ACT AIR QUALITY REPORT 2010

Environment Protection Authority | June 2011

ACT Government

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LIST OF DEFINITIONS AND ABBREVIATIONS

Term	Definition
AAQ NEPM	National Environment Protection (Ambient Air Quality) Measure
ACT	Australian Capital Territory
CO	Carbon Monoxide
BAM	Beta Attenuation Monitor
EPHC	Environment Protection and Heritage Council
ESDD	Environment and Sustainable Development Directorate
NATA	National Association of Testing Authorities
ND	Not Demonstrated
NEPC	National Environment Protection Council
NO_2	Nitrogen Dioxide
NPI	National Pollutant Inventory
O_3	Ozone
NSW	New South Wales
PMS	Performance Monitoring Station
$PM_{2.5}$	Particles with an equivalent aerodynamic diameter less than or equal to 2.5 micrometers
PM_{10}	Particles with an equivalent aerodynamic diameter less than or equal to 10 micrometers
ppm	Parts per million by volume – parts of pollutant per million parts of air
PRC	Peer Review Committee
SO_2	Sulphur Dioxide
$\mu g/m^3$	micrograms per cubic metre

OVERVIEW

This report presents the results of air quality monitoring in the ACT for the 2010 calendar year and assesses them in accordance with the requirements of the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) which was made by the National Environment Protection Council on 26 June 1998.

Canberra's overall air quality compared to other capital cities is excellent. However it does experience elevated particle pollution during winter because of 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.

Monitoring results demonstrate that the major impacts on Canberra's air quality in 2010, as in previous years, came from the accumulation of combustion particles from wood heaters in cold, highly stable air, hazard reduction burns and dust storms. With the exception of particulate matter less than 2.5 microns ($PM_{2.5}$) all measured parameters are below the AAQ NEPM standards.

There were two exceedances of the $PM_{2.5}$ 24-hr advisory reporting standard which occurred on 19 and 20 March 2010. These exceedences were because of smoke from a number of large hazard reduction burns in NSW. No exceedences of the advisory standard occurred during the winter months as a result of wood heater emissions.

Monitoring was performed in accordance with the ACT's monitoring plan, AAQ NEPM Technical Papers and ACT Health's NATA accreditation.

MONITORING SUMMARY

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 Environment and Sustainable Development Directorate (ESDD) is responsible for reporting compliance with the AAQ NEPM annually.

The ACT's population has passed the threshold where it needs a second AAQ NEPM PMS, ACT Health has been working on establishing the second station. Until a second AAQ NEPM PMS can be established data from the Civic PMS, though not ideally located, will be used for annual report purposes.

The Monash PMS, which complies with the siting standard AS/NZS 3580.1.1:2007, is approximately 300 metres west of Cockcroft Avenue in the Monash district playing fields. 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 compliance and non-compliance criteria for both PMS are listed in **Table 1** below.

Table 1 Summary of stations' siting compliance with AS 3580.1.1-2007

Station	Location category	Height above ground	Minimum distance to support structure	Clear sky angle of 120°	Unrestricted airflow of 270°/360°	20m from trees	No boilers or incinerators nearby	Minimum distance from road or traffic
Monash	Residential	☑	☑	☑	☑	☑	☑	☑
Civic	CBD	☑	☒	☒	☒	☒	☑	☒

Consistent with the ACT's Ambient Air Quality Monitoring Plan, which was approved by the National Environment Protection Council (NEPC) 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}). Because of a lack of heavy industry the ACT has never monitored sulphur dioxide (SO_2), 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, and NO_2. PM_{10} and $PM_{2.5}$ monitoring is undertaken at Monash and PM_{10} monitoring resumed at Civic on 26 May 2010 following the installation of a new instrument.

Monitoring Methods

The ACT monitoring is conducted in accordance with the relevant Australian standard as shown in **Table 2**.

Table 2 Methods used for monitoring AAQ NEPM pollutants

Pollutant	Standard	Title	Method Used
Carbon Monoxide	AS 3580.7.1-1992	Ambient Air – Determination of Carbon Monoxide – Direct Reading Instrument Method	Gas filter correlation/ Infrared.
Nitrogen dioxide	AS 3580.5.1-1993	Ambient Air – Determination of Oxides of Nitrogen – Chemiluminescence Method	Gas phase chemiluminescence.
Photochemical oxidant (ozone)	AS 3580.6.1-1990	Ambient Air – Determination of Ozone – Direct Reading Instrument Method	Non-dispersive ultraviolet.
Particles PM_{10}	AS 3580.9.11-2008	Method for sampling and analysis of ambient air Method 9.11: Determination of suspended particles matter – PM_{10} beta attenuation monitors	Beta Attenuation Monitor (BAM)
PM_{10}	AS/NZS 3580.9.6-2003	Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM_{10} high volume sampler with size-selective inlet - Gravimetric method	Gravimetric reference method
$PM_{2.5}$	AS/NZS 3580.9.10-2006	Reference Method for the Determination of Fine Particulate matter as $PM_{2.5}$ in the Atmosphere	Gravimetric reference method

NATA Accreditation Status

The ACT Government monitoring network is accredited by the National Association of Testing Authorities (NATA) for the measurement of all AAQ NEPM pollutants except SO_2 as required under Clause 12 of the AAQ NEPM.

ASSESSMENT OF COMPLIANCE WITH STANDARDS AND 2008 GOAL

For the purpose of this report, air quality is assessed against the AAQ NEPM standards and goals as specified in Schedule 2 of the AAQ NEPM and reproduced below in **Table 3**.

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 3**).

The goal of the AAQ 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 AAQ NEPM. The extent is expressed as a maximum allowable number of exceedences for each standard (refer to column 4, **Table 3**). These are set to account for unusual meteorological conditions and, in the case of particles, natural events such as dust storms and bushfires, which cannot be controlled through normal air quality management programs.

The AAQ 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 AAQ NEPM review being undertaken EPHC.

Table 3: 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 AAQ 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 AAQ NEPM if the number of exceedences of the standard is no more than the number specified in Schedule 2 of the AAQ NEPM and data availability was at least 75 percent 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 2010, no exceedences of the CO standard were recorded in the ACT.

Table 4: 2010 compliance summary for CO
AAQ NEPM standard - 9.0 ppm (8-hr 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		
Canberra							
Monash	95.1	95.1	95.6	95.4	95.3	0	Met
Civic	94.4	94.5	95.5	95.7	95.0	0	Met

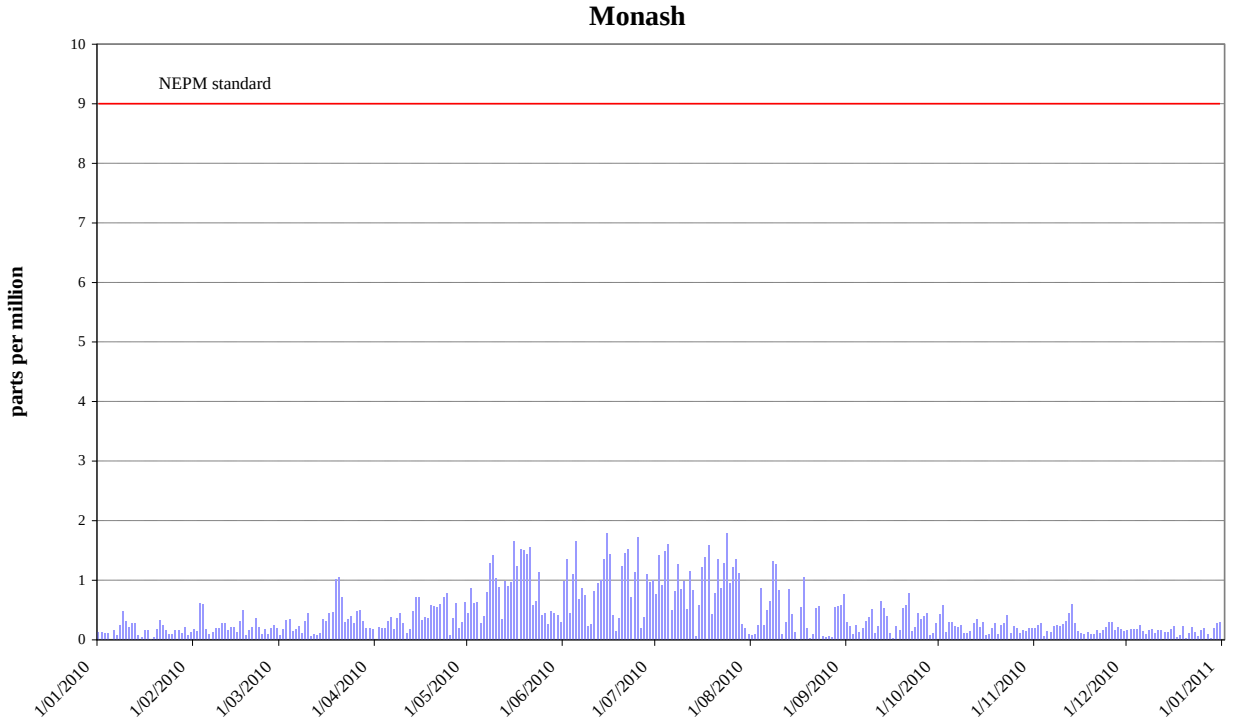

Figure 1: Daily max for CO 8-hr average - Monash

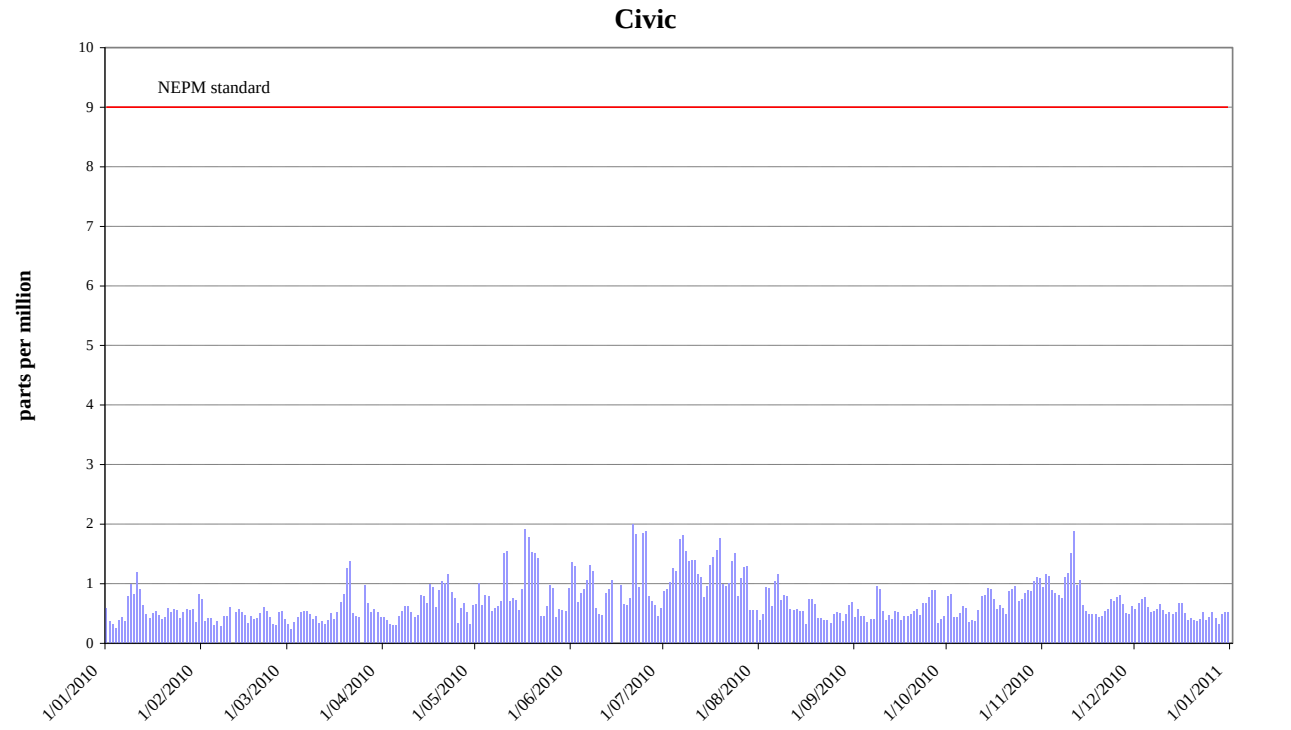

Figure 2: Daily max for CO 8-hr average - Civic

Nitrogen dioxide

During 2010, no exceedences of the NO_2 standard were recorded in the ACT. Compliance was not demonstrated for both Monash and Civic because all three NO_x instruments failed with a period of a fortnight in Q1 and there were delays in getting the new parts in (refer to **Table 5**, **Figure 3** and **Figure 4**).

Table 5: 2010 compliance summary for NO_2
AAQ 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	60.5	94.5	95.6	95.4	86.6	0.006	0	ND	ND
Civic	20.8	82.4	95.6	92.2	73.0	0.010	0	ND	ND

ND: Not demonstrated.

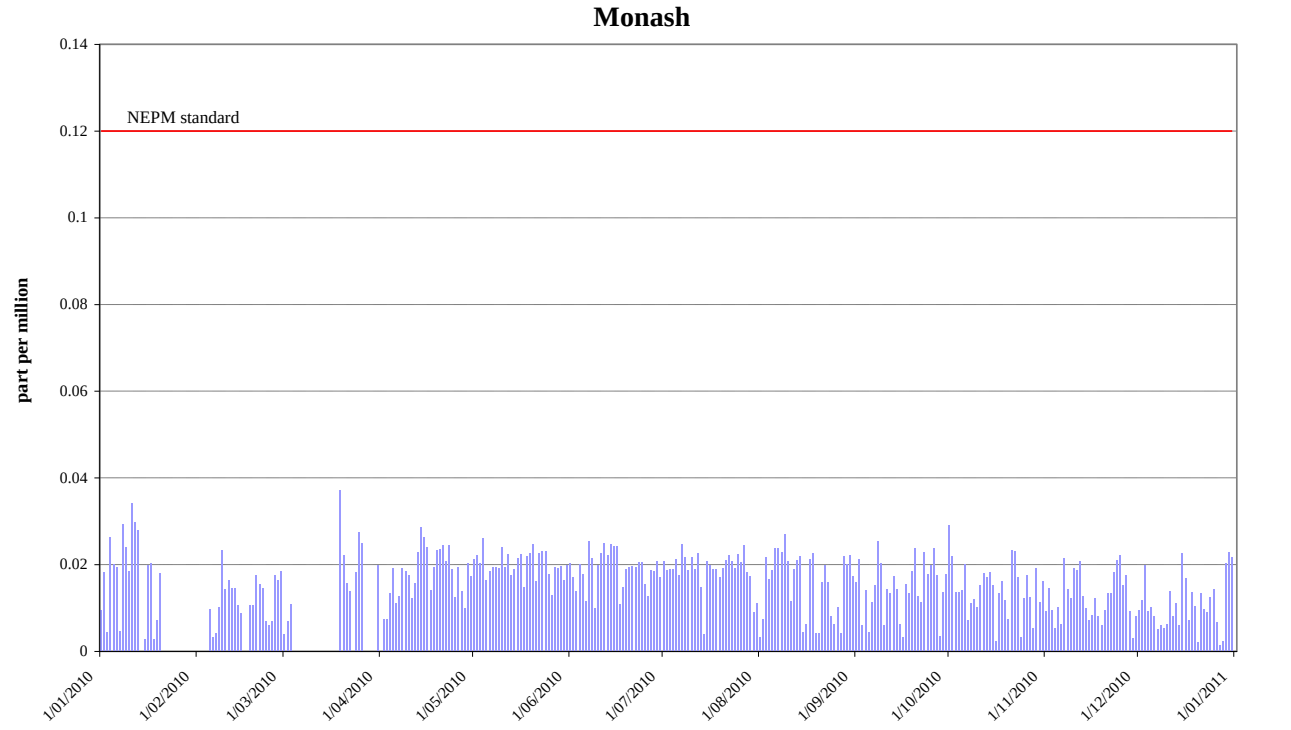

Figure 3: Daily max for NO_2 - Monash

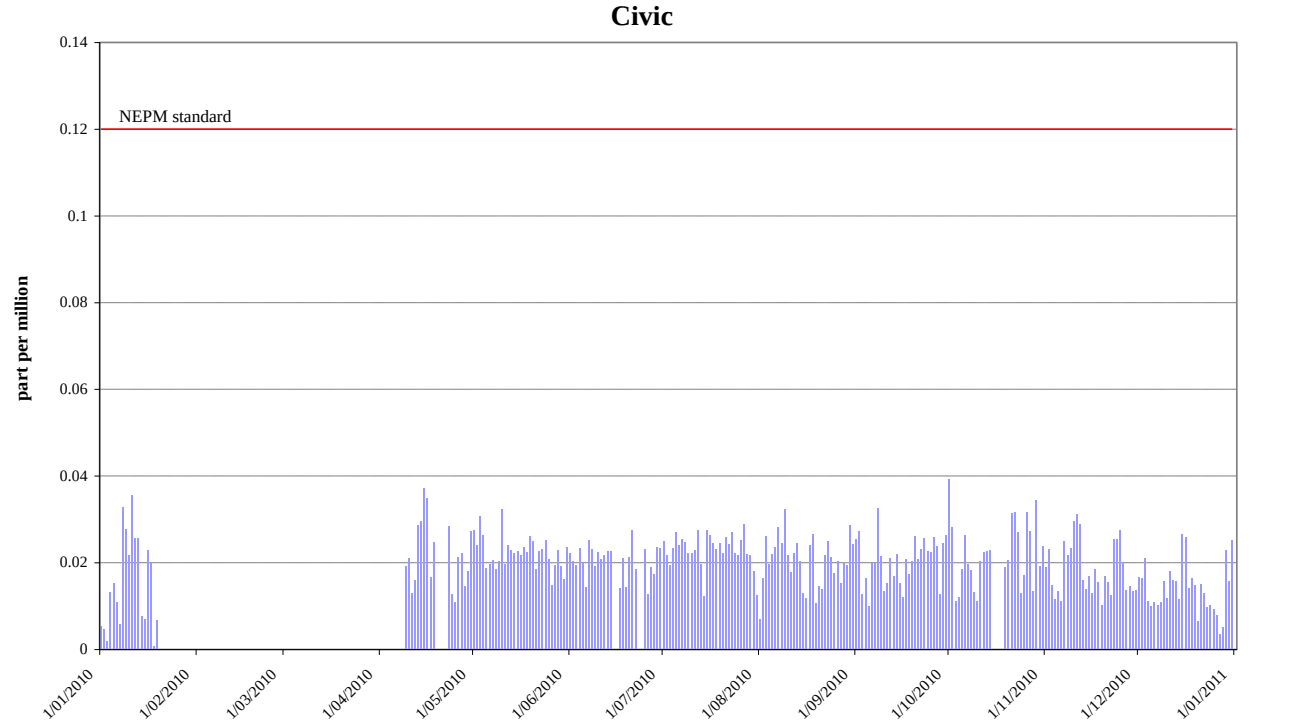

Figure 4: Daily max for NO_2 – Civic

Ozone

During 2010, no exceedences of the 1 hour and 4 hour standard for O_3 were recorded in the ACT. Compliance was not demonstrated at Monash because of a lack of data in Q1. The low data availability rate was because of an error in the data logging systems which was not detected until April (refer to **Table 6** and **Figure 5**).

Table 6: 2010 compliance summary for O_3
AAQ 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	52.7	95.1	95.7	95.5	84.9	0	0	ND	ND
Civic	94.5	95.7	95.7	95.8	95.5	0	0	Met	Met

ND: Not demonstrated.

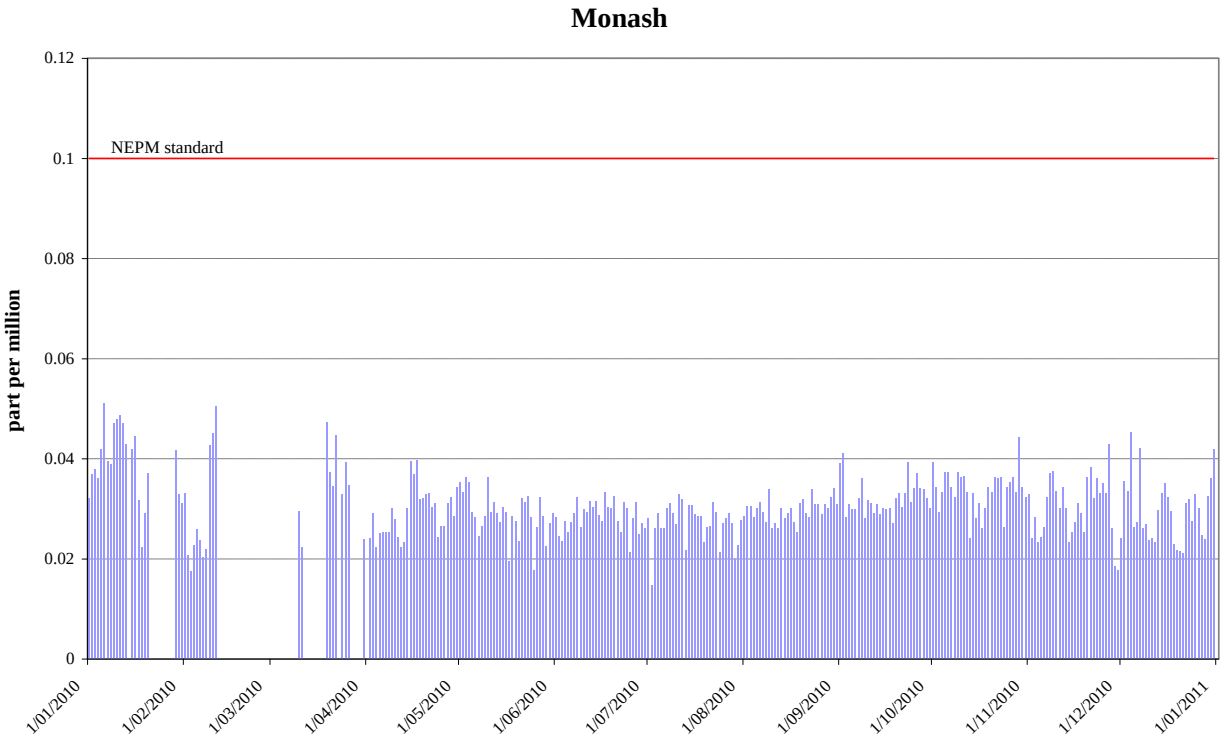

Figure 5: Daily max for 1 hour O_3 – Monash

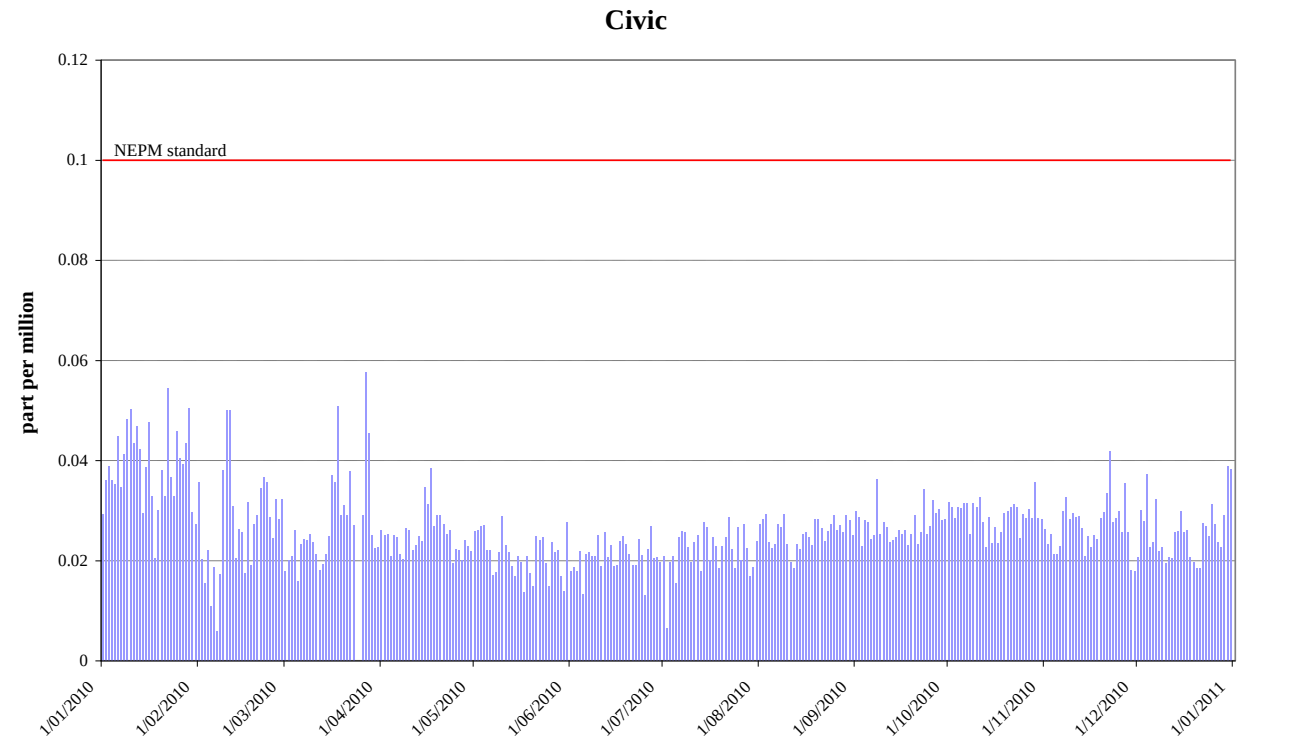

Figure 6: Daily max for 1 hour O_3 – Civic

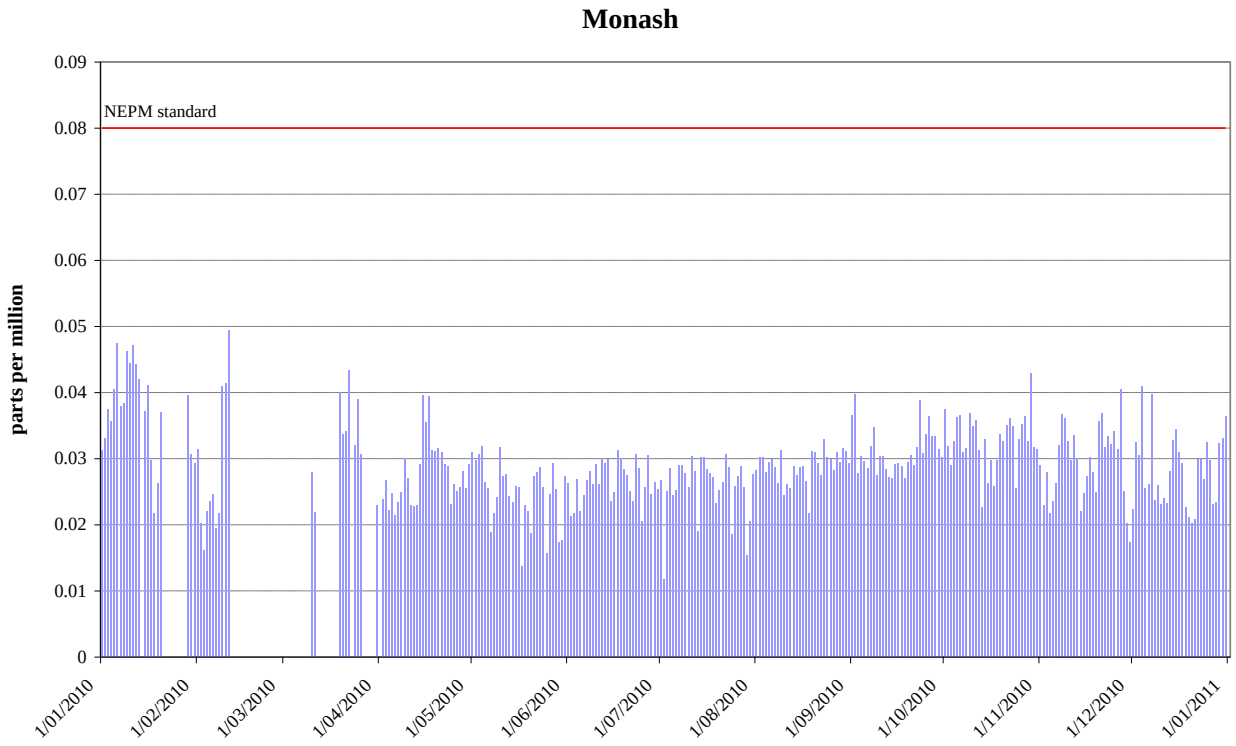

Figure 7: Daily max for 4 hours O_3 - Monash

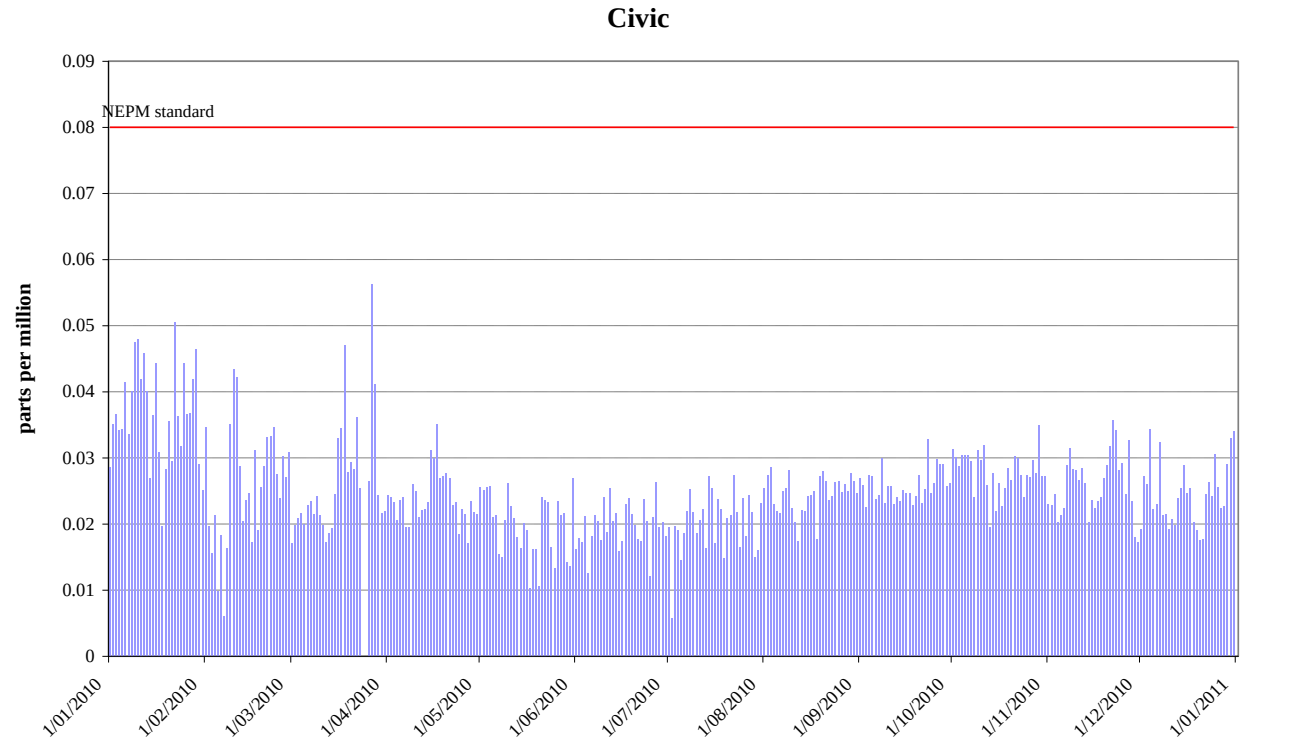

Figure 8: Daily max for 4 hours O_3 - Civic

PM_{10}

During 2010 there were no exceedences of the 24-hr PM_{10} standard recorded in the ACT. Monash complies with the 24-hr goal for PM_{10} but compliance was not demonstrated for Civic because of insufficient data in Q1 and Q2 (refer to **Table 7** and **Figure 10**) with monitoring recommencing on 26 May following the installation of a Beta Attenuation Monitor. Previous monitoring ceased in late 2008 because of instrument failure.

Table 7: 2010 compliance summary for PM_{10}
AAQ 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	95.6	98.9	98.9	91.7	95.4	0	Met
Civic	0	40.7	98.9	94.2	57.9	0	ND

ND: Not demonstrated.

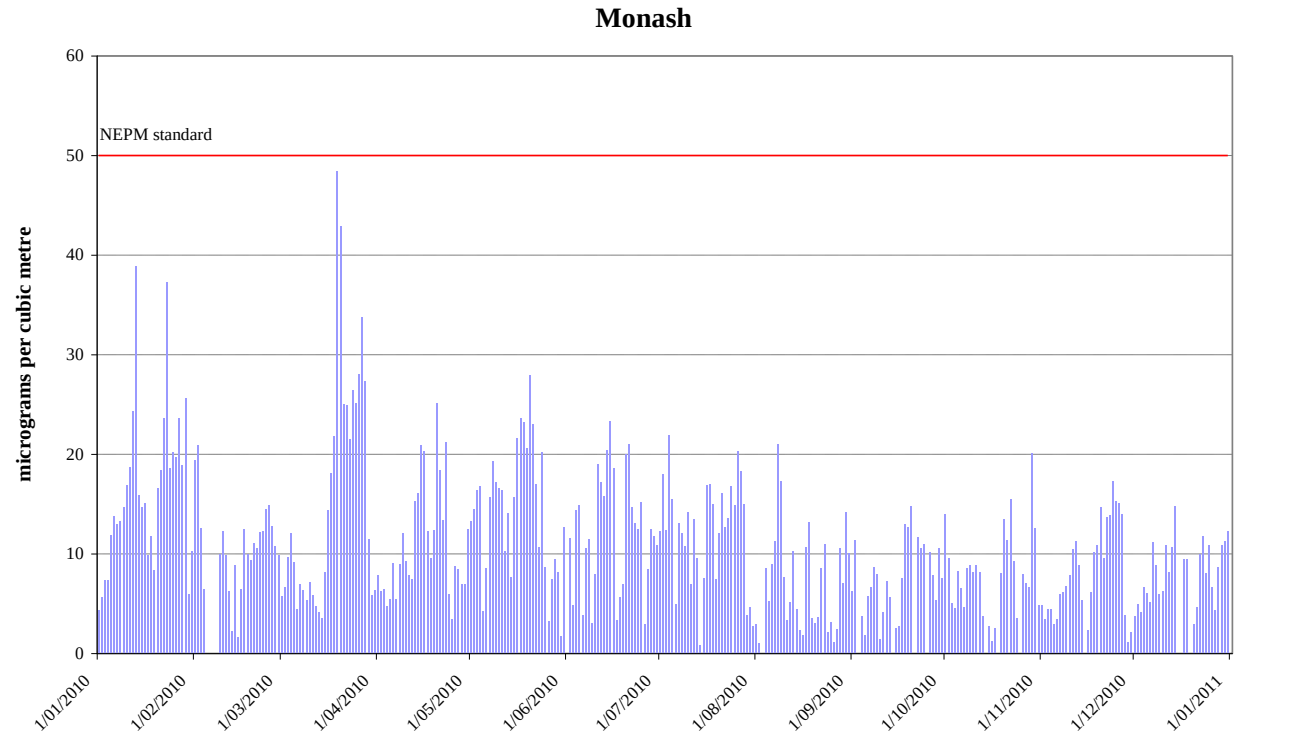

Figure 9: Daily max for PM_{10} – Monash.

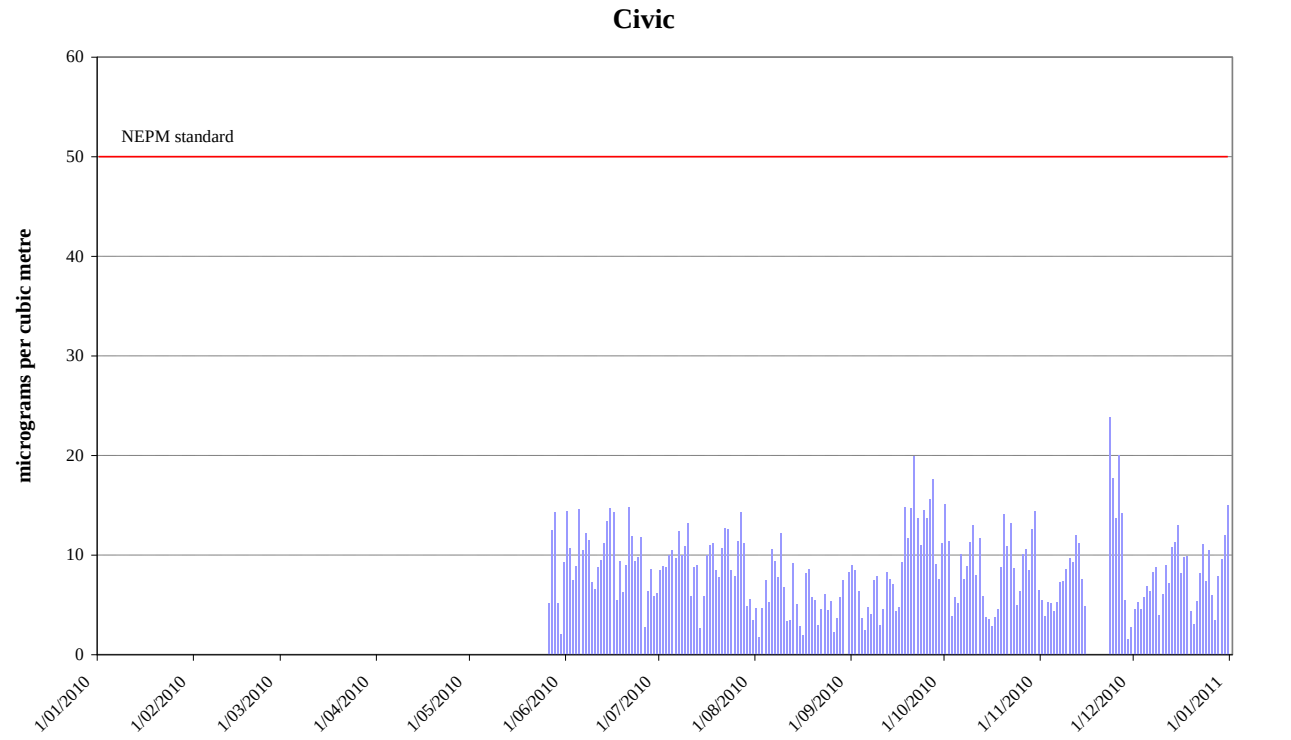

Figure 10: Daily max for PM_{10} – Civic.

$PM_{2.5}$

Two exceedences of the 24-hr advisory reporting standard were recorded on 19 and 20 March 2010 at Monash. These exceedences were because of smoke from a number of large hazard reduction burns in NSW (near Tumut, Kosciusko NP and a few to the north and north-west of the ACT).

Table 8: 2010 compliance summary for $PM_{2.5}$
AAQ 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	98.9	98.9	95.7	89.3	95.1	6.7	2

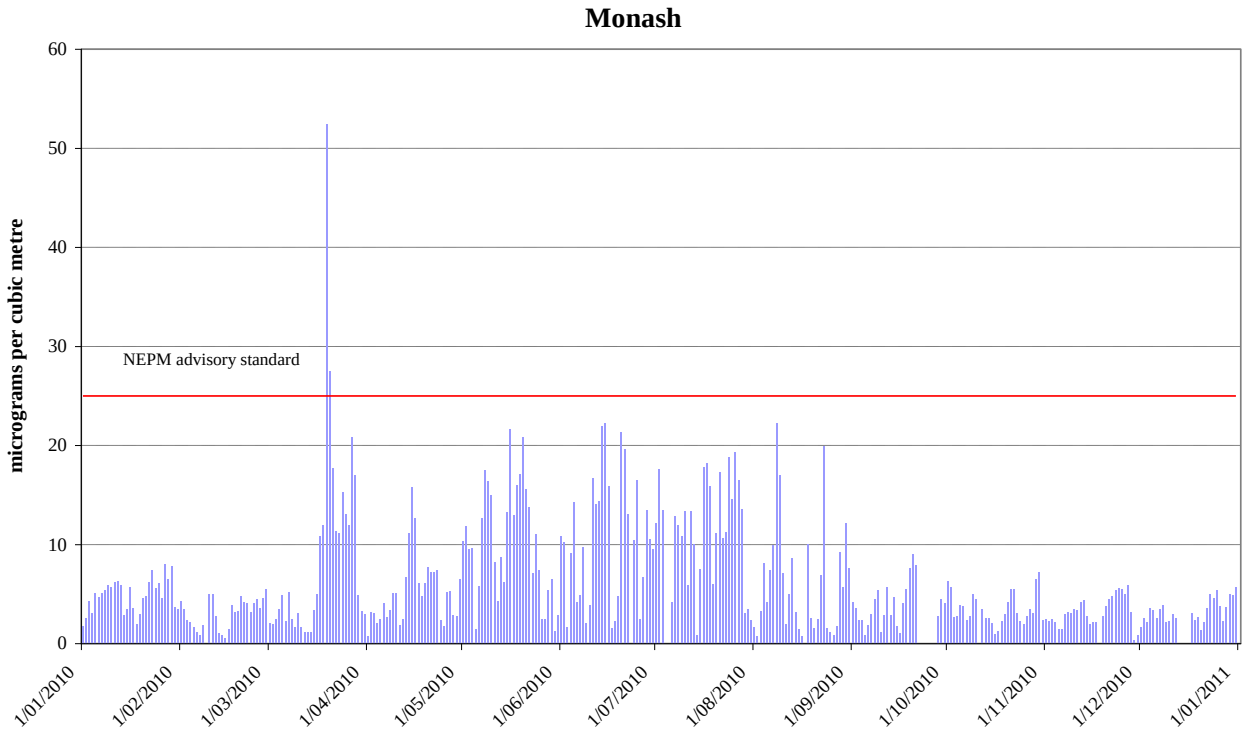

Figure 11: Daily max for $PM_{2.5}$ – Monash.

ANALYSIS OF AIR QUALITY MONITORING

Annual summary statistics contained in **Table 9** to **Table 14** 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 AAQ NEPM states that the short-term standards should not be exceeded on more than one day for CO, NO_2, O_3, and SO2 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 9: 2010 summary statistics for daily peak 8-hour CO
AAQ 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	363	1.8	15 Jun 03:00	1.8	24 Jul 05:00
Civic	361	2.0	21 Jun 23:00	1.9	17 May 23:00

Carbon monoxide levels are well below the AAQ NEPM standard and because of both an improvement in vehicle emissions and a decline in wood heaters numbers, levels are trending down (refer to **Figure 12** and **Figure 13**). The highest recorded value in the ACT during 2010 was 2.0ppm at Civic, which is only 22% of the standard.

Nitrogen dioxide

Table 10: 2010 summary statistics for daily peak 1-hour NO_2
AAQ 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	326	0.037	19 Mar 20:00	0.034	11 Jan 21:00
Civic	274	0.039	1 Oct 19:00	0.037	15 Apr 18:00

Nitrogen dioxide levels are well below the AAQ NEPM standard and have remained stable over the last decade. The highest recorded 1 hour value during 2010 was 0.039ppm at Civic. This is only 32.5% of the standard. The highest recorded annual average in 2010 was 0.010ppm at Civic. This is only 33.3% of the standard.

Ozone

Table 11: 2010 summary statistics for daily peak 1-hour O_3
AAQ 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	317	0.051	6 Jan 18:00	0.050	11 Feb 18:00
Civic	363	0.058	27 Mar 14:00	0.054	22 Jan 11:00

Table 12: 2010 summary statistics for daily peak 4-hour O_3
AAQ 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	317	0.049	11 Feb 21:00	0.047	6 Jan 18:00
Civic	363	0.056	27 Mar 16:00	0.051	22 Jan 13:00

Ozone levels are below the AAQ NEPM standard. The highest recorded 1-hour value in the ACT during 2010 was 0.058ppm at Civic, which is 58% of the standard. The highest recorded 4-hour value in the ACT during 2010 was 0.056ppm at Civic, which is 70% of the standard.

PM_{10}

Table 13: 2010 summary statistics for daily peak PM_{10}
AAQ 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	349	48.4	19 Mar	28.0	26 Mar
Civic	212	23.8	23 Nov	15.6	26 Sept

The highest PM_{10} level recorded during 2010 was 48.4$\mu g/m^3$ on 19 March 2010 when there were a number of large hazard reduction burns in NSW. This is 96.8% of the AAQ NEPM standard.

$PM_{2.5}$

Table 14: 2010 summary statistics for daily peak $PM_{2.5}$
AAQ 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	348	**52.4**	19 Mar	21.6	16 May

The 24-hour advisory reporting standard for $PM_{2.5}$ was exceeded at Monash on 19 and 20 March 2010 (52.4μg/m^3 and 27.5μg/m^3 respectively) because of a number of large hazard reduction burns in NSW.

ASSESSMENT OF PROGRESS TOWARDS ACHIEVING THE GOAL

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

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

Unfortunately compliance was "not demonstrated" for NO_2 at Civic and Monash, O_3 at Monash and PM_{10} at Civic because of less than 75 percent data availability in one or more quarters (see Monitoring Summary for more detail). With the exception of PM_{10} these pollutants are not of concern for the ACT airshed with levels of NO_2 and O_3 less than 33% and 70% of the standard respectively.

In relation to PM_{10} and $PM_{2.5}$ it is pleasing to note that there were no exceedences of either standard because of wood heater emissions, although monitoring clearly shows that levels increase during the winter months (refer to **Figure 11** for details). The two exceedences of the $PM_{2.5}$ advisory reporting standard were because of smoke coming into the ACT airshed from controlled burns in NSW.

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

It will continue to implement an integrated program to address woodsmoke. This will involve public education and enforcement activities, the licensing of firewood merchants, the implementation of the 'Don't Burn Tonight Campaign' and the on-going implementation of the Wood Heater Replacement Program.

The ACT will also work with the Commonwealth and other jurisdictions at a national level through the Standing Council on Water and the Environment to progress actions to improve air quality.

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 15: Statistical summary for daily maximum 8-hour CO Monash 2001 – 2010

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)
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
2010	99.2	0	1.8	1.7	1.5	1.4	1.1	0.6	0.3

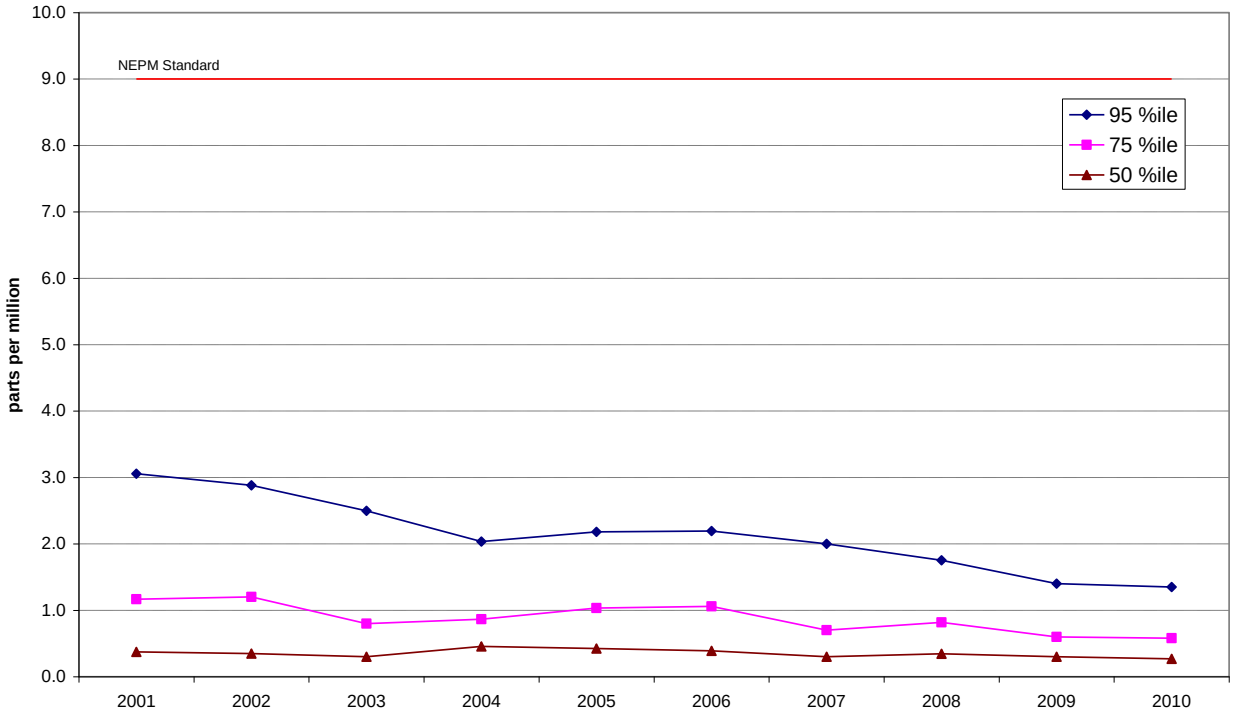

Figure 12: Statistical summary for daily maximum 8-hour CO Monash 2001 – 2010

Table 16: Statistical summary for daily maximum 8-hour CO Civic 2001 – 2010

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)
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
2010	98.6	0	2.0	1.9	1.8	1.4	1.2	0.9	0.6

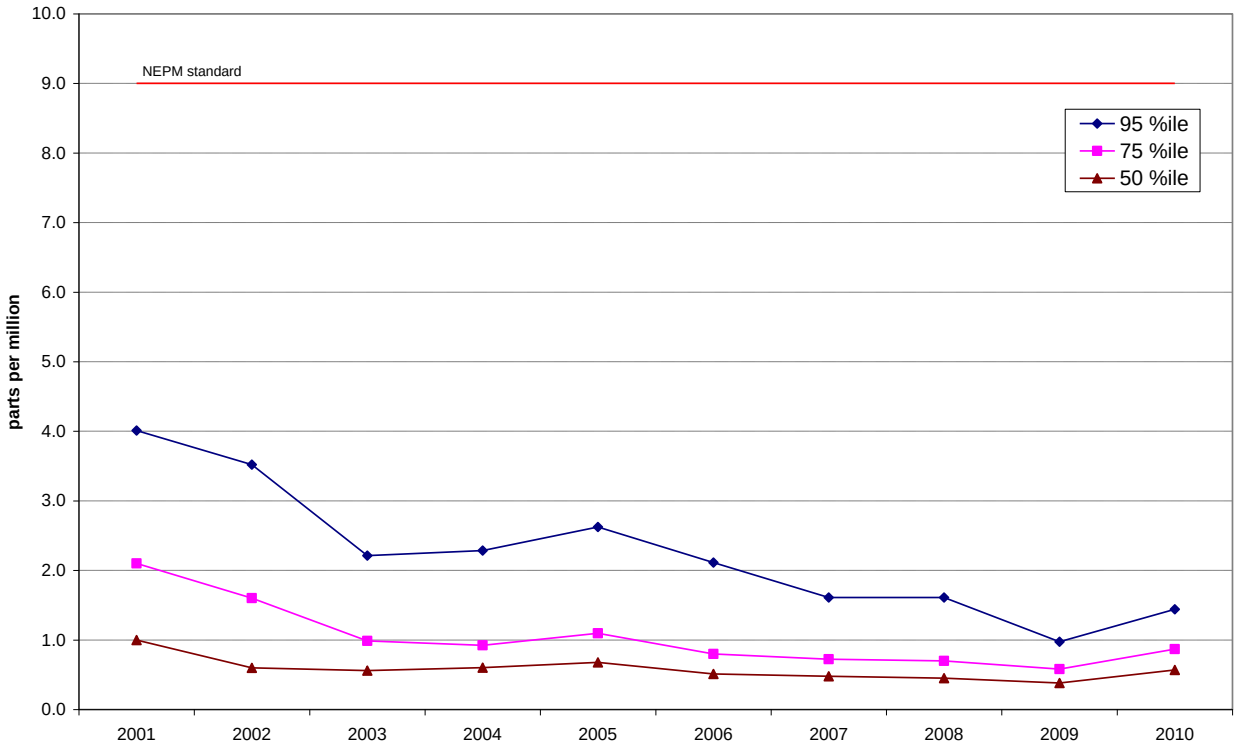

Figure 13: Statistical summary for daily maximum 8-hour CO Civic 2001 – 2010

Nitrogen dioxide

Table 17: Statistical summary for daily maximum 1-hour NO_2 Monash 2001 – 2010

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)
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
2010	89.1	0	0.037	0.029	0.028	0.025	0.023	0.021	0.017

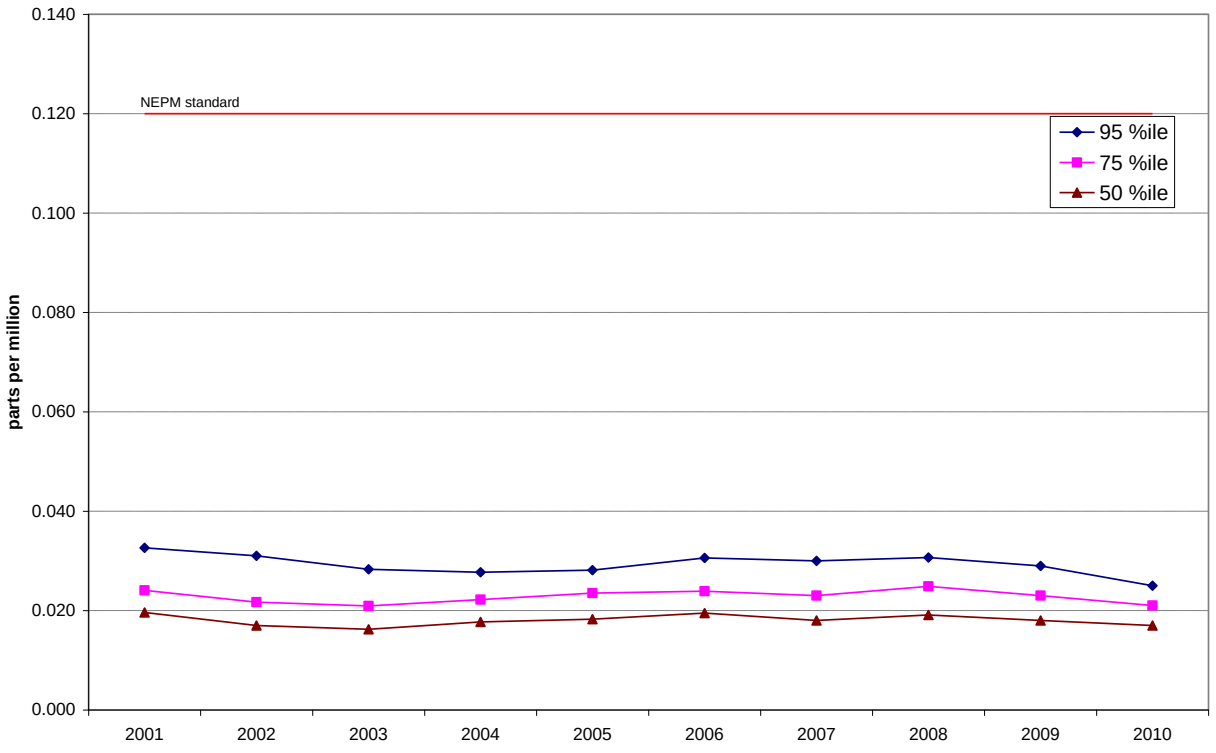

Figure 14: Statistical summary for daily maximum 1-hour NO_2 Monash 2001 – 2010

Table 18: Statistical summary for daily maximum 1-hour NO_2 Civic 2001 – 2010

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)
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
2010	74.9	0	0.039	0.035	0.033	0.030	0.027	0.024	0.021

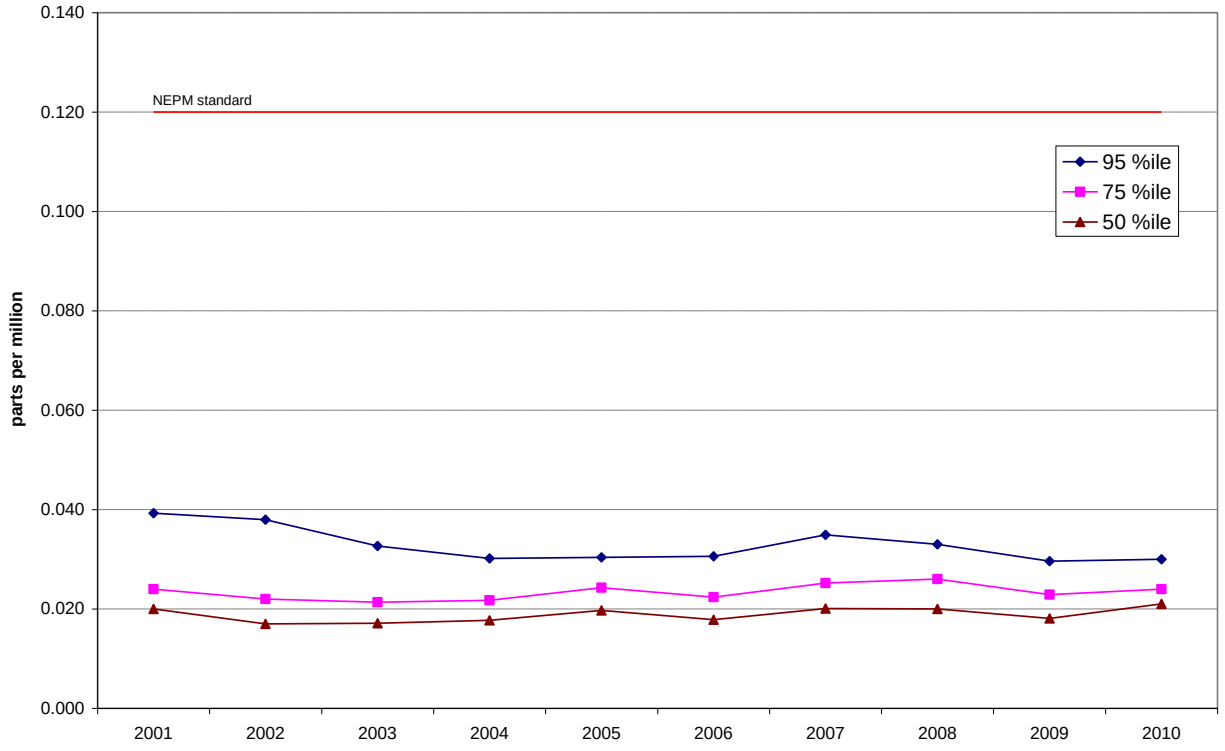

Figure 15: Statistical summary for daily maximum 1-hour NO_2 Civic 2001 – 2010

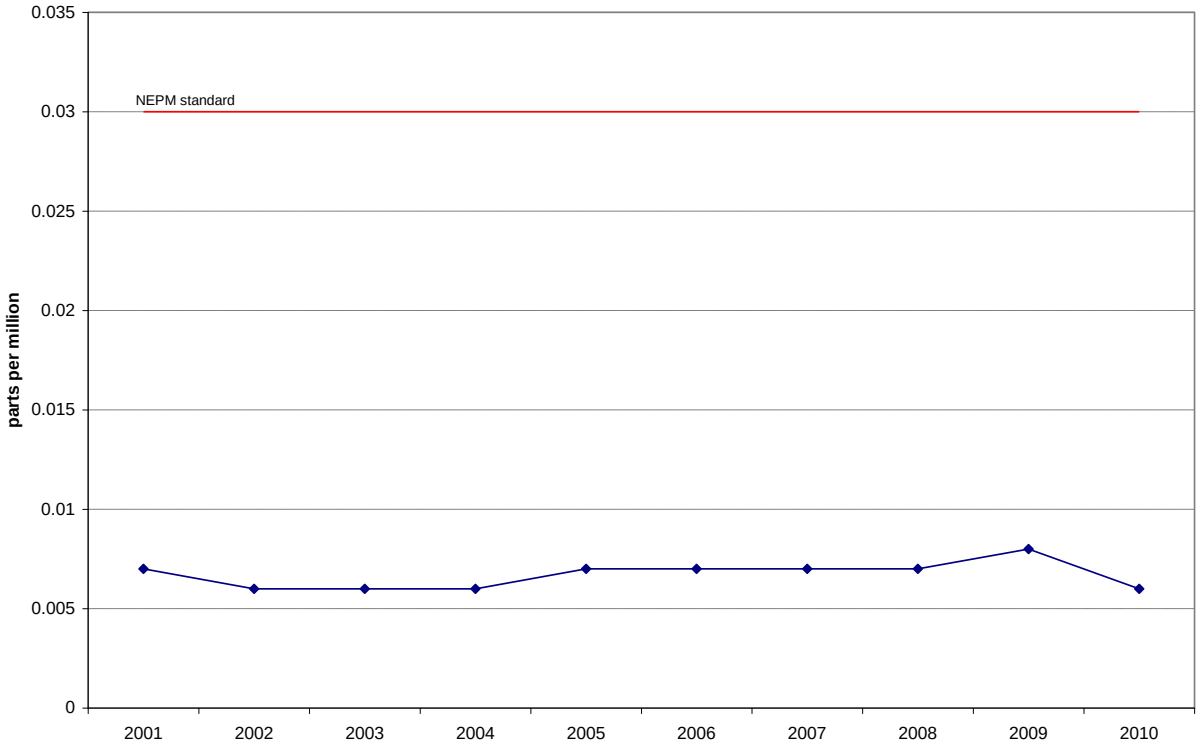

Figure 16: Annual average 1-hour NO_2 Monash 2001 – 2010

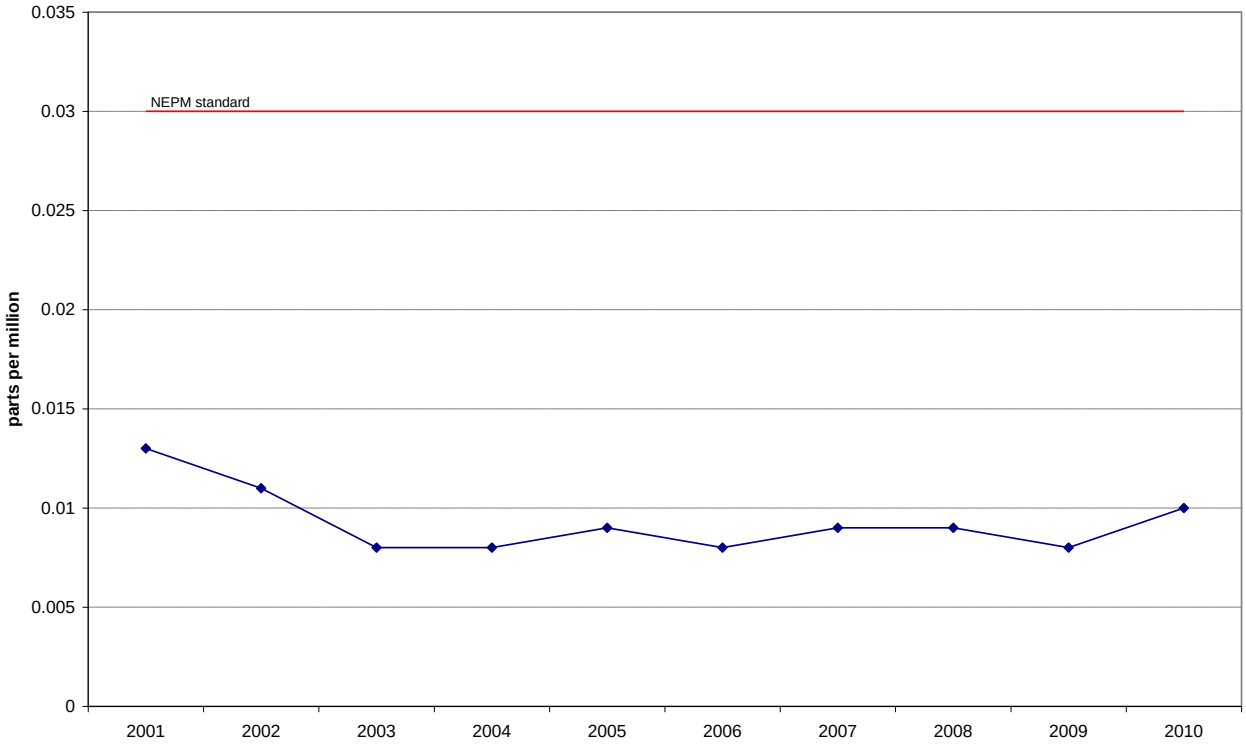

Figure 17: Annual average 1-hour NO_2 Civic 2001 – 2010

Ozone

Table 19: Statistical summary for daily maximum 1-hour O_3 Monash 2001 – 2010

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)
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
2010	86.6	0	0.051	0.048	0.046	0.042	0.037	0.033	0.030

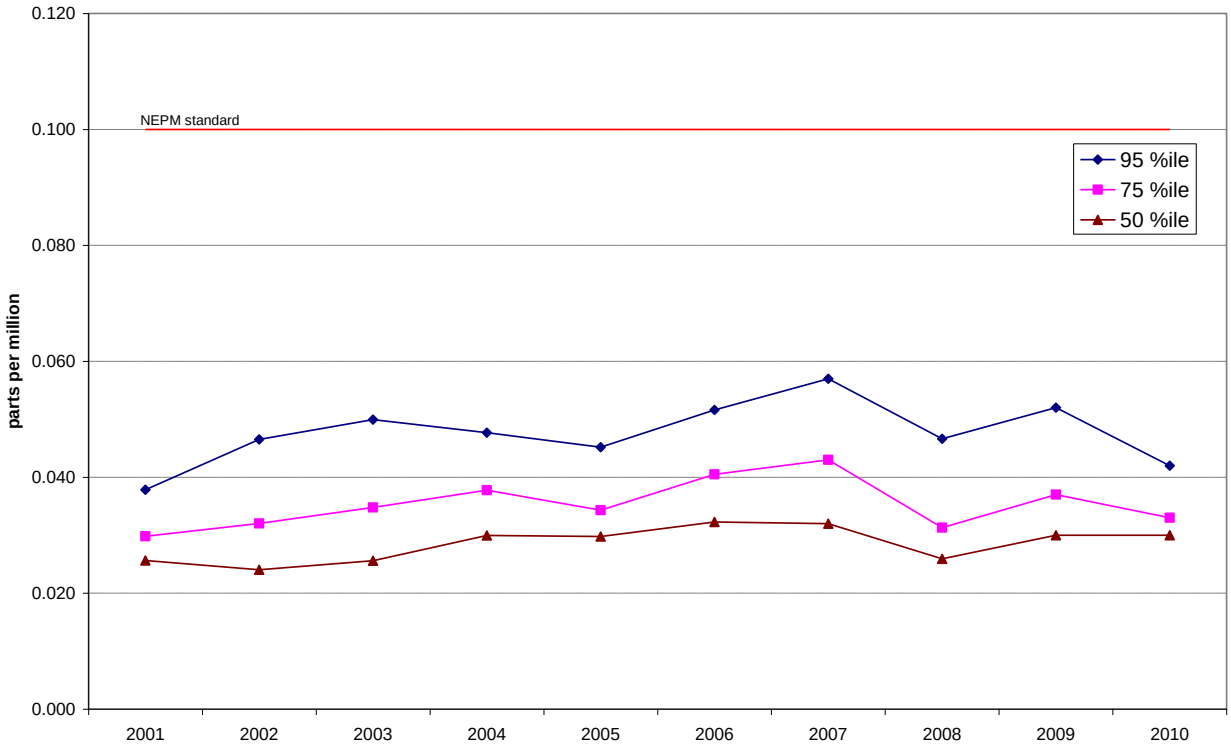

Figure 18: Statistical summary for daily maximum 1-hour O_3 Monash 2001 – 2010

Table 20: Statistical summary for daily maximum 1-hour O_3 Civic 2001 – 2010

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)
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
2010	99.2	0	0.058	0.050	0.048	0.040	0.036	0.029	0.025

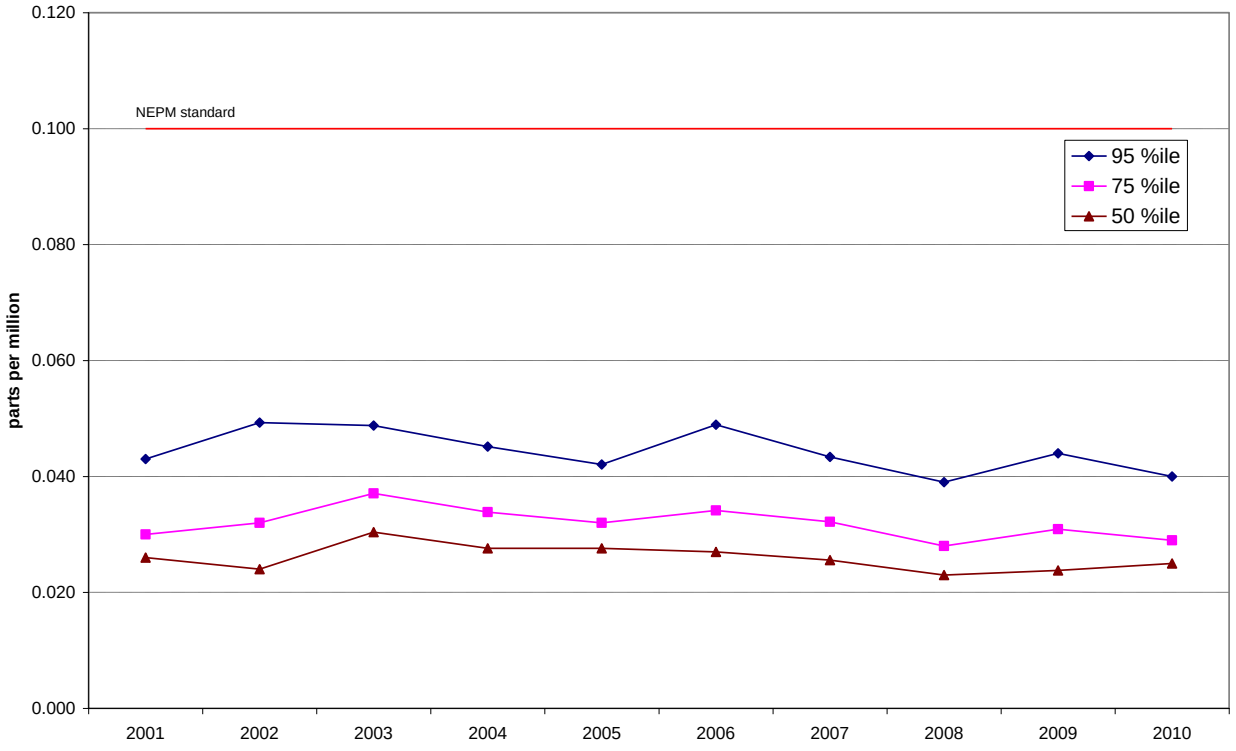

Figure 19: Statistical summary for daily maximum 1-hour O_3 Civic 2001 – 2010

Table 21: Statistical summary for daily maximum 4-hour O_3 Monash 2001 – 2010

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)
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
2010	86.6	0	0.049	0.046	0.043	0.040	0.037	0.032	0.029

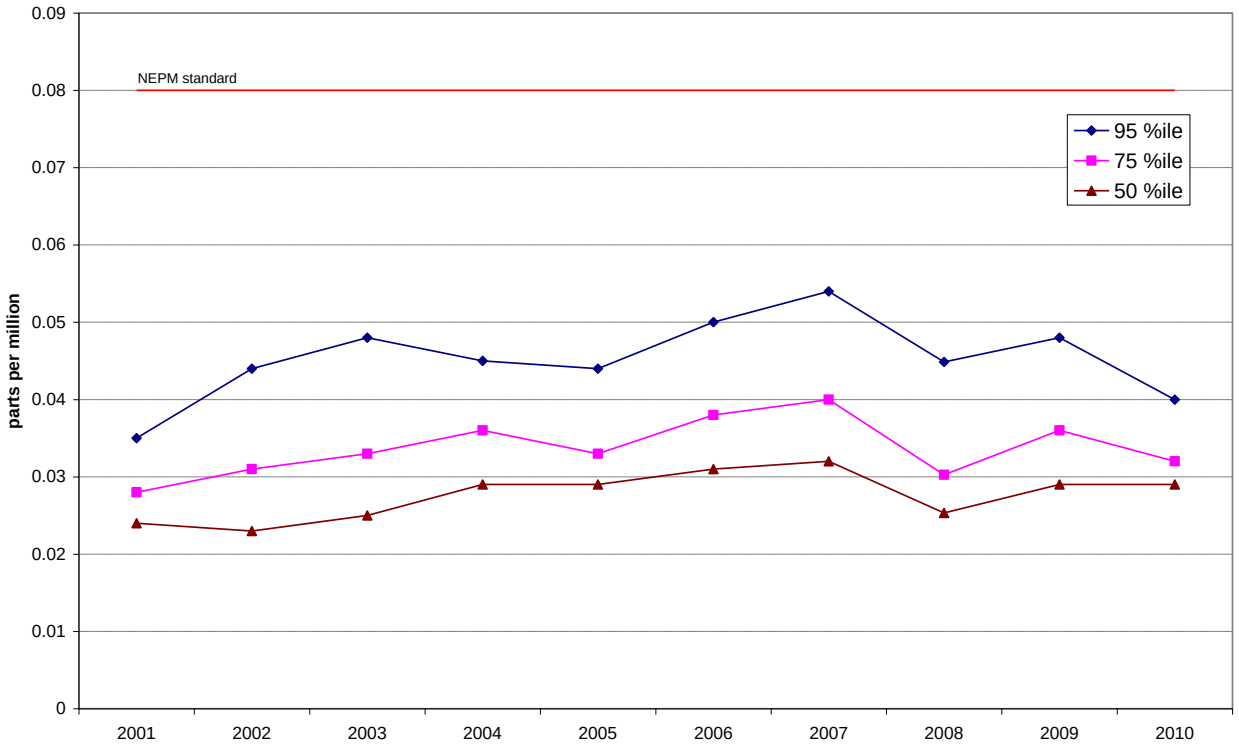

Figure 20: Statistical summary for daily maximum 4-hour O_3 Monash 2001 – 2010

Table 22: Statistical summary for daily maximum 4-hour O_3 Civic 2001 – 2010

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)
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
2010	99.2	0	0.056	0.047	0.044	0.037	0.034	0.028	0.024

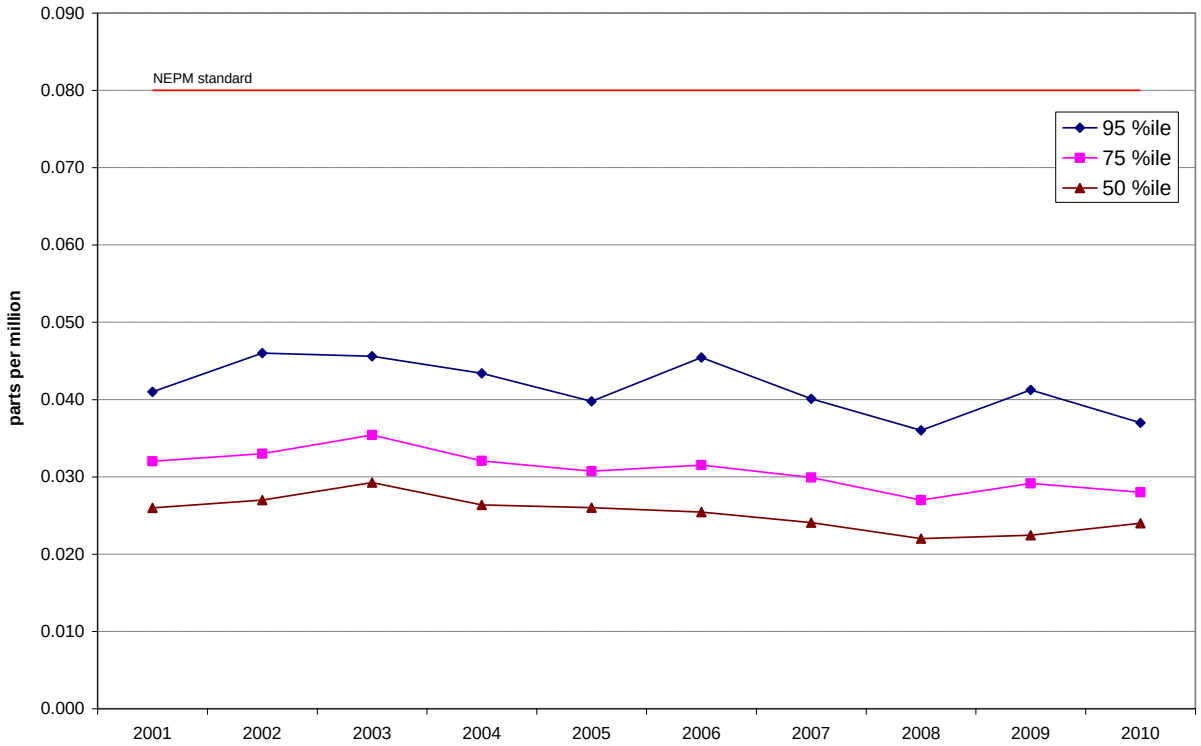

Figure 21: Statistical summary for daily maximum 4-hour O_3 Civic 2001 – 2010

PM_{10}

Table 23: Statistical summary for daily maximum 24-hour PM_{10} Monash 2001 – 2010

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)
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
2010	95.4	0	48.4	35.6	27.4	23.5	20.2	14.7	10.0

Figure 22: Statistical summary for daily maximum 24-hour PM_{10} Monash 2001 – 2010

Note 2009 data has not been included in **Figure 22** as the percentile data has been skewed because of insufficient data in Q1 and Q2 (zero and twenty five percent respectively) and the extreme readings associated with the dust storm which affected most of eastern Australia on 22 and 23 September, 2009.

Table 24: Statistical summary for daily maximum 24-hour PM_{10} Civic 2001 – 2010

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)
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
2009	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2010	57.6	0	23.8	19.7	17.1	14.7	13.7	11.1	8.4

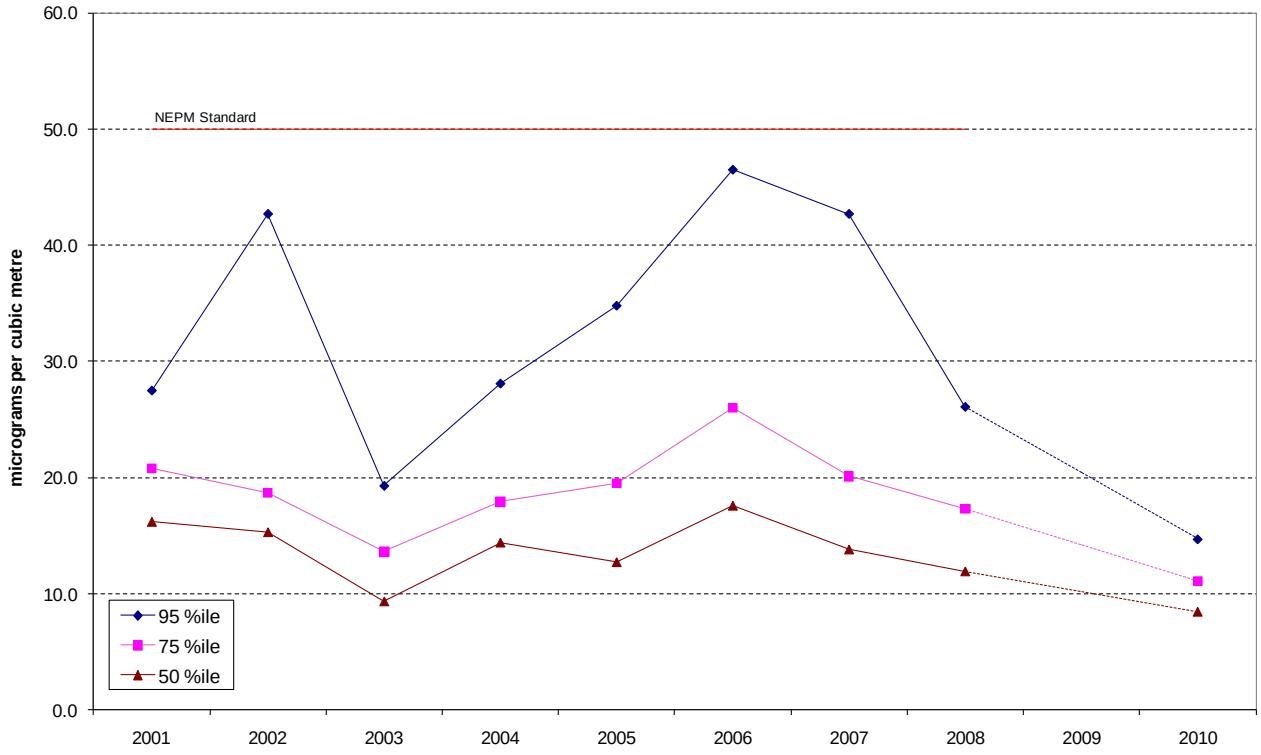

Figure 23: Statistical summary for daily maximum 24-hour PM_{10} Civic 2001 – 2010

Note No PM_{10} monitoring was conducted at Civic in 2009.

$PM_{2.5}$

Table 25: Statistical summary for daily maximum 24-hour $PM_{2.5}$ Monash 2004 – 2010

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
2010	95.1	2	52.4	22.1	20.9	17.4	14.3	7.8	4.4

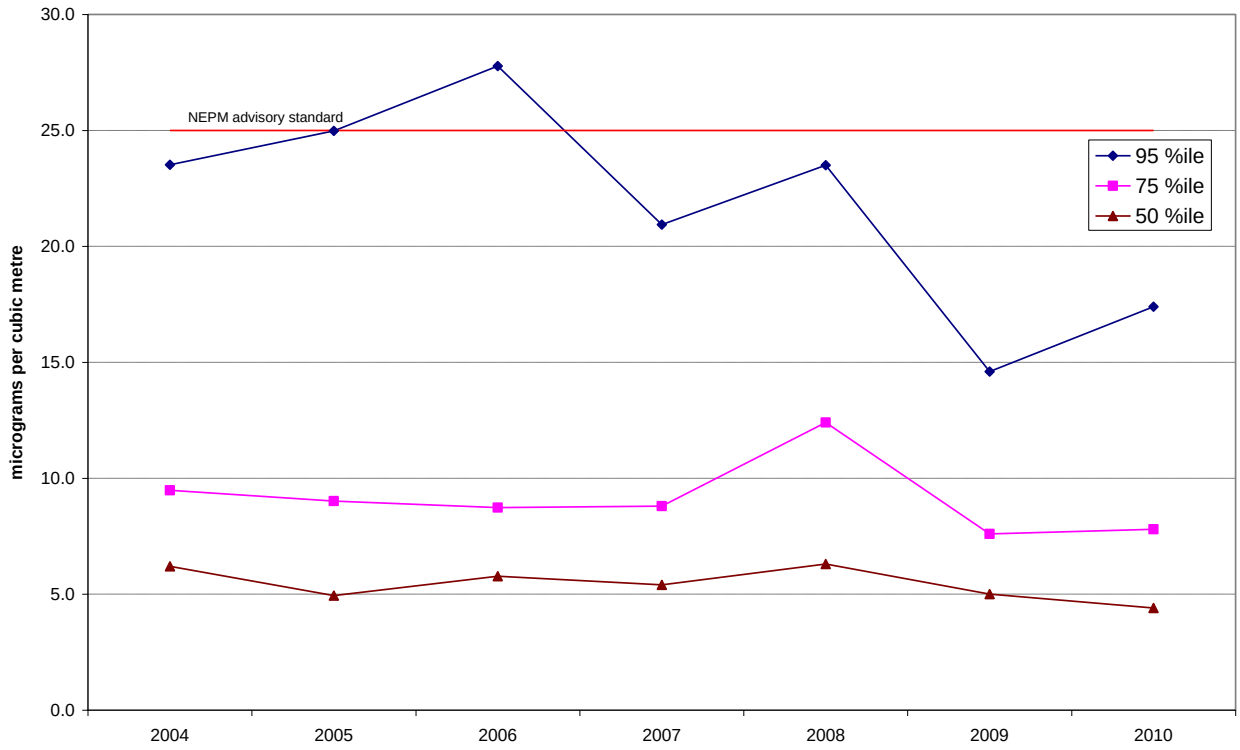

Figure 24: Statistical summary for daily maximum 24-hour $PM_{2.5}$ Monash 2004 – 2010

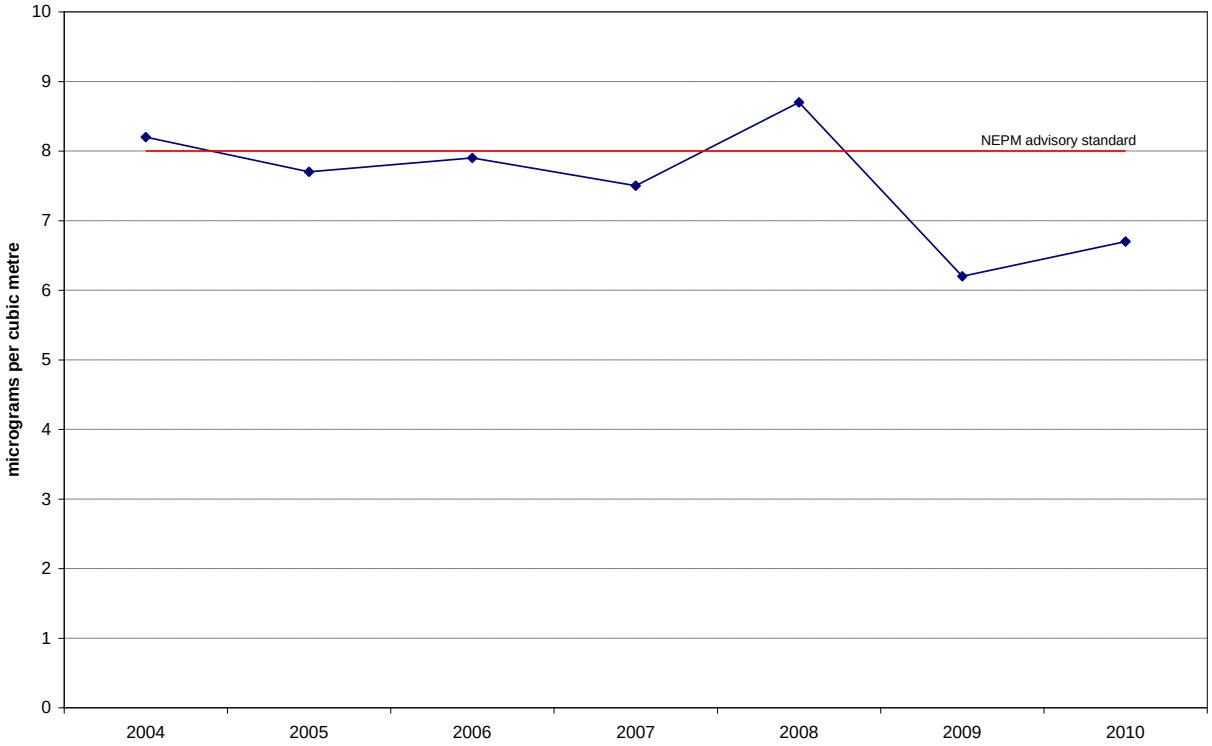

Figure 25: Annual average 24-hour $PM_{2.5}$ Monash 2004 - 2010