ACT AIR QUALITY REPORT 2009

Environment Protection Authority | June 2010

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OVERVIEW

ACT's air quality

This report presents the results of air quality monitoring in the ACT and assesses them against the requirements of the Ambient Air Quality National Environment Protection Measure (the NEPM).

Canberra's overall air quality compared to other capital cities is excellent. However it does experience elevated particle pollution during winter due to emissions from domestic wood heaters. The ACT Government acknowledges the problem and is working towards addressing the issue in an informed and measured manner to ensure a satisfactory outcome for all Canberrans.

Consistent with the reporting period defined in the NEPM this report covers a calendar year ending on 31 December 2009.

The major impacts on Canberra's air quality in 2009, as in previous years, came from the accumulation of combustion particles from wood heaters in cold, highly stable air and dust storms. With the exception of particulate matter all measured parameters are below NEPM standards.

Current Performance Monitoring Stations

The ACT Government has been undertaking ambient air quality monitoring in Canberra since the early 1990's. ACT Health is responsible for the Government's ambient air quality monitoring network, which currently consists of two performance monitoring stations (PMS).

The ACTs population has passed the threshold where it needs a second NEPM PMS. Previous annual reports have been based solely on data from the PMS at Monash. Although not ideally located for national reporting purposes, data from the PMS at Civic will be used for annual report purposes pending the establishment of another NEPM PMS by ACT Health.

The Civic PMS is located at the northern end of the carpark on the western side of the olympic swimming pool adjacent to Allara Street. The Monash PMS is approximately 300 metres west of Cockcroft Avenue in the Monash district playing fields.

Consistent with the ACT's Ambient Air Quality Monitoring Plan, which was approved by the National Environment Protection Council in 2001, this report only covers four of the six criteria pollutants, namely carbon monoxide (CO), nitrogen dioxide (NO_2), photochemical oxidants as ozone (O_3) and particulate matter less than 10 micrometres (PM_{10}). Due to a lack of heavy industry the ACT has never monitored sulphur dioxide, and ceased monitoring lead in July 2002, following the phase out of leaded fuel on 1 January 2002, with ambient air lead levels being less than 2% of the standard. The report also covers particulate matter less than 2.5 micrometres ($PM_{2.5}$).

Both stations contain instrumentation that continuously monitors CO, O_3, NO_2. Particulate matter less than 10 and 2.5 micrometres (microns) in diameter – known as PM_{10} and $PM_{2.5}$ respectively – are only measured at Monash (to put the size of these particles into perspective the average human hair is 60 – 100 microns in diameter).

Emissions (sources of pollution)

Air pollutant emissions in Canberra are dominated by motor vehicles, with the exception of particulate matter which increase during winter due to emissions from wood heaters.

The following charts are based on 2008/2009 National Pollution Inventory (NPI) data and show the main sources of emissions for oxides of nitrogen, carbon monoxide and particulate matter for Canberra. (http://www.npi.gov.au/overview/reports/act-location-report.html).

No emissions data is presented for ozone as this is a secondary pollutant, formed by the reactions of other primary pollutants. It is not directly emitted from a particular source and therefore is not reported under the NPI.

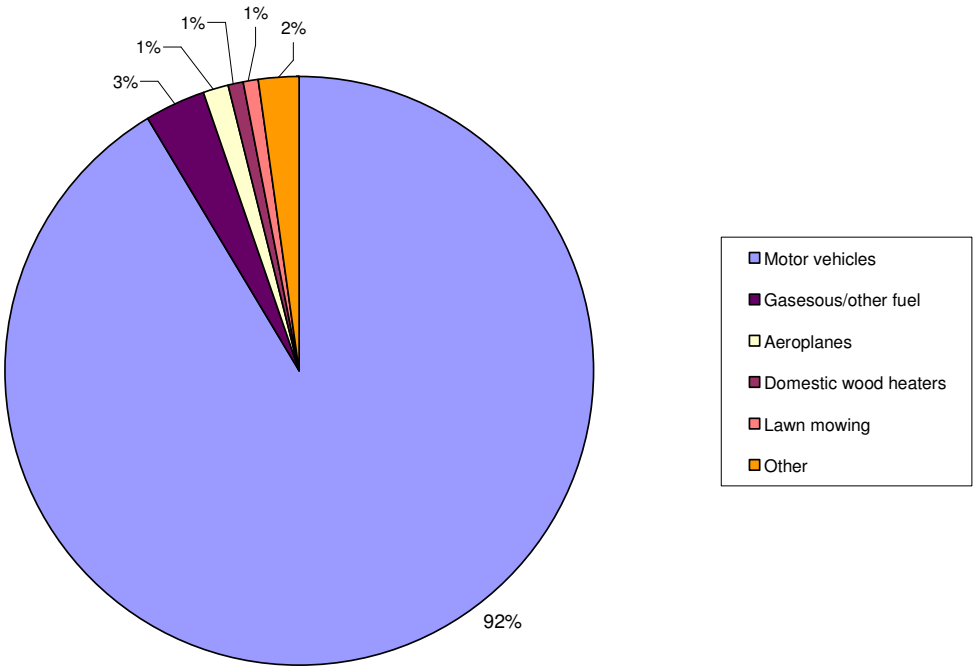

Figure 1: Sources of oxides of nitrogen

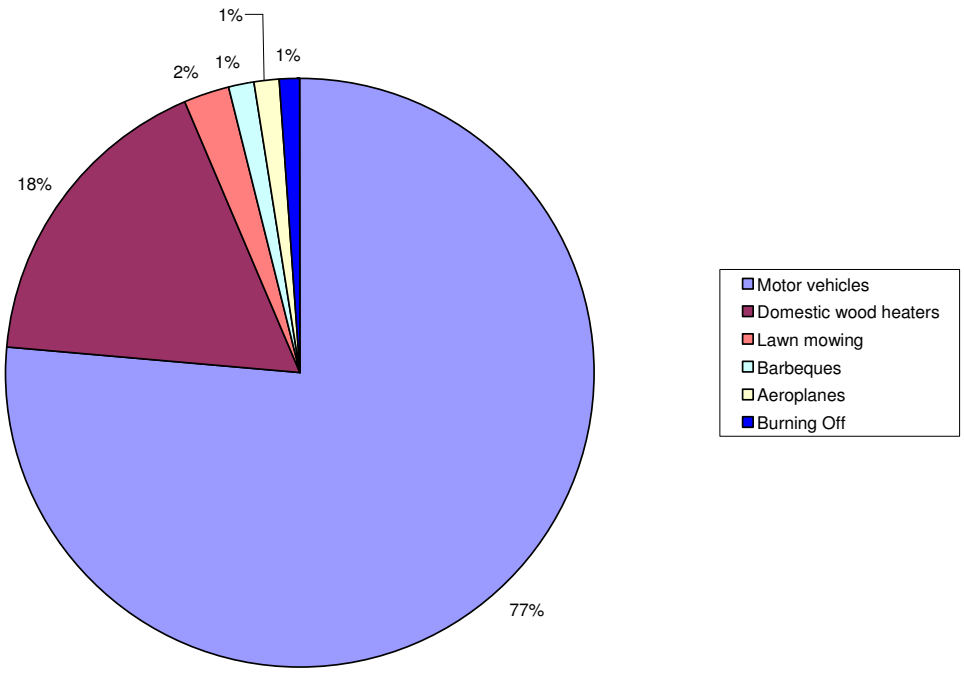

Figure 2: Sources of carbon monoxide

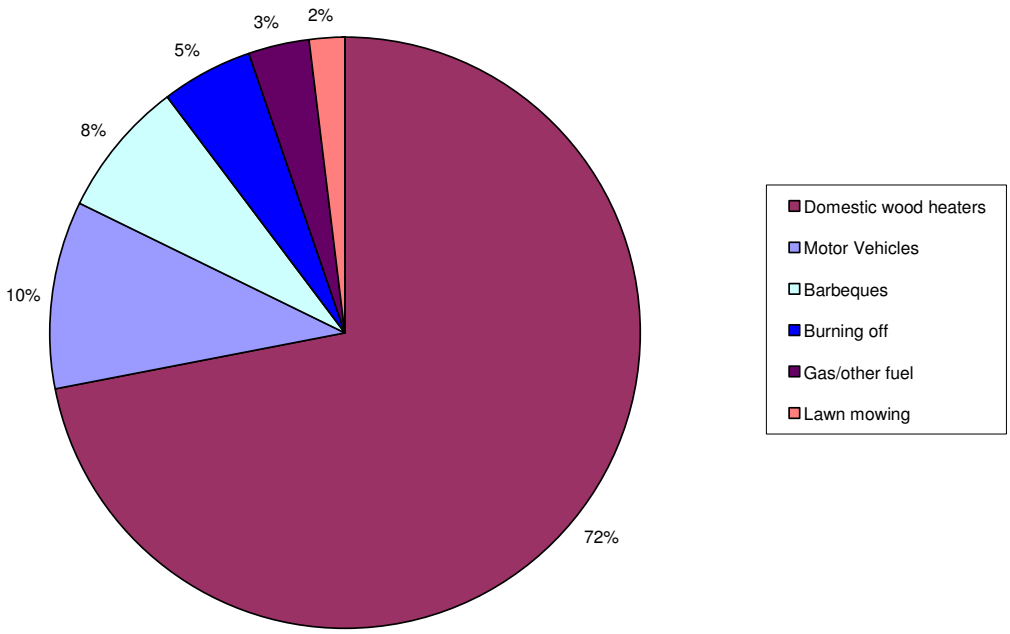

Figure 3: Sources of particulate matter PM_{10}

ASSESSMENT OF COMPLIANCE WITH STANDARDS AND 2008 GOAL

For the purpose of this report air quality is assessed against the NEPM standards and goals as specified in Schedule 2 of the NEPM and reproduced below in Table 1. The NEPM was made in June 1998.

The standards against which air quality is assessed are concentrations in parts per million (ppm) or micrograms per cubic metre (µg/m^3) (refer to column 3, Table 1).

The goal of the NEPM is to achieve the Standards as assessed in accordance with the monitoring protocol within 10 years of commencement (i.e. 2008) to the extent specified in Schedule 2 of the NEPM. The extent is expressed as a maximum allowable number of exceedences for each standard (refer to column 4, Table 1). These are set to account for unusual meteorological conditions and, in the case of particles, natural events such as dust storms and bushfires, that cannot be controlled through normal air quality management programs.

The NEPM also specifies advisory reporting standards for $PM_{2.5}$. The goal for $PM_{2.5}$ is to collect sufficient data to facilitate a review of the $PM_{2.5}$ standards. This review is currently being undertaken as part of the broader NEPM review.

Table 1: NEPM standards and goals

Pollutant	Averaging Period	Maximum concentration	Goal within 10 years Maximum allowable exceedences
Carbon monoxide	8 hours	9.0 ppm	1 day a year
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year none
Photochemical oxidants	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
Sulfur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year none
Lead	1 year	0.050 µg/m^3	none
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year
Particles as $PM_{2.5}$#	1 day 1 year	25 µg/m^3 8 µg/m^3	Gather sufficient data nationally to facilitate a review of Advisory Reporting Standard.

- Reporting standard only

The following tables summarise compliance with the standards and goals of the NEPM. For each pollutant, the data availability (quarterly and annual), the number of days when standards were exceeded, the annual mean (where an annual standard exists) and an assessment of compliance, are given for each monitoring station.

Air quality is assessed as complying with the NEPM if the number of exceedences of the standard is no more than the number specified in Schedule 2 of the NEPM and data availability was at least 75 per cent in each quarter of the year. Air quality is assessed as 'not demonstrated' if there has been insufficient data collected to demonstrate that the standards and goal have been met or not met.

Carbon monoxide

During 2009, no exceedences of the CO standard were recorded in the ACT. Levels are well below the NEPM standard and because of both an improvement in vehicle emissions and a decline in wood heaters numbers, levels are trending down (refer Figure 14 and 15). The highest recorded value in the ACT during 2009, was 2.0 ppm at Monash. This is only 22% of the standard.

Table 2: 2009 compliance summary for CO

NEPM standard - 9.0 ppm (8-hr average)

Region/ Performance monitoring station	Data availability rates (% of days)					Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Canberra							
Monash	95.8	94.3	90.4	95.3	94.0	0	Met
Civic	95.6	95.5	91.3	84.8	91.2	0	Met

The following time series graphs (Figure 4 to Figure 13) enable a quick visual comparison to the NEPM standards for the 2009 reporting period. The figures show, with the exception of particulate matter, all levels are below the standards.

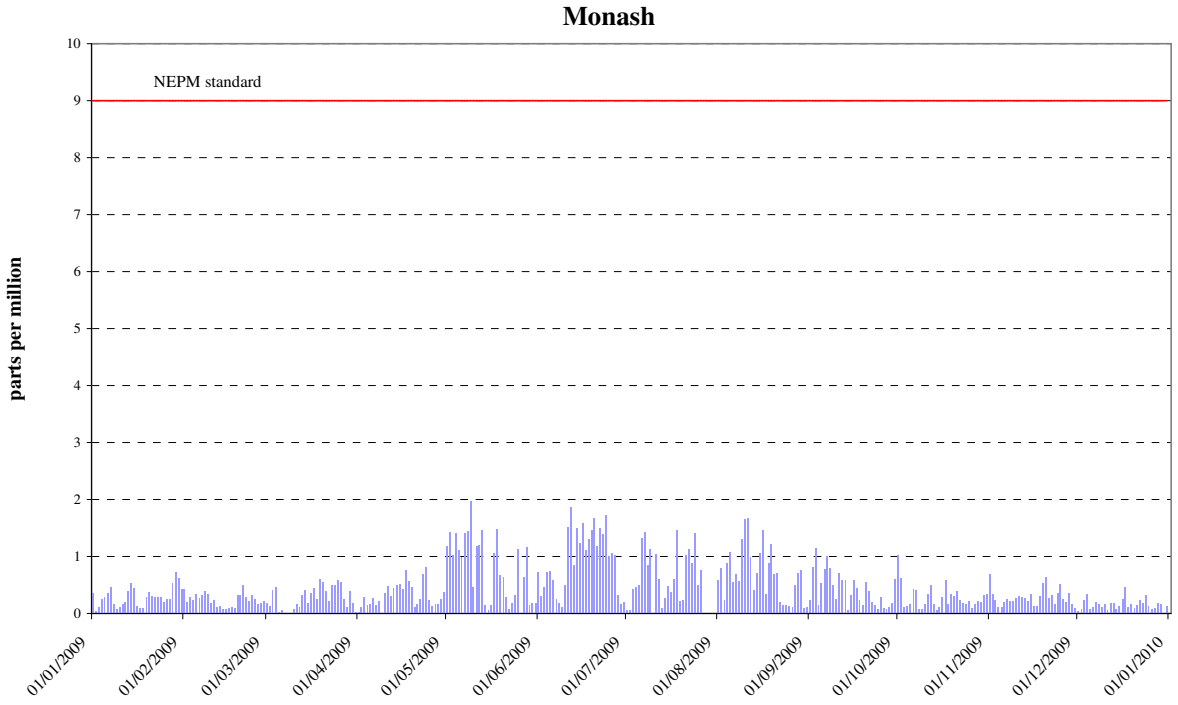

Figure 4: Daily max for CO 8-hr average – Monash.

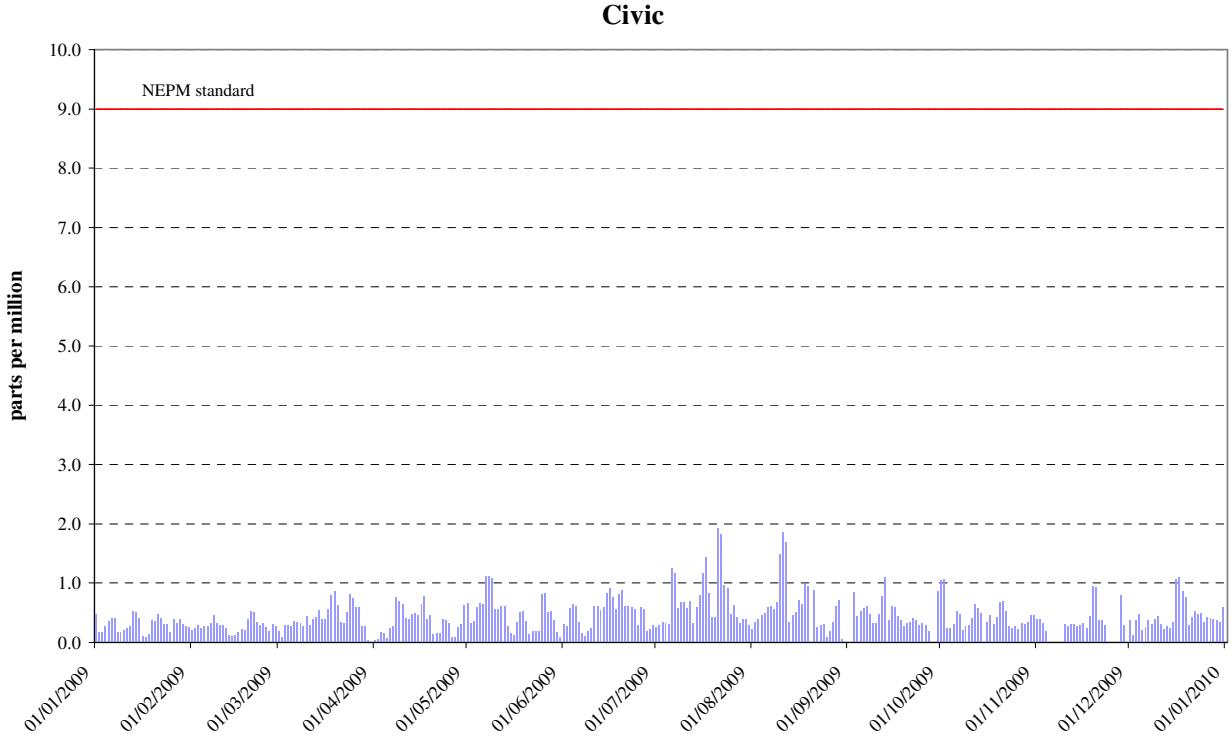

Figure 5: Daily max for CO 8-hr average – Civic.

Nitrogen dioxide

During 2009, no exceedences of the NO_2 standard were recorded in the ACT. Monash complied with both the 1 hour average and 1 year average goals for nitrogen dioxide. Compliance was not demonstrated for Civic because insufficient data was available for the first quarter of the year (Refer Table 3 and Figure 4).

NO_2 levels are well below the NEPM standard and have remained stable over the last decade. The highest recorded 1 hour value during 2009 was 0.043 ppm at Civic. This is only 36% of the standard. The highest recorded annual average in 2009, was 0.008ppm at Civic. This is only 26% of the standard.

Table 3: 2009 compliance summary for NO_2

NEPM standard – 0.12 ppm (1 hour average), 0.03 ppm (1 year average)

Region/ Performance monitoring station	Data availability rates (% of hours)					Annual mean Concentration (ppm)	Number of 1 hour exceedences (days)	Performance against the standards and goal	
	Q1	Q2	Q3	Q4	Annual			1 hour	1 year
Canberra									
Monash	95.8	94.3	90.3	94.2	93.7	0.006	0	Met	Met
Civic	52.9	75.0	95.6	90.0	78.5	0.008	0	ND	ND

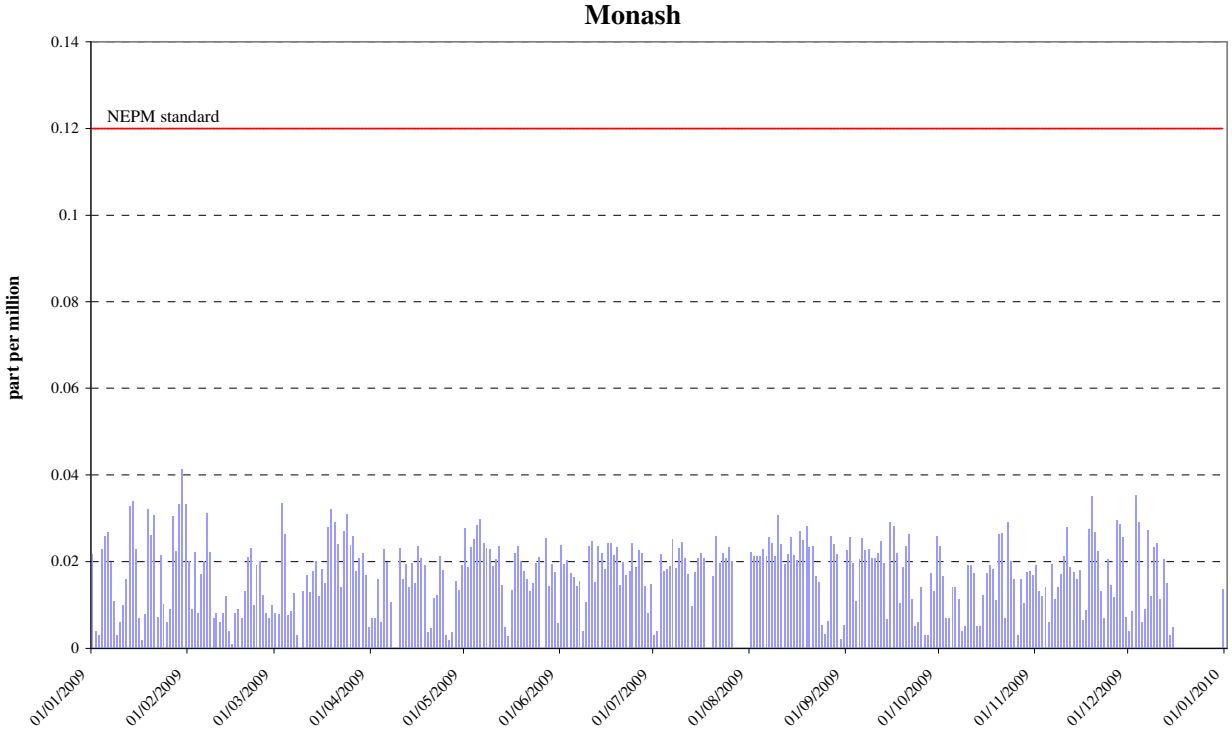

Figure 6: Daily max for NO_2 – Monash.

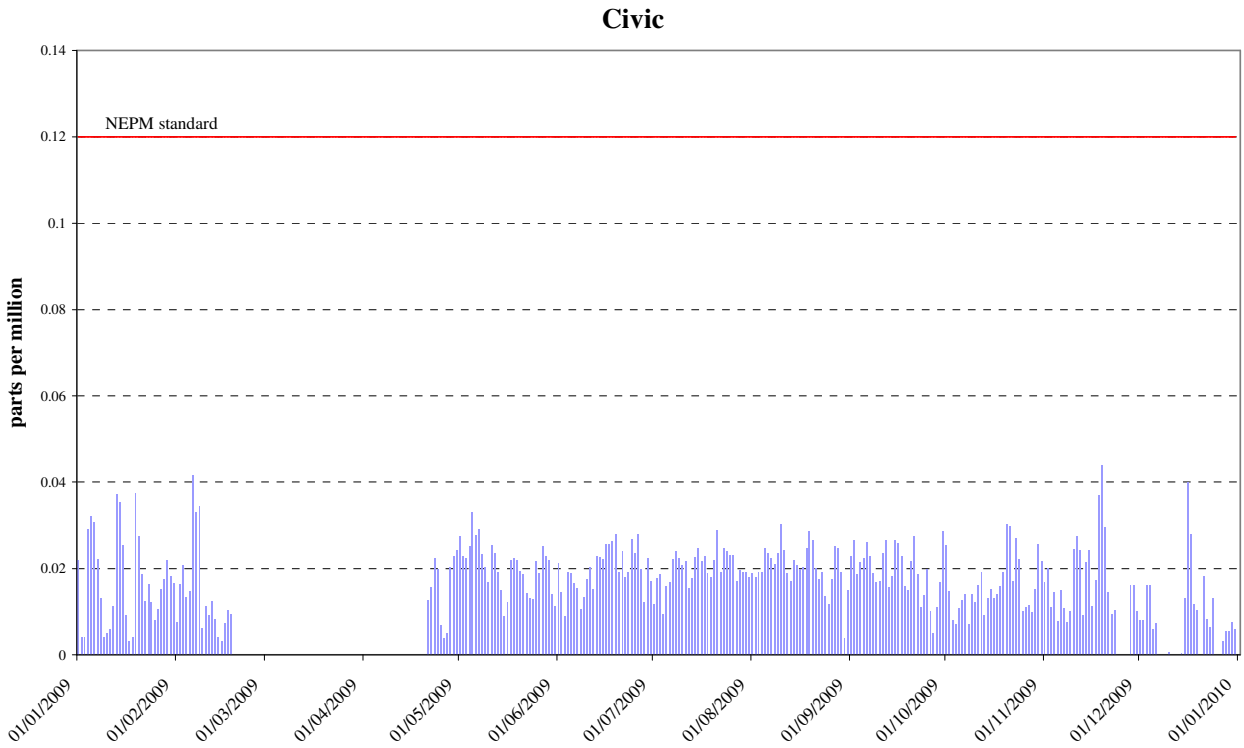

Figure 7: Daily max for NO_2 – Civic.

Ozone

During 2009, no exceedences of the 1 hour and 4 hour standard for O_3 were recorded in the ACT. Levels are below the NEPM standard and appear to have increased slightly over the last decade at Monash (refer Figure 20). The highest recorded 1-hour value in the ACT during 2009, was 0.073 ppm at Monash. This is 73% of the standard. The highest recorded 4-hour value in the ACT during 2009, was 0.068 ppm at Monash. This is 85% of the standard.

Table 4: 2009 compliance summary for O_3

NEPM standard – 0 10 ppm (1 hour average), 0.08 ppm (4 hour average)

Region/ Performance monitoring station	Data availability rates (% of hours)					Number of exceedences (days)		Performance against the standards and goal	
	Q1	Q2	Q3	Q4	Annual	1 hour	4 hours	1 hour	4 hours
Canberra									
Monash	90.5	95.5	91.4	95.5	93.2	0	0	Met	Met
Civic	95.7	95.6	94.5	92.2	94.5	0	0	Met	Met

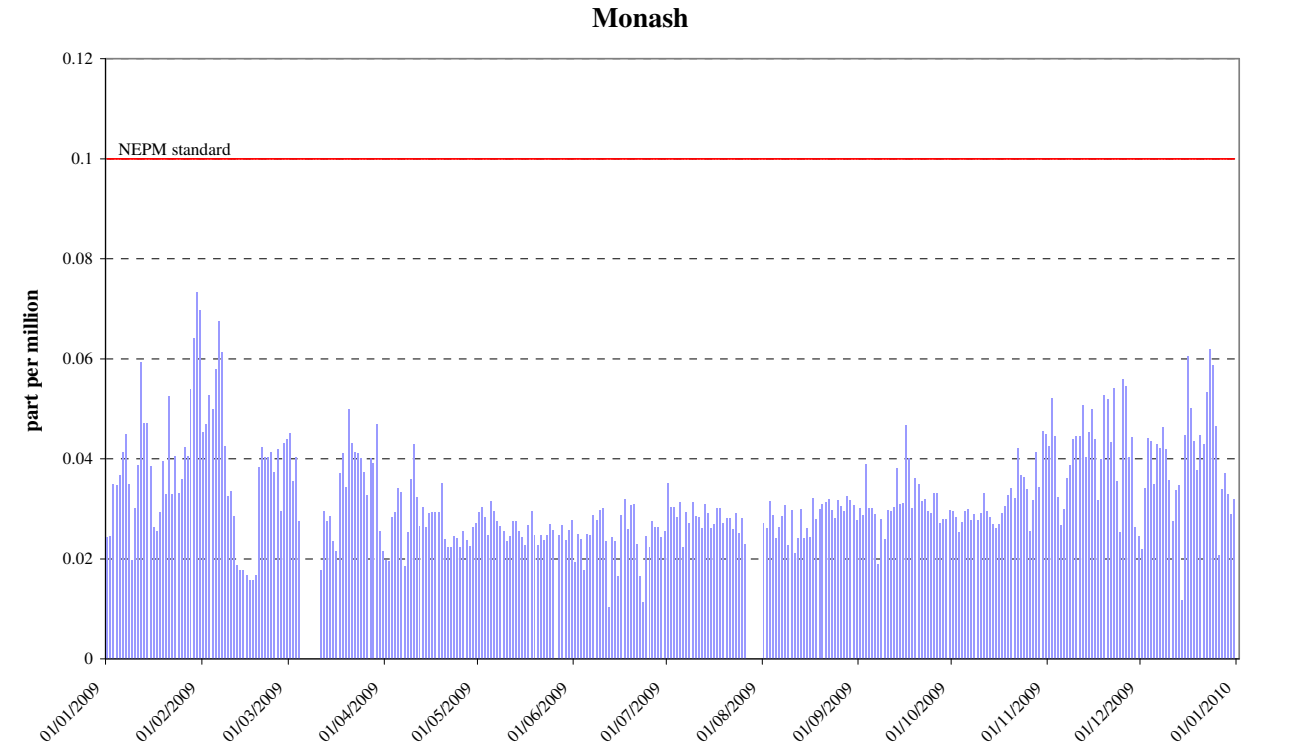

Figure 8: Daily max for 1 hour O_3 – Monash.

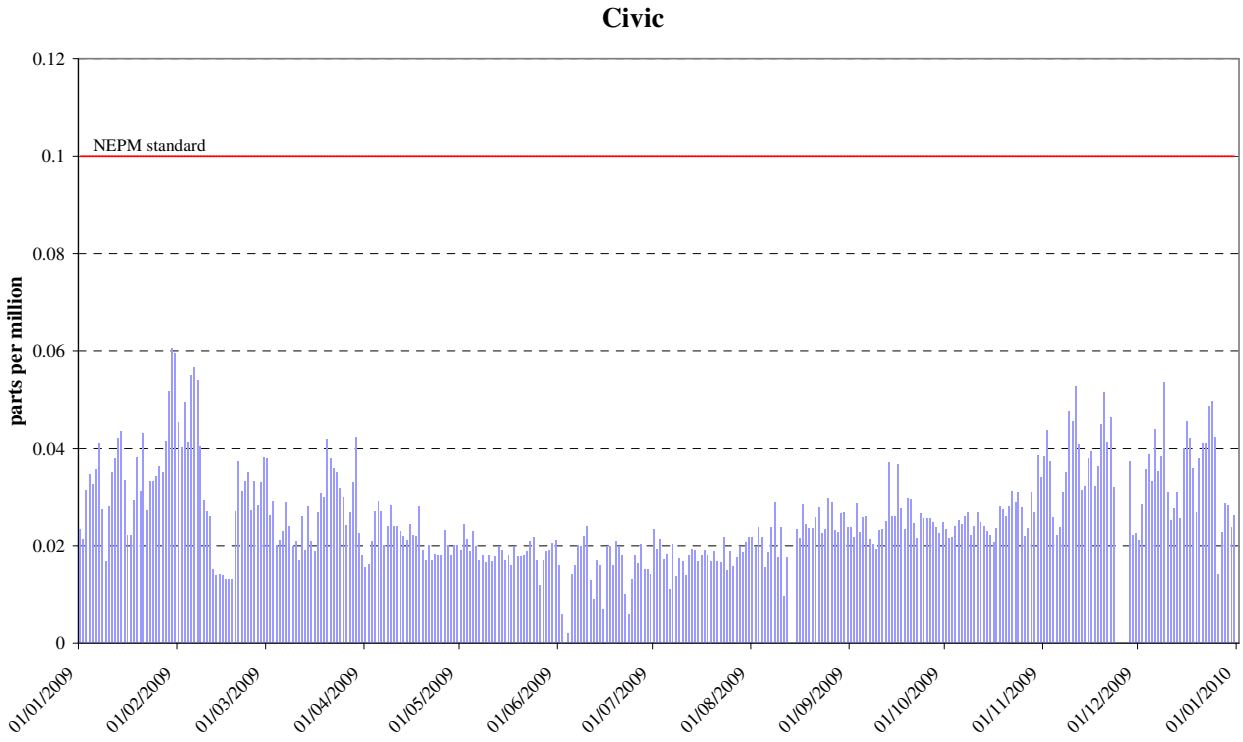

Figure 9: Daily max for 1 hour O_3 – Civic.

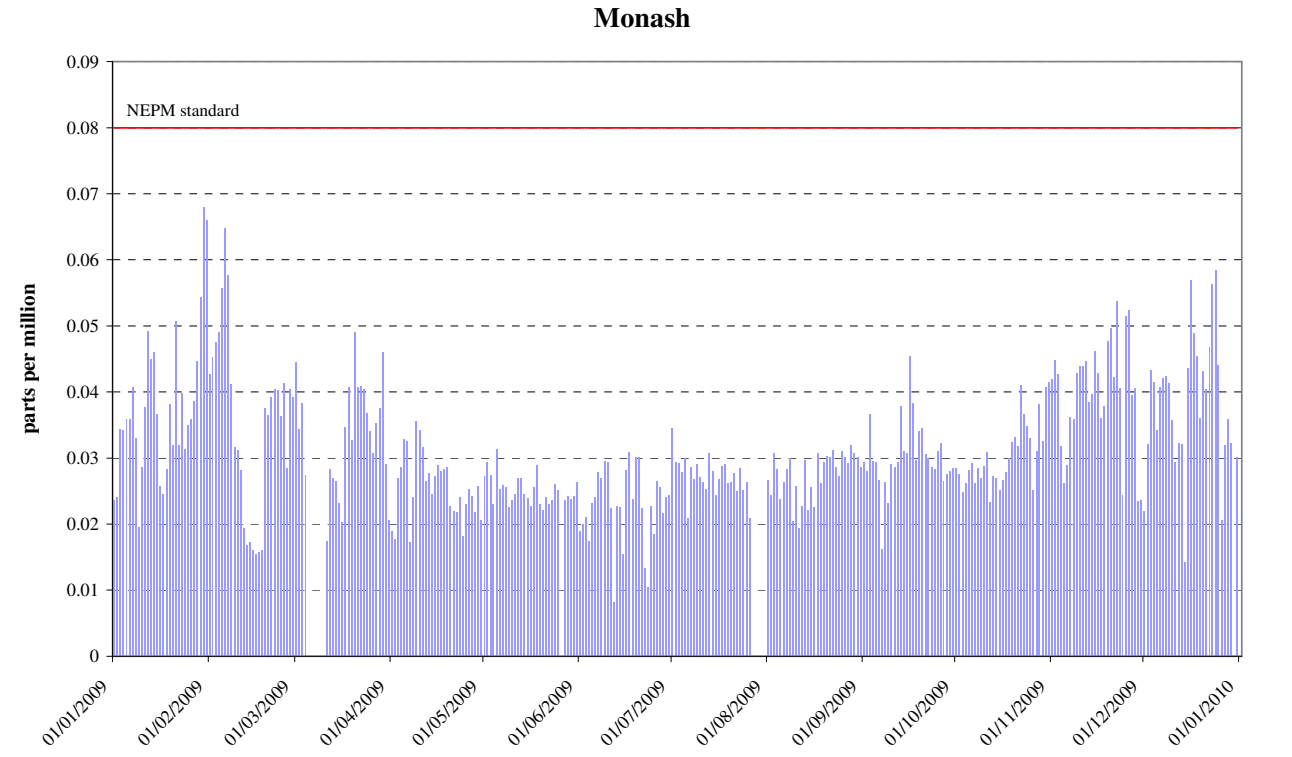

Figure 10: Daily max for 4 hour O_3 – Monash.

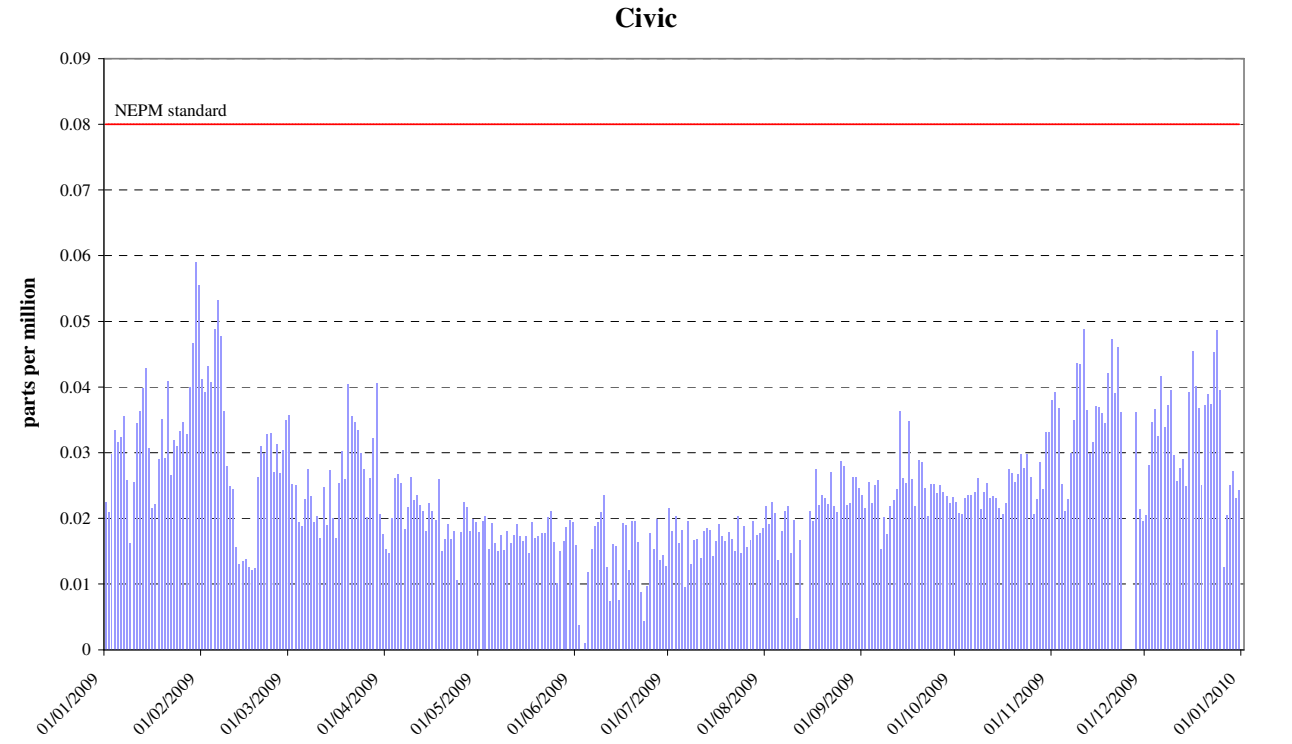

Figure 11: Daily max for 4 hour O_3 – Civic.

PM_{10}

During 2009, compliance with the NEPM goal was not met because nine exceedences of the 24-hr PM_{10} standard were recorded at Monash. Data was also not available for the period 1 January to 8 June because of instrument failure.

Table 5: 2009 compliance summary for PM_{10}

NEPM standard 50 µg/m^3 1 day average

Region/ Performance monitoring station	Data availability rates (% of days)					Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Canberra Monash	0	25	78	69	82	9	Not Met

The highest PM_{10} level recorded during 2009, was 210 µg/m^3 on 22 September when most of eastern Australia was covered in red dust after an extreme low pressure system moved across from central Australia. This is 420% of the NEPM standard.

As with previous years, exceedences continue to be caused by wood heater emissions during extremely cold and stable atmospheric conditions and natural events such as dust storms. Excluding these climatological effects, PM_{10} levels have been falling in the Tuggeranong Valley (refer Figure 24).

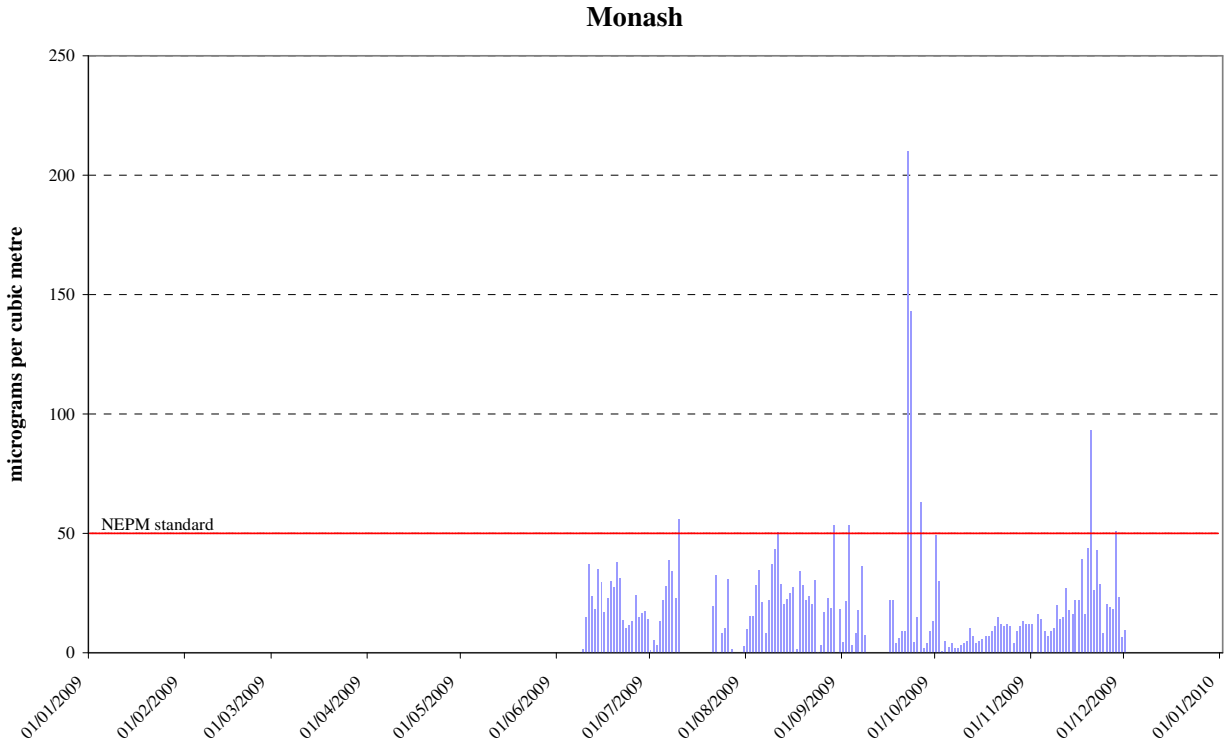

Figure 12: Daily max for PM_{10} – Monash.

$PM_{2.5}$

During 2009, two exceedences of the 24-hr advisory reporting standard were recorded at Monash. Data was not available for the period 1 January to 23 February, 5 to 26 May and 4 to 24 June because of instrument failure.

Table 6: 2009 compliance summary for $PM_{2.5}$

NEPM standard – 25 µg/m^3 (1 day), 8 µg/m^3 (1year)

Region/ Performance monitoring station	Data availability rates (% of days)					Annual mean Concentration (µg/m^3)	Number of exceedences (days)
	Q1	Q2	Q3	Q4	Annual		
Canberra Monash	24	47	76	90	64	6.2	2

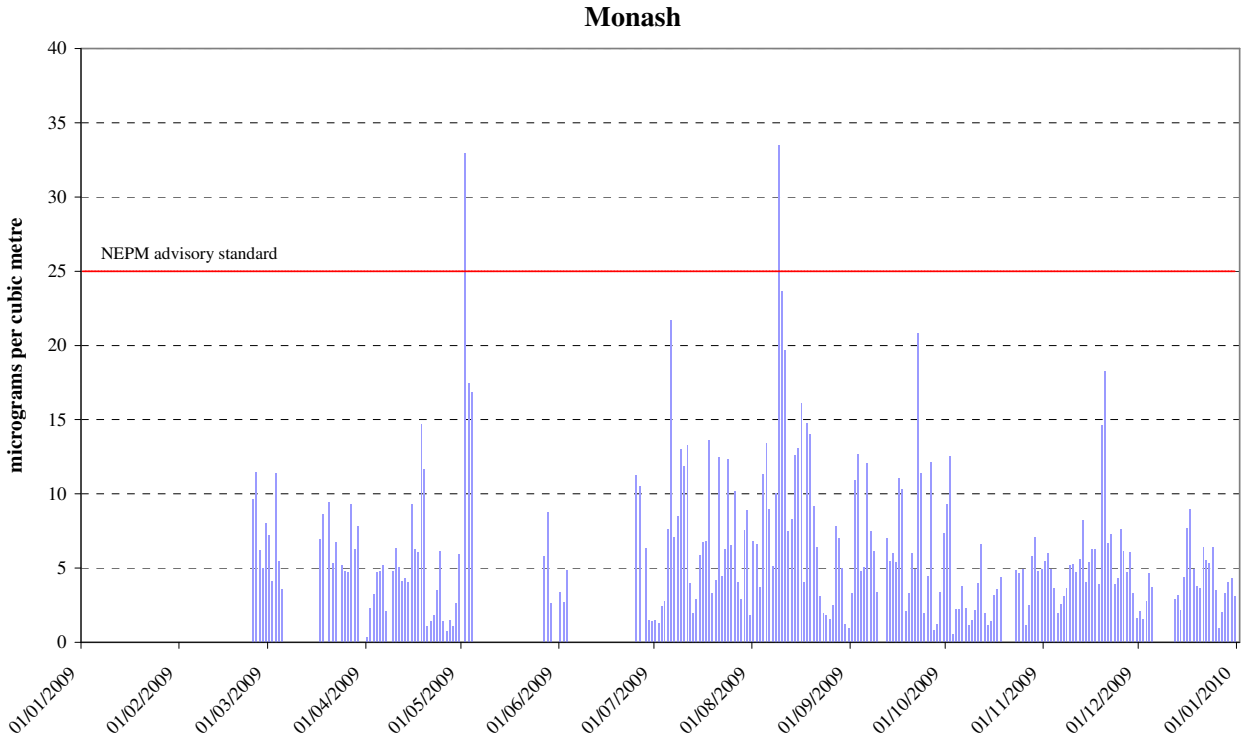

Figure 13: Daily max for $PM_{2.5}$ – Monash.

ANALYSIS OF AIR QUALITY MONITORING

Annual summary statistics described in Tables 7 to 12 below allow assessment of air quality against the standards and the extent of compliance with the goal. Instances where the standard or goal has been exceeded are highlighted in bold. The NEPM states that the short-term standards should not be exceeded on more than one day for CO, NO_2, O_3, SO_2 and on no more than five days per year for PM_{10}. The second highest daily value for the year (or the sixth for PM_{10}) indicates the extent to which the standards are or are not met**.**

Carbon monoxide

Table 7: 2009 summary statistics for daily peak 8-hour CO

NEPM standard - 9.0 ppm (8-hr average)

Region/ Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2nd Highest (ppm)	2nd Highest (date/time)
Canberra					
Monash	353	2.0	9 May 02:00	1.8	12 June 02:00
Civic	348	1.9	21 Jul 23:00	1.9	11 Aug 22:00

Nitrogen dioxide

Table 8: 2009 summary statistics for daily peak 1-hour NO_2

NEPM standard 0.12 ppm (1 hour average)

Region/ Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2nd Highest (ppm)	2nd Highest (date/time)
Canberra					
Monash	339	0.041	30 Jan 08:00	0.035	3 Dec 22:00
Civic	291	0.043	19 Nov 19:00	0.041	6 Feb 06:00

Ozone

Table 9: 2009 summary statistics for daily peak 1-hour O_3

NEPM standard 0.10 ppm (1-hour average)

Region/ Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2nd Highest (ppm)	2nd Highest (date/time)
Canberra					
Monash	353	0.073	30 Jan 13:00	0.070	31 Jan 10:00
Civic	358	0.060	30 Jan 13:00	0.060	31 Jan 13:00

Table 10: 2009 summary statistics for daily peak 4-hour O_3

NEPM standard 0.08 ppm (4-hour average)

Region/ Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2nd Highest (ppm)	2nd Highest (date/time)
Canberra					
Monash	352	0.068	30 Jan 13:00	0.066	31 Jan 17:00
Civic	358	0.059	30 Jan 13:00	0.055	31 Jan 16:00

PM_{10}

Table 11: 2009 summary statistics for daily peak PM_{10}

NEPM standard 50 $\mu g/m^3$ (24-hour average)

Region/ Performance monitoring station	Number of valid days	Highest ($\mu g/m^3$)	Highest (date)	6th Highest ($\mu g/m^3$)	6th Highest (date)
Canberra					
Monash	155	**210**	22 Sept	**53.3**	29 Aug

$PM_{2.5}$

Table 12: 2009 summary statistics for daily peak $PM_{2.5}$

NEPM standard 25 µg/m^3 (24-hour average)

Region/ Performance monitoring station	Number of valid days	Highest (µg/m^3)	Highest (date)	6th Highest (µg/m^3)	6th Highest (date)
Canberra Monash	236	33.5	9 Aug	19.7	11 Aug

ASSESSMENT OF PROGRESS TOWARDS ACHIEVING THE GOAL

The ACT is making steady progress towards achieving the goal of the NEPM, which is to achieve the standards specified in Schedule 2.

Historical monitoring indicates that the only NEPM pollutant of concern in the Canberra airshed is particulate matter, which increases during winter because of emissions coming from domestic wood heaters. In more recent years exceedences of the particulate matter standard have also been recorded from dust storms and bushfire smoke because of continuing drought conditions in the region.

Monitoring in 2009 showed that the NEPM goal and standards were met for carbon monoxide, nitrogen dioxide and ozone at Civic and Monash.

The goal was not met for PM_{10}, with nine exceedences of the standard recorded at Monash. Four could be attributed to woodsmoke as they occurred during the traditional wood heating season. The remainder are due to dust storms, including the extreme event which occurred on 22 and 23 September when most of eastern Australia was covered in red dust after an extreme low pressure system moved across from central Australia.

The 24-hour advisory reporting standard for particles (as PM2.5) was exceeded on two occasions at Monash. It should be noted however that significant gaps occurred in the PM_{10} and $PM_{2.5}$ data sets when levels would be expected to be elevated from woodsmoke.

The Monash station was closed for relocation on 26 October 2008. Due to equipment failure and on-going calibration problems in re-establishing the station PM_{10} monitoring did not recommence until 9 June 2009. Similarly, $PM_{2.5}$ monitoring ceased at Monash on 9 August 2008 and did not recommence until 24 February 2009. Data is also missing for most of May and June.

PM_{10} monitoring ceased in Civic on 8 December 2008. ACT Health is currently installing a continuous PM_{10} monitoring instrument and it is envisaged that monitoring will recommence this winter.

The ACT Government acknowledges the woodsmoke problem and is working towards addressing the issue in an informed and measured manner to ensure a satisfactory outcome for all Canberrans.

The Department of the Environment, Climate Change, Energy and Water continues to implement its integrated program to address wood smoke. This involves public education and enforcement activities, the licensing of firewood merchants, the implementation of the 'Don't Burn Tonight Campaign' and the Wood Heater Replacement Program.

The ACT is also working with the Commonwealth and other jurisdictions through the Air Quality Working Group of the Environment Protection and Heritage Council on national approaches to reduce particle and ozone precursor emissions from the product and equipment sectors, including from wood heaters, small engines, surface coatings and non-road engines.

APPENDIX A: STATISTICAL SUMMARY AND TRENDS

The following section provides a basic statistical summary, using percentiles, for each station and for each standard. Percentiles for daily maximum values are presented.

Carbon monoxide

Table 13: Statistical summary for daily maximum 8-hour CO Monash 1999 – 2009

Year	Data Availability (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	82.6	0	4.5	4.2	4.2	3.7	3.2	2.2	0.7
2000	79.1	0	5.8	4.5	4.4	3.7	3.0	1.7	0.7
2001	91.7	0	4.2	4.0	3.8	3.1	2.5	1.2	0.4
2002	92	0	4.3	3.7	3.4	2.9	2.3	1.2	0.4
2003	86.8	0	3.7	3.0	2.8	2.5	2.0	0.8	0.3
2004	94.1	0	3.2	2.7	2.5	2.0	1.6	0.9	0.5
2005	99.5	0	3.2	2.8	2.5	2.2	1.7	1.0	0.4
2006	99.7	0	3.7	2.8	2.6	2.2	1.8	1.1	0.4
2007	95.3	0	2.6	2.5	2.4	2.0	1.5	0.7	0.4
2008	88.0	0	2.4	2.2	2.1	1.8	1.5	0.8	0.3
2009	96.4	0	2.0	1.7	1.5	1.4	1.1	0.6	0.3

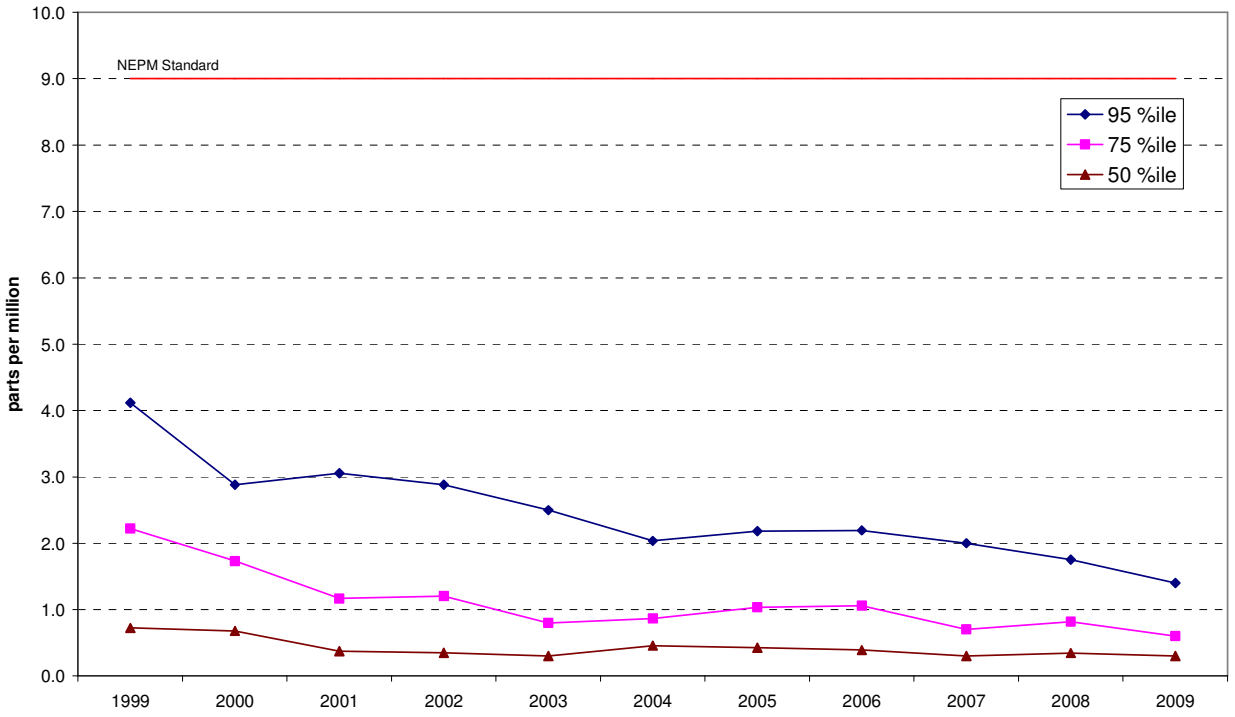

Figure 14: Statistical summary for daily maximum 8-hour CO Monash 1999 – 2009

Table 14: Statistical summary for daily maximum 8-hour CO Civic 1999 – 2009

Year	Data Availability (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	83.2	0	7.5	6.6	6.2	5.5	4.9	3.1	1.5
2000	91.7	0	6.3	5.9	5.6	4.8	3.3	1.8	1.0
2001	83.2	0	6.4	5.6	4.8	4.0	3.2	2.1	1.0
2002	86.8	0	5.1	4.7	4.4	3.52	2.9	1.6	0.6
2003	95.7	0	3.5	2.8	2.6	2.2	1.8	1.0	0.6
2004	95.7	0	4.6	3.6	3.2	2.3	1.6	0.6	0.6
2005	95.6	0	3.7	3.4	3.2	2.6	1.7	1.1	0.7
2006	95.4	0	2.8	2.7	2.6	2.1	1.4	0.8	0.5
2007	93.2	0	2.8	2.3	2.0	1.6	1.3	0.8	0.5
2008	92.7	0	2.3	2.1	2.0	1.6	1.2	0.7	0.4
2009	95.1	0	1.9	1.6	1.2	1.0	0.8	0.6	0.4

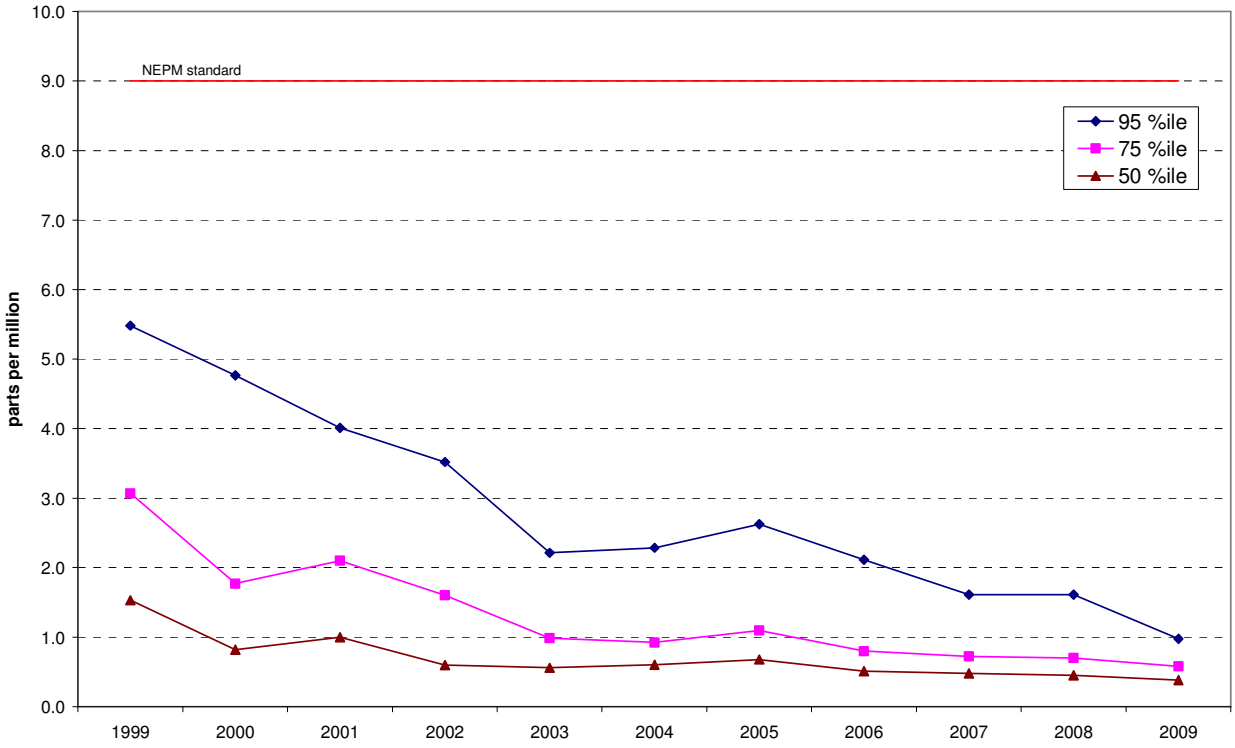

Figure 15: Statistical summary for daily maximum 8-hour CO Civic 1999 – 2009

Nitrogen dioxide

Table 15: Statistical summary for daily maximum 1-hour NO_2 Monash 1999 – 2009

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	86.3	0	0.054	0.034	0.031	0.030	0.028	0.025	0.019
2000	90.0	0	0.042	0.034	0.031	0.028	0.026	0.022	0.018
2001	86.3	0	0.039	0.036	0.036	0.033	0.029	0.024	0.020
2002	88.3	0	0.045	0.036	0.034	0.031	0.026	0.022	0.017
2003	90.4	0	0.064	0.042	0.033	0.028	0.025	0.021	0.016
2004	91.8	0	0.040	0.033	0.031	0.028	0.026	0.022	0.018
2005	97.8	0	0.041	0.034	0.031	0.028	0.027	0.024	0.018
2006	98.4	0	0.044	0.036	0.033	0.031	0.029	0.024	0.019
2007	97.0	0	0.039	0.037	0.035	0.030	0.028	0.023	0.018
2008	86.5	0	0.103	0.040	0.032	0.031	0.028	0.025	0.019
2009	92.6	0	0.041	0.034	0.033	0.029	0.027	0.023	0.019

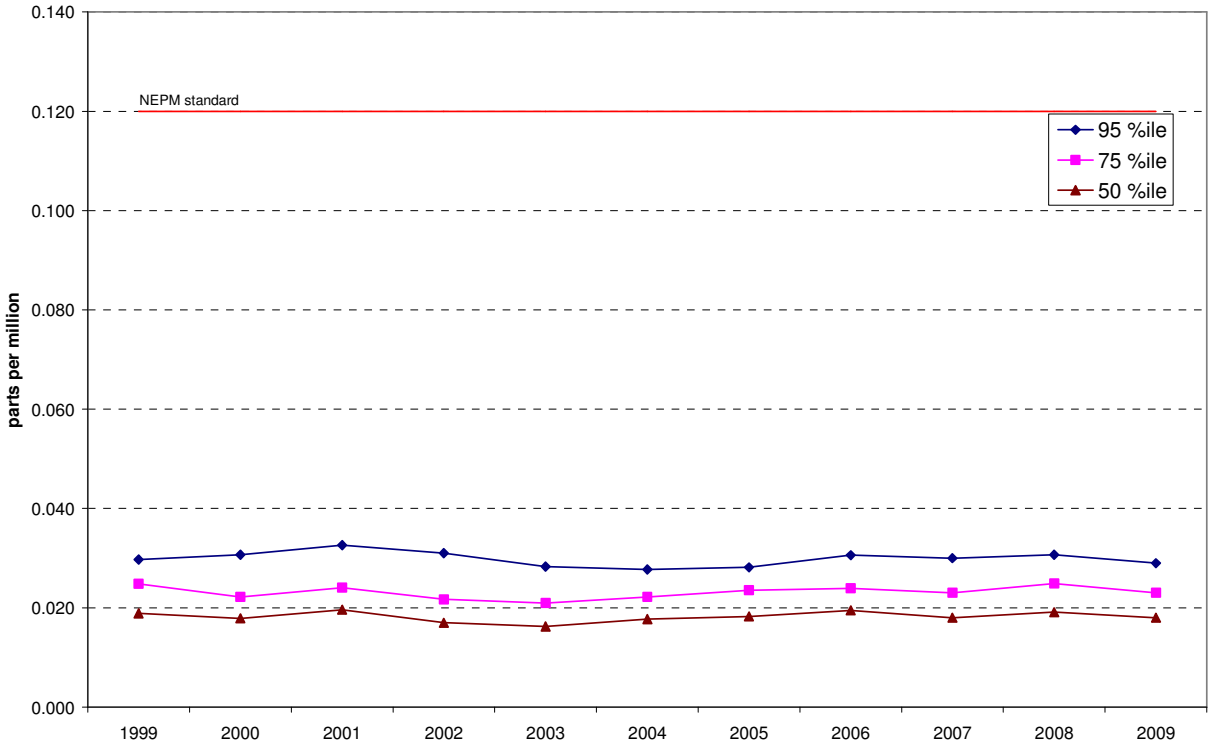

Figure 16: Statistical summary for daily maximum 1-hour NO_2 Monash 1999 – 2009

Table 16: Statistical summary for daily maximum 1-hour NO_2 Civic 1999 – 2009

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	61.6	0	0.054	0.040	0.037	0.035	0.032	0.029	0.023
2000	55.6	0	0.055	0.039	0.038	0.034	0.032	0.028	0.025
2001	87.0	0	0.048	0.045	0.042	0.039	0.037	0.032	0.027
2002	88.2	0	0.062	0.050	0.044	0.038	0.034	0.029	0.024
2003	83.6	0	0.087	0.050	0.045	0.034	0.028	0.022	0.018
2004	88.3	0	0.042	0.037	0.035	0.030	0.027	0.022	0.018
2005	95.3	0	0.040	0.036	0.033	0.030	0.029	0.024	0.020
2006	95.2	0	0.044	0.035	0.034	0.031	0.028	0.022	0.018
2007	92.8	0	0.059	0.042	0.039	0.035	0.030	0.025	0.021
2008	88.6	0	0.046	0.037	0.035	0.033	0.030	0.026	0.020
2009	79.5	0	0.044	0.038	0.036	0.030	0.027	0.023	0.018

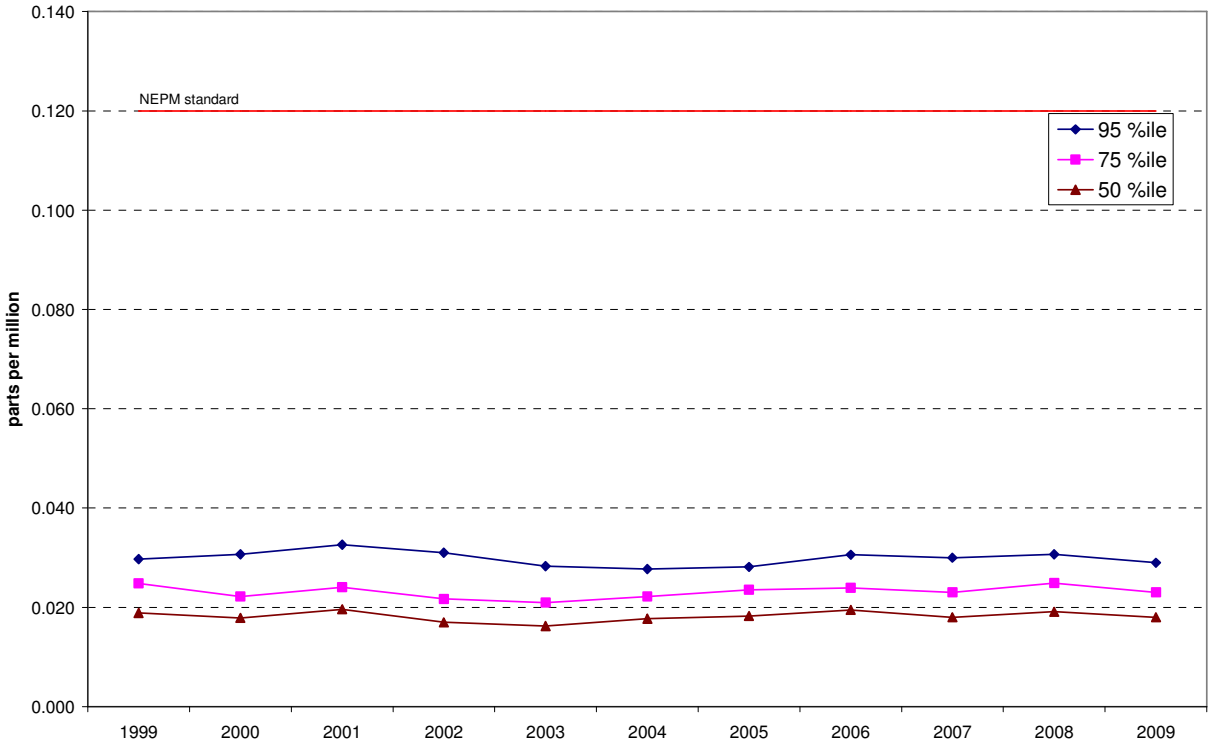

Figure 17: Statistical summary for daily maximum 1-hour NO_2 Civic1999 – 2009

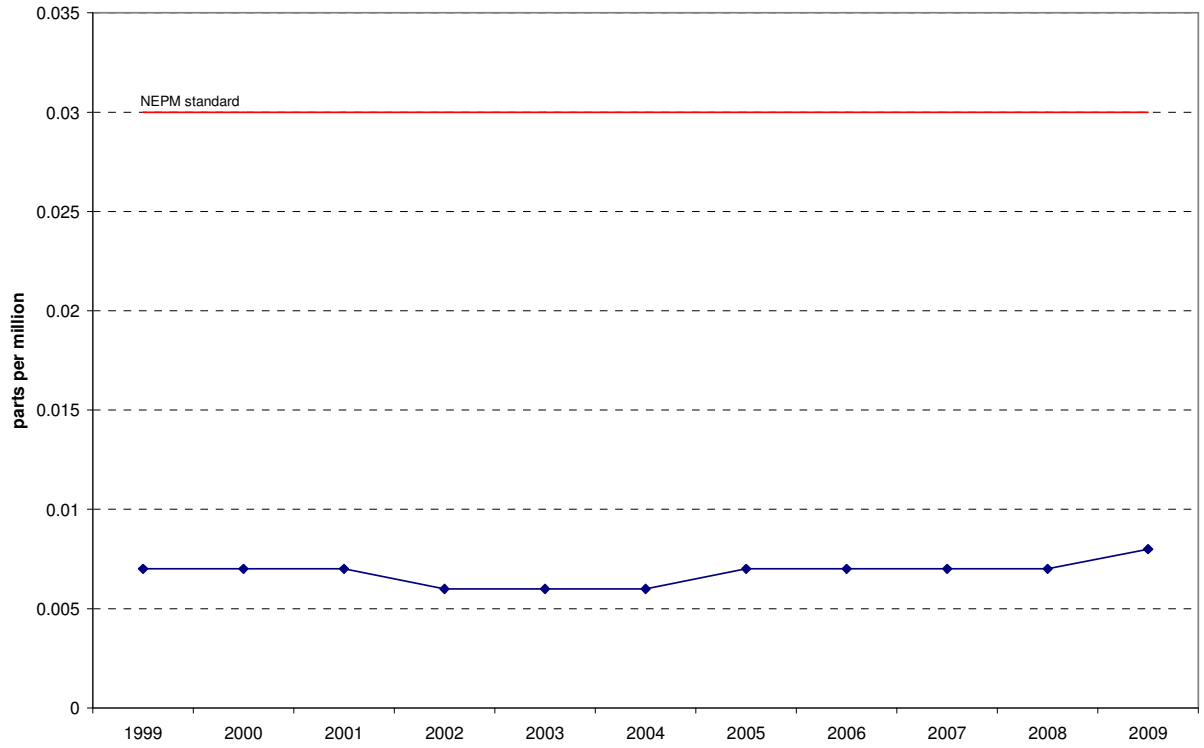

Figure 18: Annual average 1-hour NO_2 Monash 1999 – 2009

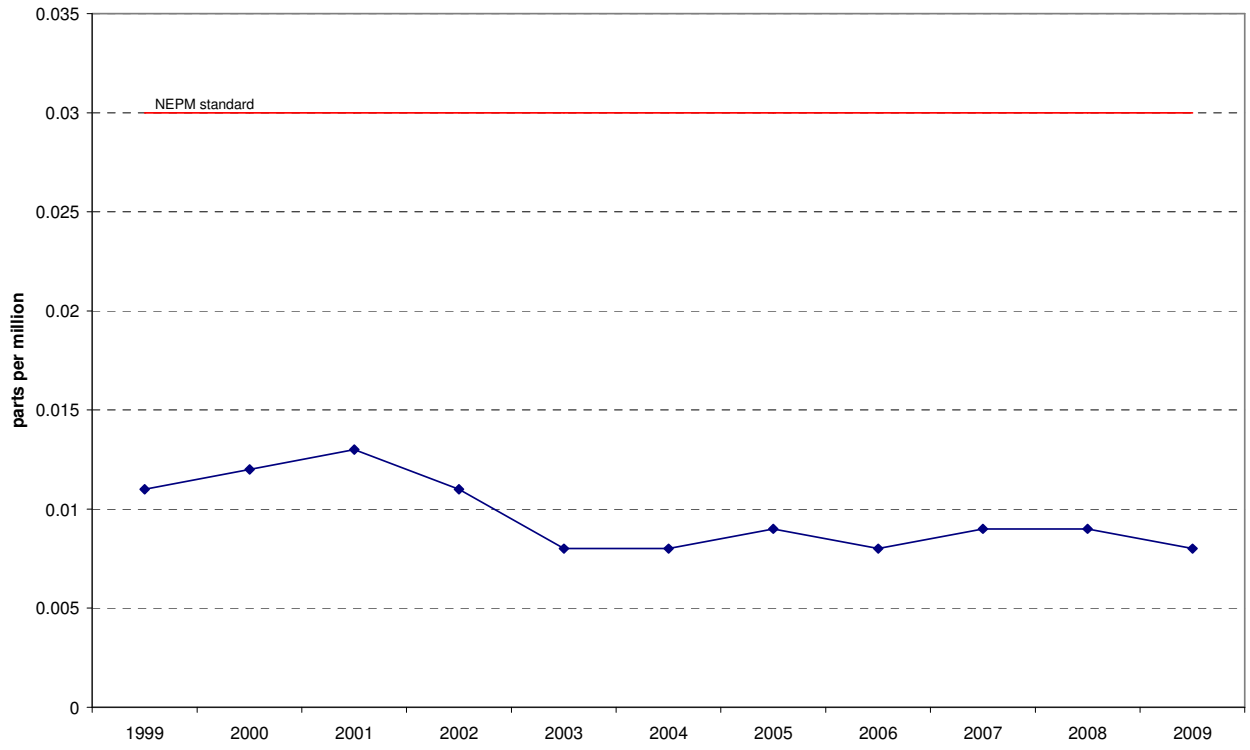

Figure 19: Annual average 1-hour NO_2 Civic 1999 – 2009

Ozone

Table 17: Statistical summary for daily maximum 1-hour O_3 Monash 1999 – 2009

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	87.5	0	0.069	0.061	0.055	0.045	0.039	0.030	0.024
2000	57.9	0	0.054	0.047	0.044	0.041	0.032	0.027	0.022
2001	81.5	0	0.062	0.044	0.041	0.038	0.034	0.030	0.026
2002	93.5	0	0.063	0.055	0.052	0.047	0.042	0.032	0.024
2003	92.4	0	0.102	0.069	0.061	0.050	0.045	0.035	0.025
2004	94.1	0	0.064	0.56	0.054	0.048	0.044	0.038	0.030
2005	97.8	0	0.065	0.058	0.053	0.045	0.041	0.034	0.030
2006	99.7	0	0.067	0.060	0.057	0.052	0.049	0.040	0.032
2007	95.4	0	0.075	0.064	0.062	0.057	0.052	0.043	0.032
2008	84.2	0	0.065	0.055	0.053	0.047	0.040	0.031	0.026
2009	96.4	0	0.073	0.063	0.059	0.052	0.045	0.038	0.030

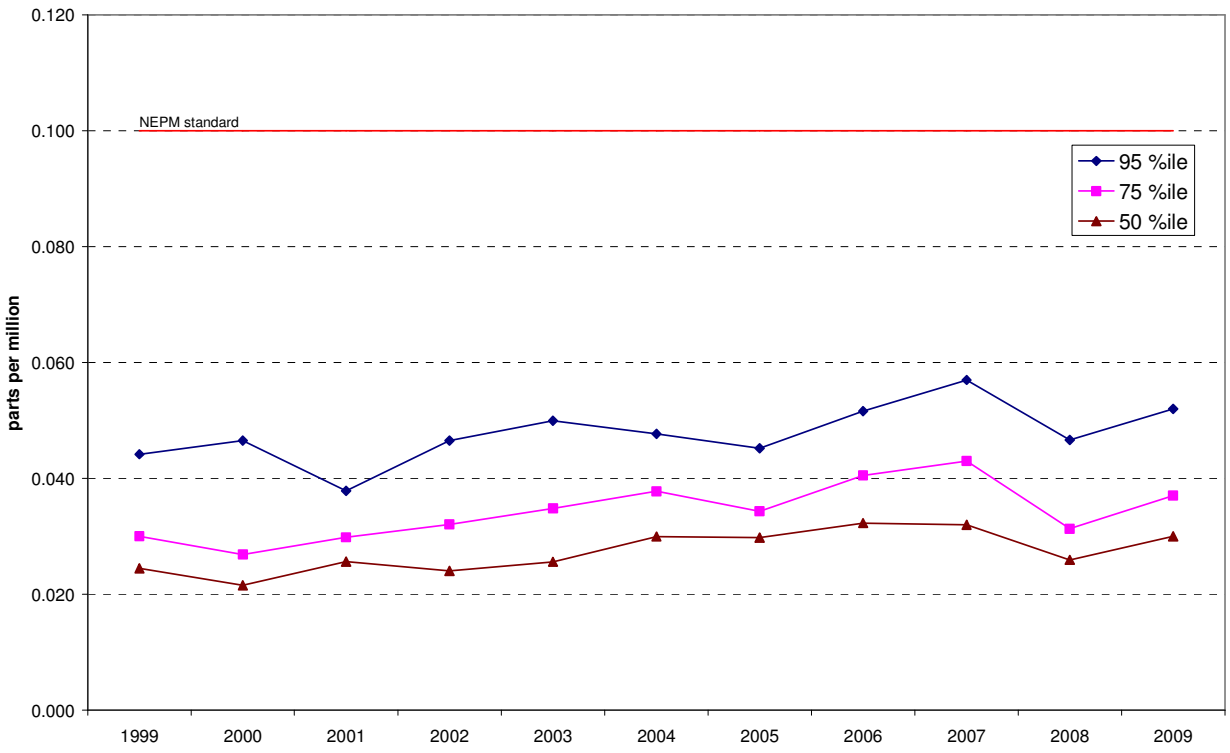

Figure 20: Statistical summary for daily maximum 1-hour O_3 Monash 1999 – 2009

Table 18: Statistical summary for daily maximum 1-hour O_3 Civic 1999 – 2009

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	64.6	0	0.091	0.056	0.051	0.040	0.035	0.027	0.023
2000	51.9	0	0.053	0.048	0.045	0.038	0.035	0.028	0.018
2001	88.3	0	0.055	0.050	0.046	0.043	0.040	0.035	0.028
2002	79.8	0	0.082	0.060	0.053	0.049	0.044	0.035	0.029
2003	93.6	0	0.094	0.065	0.055	0.049	0.045	0.037	0.031
2004	93.5	0	0.071	0.055	0.053	0.045	0.041	0.034	0.028
2005	85.5	0	0.070	0.061	0.051	0.042	0.038	0.032	0.028
2006	95.5	3	0.252	0.084	0.060	0.049	0.043	0.034	0.027
2007	91.5	1	0.112	0.057	0.050	0.044	0.040	0.032	0.026
2008	91.4	0	0.052	0.050	0.044	0.039	0.034	0.028	0.023
2009	97.8	0	0.060	0.055	0.052	0.044	0.040	0.031	0.024

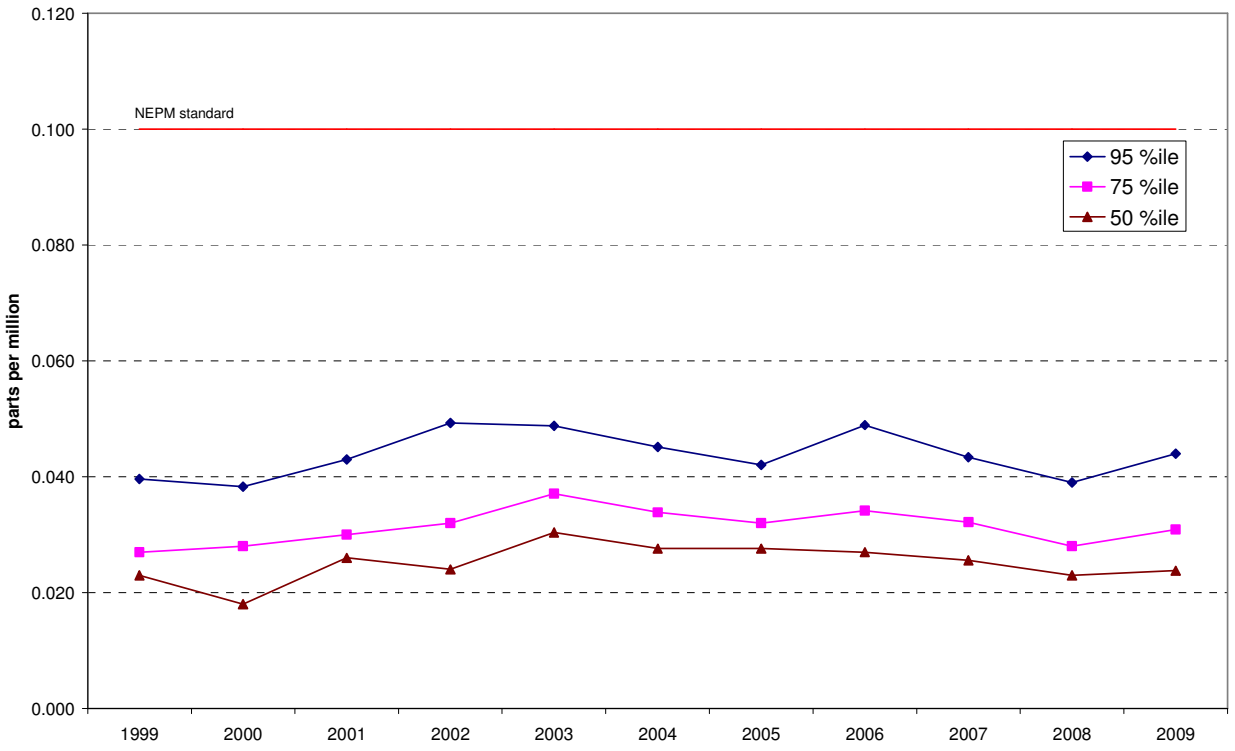

Figure 21: Statistical summary for daily maximum 1-hour O_3 Civic 1999 – 2009

Table 19: Statistical summary for daily maximum 4-hour O_3 Monash 1999 – 2009

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	87.5	0	0.063	0.054	0.046	0.042	0.036	0.029	0.024
2000	57.9	0	0.047	0.043	0.041	0.035	0.030	0.026	0.019
2001	81.5	0	0.051	0.041	0.038	0.035	0.032	0.028	0.024
2002	93.5	0	0.058	0.051	0.049	0.044	0.039	0.031	0.023
2003	92.4	1	0.082	0.063	0.058	0.048	0.043	0.033	0.025
2004	94.1	0	0.060	0.053	0.051	0.045	0.042	0.036	0.029
2005	97.5	0	0.062	0.054	0.049	0.044	0.039	0.033	0.029
2006	99.7	0	0.061	0.056	0.055	0.050	0.046	0.038	0.031
2007	100	0	0.072	0.061	0.059	0.054	0.050	0.040	0.032
2008	84.2	0	0.061	0.052	0.049	0.045	0.038	0.030	0.025
2009	96.2	0	0.068	0.058	0.056	0.048	0.044	0.036	0.029

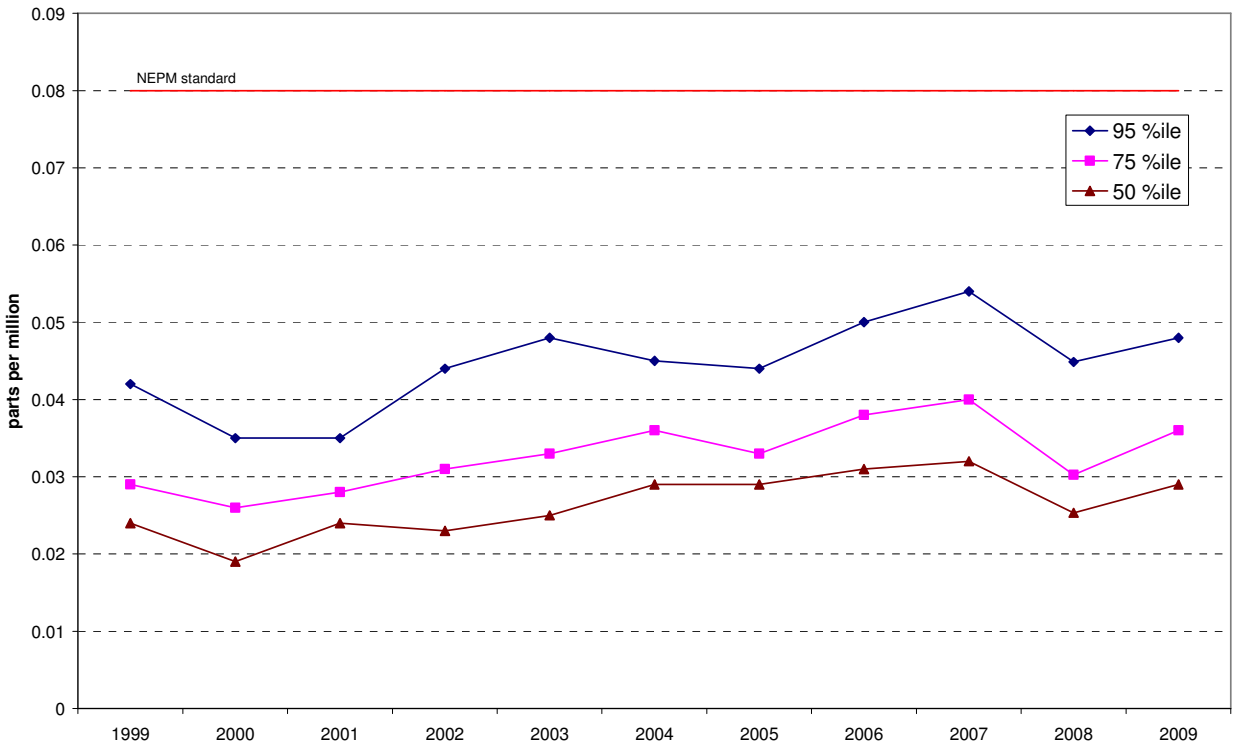

Figure 22: Statistical summary for daily maximum 4-hour O_3 Monash 1999 – 2009

Table 20: Statistical summary for daily maximum 4-hour O_3 Civic 1999 – 2009

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	64.6	0	0.053	0.050	0.044	0.036	0.030	0.025	0.021
2000	51.9	0	0.050	0.043	0.038	0.034	0.031	0.024	0.017
2001	88.3	0	0.048	0.045	0.043	0.041	0.038	0.032	0.026
2002	79.8	0	0.073	0.057	0.051	0.046	0.042	0.033	0.027
2003	93.6	0	0.078	0.055	0.051	0.046	0.042	0.036	0.029
2004	93.5	0	0.062	0.052	0.048	0.043	0.039	0.32	0.026
2005	85.5	0	0.061	0.054	0.047	0.040	0.036	0.031	0.026
2006	95.5	1	0.145	0.066	0.053	0.045	0.040	0.032	0.026
2007	91.5	1	0.097	0.052	0.046	0.040	0.037	0.030	0.025
2008	91.4	0	0.051	0.047	0.039	0.036	0.033	0.027	0.022
2009	97.8	0	0.059	0.049	0.047	0.041	0.037	0.030	0.023

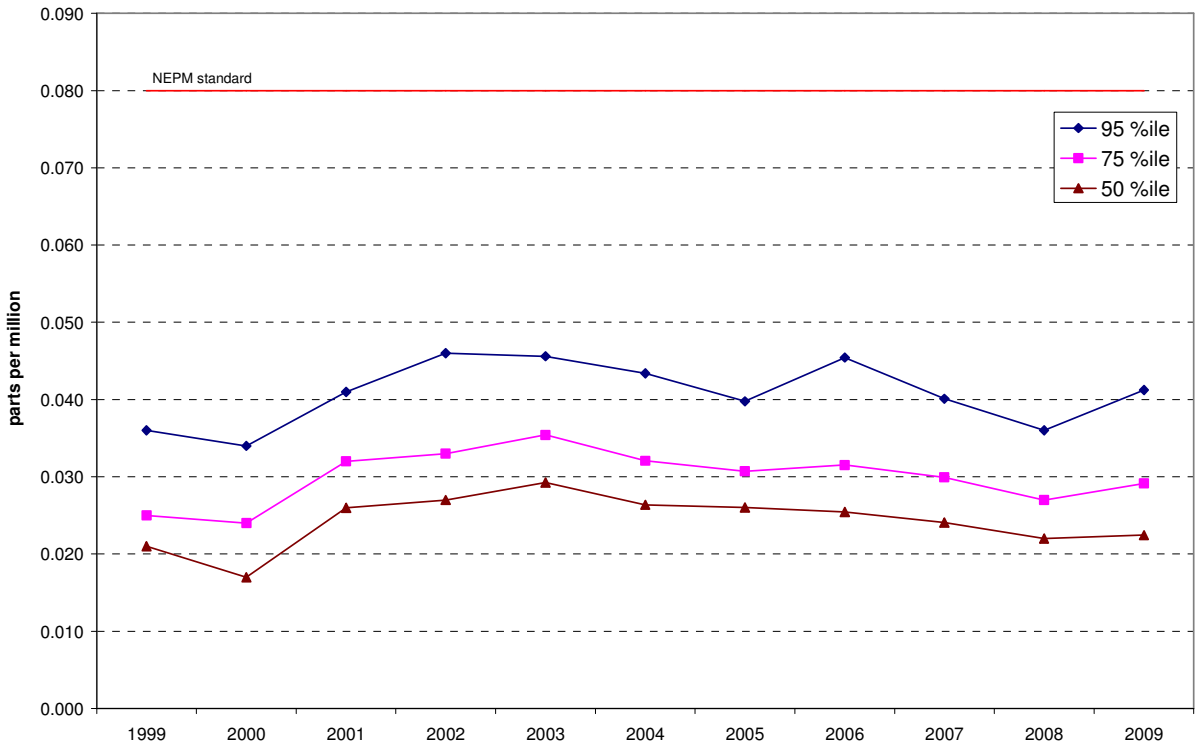

Figure 23: Statistical summary for daily maximum 4-hour O_3 Civic 1999 – 2009

PM_{10}

Table 21: Statistical summary for daily maximum 24-hour PM_{10} Monash 1999 – 2009

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	9.0	4	65.11	65.0	64.9	63.6	51.3	37.7	21.1
2000	15.3	1	56.4	52.6	49.4	47.6	42.4	23.1	14.5
2001	15.9	4	70.6	66.1	61.9	56.2	45.6	25.0	13.9
2002	75	0	108.4	56.6	48.5	42.4	37.7	25.3	16.2
2003	97.5	13	350.4	136.4	105.3	39.6	30.3	21.2	14.6
2004	99.7	3	52.0	48.2	46.0	33.8	28.5	20.7	14.7
2005	97.5	10	98.8	57.6	52.7	37.3	31.0	21.2	14.5
2006	83.8	4	55.2	51.0	44.9	33.9	28.3	22.7	16.9
2007	99.7	5	117.7	61.8	42.5	35.3	28.0	21.0	14.9
2008	82	3	96.6	45.8	35.7	29.9	26.6	20.1	14.8
2009	42.3	9	210.0	116.0	62.4	50.5	37.7	25.5	15.2

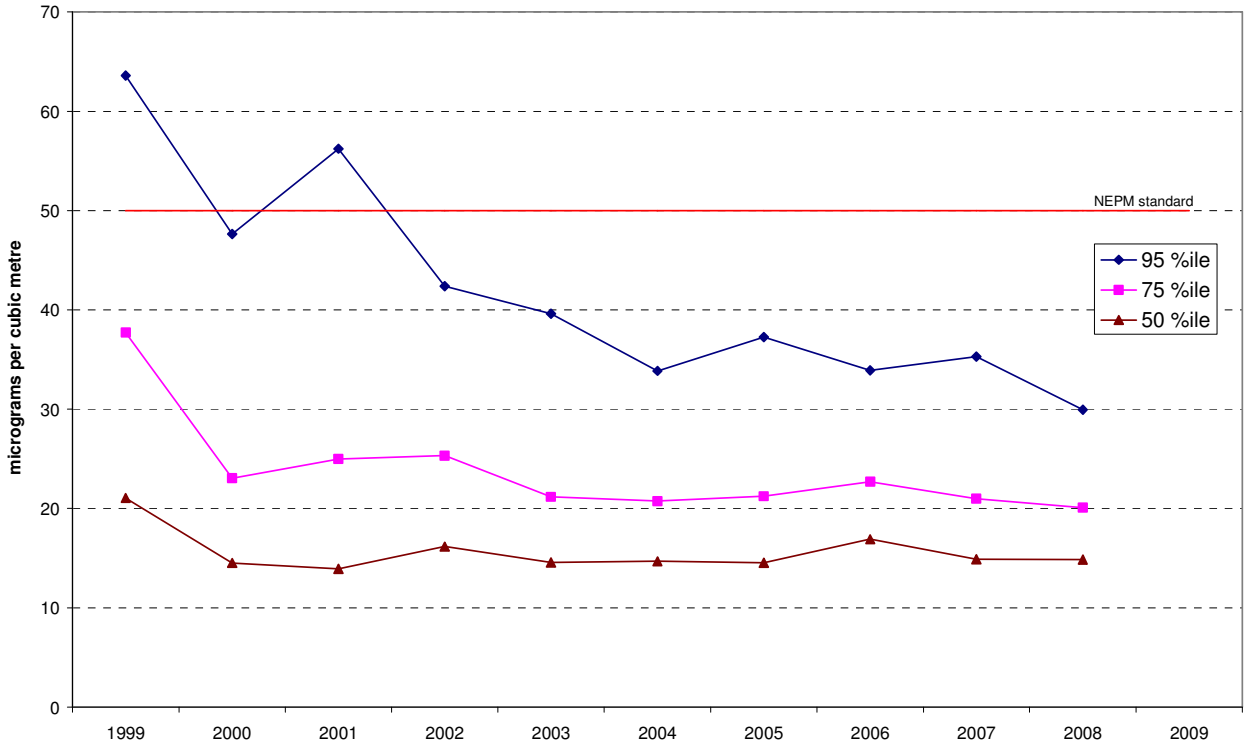

Figure 24: Statistical summary for daily maximum 24-hour PM_{10} Monash 1999 – 2009

2009 data has not been included in Figure 24 as insufficient data in quarters 1 and 2 (zero and twenty five percent respectively) has biased the percentile data.

Table 22: Statistical summary for daily maximum 24-hour PM_{10} Civic 1999 – 2008

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
1999	9	4	65.1	65.0	64.9	63.6	51.3	37.7	21.1
2000	16.7	0	39.3	35.9	33.2	31.4	29.4	23.8	15.7
2001	14.8	0	33..6	33.3	32.7	27.5	26.2	20.8	16.2
2002	15.6	3	67.4	67.1	66.3	42.7	25.4	18.7	15.3
2003	12.6	0	20.8	20.8	20.7	19.3	17.3	13.6	9.3
2004	16.7	0	33.2	32.4	32.0	28.1	22.5	17.9	14.4
2005	9.6	1	50.64	47.2	43.8	34.8	27.5	19.5	12.7
2006	13.2	2	70.8	61.2	51.5	46.5	35.1	26.0	17.6
2007	13.2	1	50.9	48.7	46.5	42.7	31.4	20.1	13.8
2008	12.0	1	53.3	42.5	31.7	26.1	24.2	17.3	11.9

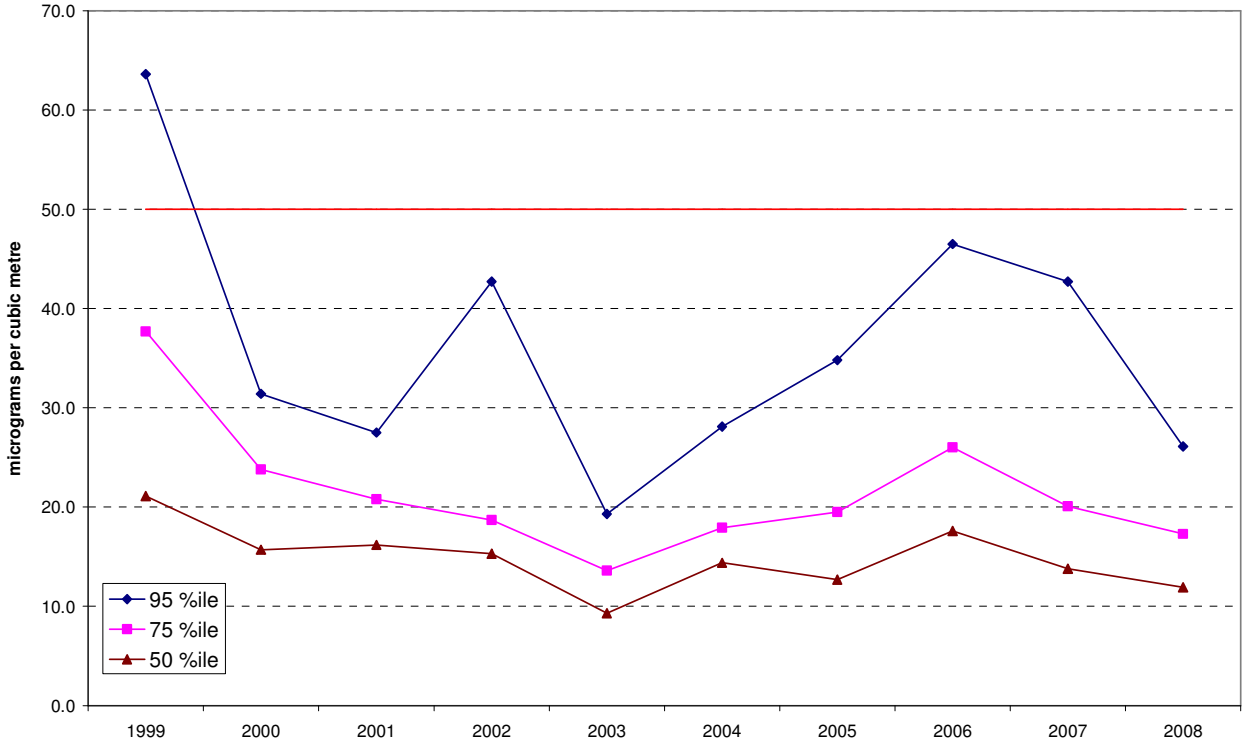

Figure 25: Statistical summary for daily maximum 24-hour PM_{10} Civic 1999 – 2008

$PM_{2.5}$

Table 23: Statistical summary for daily maximum 24-hour $PM_{2.5}$ Monash 2004 – 2009

Year	Data Recovery (%)	No. of Exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
2004	93.1	15	38.3	35.8	31.5	23.5	16.6	9.5	6.2
2005	73.6	14	38.6	31.4	29.3	25.0	20.7	9.0	4.9
2006	83.3	20	46.9	35.6	33.3	27.8	15.6	8.7	5.8
2007	58.1	8	45.7	27.8	27.6	20.9	15.7	8.8	5.4
2008	45.4	6	30.7	28.0	25.7	23.5	19.7	12.4	6.3
2009	64.5	2	33.5	23.0	20.0	14.6	12.2	7.6	5.0

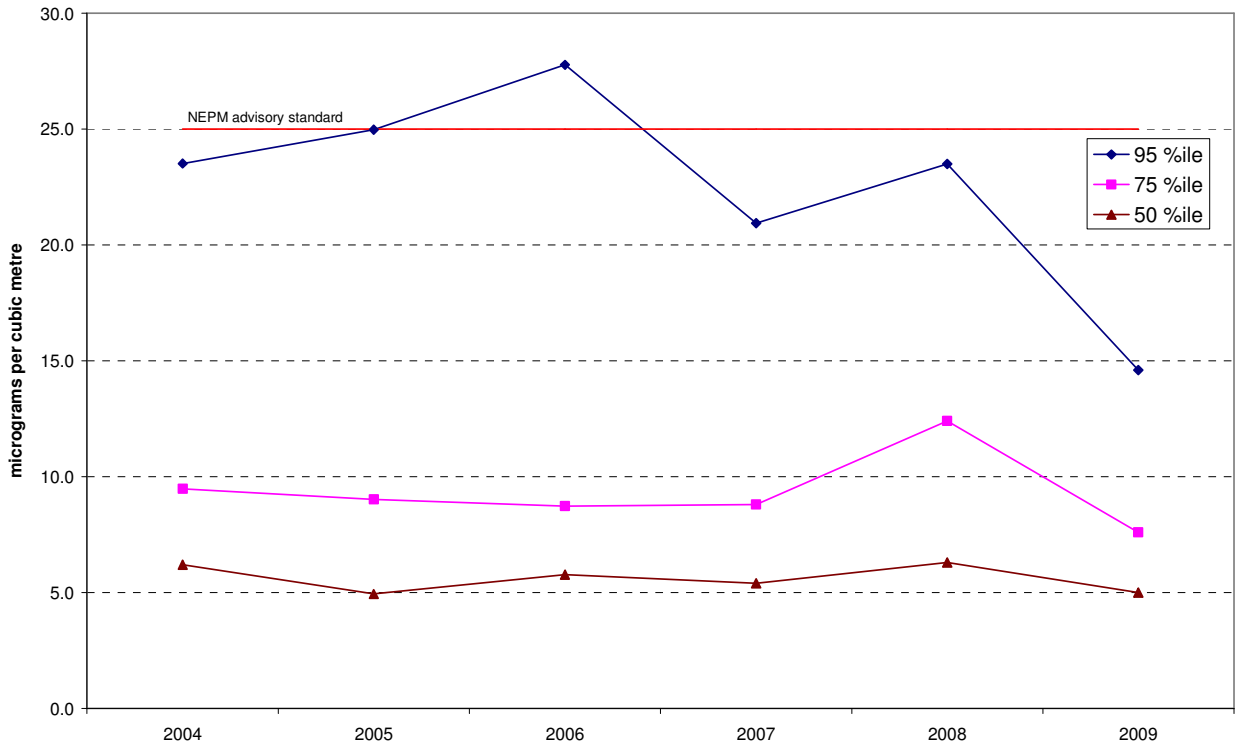

Figure 26: Statistical summary for daily maximum 24-hour $PM_{2.5}$ Monash 2004 – 2009

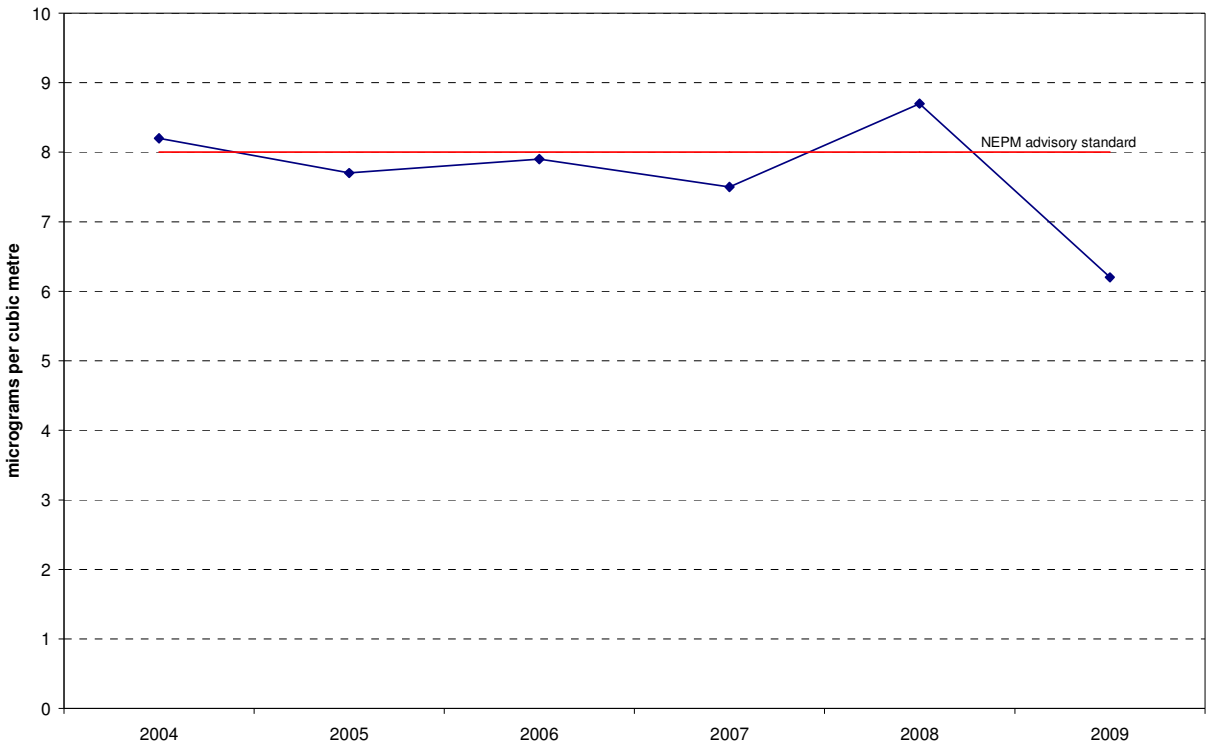

Figure 27: Annual average 24-hour $PM_{2.5}$ Monash 2004 – 2009