate matter < 10 µm (Figure 7.4);
- Particulate matter < 2.5 µm (Figure 7.5);
- Sulfur dioxide (Figure 7.6); and
- Total VOCs (Figure 7.7).

Table 7.3: Summary of Annual Emissions to Air in the Newcastle Local Government Area (2003 Base Year)

Module	Activity	Estimated Emissions (kg/year)					
		CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	TOTAL VOCS
Biogenic	agricultural burning	50.81	1.81	9.83	5.71	0.16	6.54
	bushfire and prescribed burning	170,369	4,556	14,554	13,341	456	23,501
	fugitive/windborne	NA	NA	6,693	2,605	NA	NA
	soil	NA	22,799	NA	NA	NA	NA
	vegetation	NA	NA	NA	NA	NA	303,021
Biogenic Total		**170,420**	**27,356**	**21,257**	**15,952**	**456**	**326,529**
Commercial	Automotive Fuel Retailing	NA	NA	NA	NA	NA	252,781
	Chemical Product Manufacturing n.e.c.	NA	NA	NA	NA	NA	6,337
	Concrete Slurry Manufacturing	NA	NA	783	119	NA	NA
	Construction Material Mining n.e.c.	NA	NA	33,879	6,583	NA	4.23
	Fabricated Metal Product Manufacturing n.e.c.	NA	413	192	192	NA	24.67
	Funeral Directors, Crematoria and Cemeteries	325	715	0.06	0.04	126	1.05E-6
	Furniture Manufacturing n.e.c.	NA	NA	NA	NA	NA	4,293
	Gravel and Sand Quarrying	NA	NA	66,027	14,861	NA	7.20
	Hospitals (Except Psychiatric Hospitals)	4,643	5,527	420	420	28.88	304
	Laundries and Dry-Cleaners	NA	NA	NA	NA	NA	7,546
	Metal Coating and Finishing	1,834	26,989	2,476	2,476	11.41	549
	Mining and Construction Machinery Manufacturing	NA	NA	0.20	0.20	NA	475
	Plastic Product, Rigid Fibre Reinforced, Manufacturing	NA	NA	NA	NA	NA	3,002
	Smash Repairing	NA	NA	NA	NA	NA	167,421
Commercial Total		**6,802**	**33,644**	**103,778**	**24,652**	**166**	**442,744**
Domestic-Commercial	Barbeques	7,194	2,194	384	214	124	1,597
	Cutback Bitumen	NA	NA	NA	NA	NA	75,665
	Domestic/Commercial Solvents/Aerosols	NA	NA	NA	NA	NA	717,502
	Gaseous Fuel Burning	20,608	48,359	3,864	3,864	310	2,837
	Lawn Mowing	1,486,046	6,327	8,961	8,244	538	193,669
	Lawn Mowing (Public Open Spaces)	305,434	7,263	4,157	3,860	254	44,442

Module	Activity	Estimated Emissions (kg/year)					
		CO	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**TOTAL VOCS**
	Liquid Fuel Burning (Domestic)	252	909	20.20	5.05	359	36.01
	Natural/Town Gas Leakage	NA	NA	NA	NA	NA	63,943
	Solid Fuel Burning (Domestic)	1,325,174	17,153	220,594	213,946	3,453	452,554
	Surface Coatings	NA	NA	NA	NA	NA	526,352
Domestic-Commercial Total		**3,144,708**	**82,205**	**237,980**	**230,134**	**5,037**	**2,078,597**
Industrial	Agricultural Fertilizer and/or Ammonium Nitrate Production - Production of ammonium nitrate	302,945	1,056,166	210,293	206,777	1,200	265,498
	Agricultural Fertilizer and/or Ammonium Nitrate Production - Production of phosphate fertilizer	4,854	5,504	4,427	3,308	44.58	303
	Aircraft (helicopter) facilities	NA	NA	NA	NA	NA	129
	Animal slaughtering	2,260	56,921	1,828	705	75,855	12,807
	Bitumen pre-mix or hotmix production	7,700	2,420	111,114	110,568	1,500	1,509
	Bulk cargo handling	NA	NA	80,043	11,713	NA	645
	Cement or lime handling	369	440	4,243	2,384	2.30	28.76
	Chemical Storage - Other Chemical Storage	NA	NA	NA	NA	NA	259,000
	Chemical Storage - Storage of Petroleum and/or Petroleum Products	NA	NA	NA	NA	NA	180,925
	Coal loading	NA	NA	225	22.42	NA	3,904
	Coal mining	NA	NA	16,271	3,167	NA	NA
	Concrete batching	NA	NA	5,860	882	NA	0.06
	Crushing, grinding or separating works	1,440	126	22,662	7,217	1.18	910
	Hazardous, industrial or group A waste generation or storage	6.13	7.30	0.55	0.55	0.04	15,959
	Hazardous, industrial, group A or group B waste processing	34.54	41.12	3.13	3.13	0.21	2.26
	Inert waste landfilling	NA	NA	54,051	10,886	NA	NA
	Metal plating or coating works	1,761	2,096	2,468	2,468	10.95	521
	Milk processing	2,594	3,098	260	260	16.18	346
	Mooring and boat storage	NA	NA	NA	NA	NA	713
	Other activities - printing	NA	NA	NA	NA	NA	56,000

Module	Activity	Estimated Emissions (kg/year)					
		CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	TOTAL VOCS
	Other agricultural crop processing	6,971	8,298	802	802	120	3,847
	Other chemical processing	23,919	79,429	32,576	32,576	52,765	46,200
	Other metal processing	58,123	103,632	15,425	15,425	392	108,537
	Other vessel construction or maintenance	NA	578	17,931	16,472	NA	4,780
	Primary non-ferrous production (excluding aluminium)	20,211	46,905	13,081	11,589	8,442	1,480
	Scrap metal recovery	NA	1,859	NA	NA	NA	1.65
	Secondary iron and steel production	2,597,140	25,387	28,263	25,170	2,007	188,240
	Sewage Treatment - processing by large plants (> 10000 ML per year)	NA	NA	NA	NA	NA	1,062
	Sewage Treatment - processing by small plants (< 10000 ML per year)	NA	NA	NA	NA	NA	7.69
	Solid waste landfilling	5,456	NA	23,207	4,694	NA	61,912
	Vessel construction or maintenance using dry or floating docks	NA	NA	3,891	3,575	NA	25,680
	Waste storage, transfer, separating or processing	4.15	4.94	299	56.43	0.03	650
	Wood or timber milling	NA	NA	272	100.00	NA	NA
	Wood preservation	NA	NA	NA	NA	NA	41.55
Industrial Total		**3,035,786**	**1,392,912**	**649,496**	**470,820**	**142,357**	**1,241,639**
Off-Road Mobile	Commercial Boats	27,209	12,064	814	756	291	5,083
	Commercial Ships	273,935	1,615,760	55,831	53,416	823,491	60,146
	Commercial Vehicles	27,880	23,297	26,777	12,213	731	3,492
	Construction Vehicles	33,413	9,658	756	728	295	3,130
	Industrial Vehicles	42,194	95,670	177,051	73,038	2,740	8,139
	Railways	14,404	113,505	3,380	3,054	15,864	4,878
	Recreational Boating	102,668	1,830	2,480	2,283	228	38,647
Off-Road Mobile Total		**521,702**	**1,871,784**	**267,089**	**145,487**	**843,640**	**123,516**
On-Road Mobile	On-Road Mobile	16,824,550	2,623,630	93,049	88,652	51,214	1,880,961
On-Road Mobile Total		**16,824,550**	**2,623,630**	**93,049**	**88,652**	**51,214**	**1,880,961**
Newcastle City Council Total		**23,703,969**	**6,031,532**	**1,372,648**	**975,696**	**1,042,870**	**6,093,985**

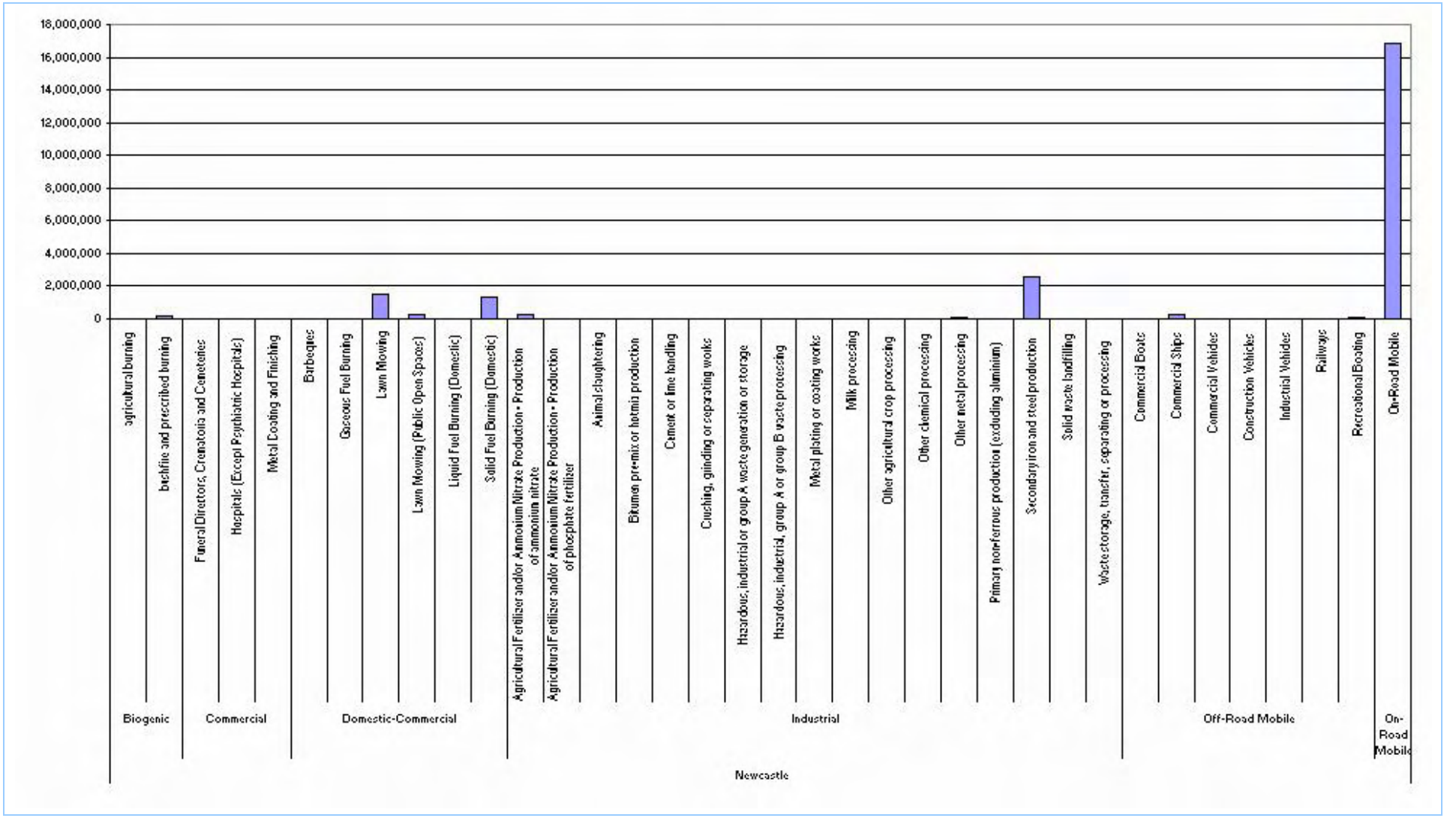

Figure 7.2: Estimated Annual Air Emissions by Source in the Newcastle Local Government Area (2003 Base Year) – Carbon Monoxide (kg/year)

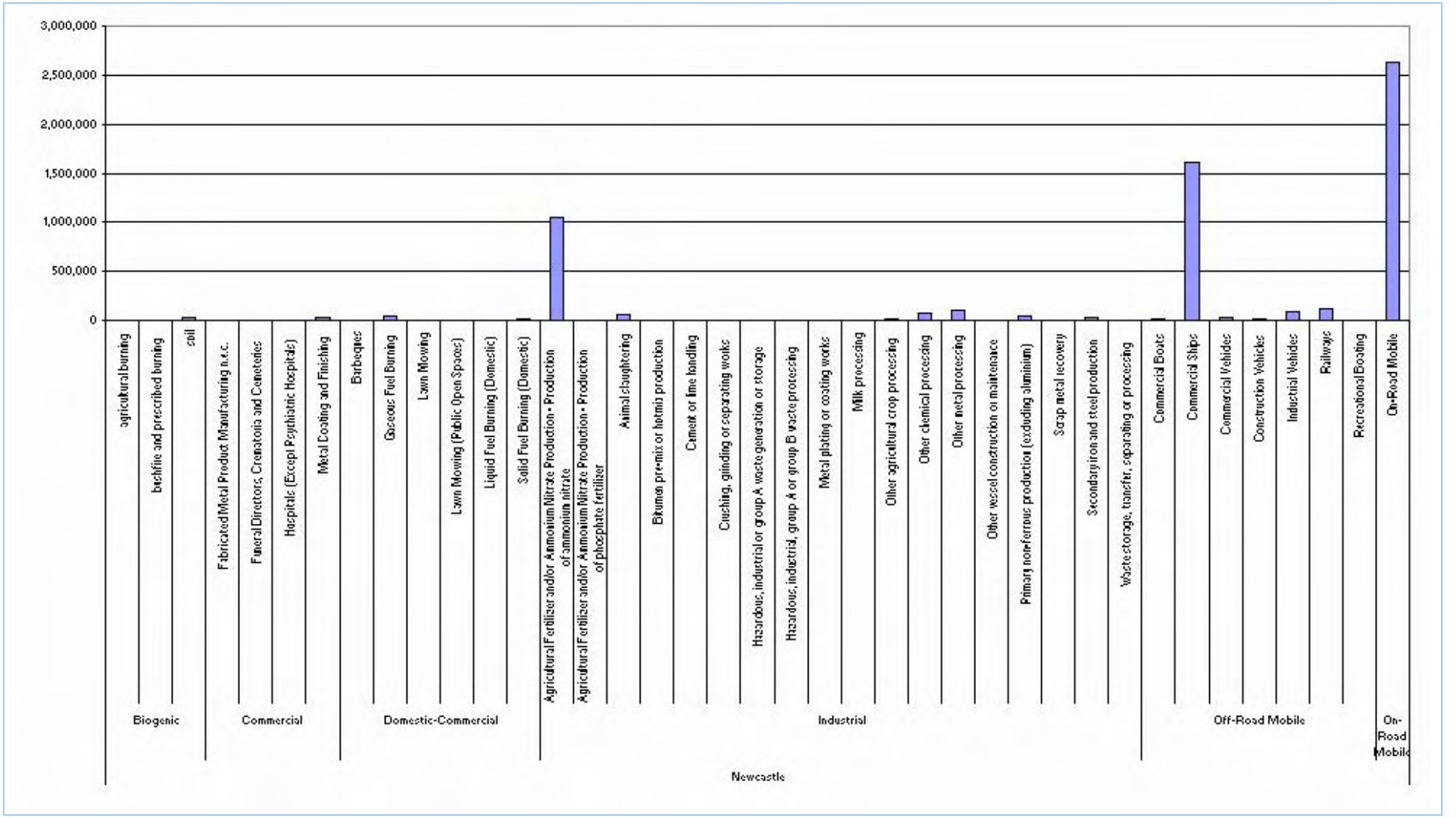

Figure 7.3: Estimated Annual Air Emissions by Source in the Newcastle Local Government Area (2003 Base Year) – Oxides of Nitrogen (kg/year)

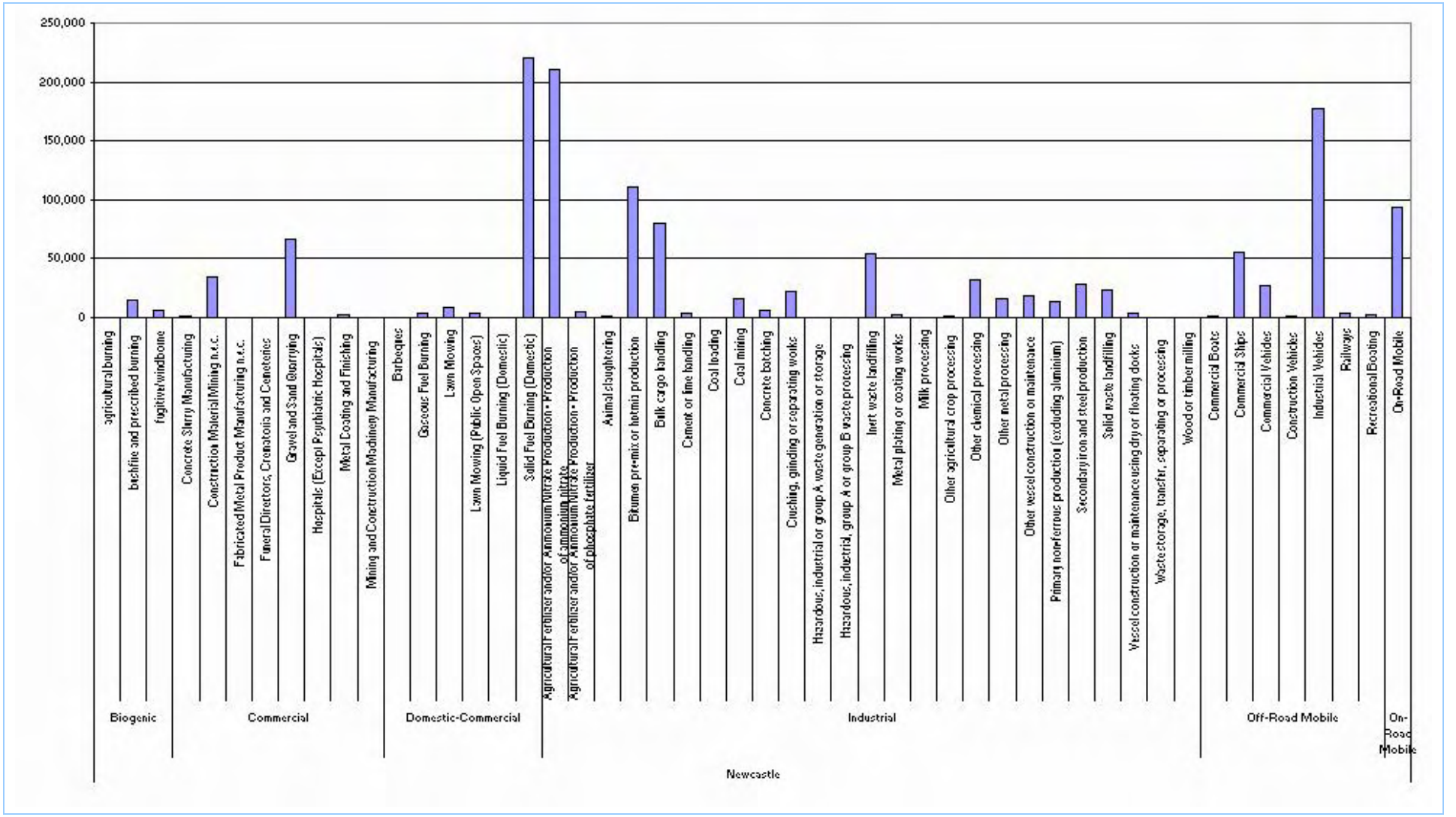

Figure 7.4: Estimated Annual Air Emissions by Source in Newcastle Local Government Area (2003 Base Year) – Particulate Matter < 10 µm (kg/year)

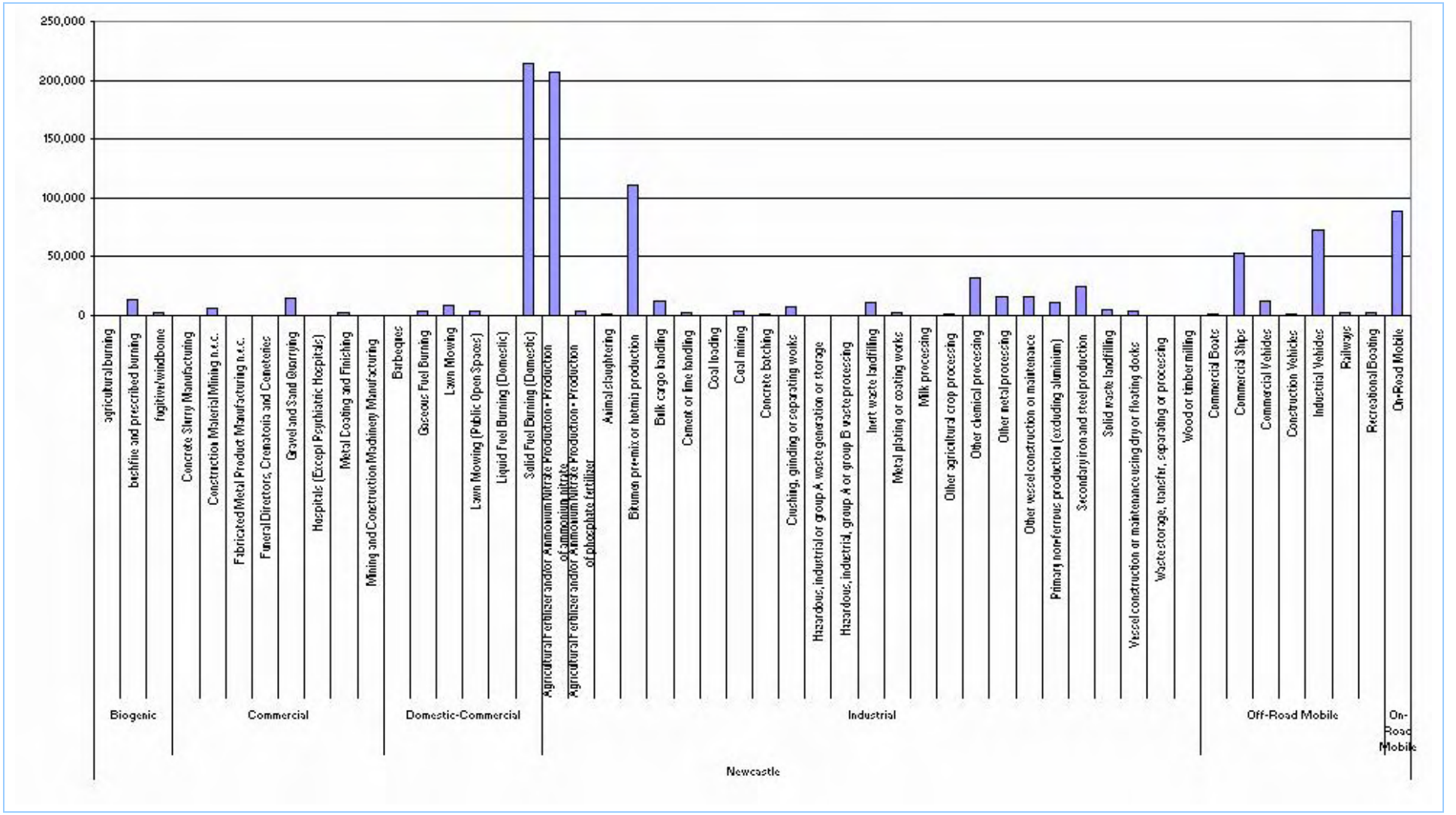

Figure 7.5: Estimated Annual Air Emissions by Source in the Newcastle Local Government Area (2003 Base Year) – Particulate Matter < 2.5 µm (kg/year)

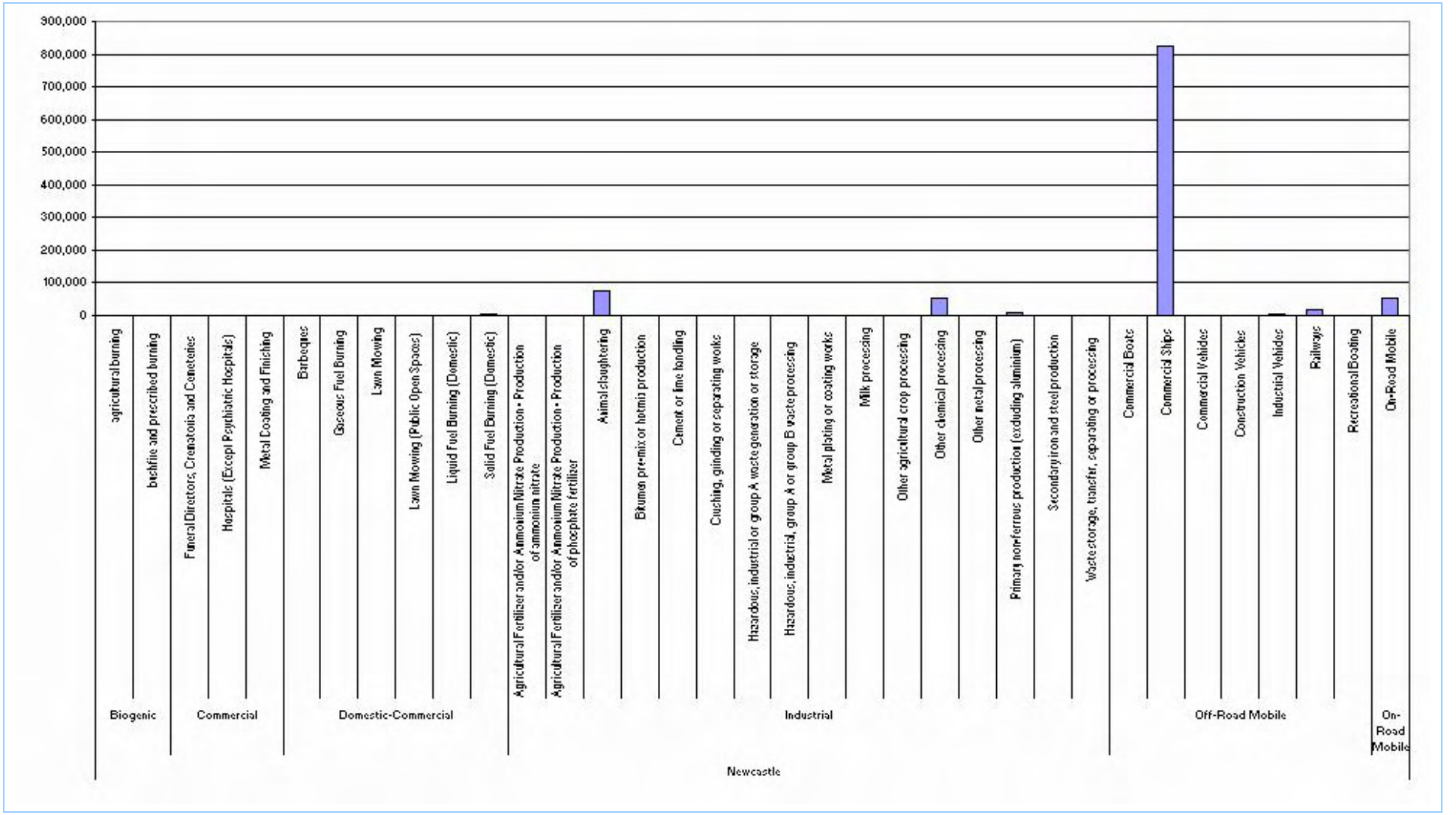

Figure 7.6: Estimated Annual Air Emissions by Source in the Newcastle Local Government Area (2003 Base Year) – Sulfur Dioxide (kg/year)

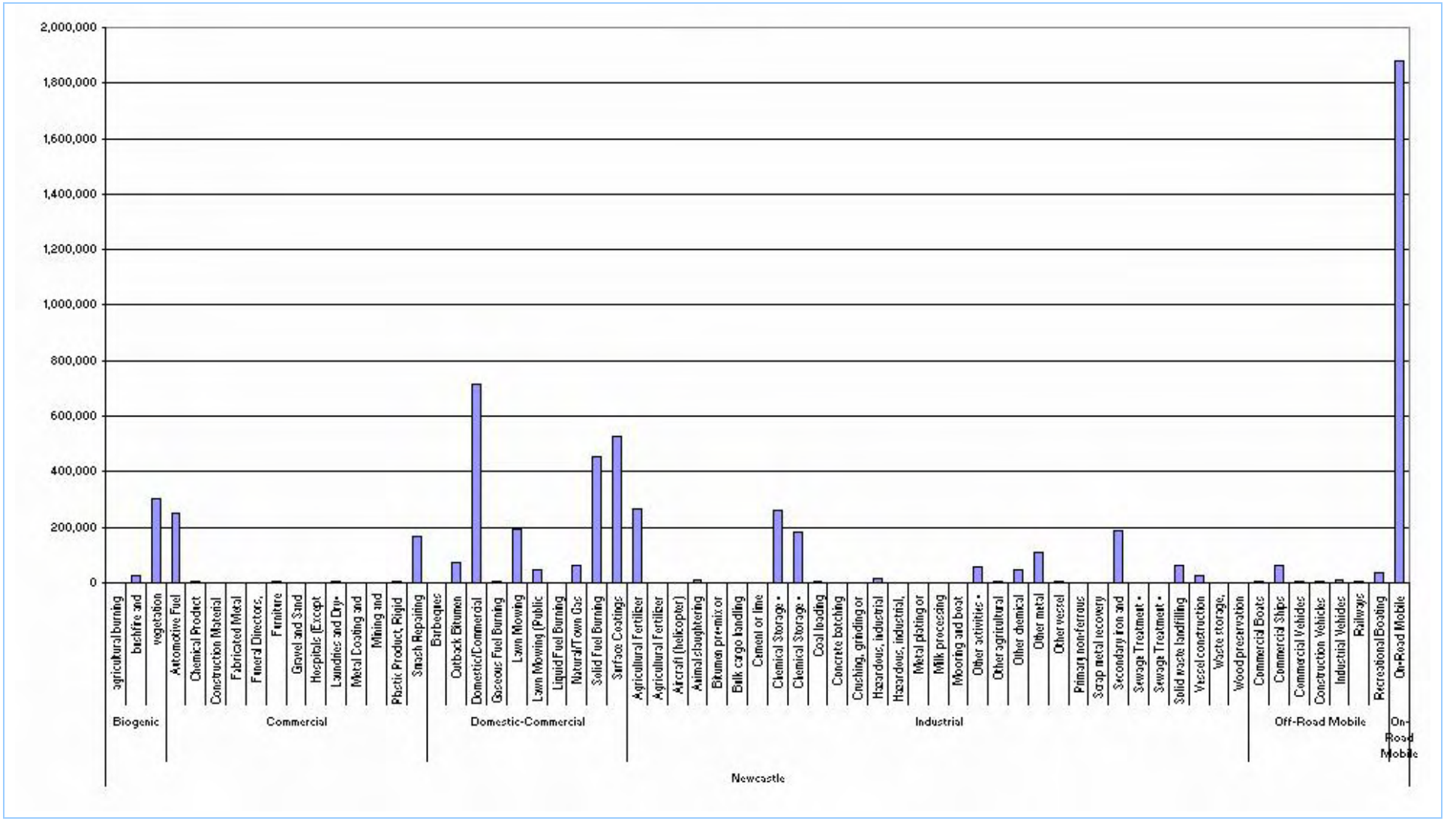

Figure 7.7: Estimated Annual Air Emissions by Source in the Newcastle Local Government Area (2003 Base Year) – Total VOCs (kg/year)

8 FACILITY PRIORITISATION

To confirm the EPA was continuing to appropriately target its regulatory activities, OEH performed an analysis of air emissions data based on the 2003 calendar year for industrial facilities in the NSW Greater Metropolitan Region in 2007. The methodology used to priotitise followed the California Air Pollution Control Officer's Association (CAPCOA) Air Toxics "Hot Spots" Program Facility Prioritisation Guidelines (CAPCOA, 1990; SCAQMD, 2005a; SCAQMD, 2005b; SCAQMD, 2005c; and SCAQMD, 2004). This analysis prioritised industrial facilities according to potential short and long-term health effects.

8.1 Priority Premises

Priority industrial premises ranked for potential health impacts in the Newcastle Local Government Area are detailed in Table 8.1.

Table 8.1: Priority industrial premises ranked for potential health impacts in the Newcastle Local Government Area

Substance Name	Prioritisation Score
KOPPERS CARBON MATERIALS & CHEMICALS PTY LTD (NSW Lic:2156 ID:393)	67
COMMONWEALTH STEEL COMPANY LTD (NSW Lic:822 ID:149)	13
ORICA AUSTRALIA PTY LTD (NSW Lic:828 ID:151)	7
BORAL ASPHALT (NSW Lic:2566 ID:432)	6
BARTTER ENTERPRISES PTY LTD (NSW Lic:1329 ID:252)	2
CALTEX NEWCASTLE TERMINAL (NSW Lic:452 ID:67)	1
KOORAGANG ISLAND WASTE FACILITY (NSW Lic:6437 ID:785)	1
ONESTEEL- NEWCASTLE MARKET MILLS (NSW Lic:11149 ID:990)	1

8.2 Priority Substances

Priority industrial emissions ranked for potential health impacts in the Newcastle Local Government are detailed in Table 8.2.

Table 8.2: Priority industrial emissions ranked for potential health impacts in the Newcastle Local Government Area

Substance Name	Prioritisation Score
POLYCYCLIC AROMATIC HYDROCARBONS	64
BENZENE	14
ARSENIC & COMPOUNDS	6
ACROLEIN (2-PROPENAL)	4
FORMALDEHYDE	2
CHROMIUM (VI) COMPOUNDS	2

The major sources of priority industrial emissions are summarised in Table 8.3.

Table 8.3: Major Sources of Priority Industrial Pollutants in Newcastle Local Government Area

Substance Name	Biogenic	Commercial	Domestic	Off-Road Mobile	On-Road Mobile	Industrial
POLYCYCLIC AROMATIC HYDROCARBONS	0%	0%	51%	6%	43%	1%
BENZENE	0%	1%	17%	1%	44%	37%
ARSENIC & COMPOUNDS	0%	0%	1%	33%	1%	64%
ACROLEIN (2-PROPENAL)	0%	0%	3%	10%	38%	49%
FORMALDEHYDE	0%	0%	35%	8%	22%	34%
CHROMIUM (VI) COMPOUNDS	5%	4%	46%	22%	0%	22%

Industrial emissions of polycyclic aromatic hydrocarbons contribute 1% of total emissions in the Newcastle Local Government Area.

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