ACT Government
Environment and Planning

ACT Air Quality Report 2013

Environment Protection Authority

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List of definitions and abbreviations

AAQ NEPM	National Environment Protection (Ambient Air Quality) Measure
ACT	Australian Capital Territory
CO	Carbon Monoxide
BAM	Beta Attenuation Monitor
NATA	National Association of Testing Authorities
ND	Not Demonstrated
NO_2	Nitrogen Dioxide
O_3	Ozone
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
Q	Quarter (e.g. Q1 means the first quarter of the year)
SO_2	Sulfur Dioxide
$\mu g/m^3$	micrograms per cubic metre

Overview

This report presents the results of ambient air quality monitoring in the ACT for the 2013 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.

The AAQ NEPM establishes:

- requirements for monitoring air quality;
- air quality standards that are levels of specified pollutants against which air quality can be assessed; and
- a goal that the air quality standards be met to the extent specified in the NEPM. Recognising that certain events can impact on air quality, the NEPM specifies a maximum number of days on which it is permissible to exceed the standard.

The ACT monitors four of the six NEPM pollutants, namely carbon monoxide (CO), nitrogen dioxide (NO_2), photochemical oxidants as ozone (O_3) and particulate matter (particles less than 10 microns in diameter – PM_{10} and particles less than 2.5 microns – $PM_{2.5}$). Due to a lack of heavy industry, the ACT has never monitored sulfur dioxide (SO_2) as it is primarily an industrial pollutant, and lead monitoring ceased in 2002 with the phase out of leaded petrol. Monitoring was performed in accordance with the ACT's monitoring plan, AAQ NEPM Technical Papers and ACT Health's accreditation by the National Association of Testing Authorities (NATA).

Monitoring results demonstrate that Canberra's air quality is excellent compared to other capital cities, with no exceedences of the AAQ NEPM standards for CO, NO_2, and O_3. The major impacts on Canberra's air quality in 2013, as in previous years, came from the accumulation of combustion particles from wood heaters in cold, highly stable air and hazard reduction burns.

One exceedence of the PM_{10} 24-hour standard was measured on 19 October at the Civic station. The cause of this exceedence was a controlled burn in NSW. There were six exceedences of the $PM_{2.5}$ 24-hour advisory reporting standard measured at Monash. Four exceedences occurred between May and July and can be attributed to domestic wood heater emissions. Two exceedences occurred on 19 and 20 October due to smoke coming from a hazard reduction burn in NSW.

The ACT Government acknowledges that woodsmoke from domestic wood heaters is the largest source of air pollution in Canberra and has implemented a range of programs to address it. The monitoring results show that these programs have been effective in reducing woodsmoke with particle levels continuing to trend down.

Monitoring summary

Current Performance Monitoring Stations

The ACT Government has been undertaking ambient air quality monitoring in Canberra since the early 1990's. The Health Directorate is responsible for the Government's ambient air quality monitoring network. The Environment and Planning Directorate is responsible for annual reporting under the AAQ NEPM.

The AAQ NEPM monitoring network in the ACT currently consists of two monitoring stations at Monash and Civic respectively. The Monash station is approximately 300 metres west of Cockcroft Avenue in the Monash District Playing Fields. The Civic station 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 stations against the siting standard AS/NZS 3580.1.1:2007 are listed in Table 1 below.

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

Station	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	☑	☑	☑	☑	☑	☑	☑
Civic	☑	☒	☒	☒	☒	☑	☒

During this reporting period the ACT Government established another performance monitoring station (PMS) in Florey. The new station has been operational since 28 February 2014 and is fully compliant with the AAQ NEPM. Data from this station will be used for the 2014 annual report.

Both Monash and Civic stations contain instrumentation that continuously monitors CO, O_3, NO_2 and PM_{10}. The monitoring of $PM_{2.5}$ is only undertaken at Monash.

Monitoring Methods

The ACT monitoring is conducted in accordance with the relevant Australian Standards as shown in Table 2. Data not meeting the requirements of these Standards are identified as invalid and not included in this report.

Table 2 Methods used for monitoring AAQ NEPM pollutants

Pollutant	Standard	Title	Method Used
Carbon Monoxide	AS 3580.7.1-2011	Ambient Air – Determination of Carbon Monoxide – Direct Reading Instrument Method	Gas filter correlation/Infrared
Nitrogen dioxide	AS 3580.5.1-2011	Ambient Air – Determination of Oxides of Nitrogen – Chemiluminescence Method	Gas phase chemiluminescence
Photochemical oxidant (ozone)	AS 3580.6.1-2011	Ambient Air – Determination of Ozone – Direct Reading Instrument Method	Non-dispersive ultraviolet
PM_{10}	AS 3580.9.11-2008	Method for Sampling and Analysis of ambient air Method – Determination of suspended particles matter – PM_{10} beta attenuation monitors	Beta Attenuation Monitor (BAM)
PM_{10}	AS/NZS 3580.9.6-2004	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 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 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, which has been completed through the review of the AAQ NEPM.

Table 3: AAQ 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	0.12 ppm	1 day a year
	1 year	0.03 ppm	none
Photochemical oxidants	1 hour	0.10 ppm	1 day a year
	4 hours	0.08 ppm	1 day a year
Sulfur dioxide	1 hour	0.20 ppm	1 day a year
	1 day	0.08 ppm	1 day a year
	1 year	0.02 ppm	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	25 µg/m^3	Not applicable
	1 year	8 µg/m^3	Not applicable

#- Advisory reporting standards only

The following tables (Table 4 to Table 8) 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.

A station's performance is assessed as complying with the AAQ NEPM (i.e. 'MET') if the number of exceedences is no more than the number specified in Schedule 2 of the AAQ NEPM and data availability was at least 75% in each quarter of the year. A region demonstrates compliance with the AAQ NEPM when either all stations in the region demonstrate compliance, or when the region meets approved pollutant screening criteria.

A station's performance is assessed as not complying with the AAQ NEPM (i.e. 'NOT MET') if there is more than the number of exceedences specified in Schedule 2 of the AAQ NEPM, even if the data availability rates are less than the 75% required.

A station's performance is assessed as 'NOT DEMONSTRATED' (ND) if it records exceedences on a number of days less than that allowed, but has data availability rates less than 75% in any quarter. This may be due to instrument failures, temporary closures for upgrading or closures to allow relocation of the station.

These categories (i.e. MET, NOT MET and ND) are used in the tables on the following pages.

Carbon monoxide

During 2013, no exceedences of the CO standard were recorded in the ACT and compliance against the AAQ NEPM goal was demonstrated at both stations.

Table 4: 2013 compliance summary for CO
AAQ NEPM standard- 9.0 ppm (8-hour average)

Performance monitoring station	Data availability rates (% of hours)					Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Monash	93.6	90.0	95.6	95.1	93.6	0	MET
Civic	95.6	95.0	95.1	92.7	94.6	0	MET

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

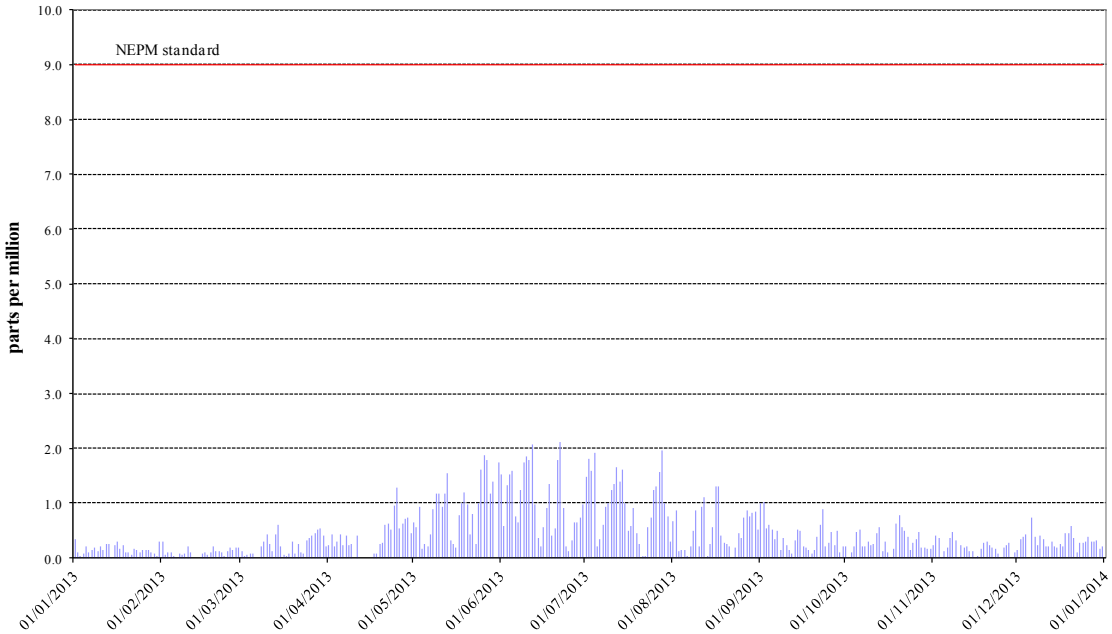
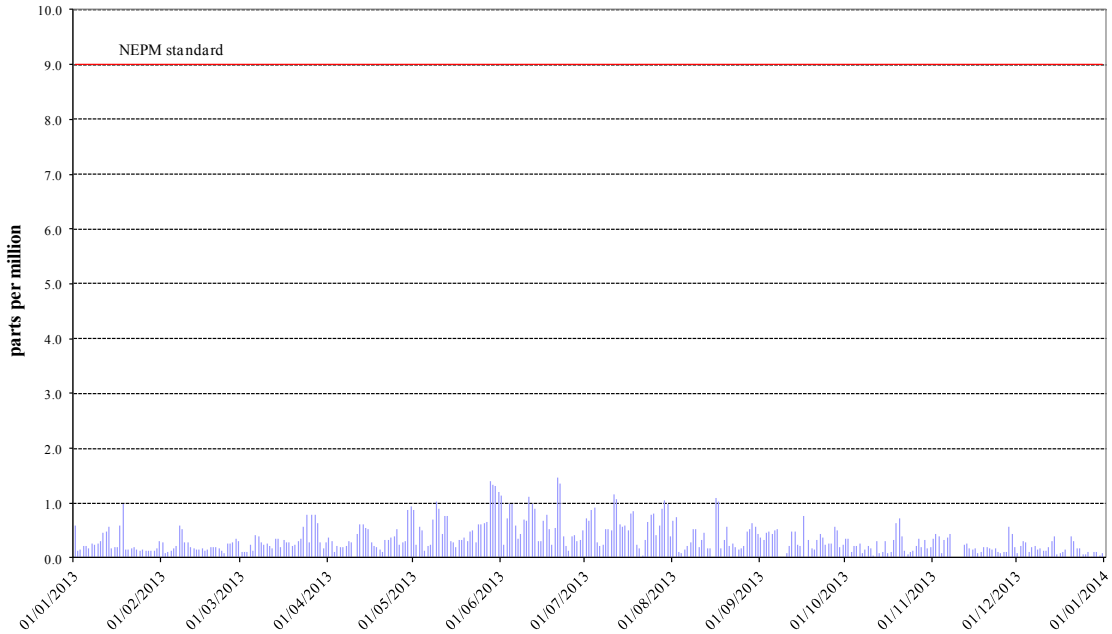


Figure 2: Daily max for CO 8-hour average - Civic



Nitrogen dioxide

During 2013, no exceedences of the NO_2 standards were recorded in the ACT. Compliance against the AAQ NEPM goal was demonstrated at both stations.

Table 5: 2013 compliance summary for NO_2
AAQ NEPM standard – 0.12 ppm (1-hour average), 0.03 ppm (1-year average)

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
Monash	94.5	90.3	95.6	95.1	93.9	0.005	0	MET	MET
Civic	95.6	95.0	94.1	92.7	94.3	0.007	0	MET	MET

Figure 3: Daily max for NO_2 – Monash

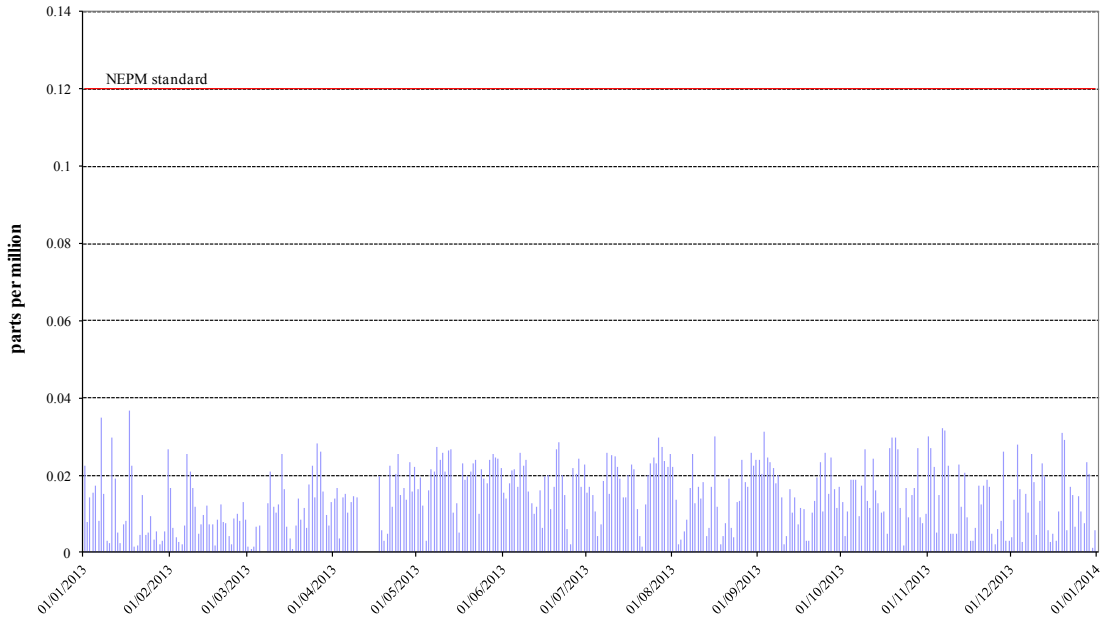
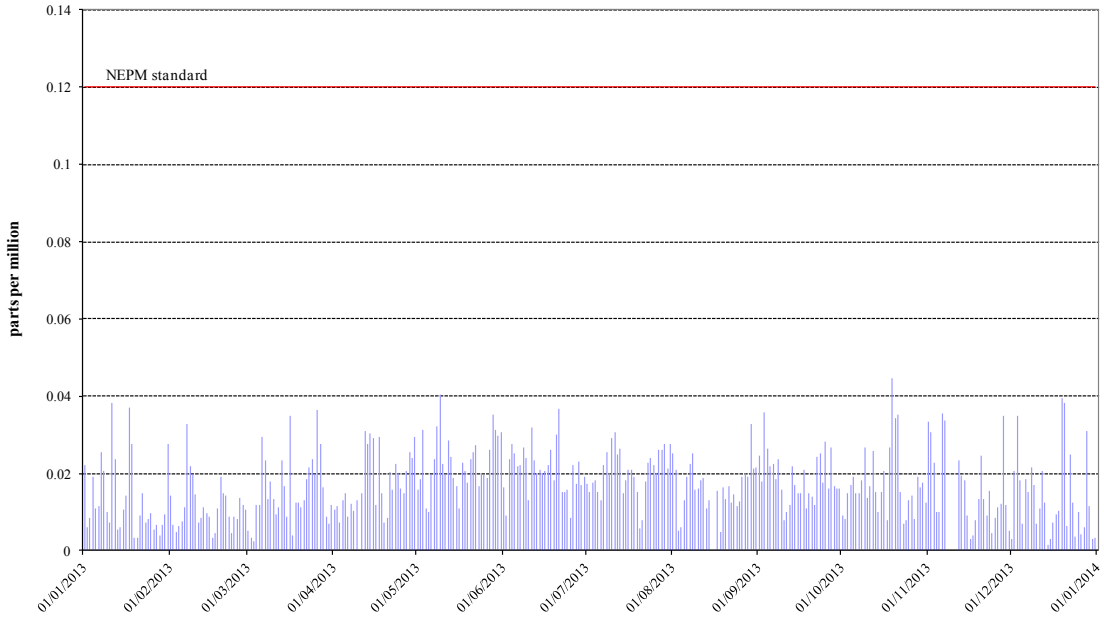


Figure 4: Daily max for NO_2 – Civic



Ozone

During 2013, no exceedences of the 1-hour and 4-hour standards for O_3 were recorded in the ACT, and compliance against the AAQ NEPM goal was demonstrated at both stations.

Table 6: 2013 compliance summary for O_3
AAQ NEPM standard – 0.10 ppm (1-hour average), 0.08 ppm (4-hour average)

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
Monash	94.6	90.8	95.5	95.8	94.2	0	0	MET	MET
Civic	76.3	90.7	95.4	92.3	88.7	0	0	MET	MET

Figure 5: Daily max for 1 hour O_3 – Monash

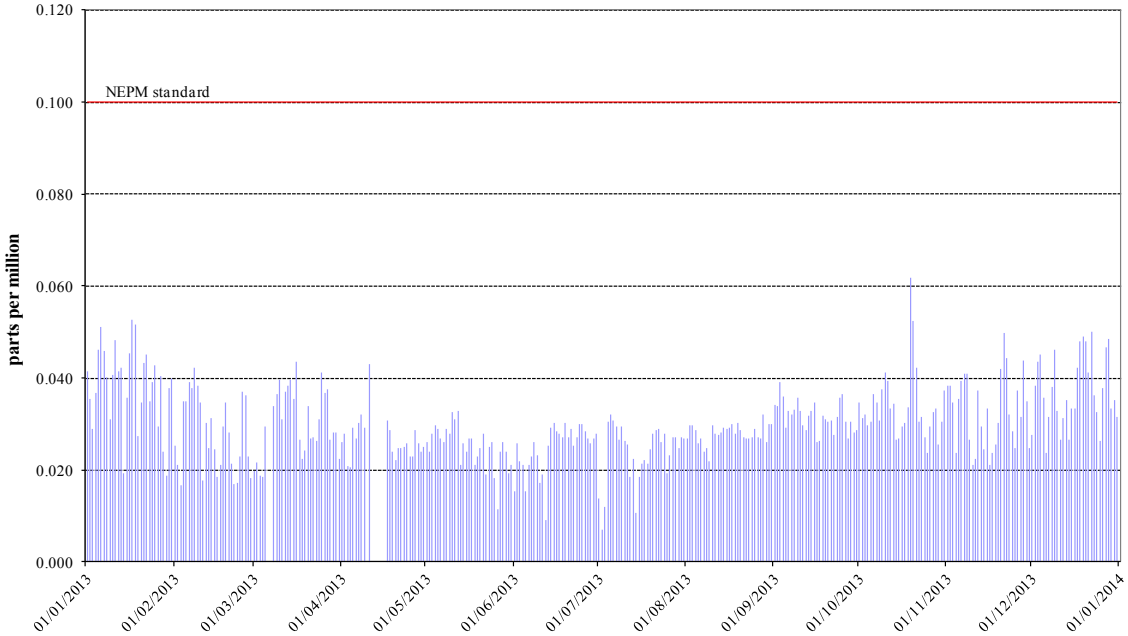


Figure 6: Daily max for 1 hour O_3 – Civic

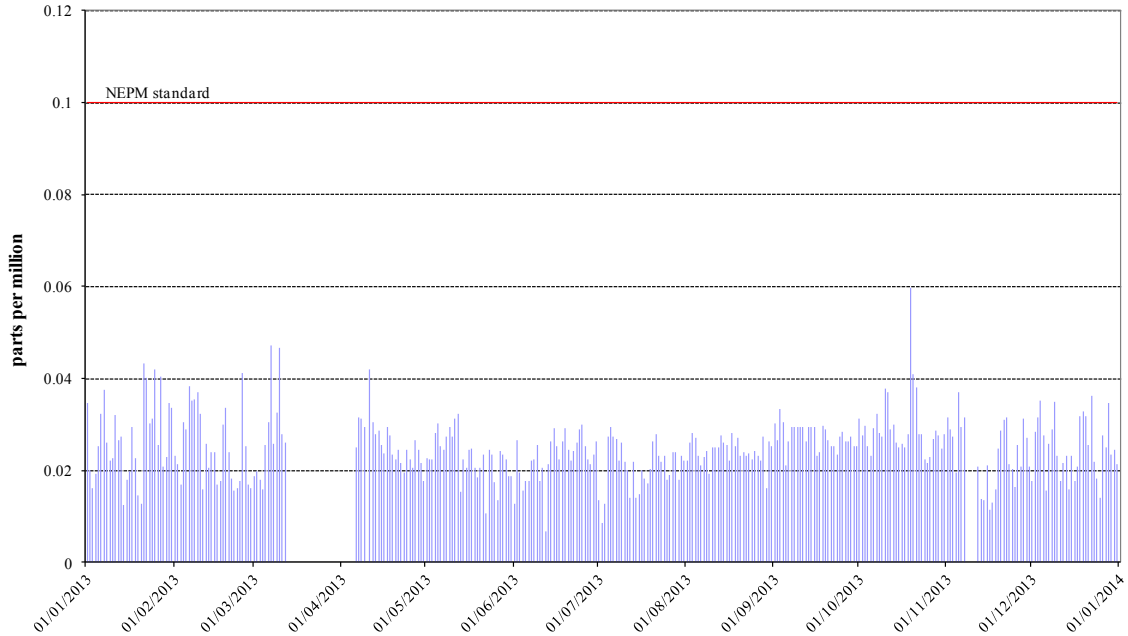


Figure 7: Daily max for 4 hours O_3 - Monash

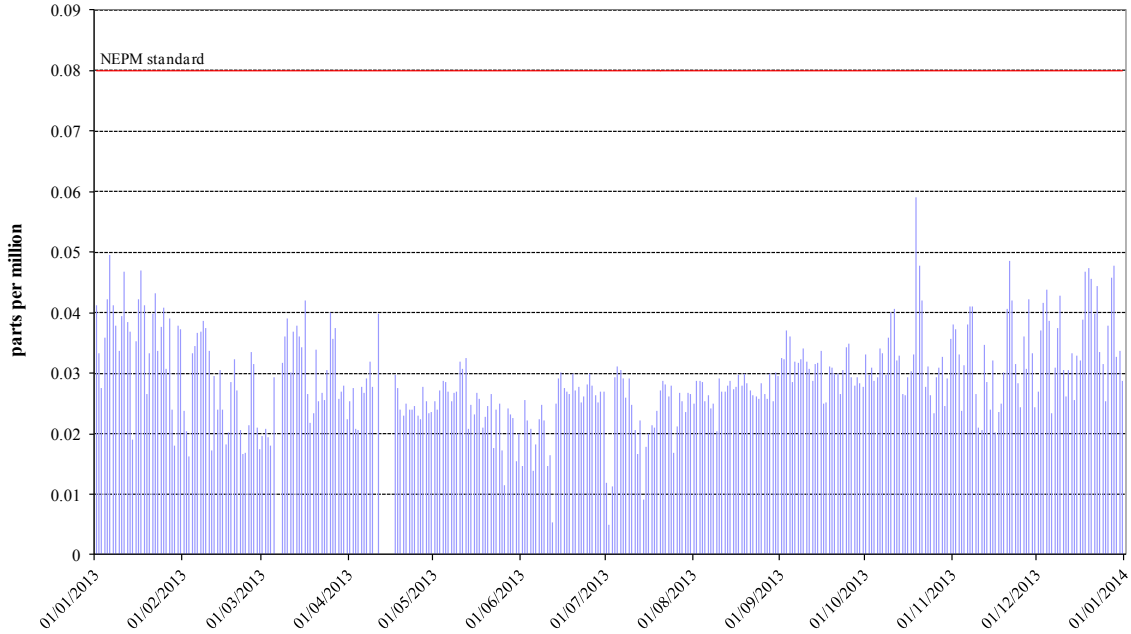
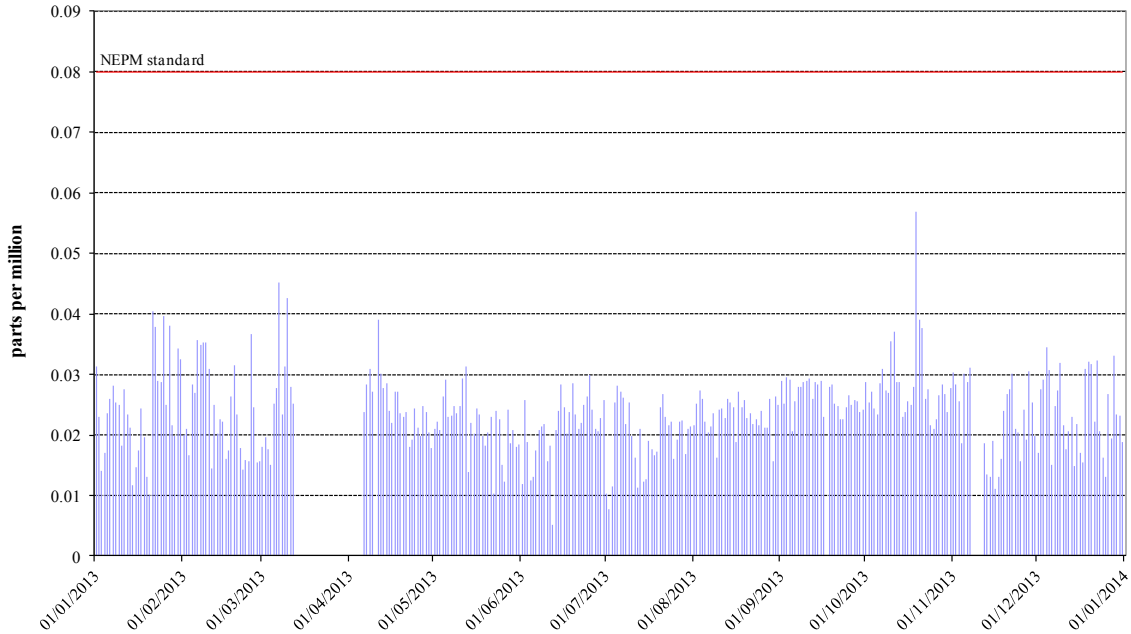


Figure 8: Daily max for 4 hours O_3 - Civic



PM_{10}

During 2013, there was one exceedence of the 24-hour PM_{10} standard recorded at Civic. Compliance against the AAQ NEPM goal was demonstrated at both stations.

Table 7: 2013 compliance summary for PM_{10}
AAQ NEPM standard 50 µg/m³ 1-day average

Performance monitoring station	Data availability rates (% of days)					Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Monash	95.6	93.4	90.3	100	95.6	0	MET
Civic	83.3	100	98.4	91.8	92.9	1	MET

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

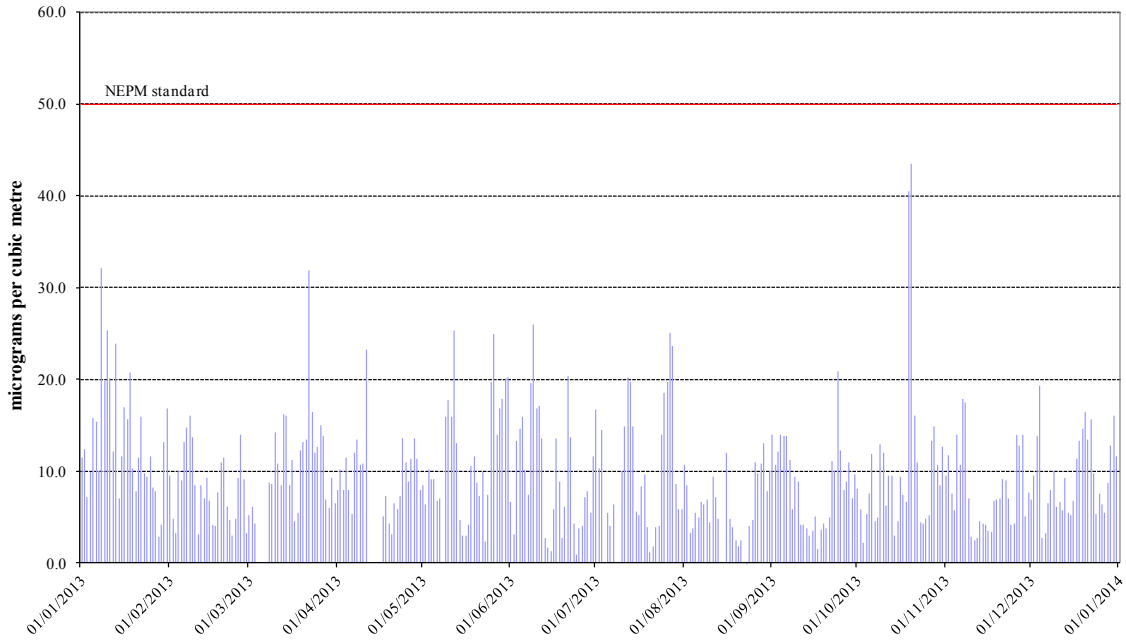
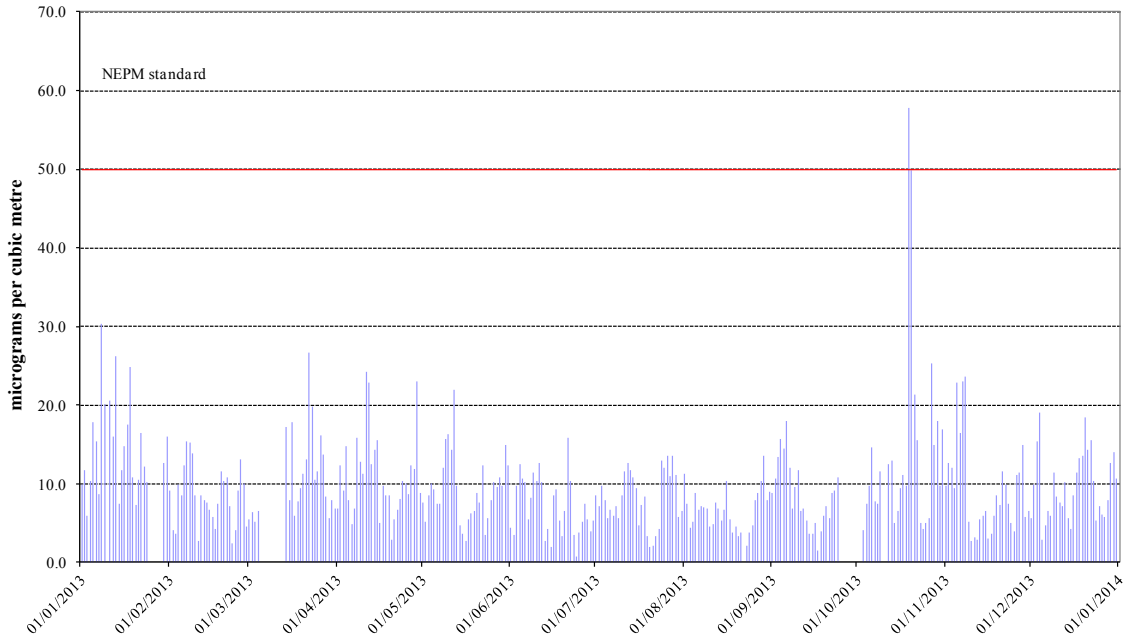


Figure 10: Daily max for PM_{10} – Civic



$PM_{2.5}$

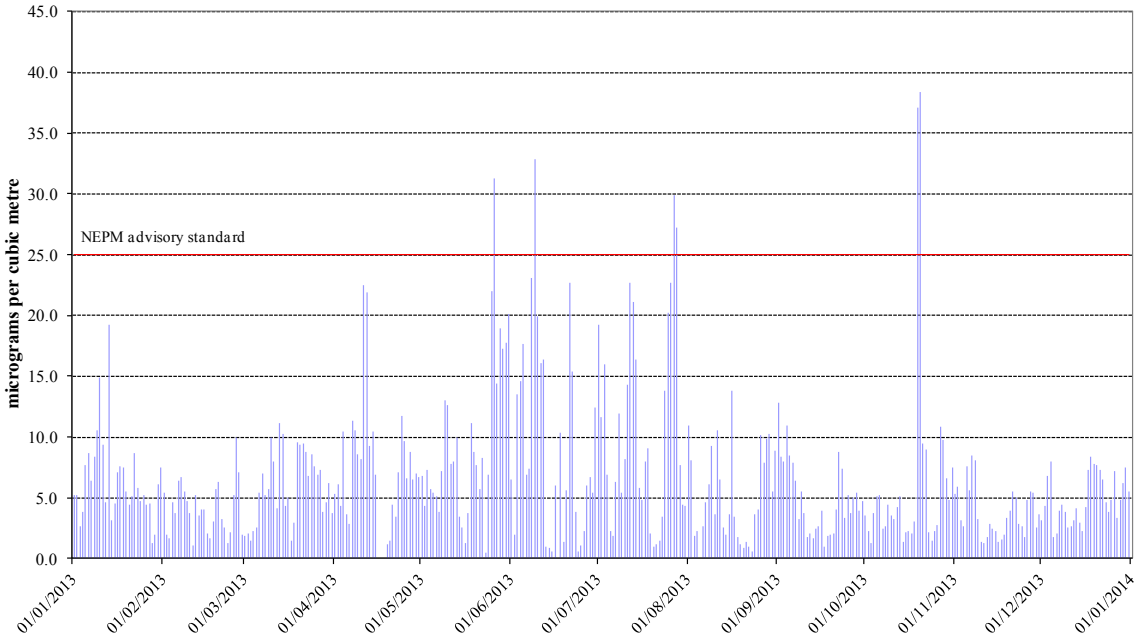
Six exceedences of the 24-hour advisory reporting standard were recorded at Monash during 2013.

Table 8: 2013 compliance summary for $PM_{2.5}$

AAQ NEPM standard – 25 µg/m³ (1-day), 8 µg/m³ (1-year)

Performance monitoring station	Data availability rates (% of days)					Annual mean Concentration (µg/m³)	Number of exceedences (days)
	Q1	Q2	Q3	Q4	Annual		
Monash	100	95.6	98.4	100	98.6	6.9	6

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 and O_3, 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: 2013 summary statistics for daily peak 8-hour CO
AAQ NEPM standard- 9.0 ppm (8-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2nd Highest (ppm)	2nd Highest (date/time)
Monash	350	2.1	22 Jun 04:00	2.1	22 Jun 03:00
Civic	357	1.5	21 Jun 23:00	1.4	21 Jun 00:00

Carbon monoxide levels are well below the AAQ NEPM standard. The highest recorded value in the ACT during 2013 was 2.1ppm at Monash, where levels reached 23% of the standard.

Nitrogen dioxide

Table 10: 2013 summary statistics for daily peak 1-hour NO_2
AAQ NEPM standard 0.12 ppm (1-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2nd Highest (ppm)	2nd Highest (date/time)
Monash	357	0.037	17 Jan 21:00	0.035	07 Jan 21:00
Civic	358	0.045	19 Oct 20:00	0.040	09 May 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 2013 was 0.045ppm at Civic, which is only 38% of the standard. The highest recorded annual average in 2013 was 0.007ppm at Civic. This is 23% of the annual standard 0.03ppm.

Ozone

Table 11: 2013 summary statistics for daily peak 1-hour O_3
AAQ NEPM standard 0.10 ppm (1-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2nd Highest (ppm)	2nd Highest (date/time)
Monash	357	0.062	19 Oct 18:00	0.053	17 Jan 12:00
Civic	336	0.060	19 Oct 18:00	0.047	07 Mar 14:00

Table 12: 2013 summary statistics for daily peak 4-hour O_3
AAQ NEPM standard 0.08 ppm (4-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2nd Highest (ppm)	2nd Highest (date/time)
Monash	357	0.059	19 Oct 18:00	0.050	06 Jan 14:00
Civic	335	0.057	19 Oct 18:00	0.045	07 Mar 16:00

Ozone levels are below the AAQ NEPM standard. The highest recorded 1-hour value in the ACT during 2013 was 0.062ppm at Monash, which is 62% of the standard. The highest recorded 4-hour value in the ACT during 2013 was 0.059ppm at Monash. This is 74% of the standard.

PM_{10}

Table 13: 2013 summary statistics for daily peak PM_{10}
AAQ NEPM standard 50 µg/m³ (24-hour average)

Performance monitoring station	Number of valid days	Highest (µg/m³)	Highest (date)	6th Highest (µg/m³)	6th Highest (date)
Monash	349	43.5	20 October	25.3	10 January
Civic	339	57.8	19 October	25.3	27 October

PM_{10} levels are below the AAQ NEPM standard. The highest PM_{10} level recorded during 2013 was 57.8µg/m³ at Civic on 19 October 2013. This is due to a hazard reduction burn in NSW.

$PM_{2.5}$

Table 14: 2013 summary statistics for daily peak $PM_{2.5}$
AAQ NEPM standard 25 µg/m³ (24-hour average)

Performance monitoring station	Number of valid days	Highest (µg/m³)	Highest (date)	6th Highest (µg/m³)	6th Highest (date)
Monash	360	**38.4**	20 October	**27.2**	28 July

The 24-hour advisory reporting standard for $PM_{2.5}$ was exceeded six times at Monash. Four exceedences occurred between May and July and can be attributed to domestic wood heater emissions. Two exceedences occurred on 19 and 20 October respectively due to smoke coming from a hazard reduction burn in NSW.

Assessment of progress towards achieving the goal

The ACT is currently compliant with the goal specified in Schedule 2 of the AAQ NEPM.

Historical monitoring results indicate 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 standards have also been attributed to dust storms and smoke from controlled burns.

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 'Burn Right Tonight Campaign', and the on-going administration of the Wood Heater Replacement Program.

The ACT is also working with the Commonwealth and other jurisdictions at a national level to progress actions to improve air quality. At the Environment Ministers Meeting on 29 April 2014, Ministers signalled their intention to vary the AAQ NEPM for particles reflecting the latest scientific understanding on health risks arising from particle pollution. The Measure seeks to establish a more stringent reporting standard for particle pollution ($PM_{2.5}$ and PM_{10}). An Impact Statement on the proposed variation will be released for public consultation following the completion of statutory processes.

Reflecting the significance of fine particle emissions from 'non-road spark ignition engines' (marine engines and garden equipment) and wood heaters, Ministers requested finalisation, by September 2014, of Decision Regulation Impact Statements on potential emission control options for these sectors.

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 2004 – 2013

Year	Data Avail. (%)	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	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	1.6	1.4	1.1	0.6	0.3
2011	98.6	0	2.2	1.9	1.8	1.5	1.1	0.5	0.2
2012	99.7	0	1.8	1.7	1.7	1.2	1.0	0.6	0.3
2013	95.9	0	2.1	1.9	1.8	1.5	1.2	0.6	0.3

Figure 12: Statistical summary for daily maximum 8-hour CO Monash 2004 – 2013

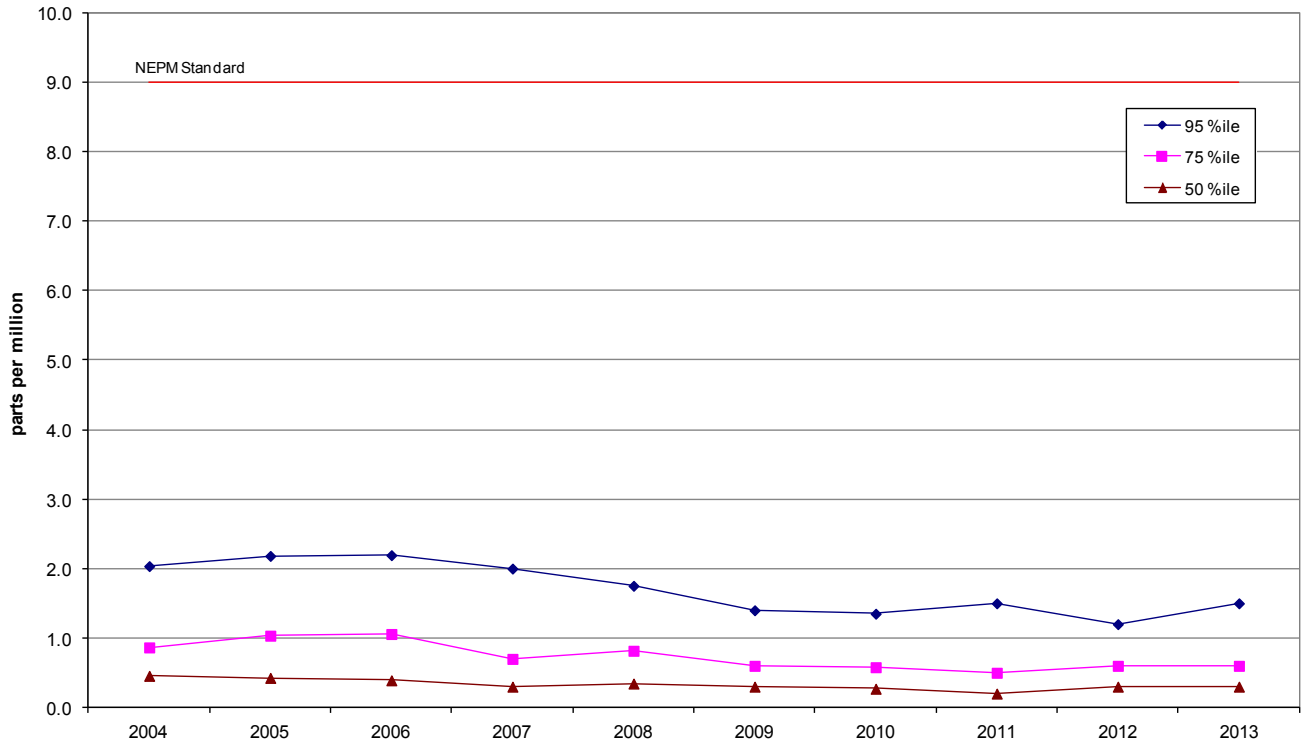
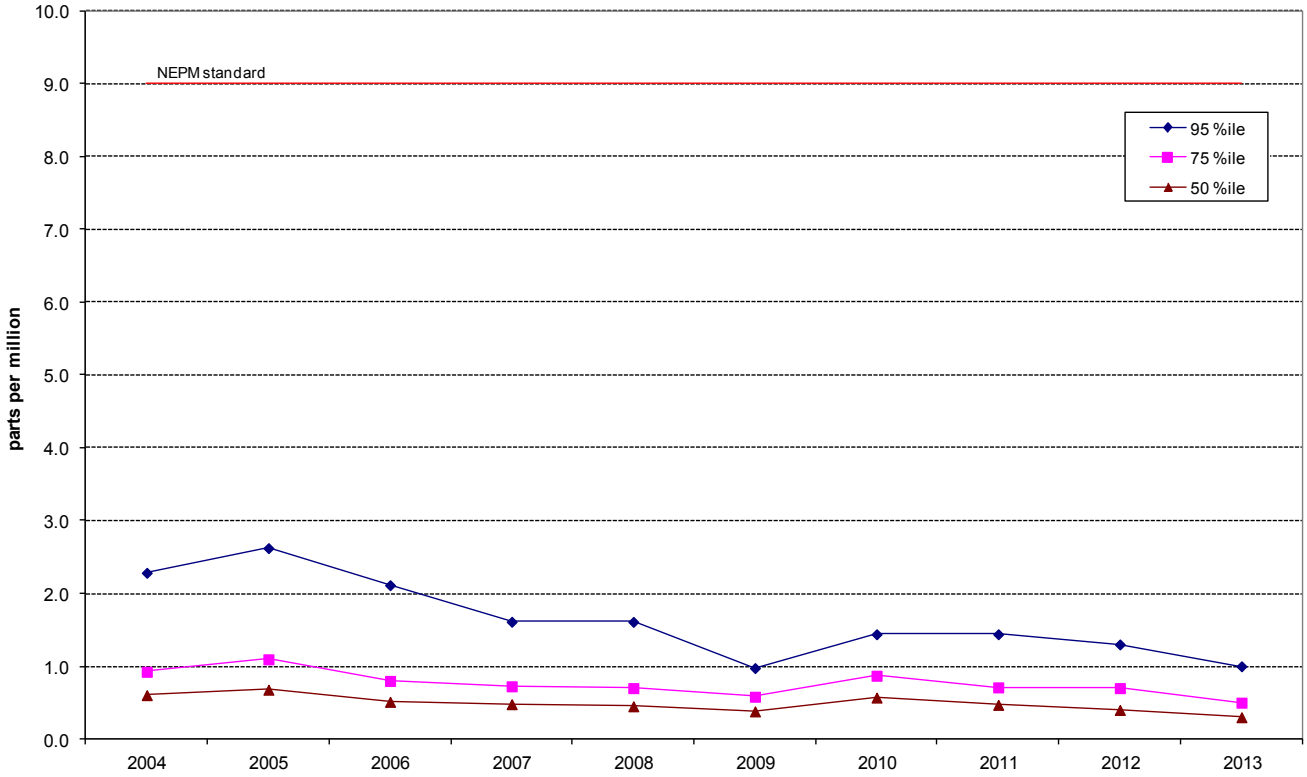


Table 16: Statistical summary for daily maximum 8-hour CO Civic 2004 – 2013

Year	Data Avail. (%)	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	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
2011	97.8	0	2.0	1.8	1.6	1.4	1.0	0.7	0.5
2012	95.9	0	1.8	1.5	1.4	1.3	1.1	0.7	0.4
2013	97.8	0	1.5	1.3	1.1	1.0	0.8	0.5	0.3

Figure 13: Statistical summary for daily maximum 8-hour CO Civic 2004 – 2013



Nitrogen dioxide

Table 17: Statistical summary for daily maximum 1-hour NO_2 Monash 2004 – 2013

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	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
2011	96.7	0	0.043	0.031	0.030	0.029	0.026	0.022	0.015
2012	97.5	0	0.033	0.030	0.029	0.026	0.025	0.021	0.014
2013	97.5	0	0.037	0.031	0.030	0.027	0.025	0.021	0.014

Figure 14: Statistical summary for daily maximum 1-hour NO_2 Monash 2004 – 2013

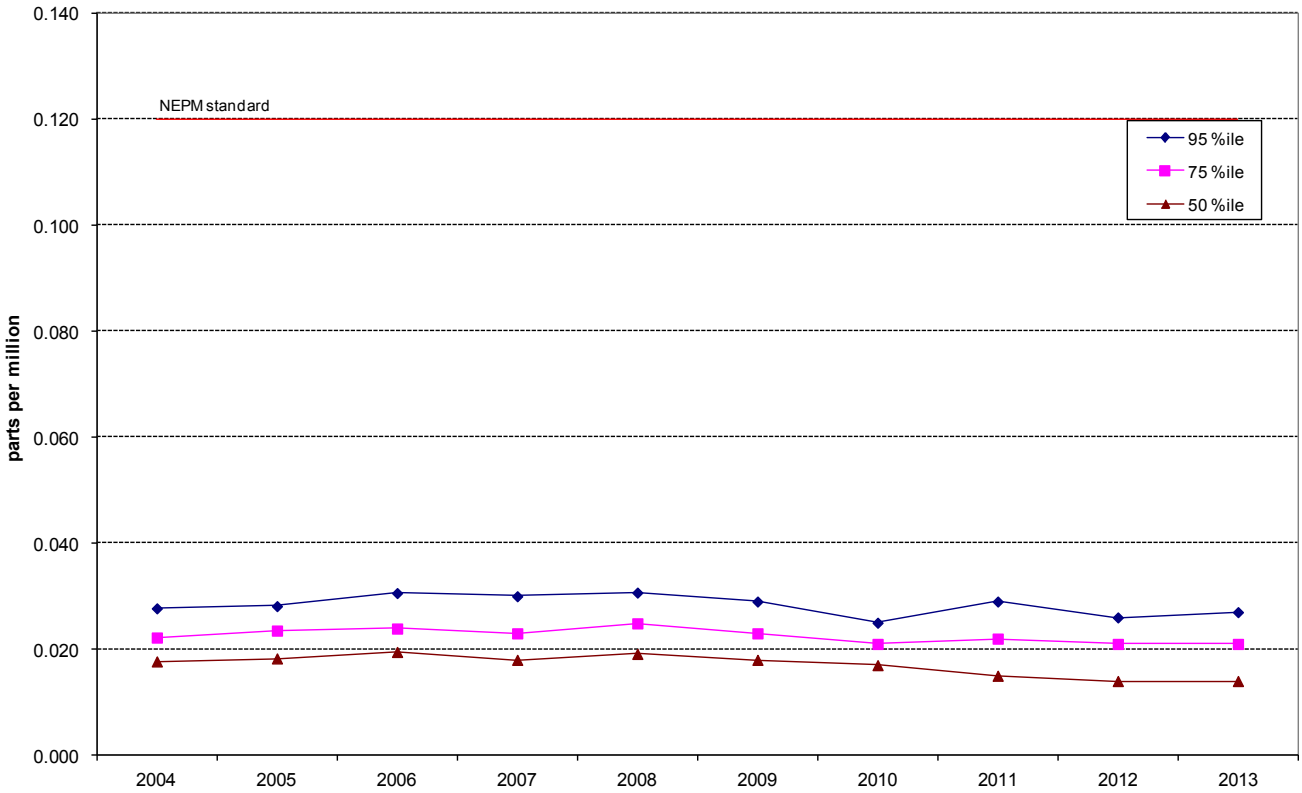


Figure 15: Annual average 1-hour NO_2 Monash 2004 – 2013

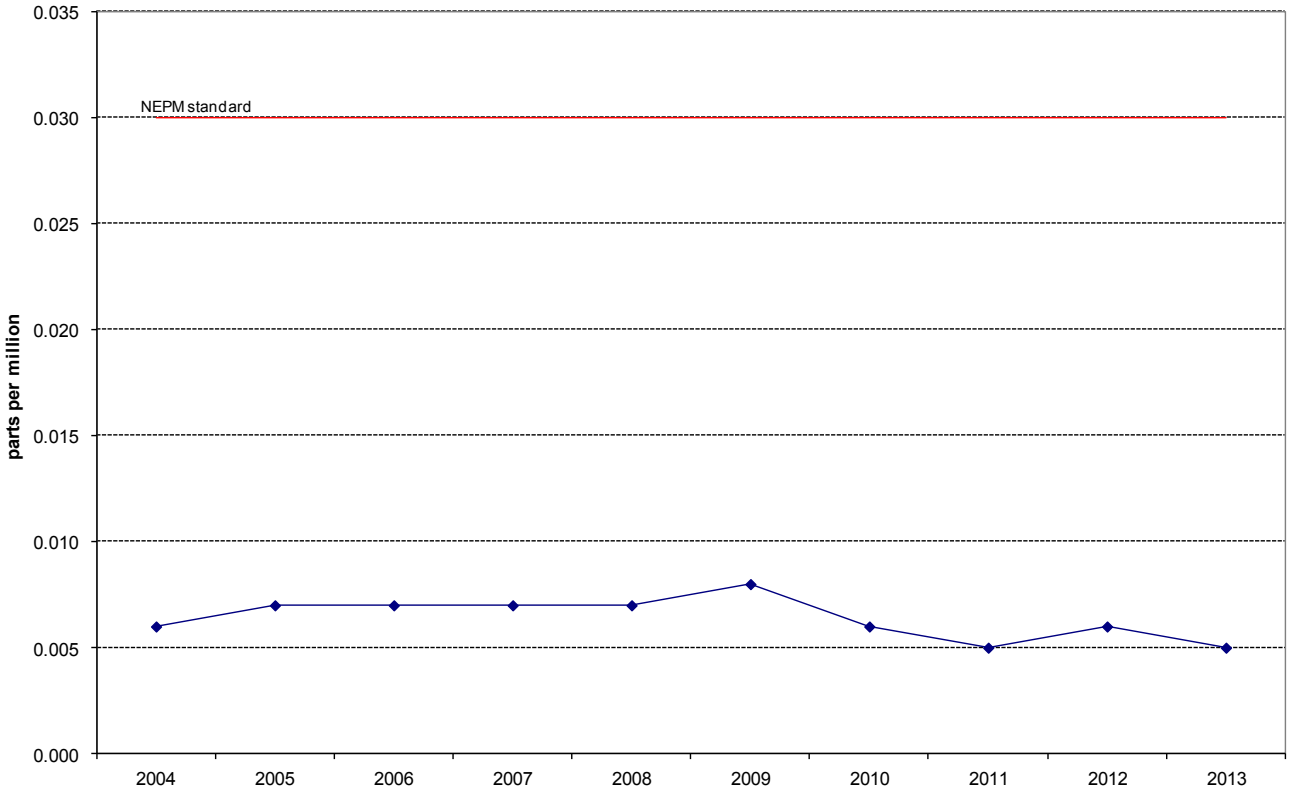


Table 18: Statistical summary for daily maximum 1-hour NO_2 Civic 2004 – 2013

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	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
2011	88.8	0	0.046	0.036	0.035	0.032	0.029	0.023	0.018
2012	98.6	0	0.044	0.036	0.033	0.030	0.029	0.024	0.019
2013	98.1	0	0.045	0.038	0.036	0.033	0.029	0.022	0.016

Figure 16: Statistical summary for daily maximum 1-hour NO_2 Civic 2004 – 2013

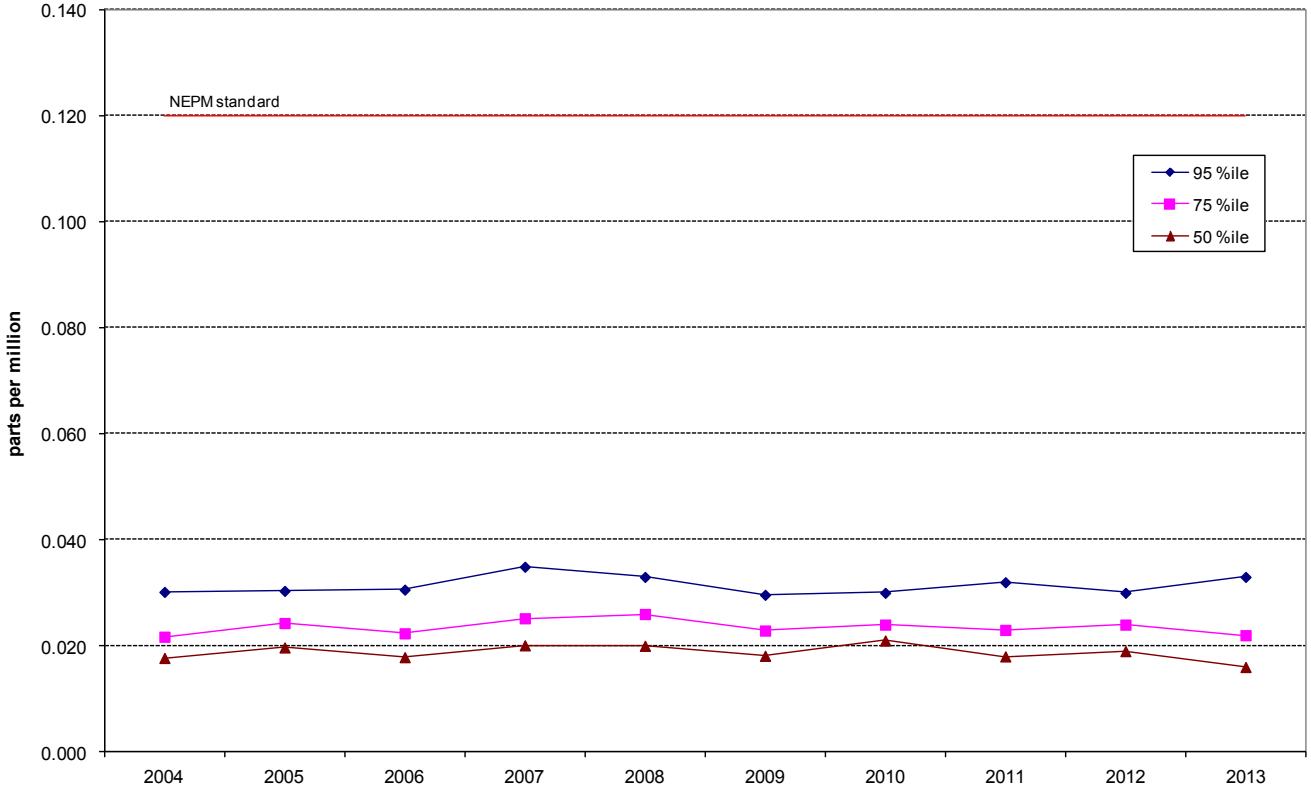
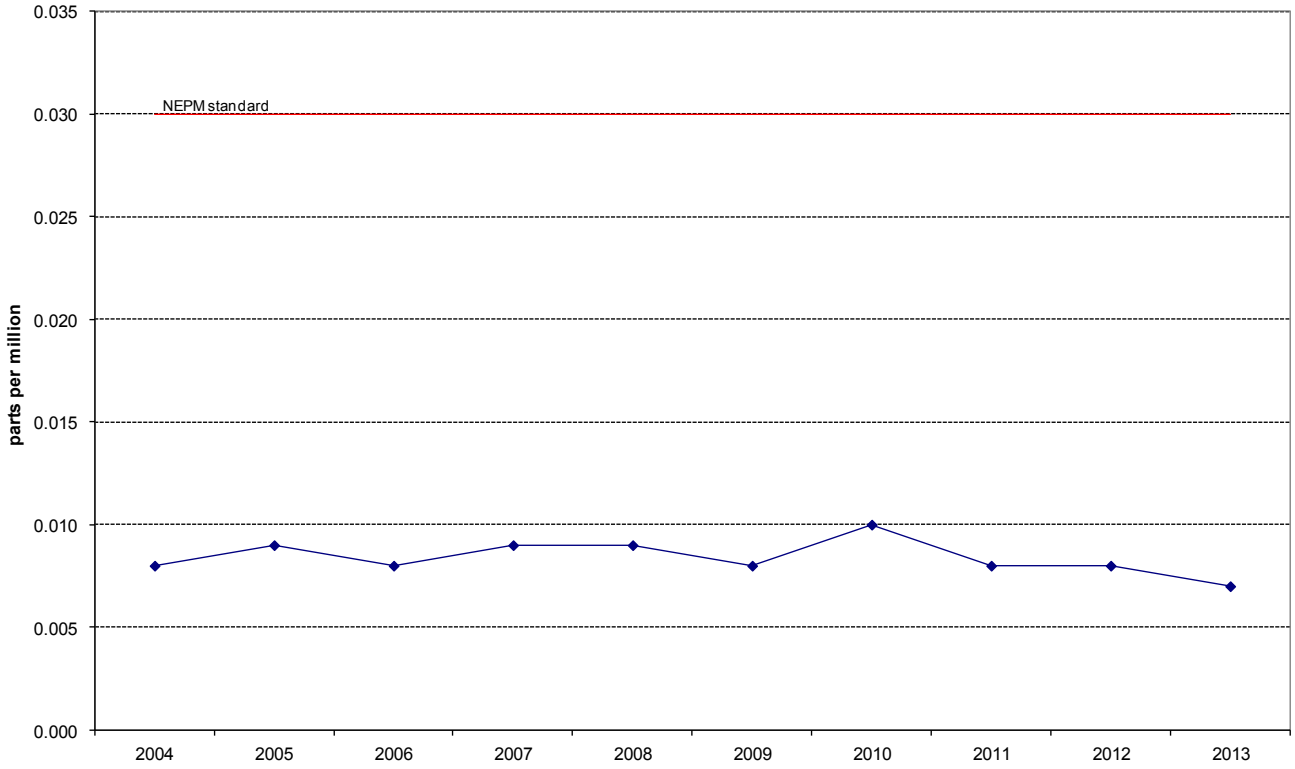


Figure 17: Annual average 1-hour NO_2 Civic 2004 – 2013



Ozone

Table 19: Statistical summary for daily maximum 1-hour O_3 Monash 2004 – 2013

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	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
2011	99.2	0	0.056	0.052	0.047	0.044	0.040	0.033	0.028
2012	100	0	0.055	0.048	0.046	0.043	0.040	0.034	0.029
2013	97.8	0	0.062	0.051	0.049	0.045	0.041	0.035	0.029

Figure 18: Statistical summary for daily maximum 1-hour O_3 Monash 2004 – 2013

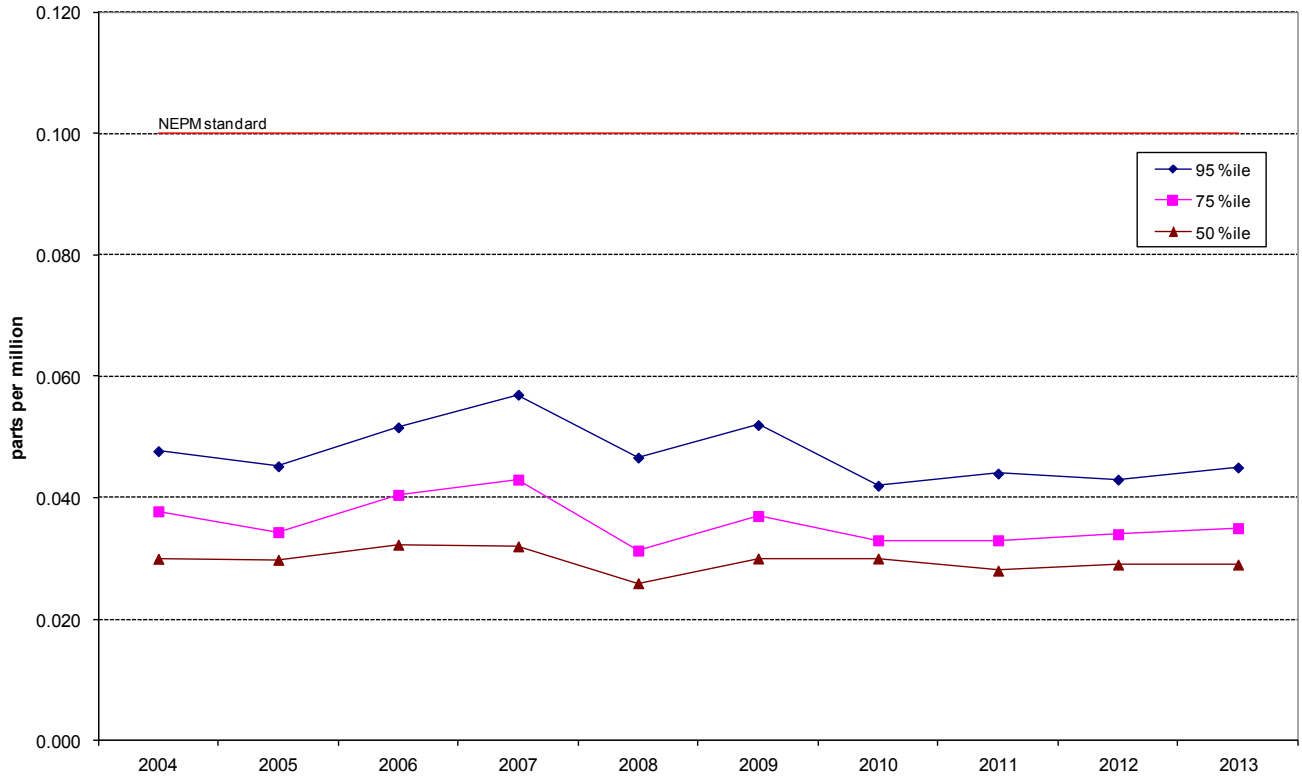


Table 20: Statistical summary for daily maximum 1-hour O_3 Civic 2004 – 2013

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	93.5	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
2011	96.4	0	0.052	0.046	0.045	0.041	0.036	0.030	0.026
2012	100	0	0.053	0.041	0.038	0.034	0.030	0.024	0.020
2013	92.1	0	0.060	0.043	0.041	0.036	0.032	0.028	0.024

Figure 19: Statistical summary for daily maximum 1-hour O_3 Civic 2004 – 2013

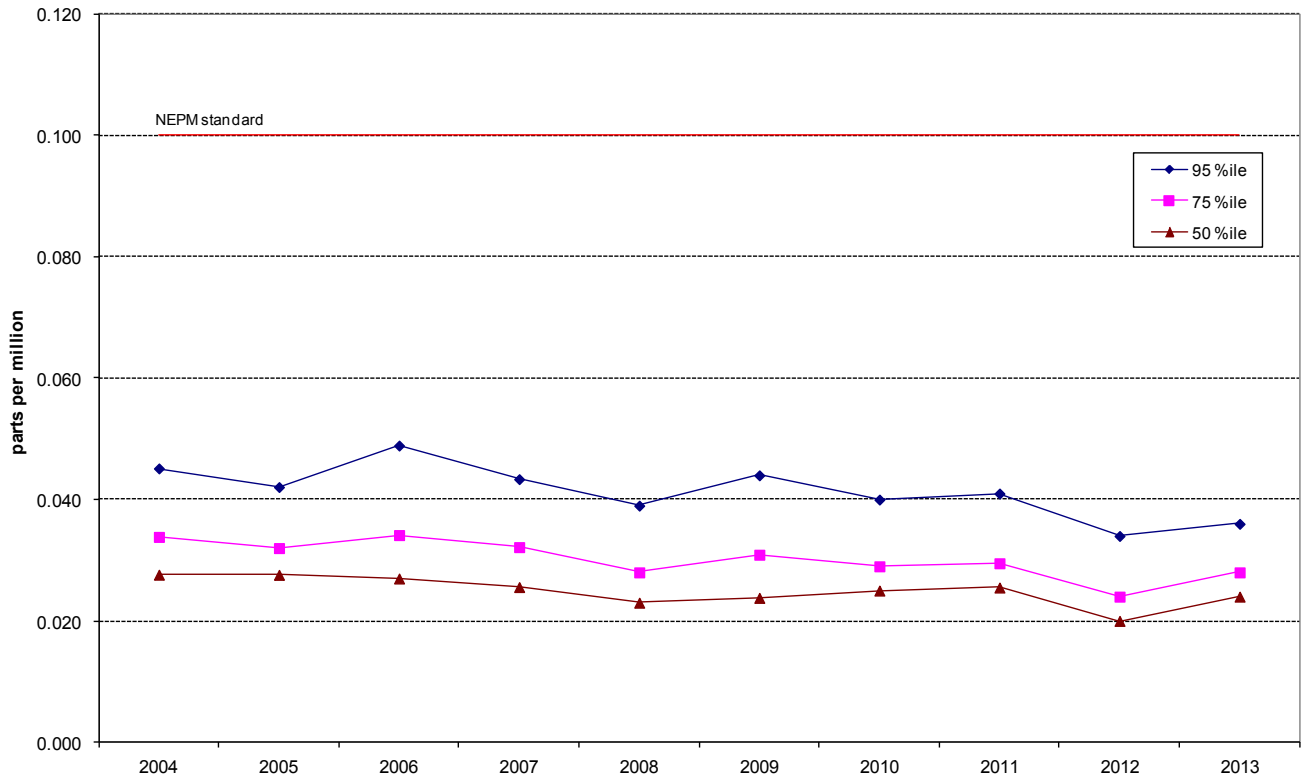


Table 21: Statistical summary for daily maximum 4-hour O_3 Monash 2004 – 2013

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	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
2011	98.9	0	0.054	0.048	0.044	0.041	0.038	0.032	0.027
2012	99.7	0	0.052	0.048	0.046	0.043	0.040	0.034	0.029
2013	97.8	0	0.059	0.048	0.047	0.042	0.039	0.033	0.028

Figure 20: Statistical summary for daily maximum 4-hour O_3 Monash 2004 – 2013

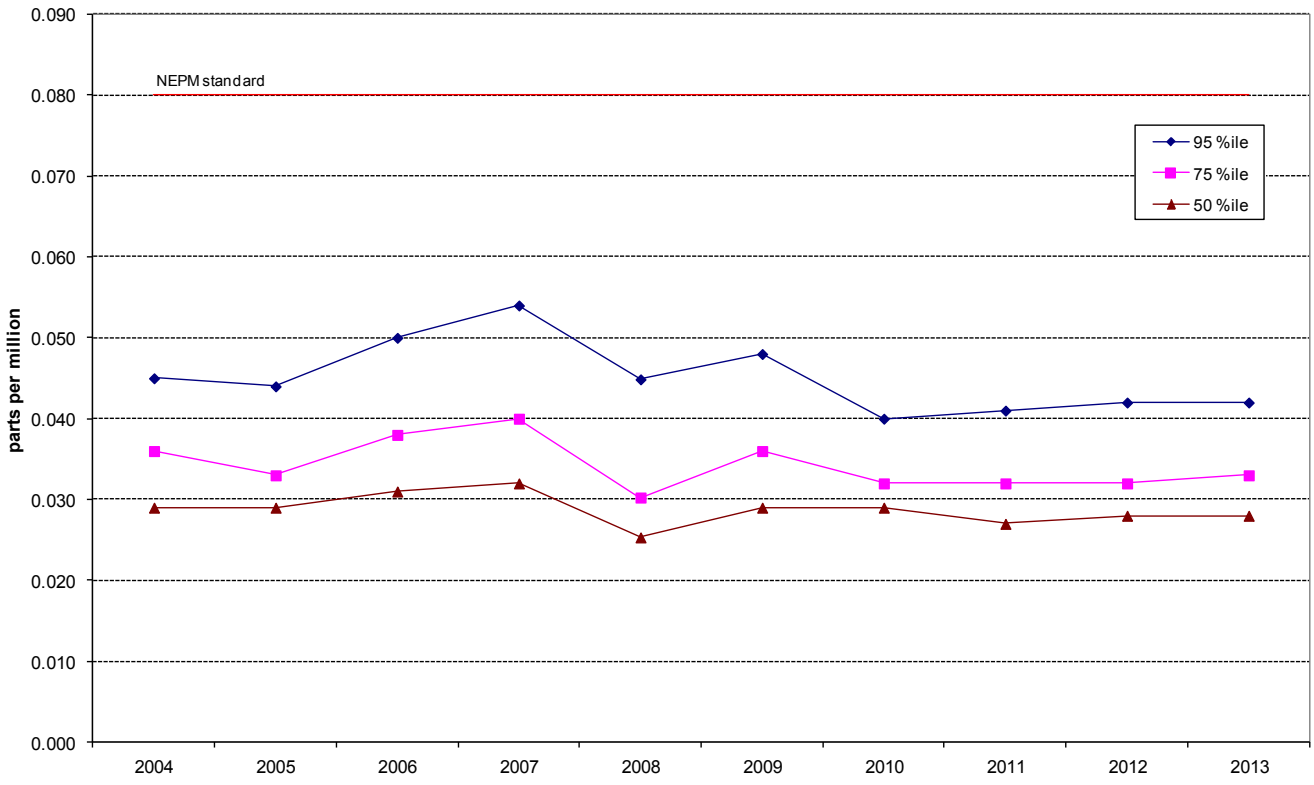
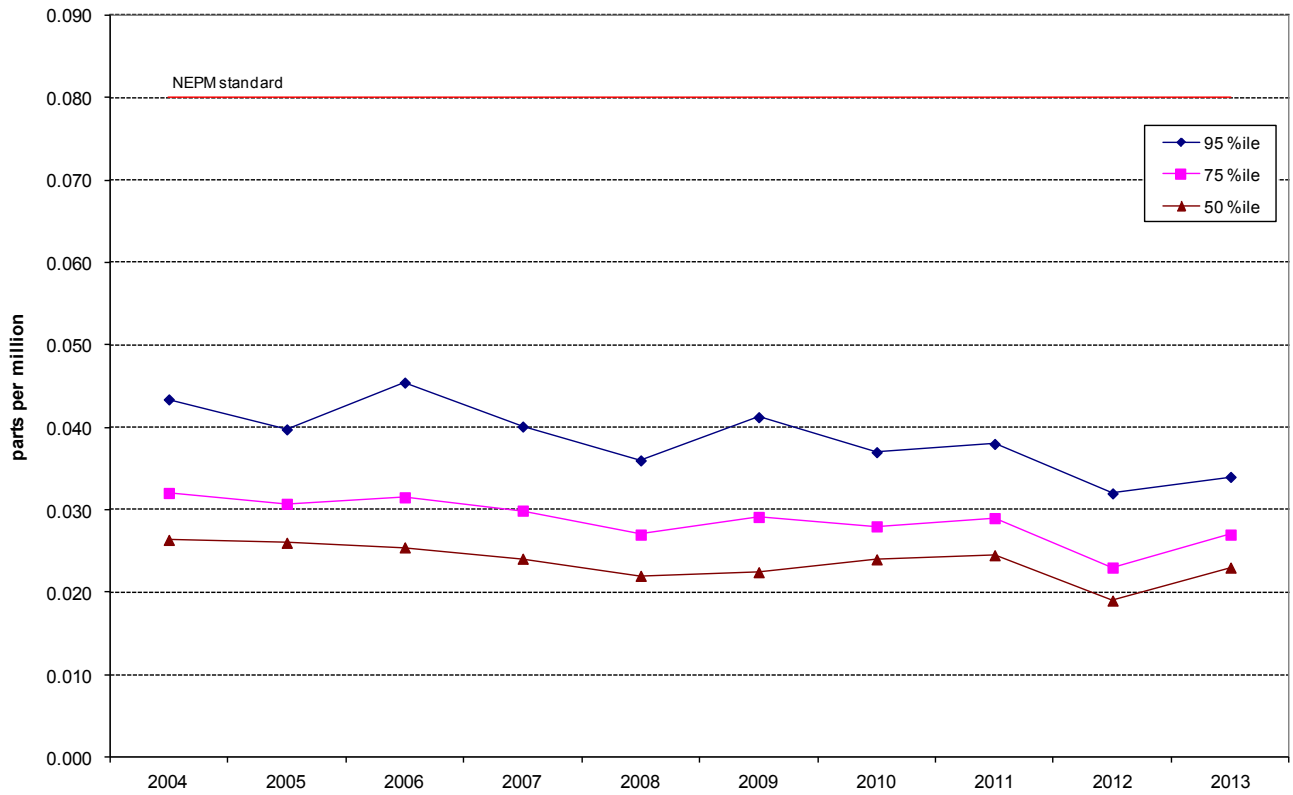


Table 22: Statistical summary for daily maximum 4-hour O_3 Civic 2004 – 2013

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	93.5	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
2011	96.4	0	0.050	0.044	0.041	0.038	0.035	0.029	0.025
2012	100	0	0.042	0.037	0.036	0.032	0.028	0.023	0.019
2013	91.8	0	0.057	0.040	0.038	0.034	0.030	0.027	0.023

Figure 21: Statistical summary for daily maximum 4-hour O_3 Civic 2004 – 2013

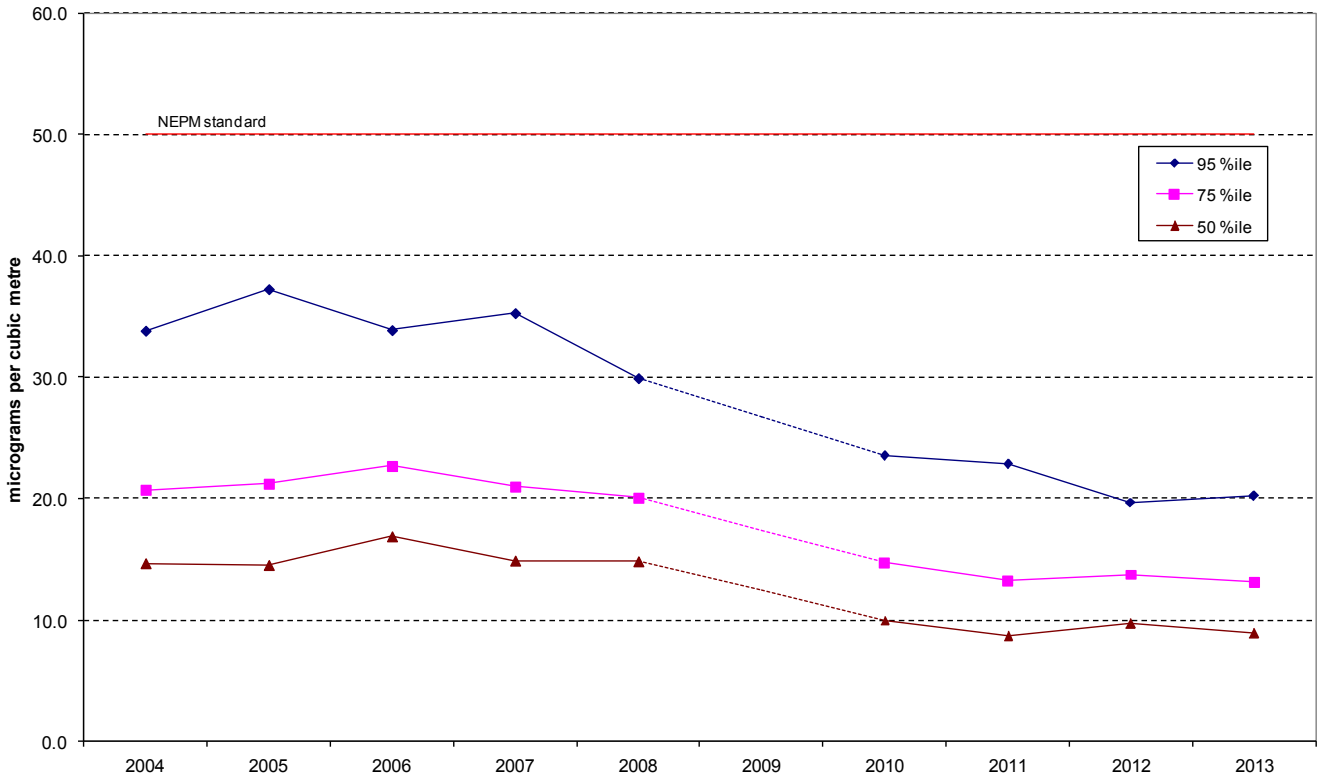


PM_{10}

Table 23: Statistical summary for daily maximum 24-hour PM_{10} Monash 2004 – 2013

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	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
2011	99.2	0	40.0	33.7	30.3	22.8	18.6	13.2	8.7
2012	98.6	0	41.0	24.2	21.8	19.7	17.4	13.7	9.7
2013	95.6	0	43.5	29.1	25.1	20.2	16.8	13.1	8.9

Figure 22: Statistical summary for daily maximum 24-hour PM_{10} Monash 2004 – 2013

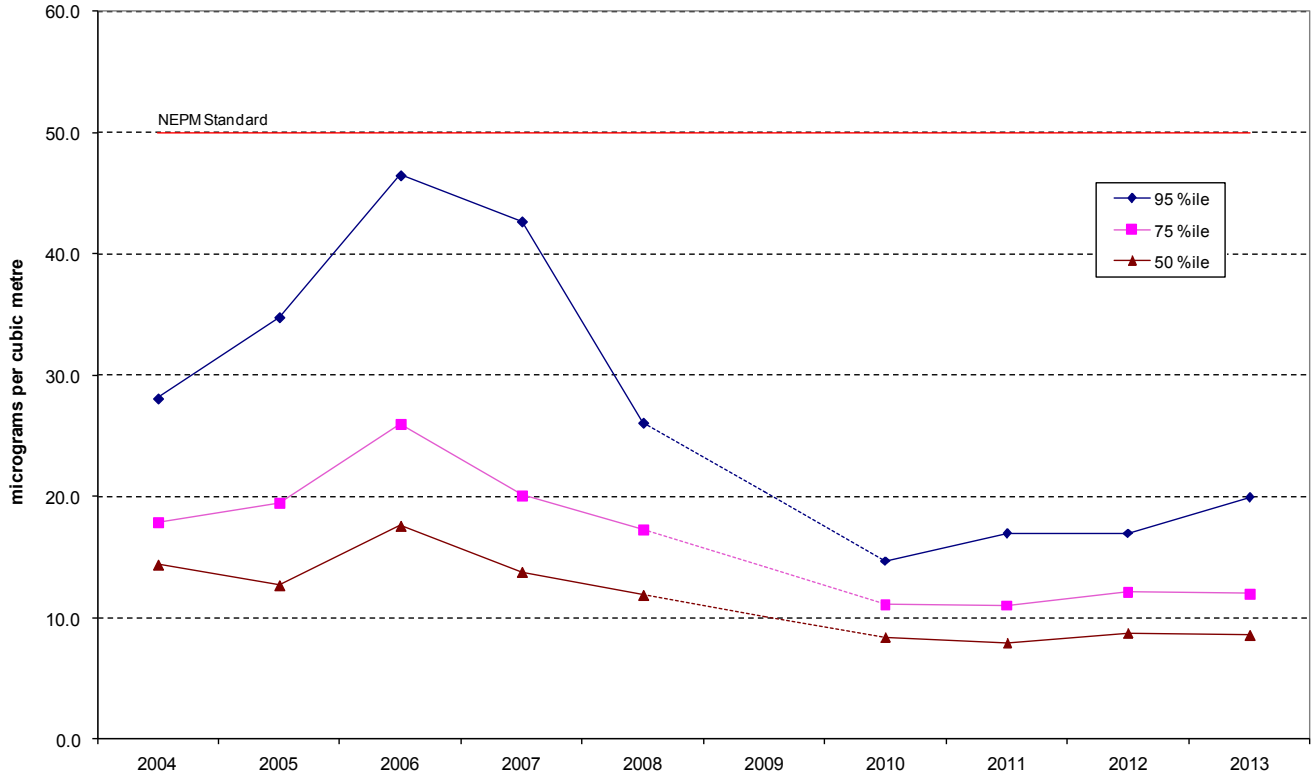


Note 2009 data has not been included in Figure 22 as the percentile data has been skewed because of insufficient data in Q1 and Q2 (zero and 25% respectively) and the extreme readings associated with the dust storm which affected most of eastern Australia on 22 and 23 September, 2009.

Table 24: Statistical summary for daily maximum 24-hour PM_{10} Civic 2004 – 2013

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	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
2011	97.0	0	29.2	22.3	20.9	16.9	14.4	11.0	7.9
2012	95.1	0	49.5	22.8	20.2	17.0	14.9	12.1	8.7
2013	92.9	1	57.8	26.5	24.4	19.9	15.8	12.0	8.6

Figure 23: Statistical summary for daily maximum 24-hour PM_{10} Civic 2004 – 2013



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 – 2013

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
2011	92.1	4	32.8	25.6	22.9	20.0	12.5	7.0	4.5
2012	95.1	3	29.2	23.8	19.8	16.5	13.2	8.3	5.0
2013	98.6	6	38.4	30.5	22.7	19.2	12.9	8.1	5.2

Figure 24: Statistical summary for daily maximum 24-hour $PM_{2.5}$ Monash 2004 – 2013