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ACT AIR QUALITY REPORT 2016

Environment Protection Authority

June 2017

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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
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 2016 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.

As the AAQ NEPM was varied to introduce revised national standards for particulate matters in 2016, air quality in this report is assessed against the revised AAQ NEPM standards shown in Table 3. In accordance with its agreed policy position, the ACT will assess its compliance for the annual average for particulate matter less than 10 microns (PM_{10}) against a lower standard of 20 µg/m^3 rather than the AAQ NEPM standard of 25 µg/m^3.

The ACT monitors four of the six NEPM pollutants:

- 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 in diameter – $PM_{2.5}$).

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 in the ACT 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 in 2016 demonstrate that Canberra's air quality is generally excellent, with no exceedences of the AAQ NEPM standards for carbon monoxide, nitrogen dioxide, ozone, and particles as PM10. The major impacts on Canberra's air quality in 2016 came from the accumulation of combustion particles from hazard reduction burns and wood heaters.

There were 9 days when particles as $PM_{2.5}$ exceeded the daily standard, with 8 days exceedences at Monash and 1 day at Florey. Six exceedences occurred between April and

May, which are due to smoke coming from hazard reduction burns early in this period and a combination of both hazard reduction burns and wood heater emissions later in this period. The other three exceedences, which occurred between June and July, can be linked directly to increased domestic wood heater emissions during the cold winter months.

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 Protection Authority within the Chief Minister, Treasury and Economic Development Directorate is responsible for annual reporting under the AAQ NEPM.

The AAQ NEPM monitoring network in the ACT currently consists of three monitoring stations at Monash, Civic and Florey 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 Florey station, which has been operational since 28 February 2014, is located at the end of Neumann Place, Florey in public land. The compliance and non-compliance criteria for the above 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	☑	☒	☒	☒	☑	☑	☑
Florey	☑	☑	☑	☑	☑	☑	☑

Both Monash and Florey stations contain instrumentation that continuously monitors carbon monoxide, nitrogen dioxide, ozone and particles as PM_{10} and $PM_{2.5.}$ Following the establishment of the Florey station, the Civic station only monitors ozone and particles as PM_{10} and $PM_{2.5}$.

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	Methods for sampling and analysis of ambient air - Determination of carbon monoxide - Direct-reading instrumental method	Gas filter correlation/ Infrared.
Nitrogen dioxide	AS 3580.5.1-2011	Methods for sampling and analysis of ambient air - Determination of oxides of nitrogen - Direct-reading instrumental method	Gas phase chemiluminescence.
Photochemical oxidant (ozone)	AS 3580.6.1-2011	Methods for sampling and analysis of ambient air - Determination of ozone - Direct-reading instrumental method	Non-dispersive ultraviolet.
Particles PM_{10}	AS /NZS 3580.9.11-2016	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 3580.9.6-2015	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 3580.9.10-2008	Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - $PM_{2.5}$ low volume sampler - Gravimetric method	Gravimetric reference method

Particulate Matters Monitoring Variation

The AAQ NEPM was varied to introduce a daily standard of 25 µg /m^3 and a 8 µg /m^3 annual standard for $PM_{2.5}$ in 2016. The varied AAQ NEPM also removed the number of allowable exceedances for $PM_{2.5}$ and PM_{10}.

NATA Accreditation Status

The ACT Government monitoring network is accredited by NATA for the measurement of all AAQ NEPM pollutants except sulfur dioxide and lead as required under Clause 12 of the AAQ NEPM.

ASSESSMENT OF COMPLIANCE WITH STANDARDS AND GOALS

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 National Environment Protection Standards as assessed in accordance with the monitoring protocol 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 (shown in column 4, Table 3). For $PM_{2.5}$, there is an additional goal to further reduce concentrations to below a daily concentration of 20 µg /m^3 and an annual concentration of 7 µg /m^3 by 2025.

Table 3: AAQ NEPM standards and goals

Pollutant	Averaging Period	Maximum concentration	Maximum allowable exceedences	Monitoring Station
Carbon monoxide	8 hours	9.0 ppm	1 day a year	Monash Florey
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year None	Monash Florey
Photochemical oxidants	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year	Monash Florey Civic
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	Not monitored
Lead	1 year	0.50 µg/m^3	None	Not monitored
Particles as PM_{10}	1 day 1 year	50 µg/m^3 25 µg/m^3	None None	Monash Florey Civic
Particles as $PM_{2.5}$	1 day 1 year	25 µg/m^3 8 µg/m^3	None None	Monash Florey Civic

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.

Air quality 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.

Air quality 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.

Air quality is assessed as 'NOT DEMONSTRATED' (ND) if there has been insufficient data collected to demonstrate that the standards and goal have been met or not met.

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

Carbon monoxide

During 2016, no exceedences of the carbon monoxide standard were recorded in the ACT and compliance was demonstrated at Monash and Florey.

Table 4: 2016 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	95.8	95.8	95.8	95.7	95.8	0	MET
Florey	95.8	95.8	95.8	94.5	95.5	0	MET

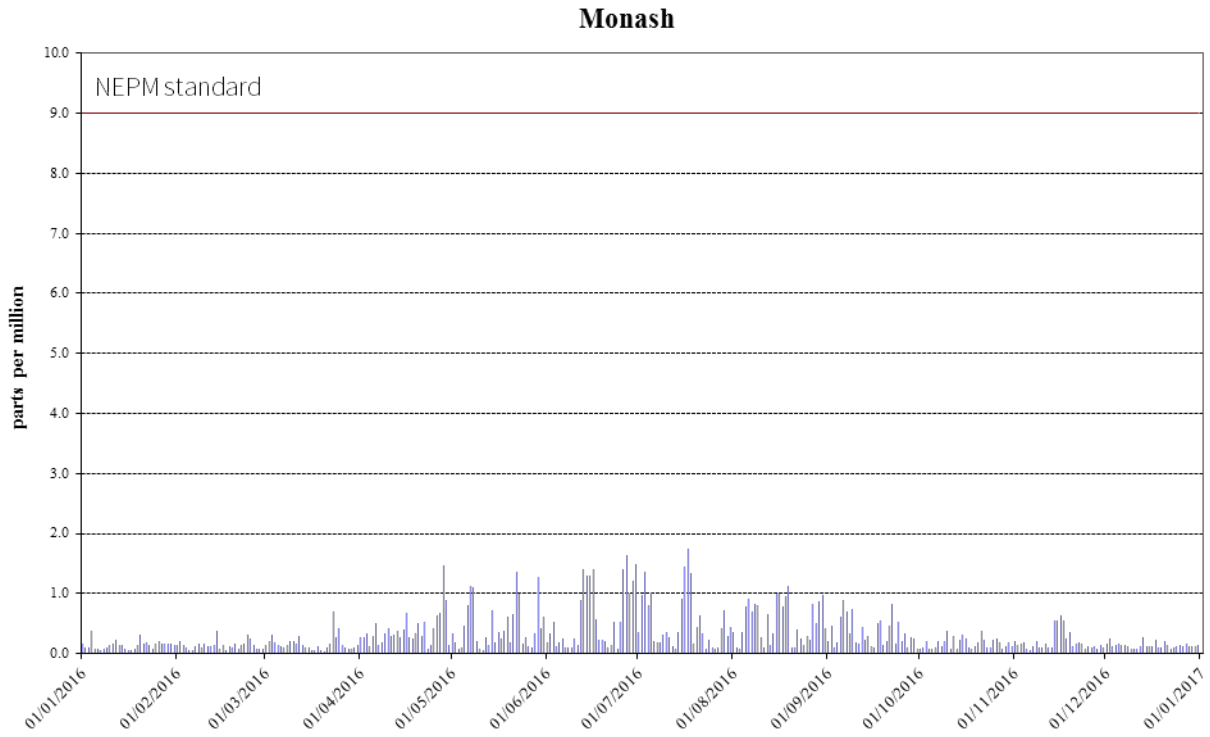

Figure 1: Daily max for CO 8-hour average – Monash

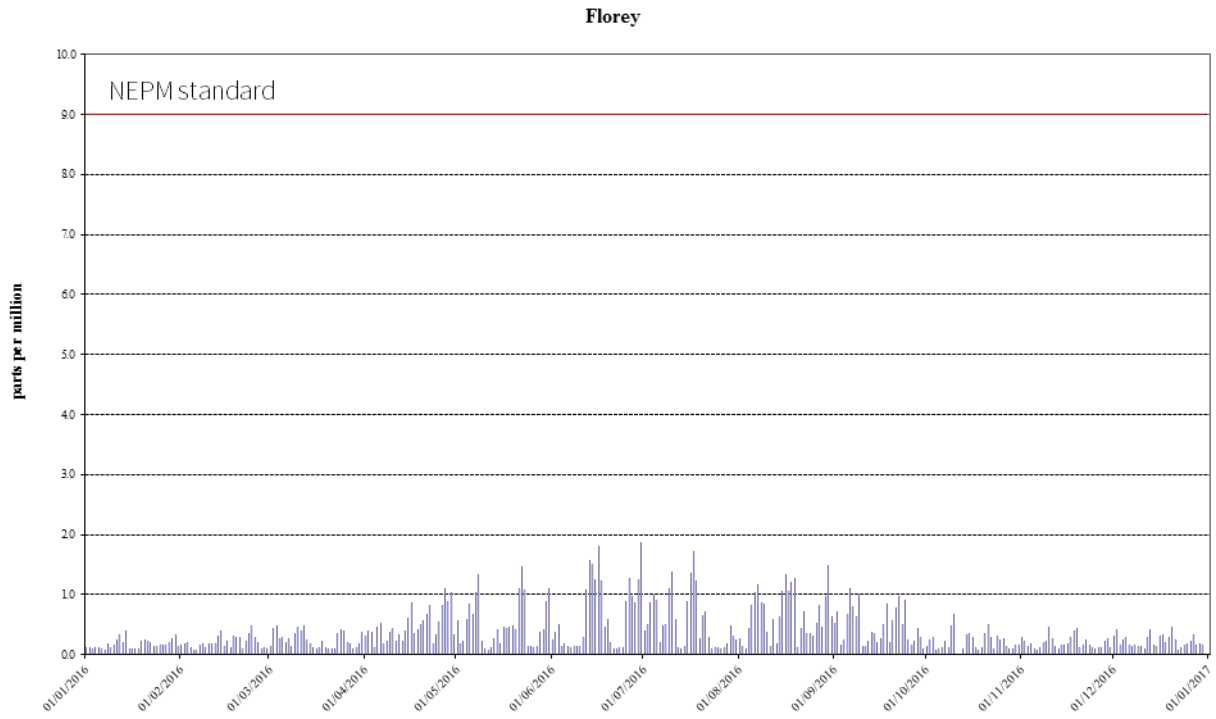

Figure 2: Daily max for CO 8-hour average – Florey

Nitrogen dioxide

During 2016, no exceedences of the nitrogen dioxide standards were recorded in the ACT and compliance was demonstrated at Monash and Florey.

Table 5: 2016 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	95.8	95.8	95.4	95.5	95.6	0.004	0	MET	MET
Florey	95.8	95.1	94.2	93.7	94.7	0.005	0	MET	MET

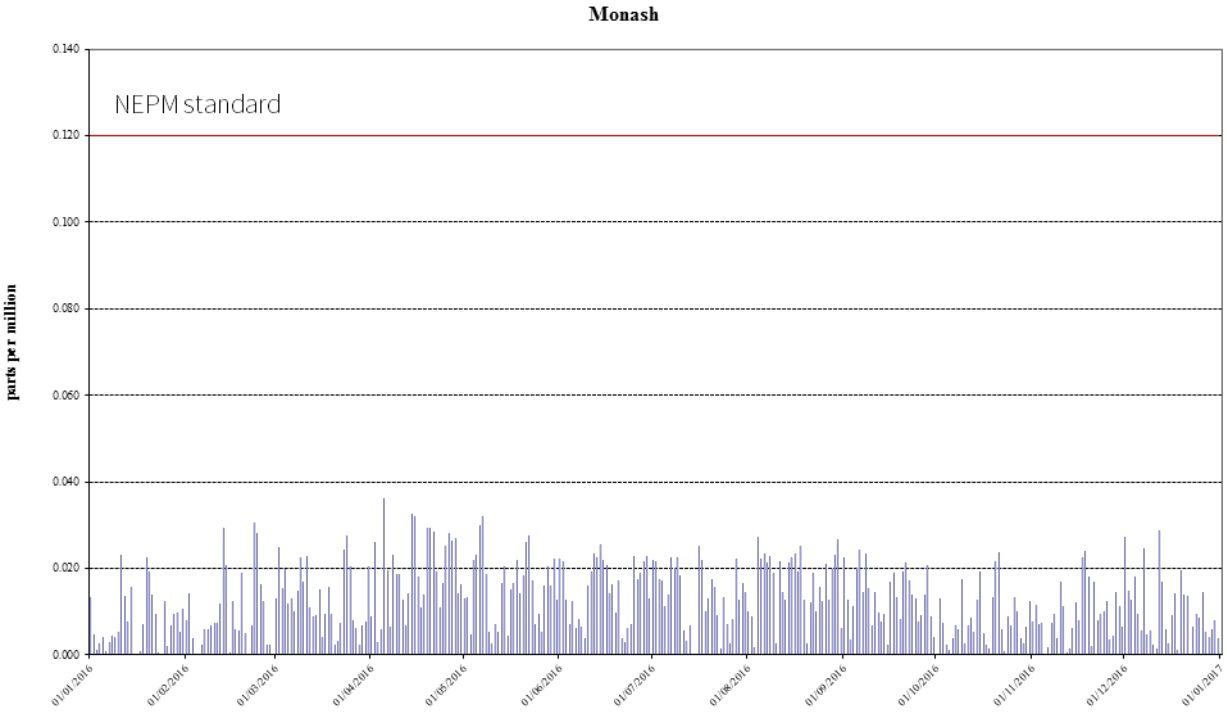

Figure 3: Daily max for NO_2 – Monash

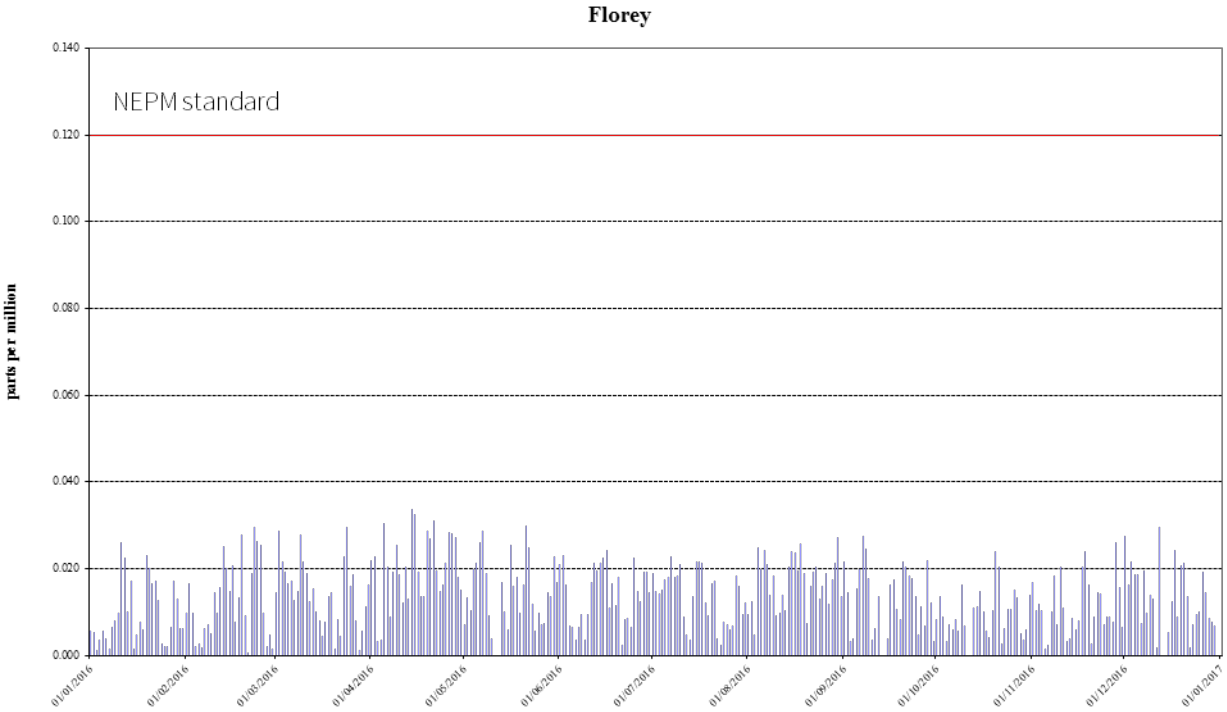

Figure 4: Daily max for NO_2 – Florey

Ozone

During 2016, no exceedences of the 1-hour and 4-hour standards for ozone were recorded in the ACT and compliance was demonstrated at all stations.

Table 6: 2016 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	95.8	95.8	94.4	94.7	95.2	0	0	MET	MET
Civic	95.8	95.8	95.8	95.8	95.8	0	0	MET	MET
Florey	95.8	95.8	95.8	95.8	95.8	0	0	MET	MET

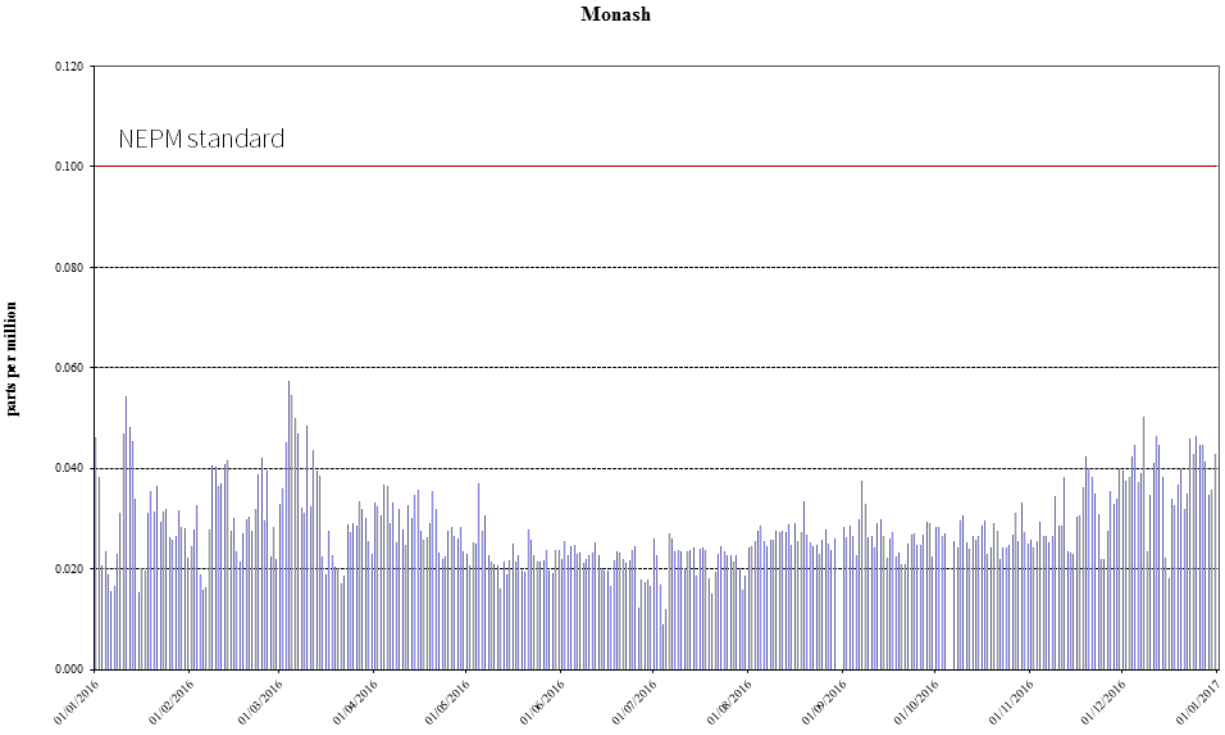

Figure 5: Daily max for 1 hour O_3 – Monash

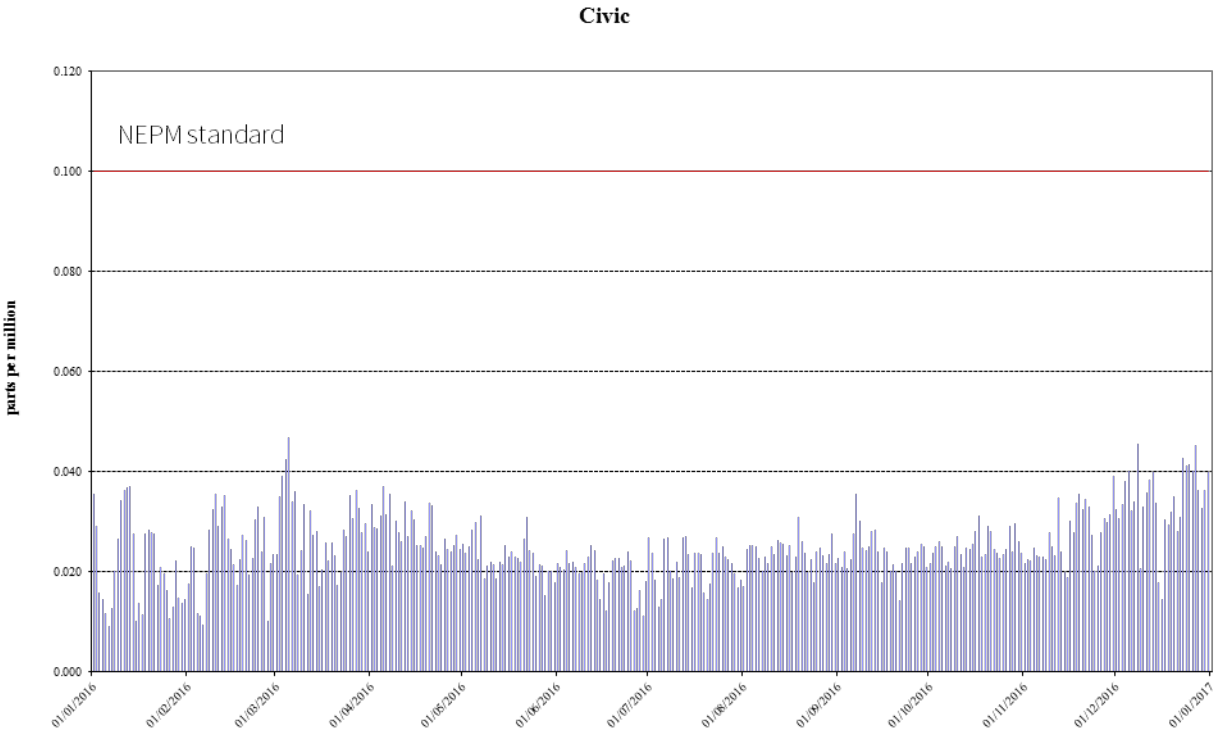

Figure 6: Daily max for 1 hour O_3 – Civic

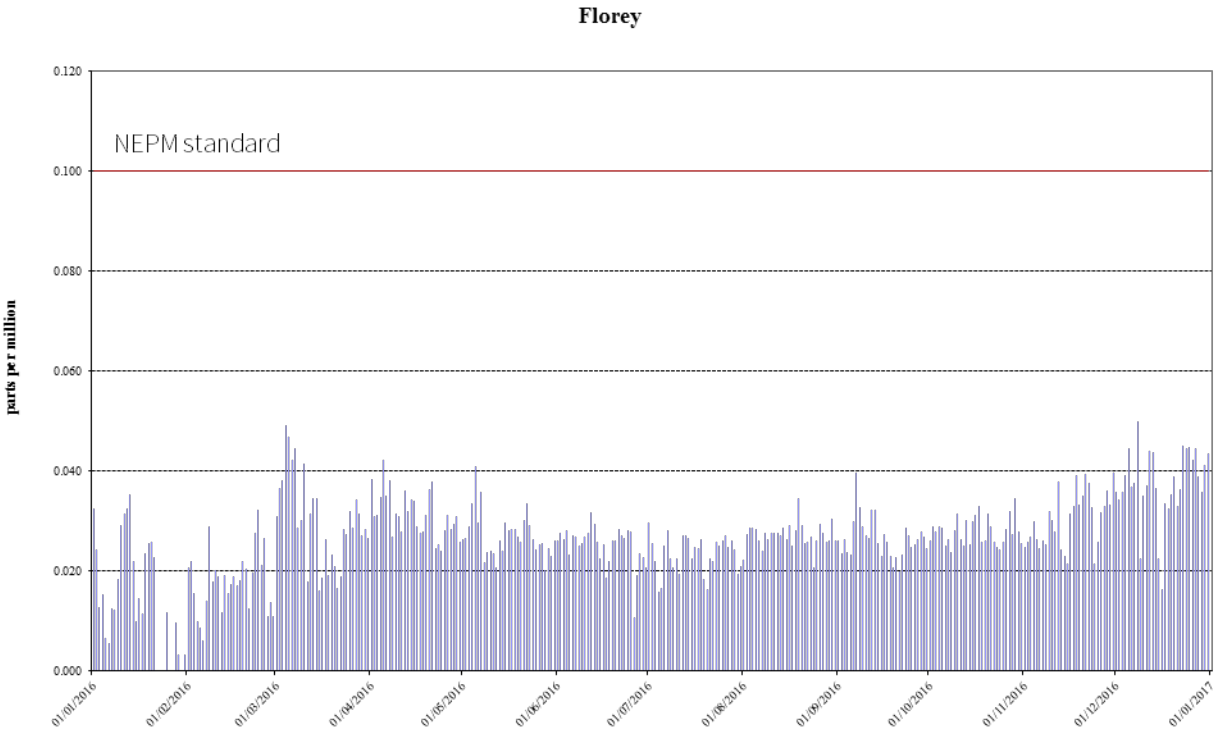

Figure 7: Daily max for 1 hour O_3 – Florey

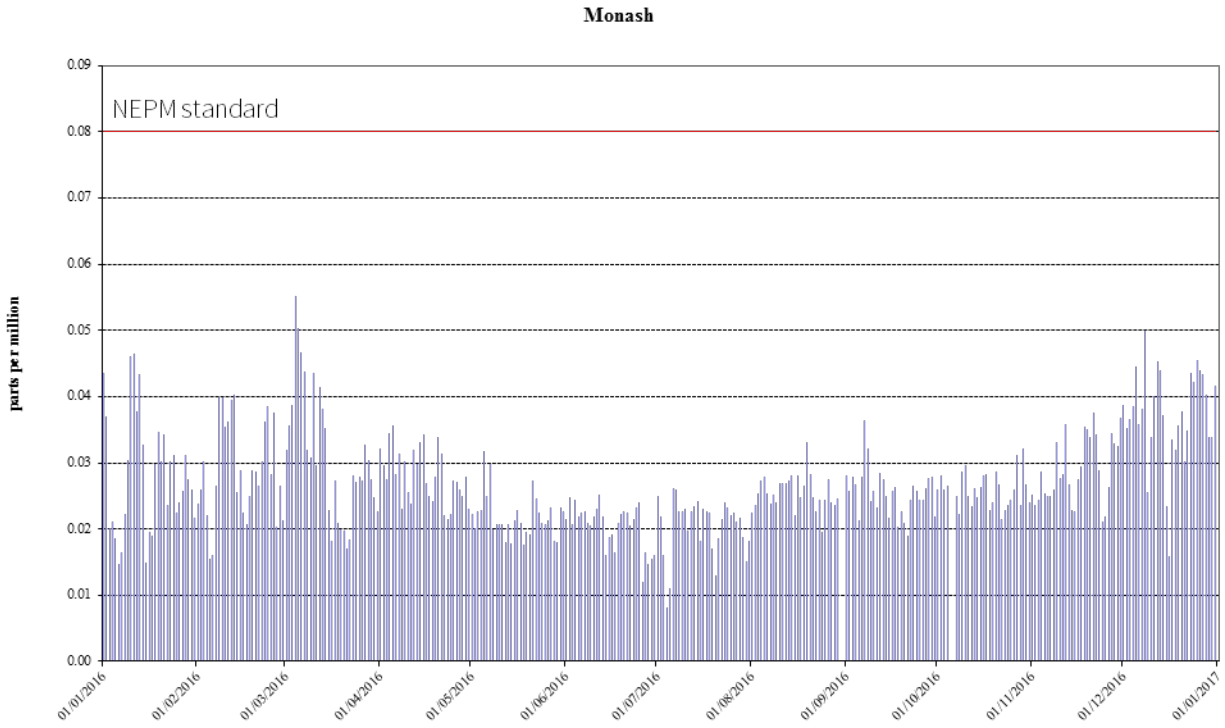

Figure 8: Daily max for 4 hours O_3 - Monash

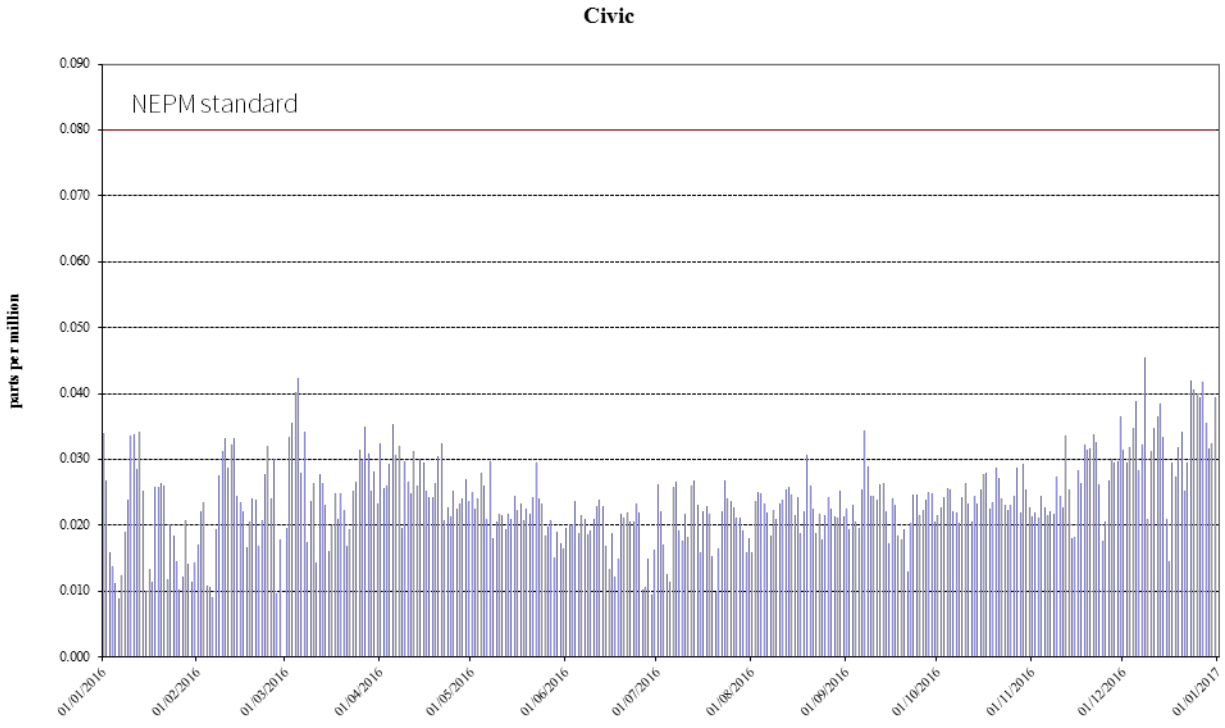

Figure 9: Daily max for 4 hours O_3 – Civic

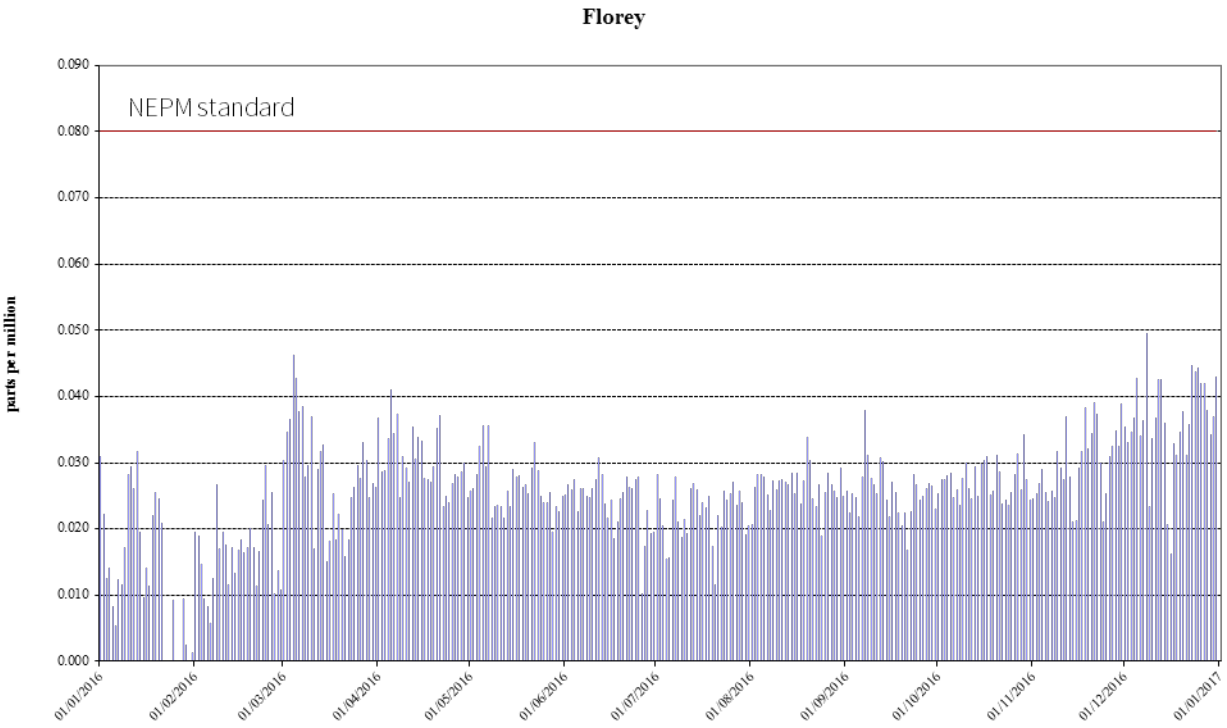

Figure 10: Daily max for 4 hours O_3 – Florey

PM_{10}

During 2016, no exceedences of the daily and annual average PM_{10} standards were recorded in the ACT and compliance was demonstrated at all stations.

Table 7: 2016 compliance summary for PM_{10}

AAQ NEPM standard 50 μg/m^3 1-day average, 20 μg/m^3 (1-year average)*

Performance monitoring station	Data availability rates (% of days)					Annual mean Concentration (μg/m^3)*	Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual			
Monash	100	100	97.8	100	99.5	9.7	0	MET
Civic	100	100	100	100	100	10.1	0	MET
Florey	100	97.8	100	97.8	98.9	10.7	0	MET

* ACT policy position 20 μg/m^3 not AAQ NEPM standard of 25 μg/m^3

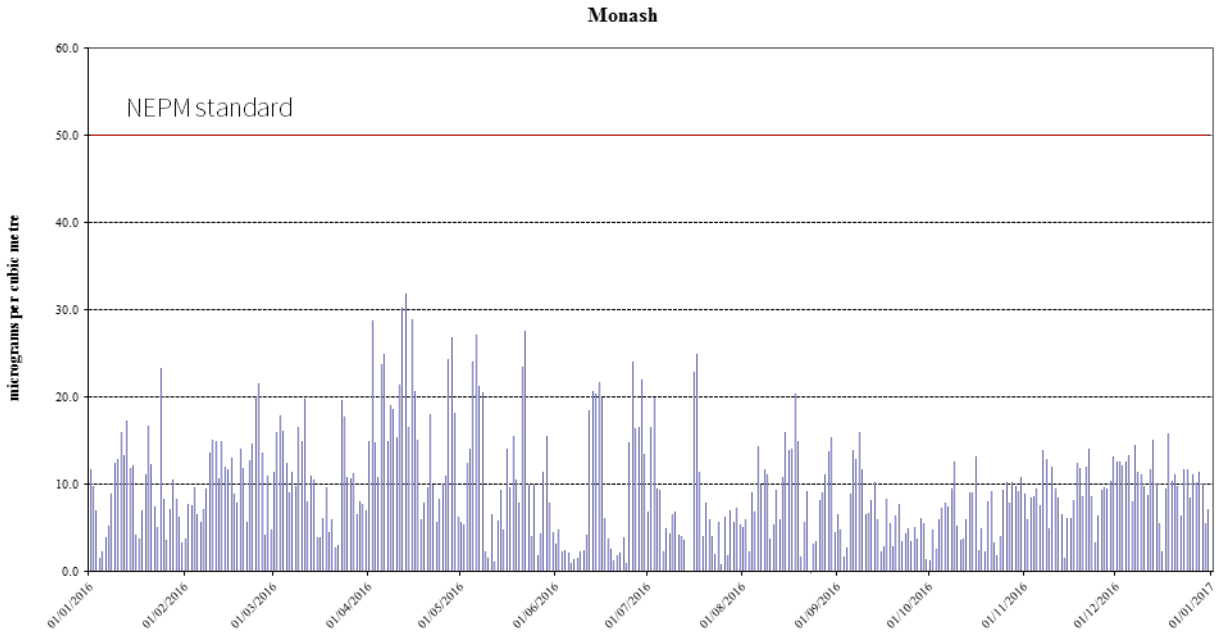

Figure 11: Daily max for PM_{10} – Monash

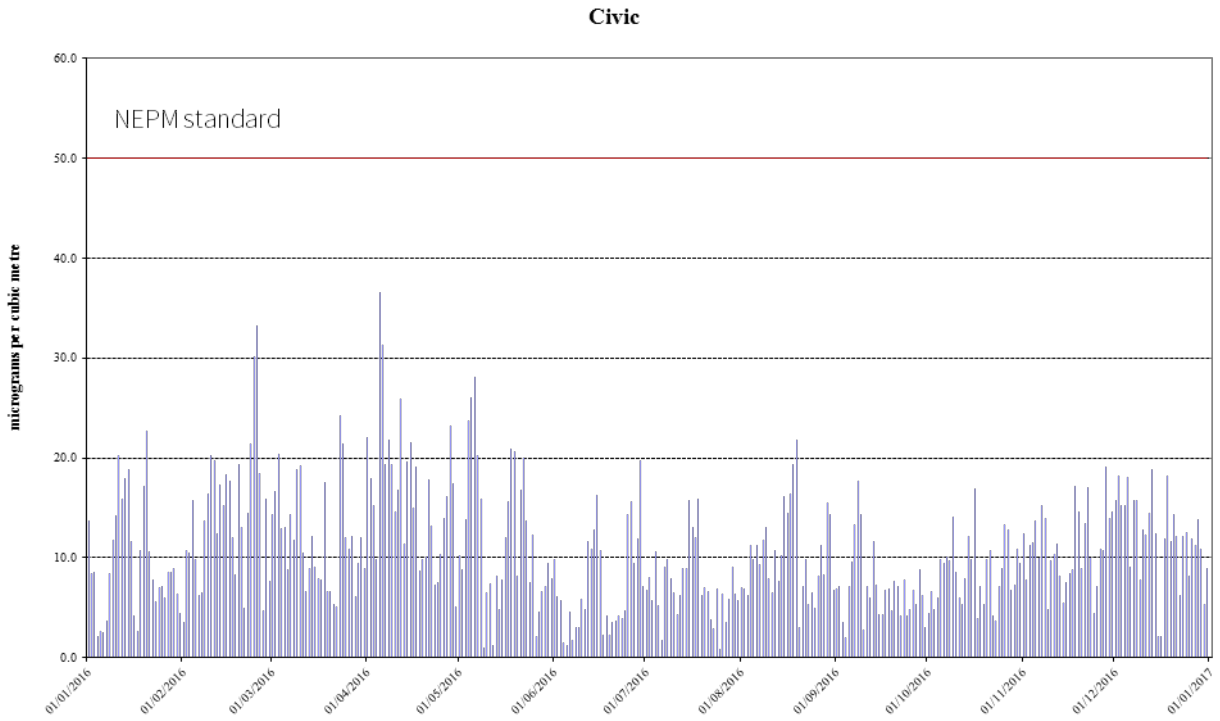

Figure 12: Daily max for PM_{10} – Civic

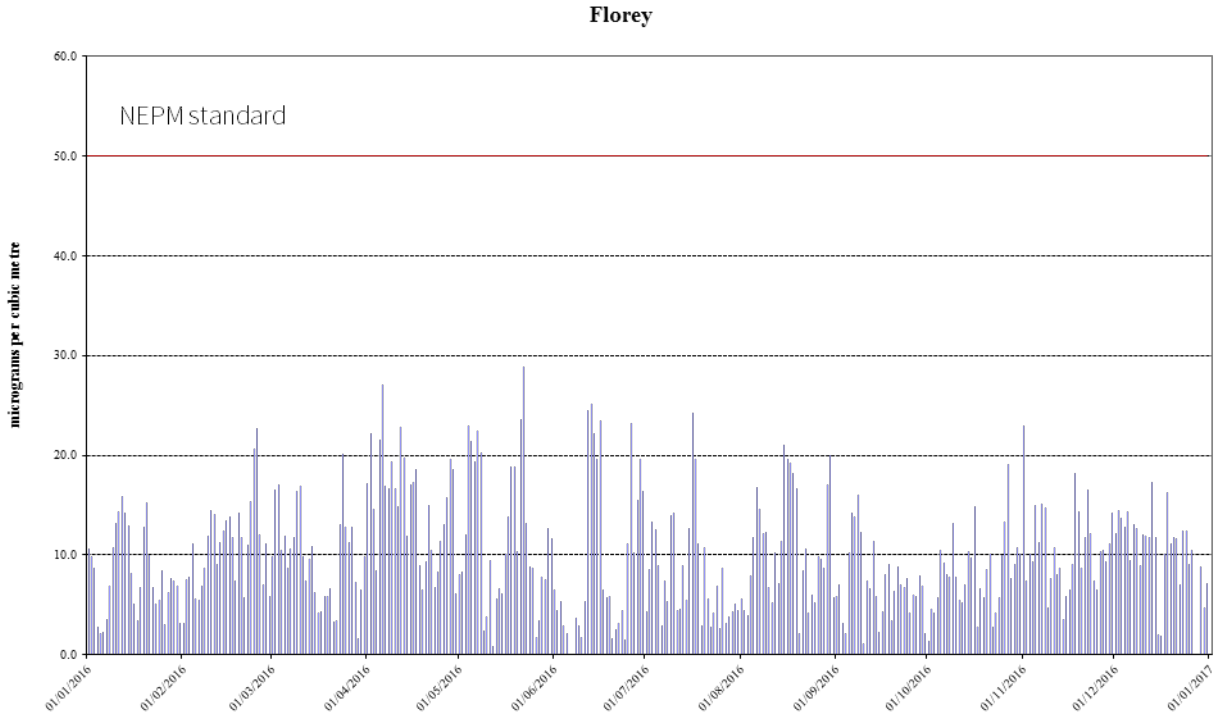

Figure 13: Daily max for PM_{10} – Florey

PM2.5

During 2016, while no exceedences of the annual average $PM_{2.5}$ standard were recorded in the ACT, nine exceedences of the daily $PM_{2.5}$ standard were recorded at Monash and Florey. Compliance against the AAQ NEPM $PM_{2.5}$ standards was only demonstrated at Civic.

Table 8: 2016 compliance summary for $PM_{2.5}$

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

Performance monitoring station	Data availability rates (% of days)					Annual mean Concentration (μg/m^3)	Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual			
Monash	96.7	100	95.7	100	98.1	7.1	8	NOT MET
Civic	79.1	94.5	100	100	93.4	5.5	0	MET
Florey	95.6	98.9	100	100	98.6	7.0	1	NOT MET

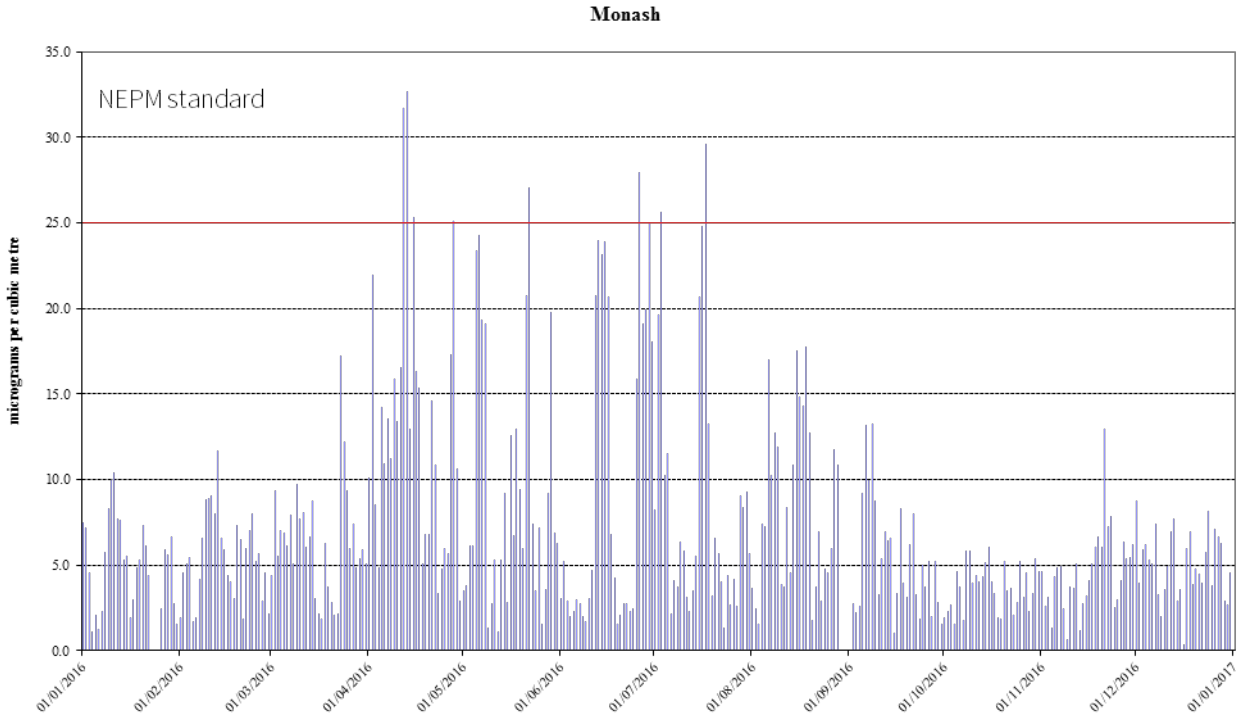

Figure 14: Daily max for $PM_{2.5}$ – Monash

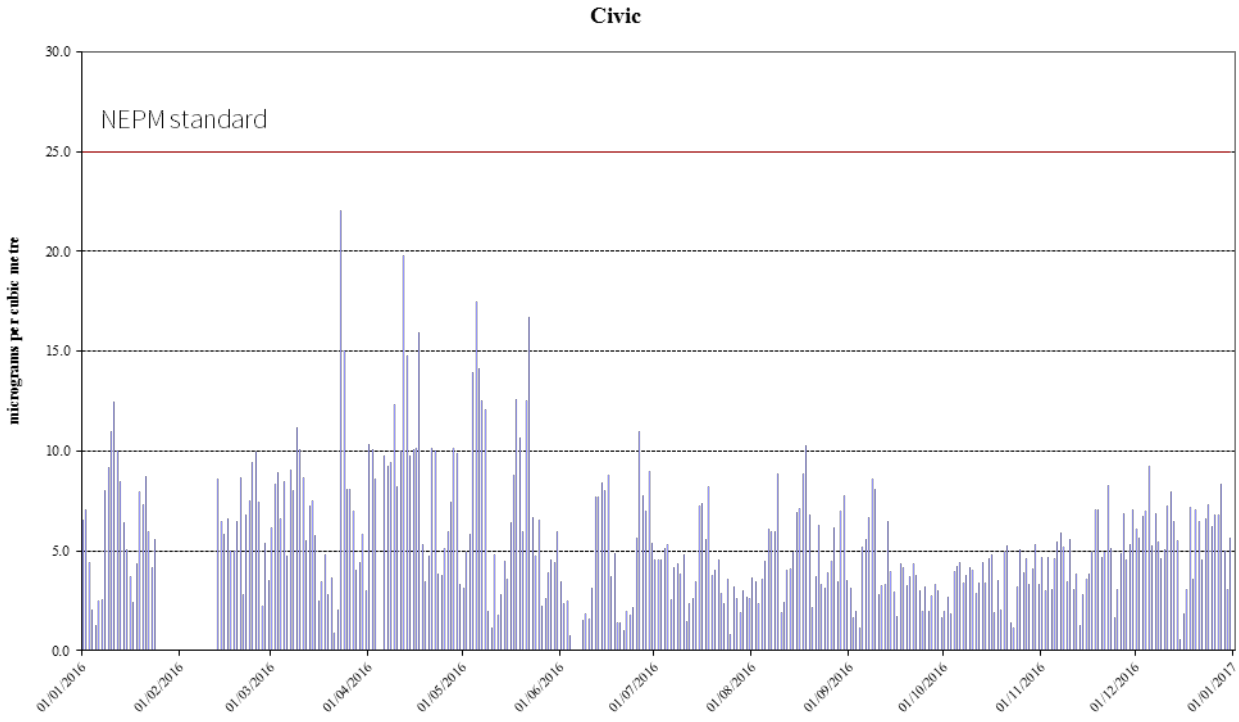

Figure 15: Daily max for $PM_{2.5}$ – Civic

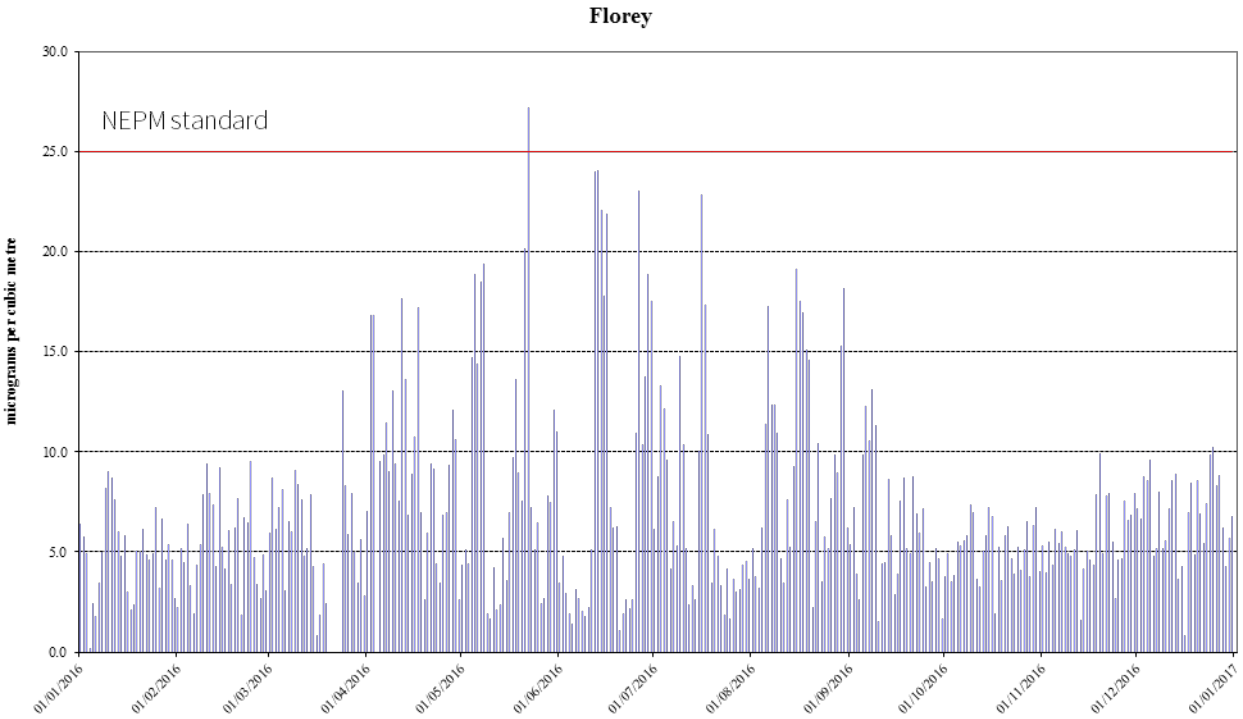

Figure 16: Daily max for $PM_{2.5}$ – Florey

ANALYSIS OF AIR QUALITY MONITORING

Annual summary statistics contained in Table 9 to Table 14 below allow the assessment of air quality against the standards and the extent of compliance with the goal. Instances where the standard has been exceeded are highlighted in bold.

In 2016, the standards were met at all stations except for $PM_{2.5}$ at Monash and Florey. In total, there were nine exceedences of the standard during April to July. All of the days when $PM_{2.5}$ exceedences were recorded in the ACT are because of emissions from domestic wood heater emissions.

Carbon monoxide

Table 9: 2016 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	366	1.7	17 Jul 08:00	1.6	27 Jun 06:00
Florey	363	1.9	30 Jun 04:00	1.8	16 Jun 04:00

Carbon monoxide levels are well below the AAQ NEPM standard at all stations. The highest recorded value in the ACT during 2016 was 1.9 ppm at Florey, which is 21% of the standard.

Nitrogen dioxide

Table 10: 2016 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	364	0.036	05 Apr 20:00	0.033	14 Apr 20:00
Florey	357	0.034	14 Apr 19:00	0.033	15 Apr 19:00

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 2016 was 0.036 ppm at Monash, which is only 30% of the standard. The highest recorded annual average in 2016 was 0.005ppm at Florey (refer to Table 5). This is 17% of the annual standard 0.03ppm.

Ozone

Table 11: 2016 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	362	0.057	04 Mar 15:00	0.055	05 Mar 12:00
Civic	366	0.047	05 Mar 12:00	0.046	08 Dec 13:00
Florey	366	0.050	08 Dec 13:00	0.049	04 Mar 14:00

Table 12: 2016 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	362	0.055	04 Mar 16:00	0.050	05 Mar 15:00
Civic	366	0.045	08 Dec 16:00	0.042	05 Mar 15:00
Florey	366	0.050	08 Dec 16:00	0.046	04 Mar 16:00

Ozone levels are below the AAQ NEPM standard. The highest recorded 1-hour value in the ACT during 2016 was 0.057 ppm at Monash, which is 57% of the standard. The highest recorded 4-hour value in the ACT during 2016 was 0.055 ppm at Monash, which is 69% of the standard.

PM_{10}

Table 13: 2016 summary statistics for daily peak PM_{10}

AAQ NEPM daily standard 50 $\mu g/m^3$

Performance monitoring station	Number of valid days	Highest ($\mu g/m^3$)	Highest (date)
Monash	364	31.9	13 April
Civic	366	36.6	05 April
Florey	362	28.8	22 May

PM_{10} levels are below the AAQ NEPM standard. The highest PM_{10} level recorded during 2016 was 36.6µg/m^3 at Civic on 05 April 2016. The highest recorded annual average in 2016 was 10.7µg/m^3 at Florey (refer to Table 7). This is 53% of the ACT policy standard annual of 20µg/m^3.

$PM_{2.5}$

Table 14: 2016 summary statistics for daily peak $PM_{2.5}$

AAQ NEPM daily standard 25 µg/m^3

Performance monitoring station	Number of valid days	Highest (µg/m^3)	Highest (date)
Monash	359	**32.7**	13 April
Civic	342	22.1	23 March
Florey	361	**27.2**	22 May

The daily reporting standard for $PM_{2.5}$ was exceeded eight times at Monash and once at Florey. Six exceedences occurred between April and May, which are likely due to smoke coming from hazard reduction burns. The other three exceedences, which occurred between June and July, can be linked to increased domestic wood heater emissions during the cold winter months. The highest recorded annual average in 2016 was 7.1µg/m^3 at Monash (refer to Table 8). This is 89% of the annual standard 8µg/m^3.

ASSESSMENT OF PROGRESS TOWARDS ACHIEVING THE GOAL

The goals and standards have been consistently met in the ACT for carbon monoxide, nitrogen dioxide, and ozone since the commencement 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.

PM2.5 is the pollutant that is the most affected by wood smoke as the majority of particles are less than 1 micron in diameter. Figure 14 and 16 clearly show that PM2.5 levels increase significantly during the cooler months of the year. In the last few years the annual average PM2.5 readings for Monash and Florey have also increased and are now approaching the NEPM standard. This increase may be because of an increase in wood heater use as a result of the increase in the cost of gas and electricity.

The ACT Government acknowledges that woodsmoke is a problem and will continue to implement an integrated program to address woodsmoke. This will involve public education and enforcement activities, the implementation of the 'Burn Right Tonight Campaign', the regulation of the sale of firewood and the on-going administration of the Wood Heater Replacement Program. However, the ACT Government is cognisant of the increase of pollution levels in recent years and, if the trend continues, may need to review and adjust interventions to address woodsmoke.

APPENDIX A: STATISTICAL SUMMARY AND TRENDS

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

Carbon monoxide

Table 15: Statistical summary for daily maximum 8-hour CO Monash 2007 – 2016

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)
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
2014	94.0	0	1.8	1.6	1.5	1.4	1.1	0.7	0.4
2015	94.8	0	1.9	1.7	1.6	1.4	1.1	0.6	0.3
2016	95.8	0	1.7	1.5	1.4	1.0	0.8	0.4	0.2

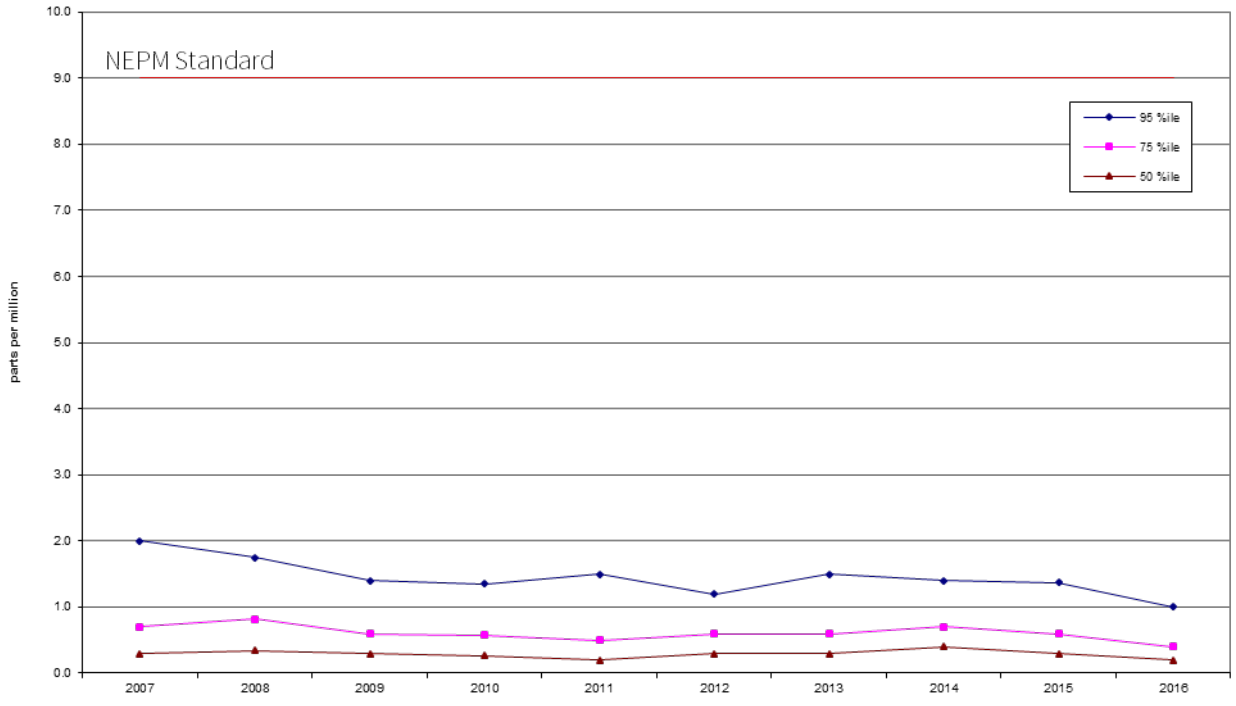

Figure 17: Statistical summary for daily maximum 8-hour CO Monash 2007 – 2016

Table 16: Statistical summary for daily maximum 8-hour CO Florey 2014 – 2016

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)
2014	79.2	0	2.2	1.7	1.5	1.4	1.2	0.7	0.3
2015	94.9	0	2.0	1.8	1.7	1.5	1.2	0.6	0.3
2016	95.5	0	1.9	1.5	1.4	1.2	0.9	0.5	0.3

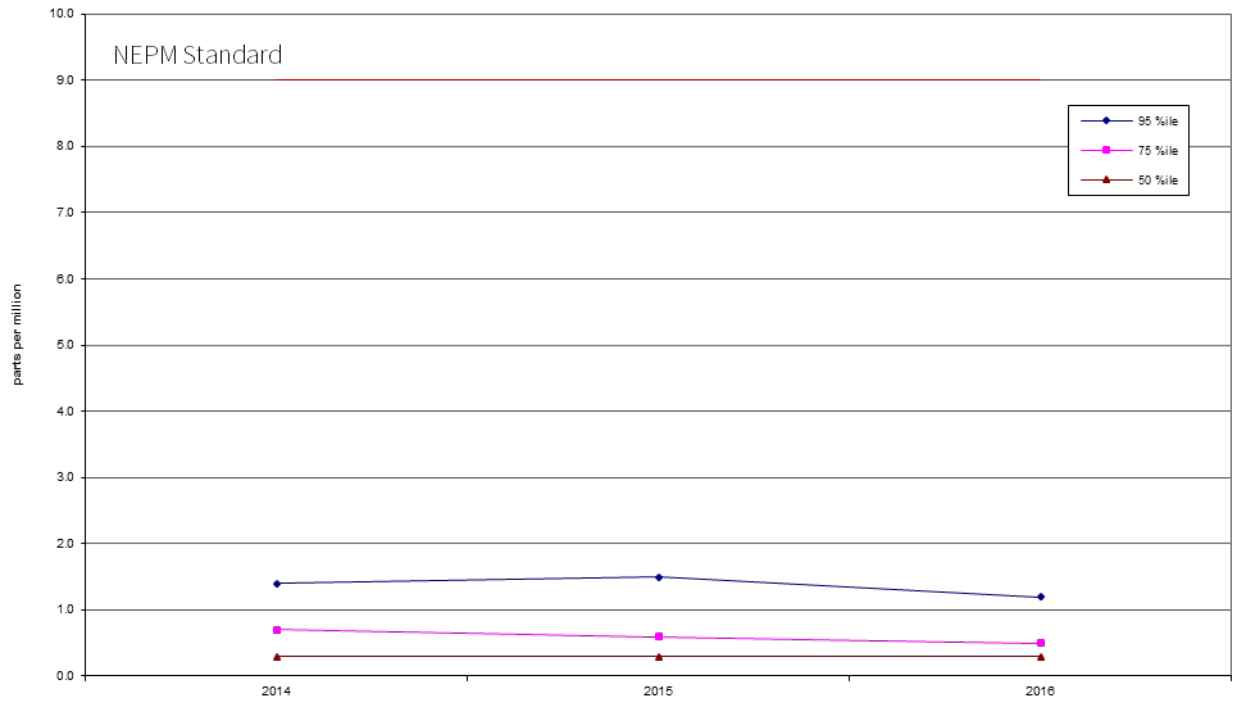

Figure 18: Statistical summary for daily maximum 8-hour CO Florey 2014 – 2016

Nitrogen dioxide

Table 17: Statistical summary for daily maximum 1-hour NO_2 Monash 2007 – 2016

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)
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
2014	94.1	0	0.036	0.030	0.029	0.027	0.025	0.020	0.015
2015	94.8	0	0.032	0.028	0.027	0.026	0.024	0.020	0.014
2016	95.6	0	0.036	0.031	0.029	0.027	0.023	0.019	0.012

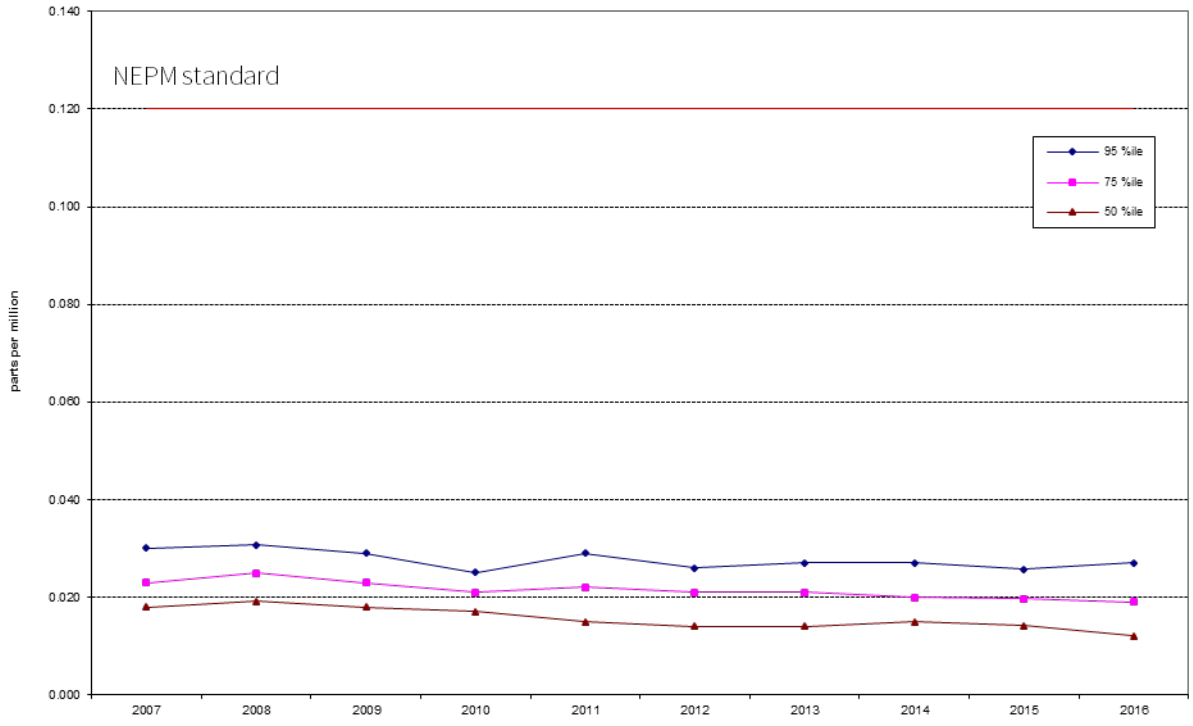

Figure 19: Statistical summary for daily maximum 1-hour NO_2 Monash 2007 – 2016

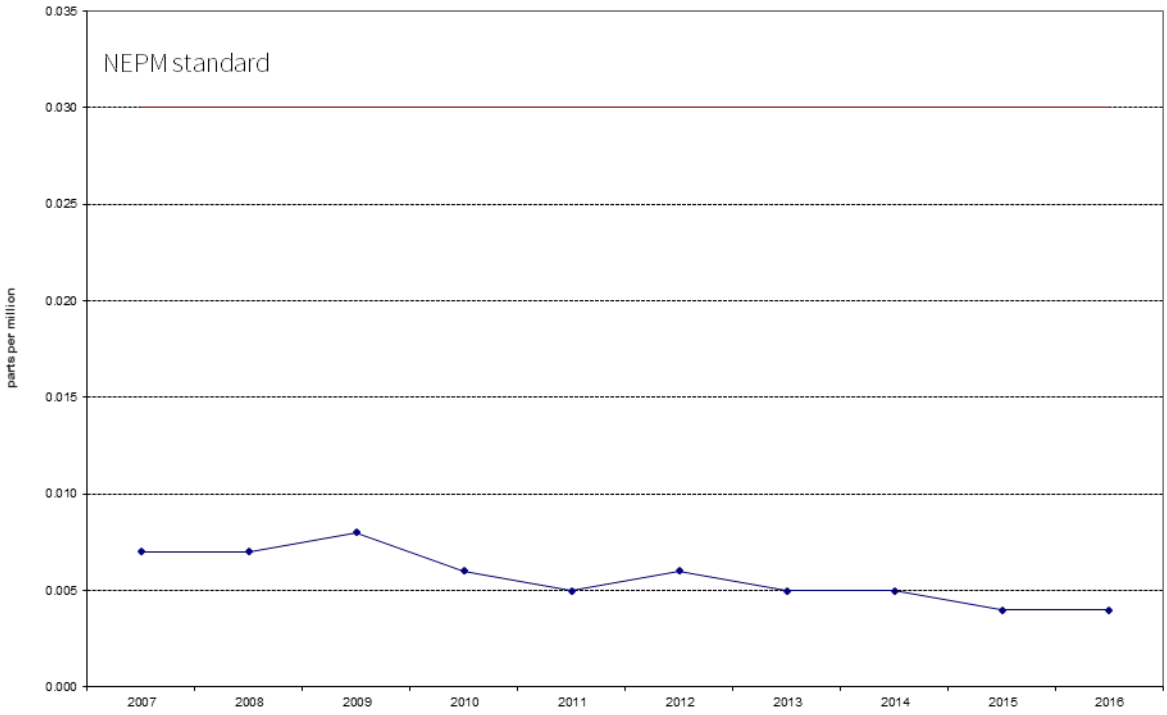

Figure 20: Annual average 1-hour NO_2 Monash 2007 – 2016

Table 18: Statistical summary for daily maximum 1-hour NO_2 Florey 2014 – 2016

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)
2014	78.3	0	0.045	0.032	0.030	0.027	0.023	0.020	0.015
2015	91.5	0	0.033	0.031	0.030	0.027	0.025	0.020	0.014
2016	94.7	0	0.034	0.030	0.029	0.027	0.024	0.019	0.013

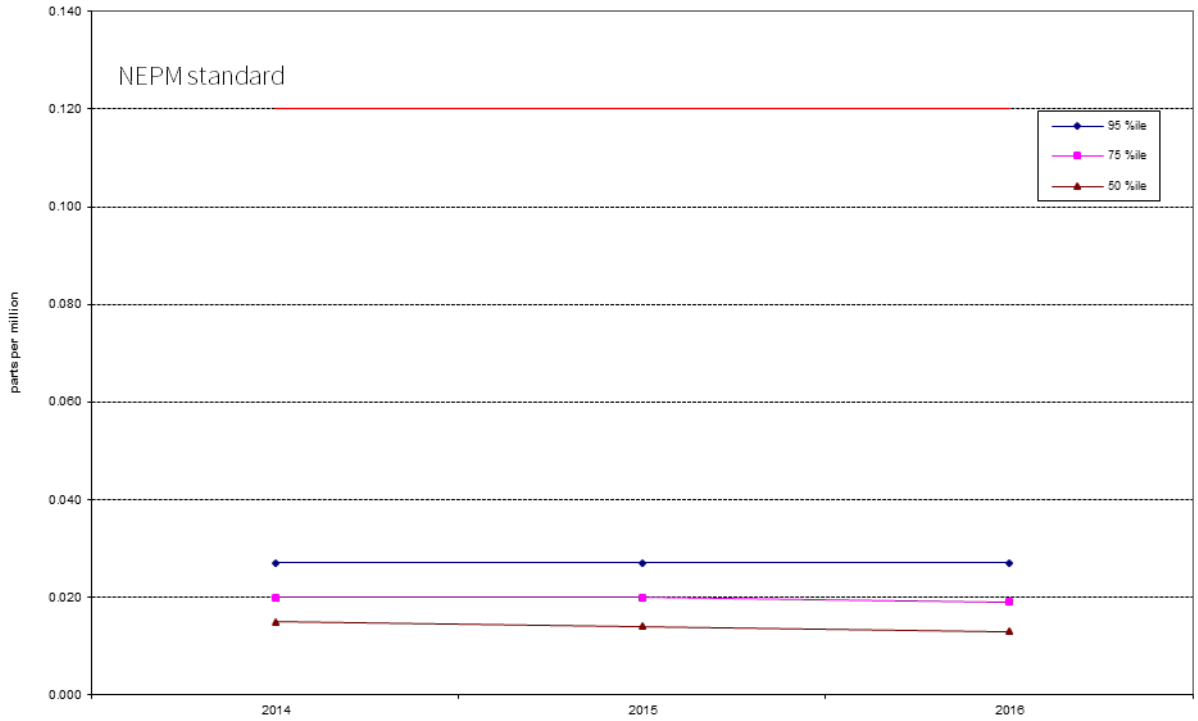

Figure 21: Statistical summary for daily maximum 1-hour NO_2 Florey 2014 – 2016

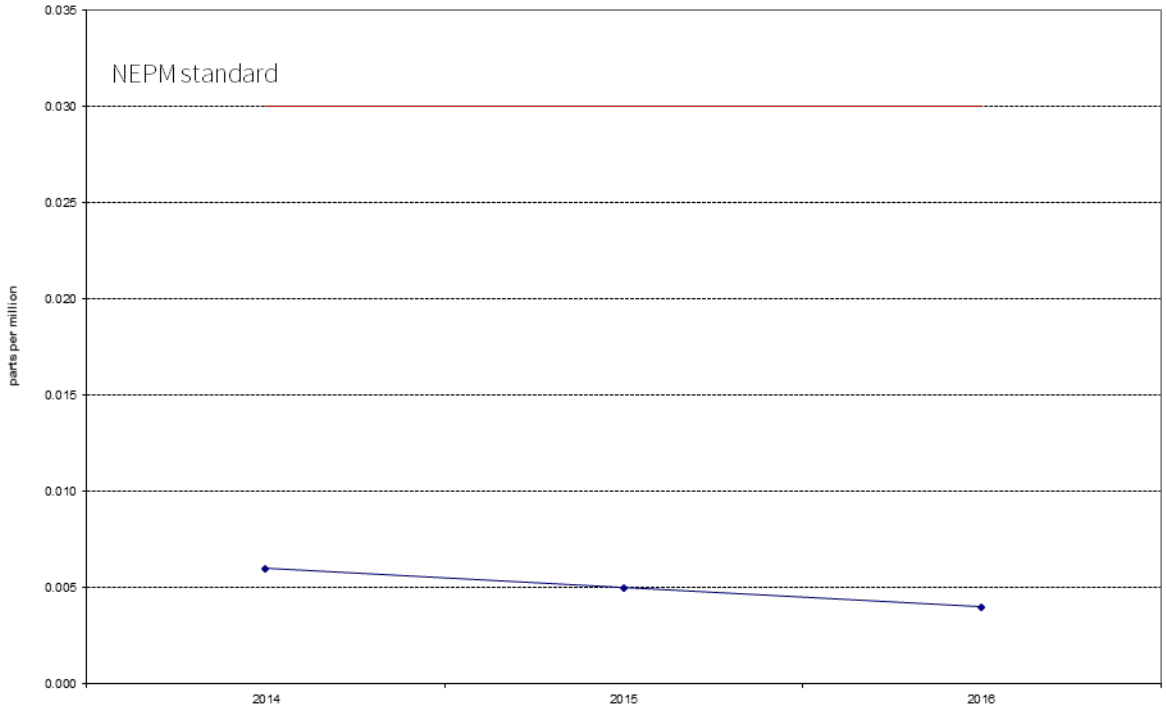

Figure 22: Annual average 1-hour NO_2 Florey 2014 – 2016

Ozone

Table 19: Statistical summary for daily maximum 1-hour O_3 Monash 2007 – 2016

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)
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
2014	94.8	0	0.087	0.060	0.057	0.050	0.044	0.036	0.030
2015	92.8	0	0.065	0.050	0.046	0.044	0.040	0.034	0.026
2016	95.2	0	0.057	0.050	0.047	0.044	0.039	0.032	0.026

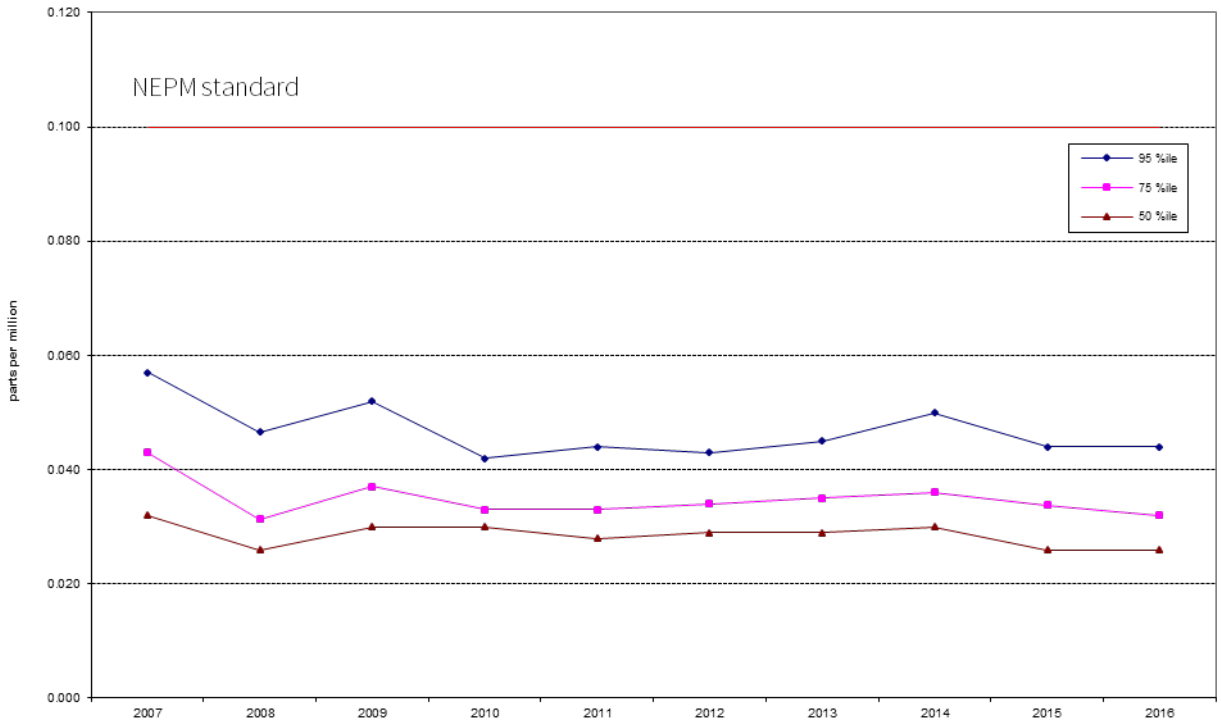

Figure 23: Statistical summary for daily maximum 1-hour O_3 Monash 2007 – 2016

Table 20: Statistical summary for daily maximum 1-hour O_3 Civic 2007 – 2016

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)
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
2014	94.0	0	0.060	0.050	0.046	0.039	0.036	0.028	0.022
2015	89.0	0	0.042	0.039	0.037	0.034	0.031	0.026	0.022
2016	95.8	0	0.047	0.043	0.040	0.036	0.034	0.028	0.024

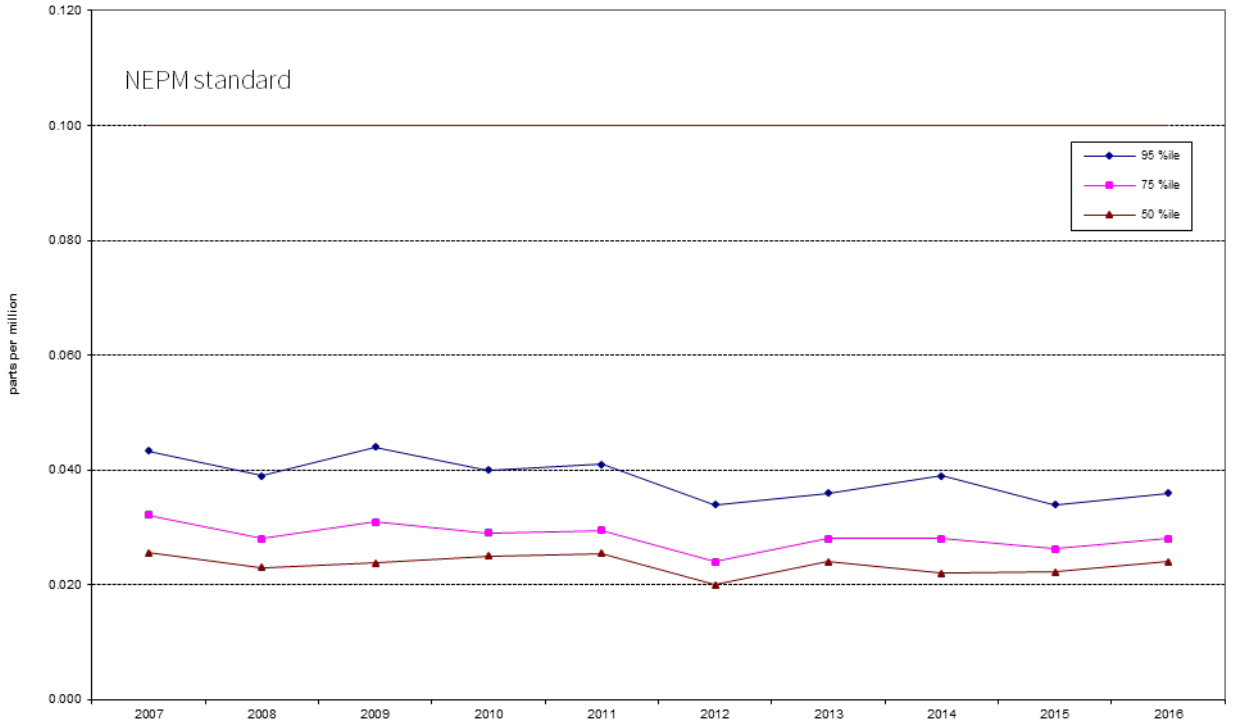

Figure 24: Statistical summary for daily maximum 1-hour O_3 Civic 2007 – 2016

Table 21: Statistical summary for daily maximum 1-hour O_3 Florey 2014 – 2016

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)
2014	79.4	0	0.074	0.039	0.039	0.034	0.030	0.027	0.023
2015	94.2	0	0.040	0.038	0.036	0.032	0.030	0.025	0.021
2016	95.8	0	0.050	0.045	0.045	0.040	0.036	0.031	0.027

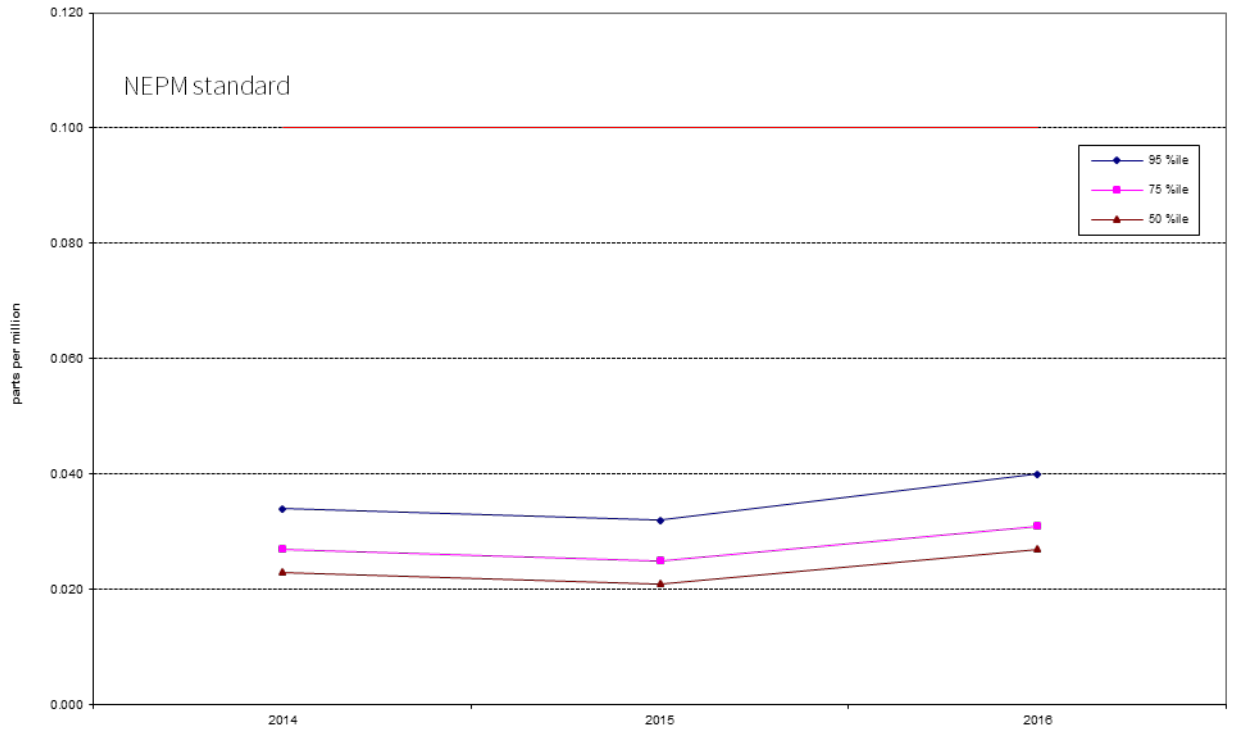

Figure 25: Statistical summary for daily maximum 1-hour O_3 Florey 2014 – 2016

Table 22: Statistical summary for daily maximum 4-hour O_3 Monash 2007 – 2016

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)
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
2014	94.8	0	0.060	0.055	0.052	0.046	0.042	0.034	0.029
2015	92.8	0	0.050	0.046`	0.044	0.041	0.039	0.033	0.025
2016	95.2	0	0.055	0.047	0.045	0.042	0.037	0.030	0.025

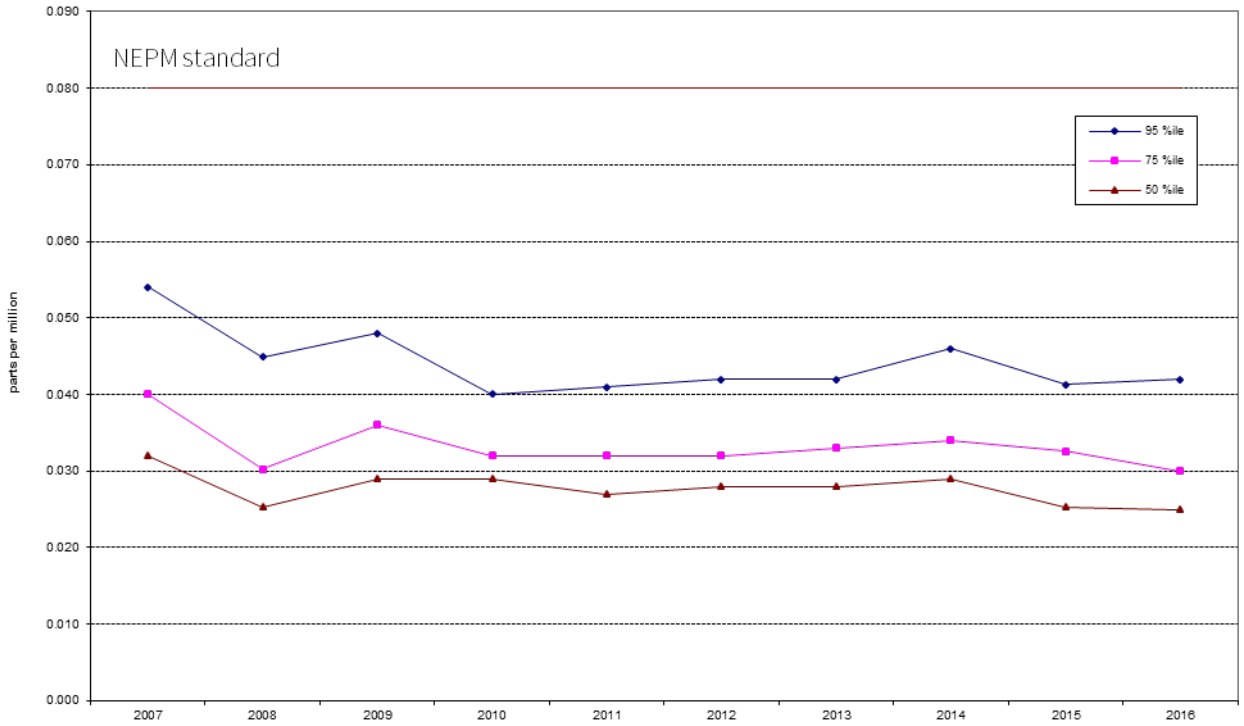

Figure 26: Statistical summary for daily maximum 4-hour O_3 Monash 2007 – 2016

Table 23: Statistical summary for daily maximum 4-hour O_3 Civic 2007 – 2016

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)
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
2014	94.0	0	0.047	0.045	0.040	0.036	0.034	0.026	0.020
2015	89.0	0	0.041	0.038	0.035	0.031	0.029	0.025	0.021
2016	95.8	0	0.045	0.041	0.039	0.035	0.032	0.027	0.023

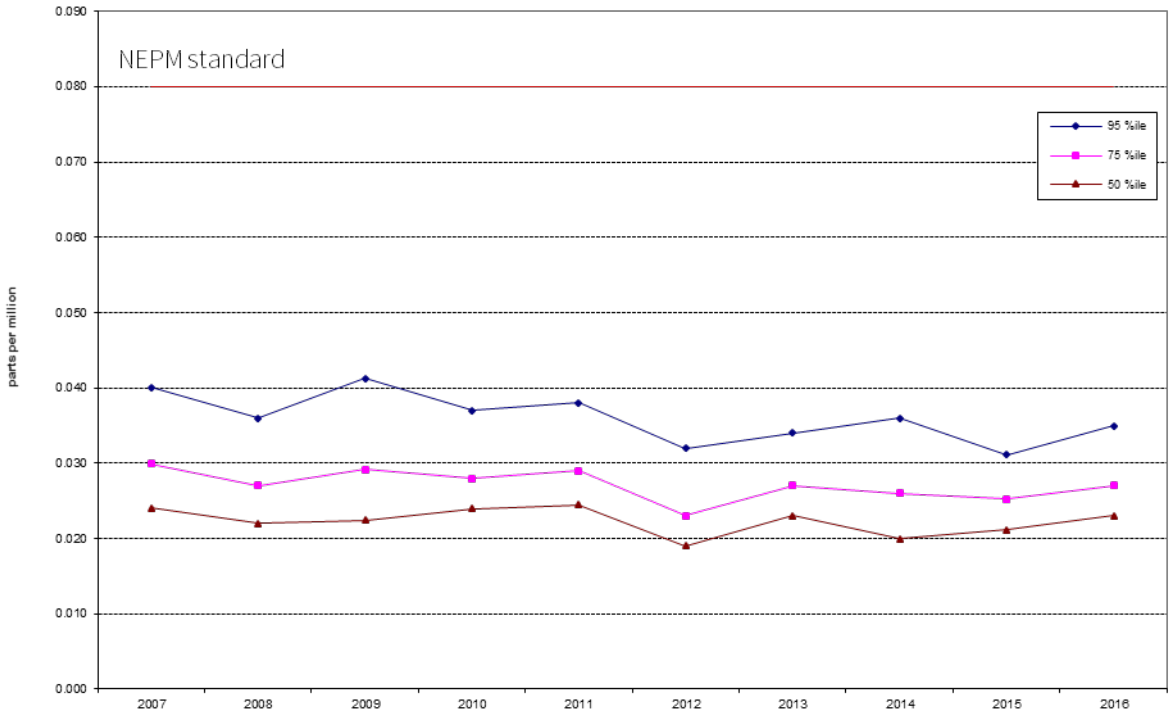

Figure 27: Statistical summary for daily maximum 4-hour O_3 Civic 2007 – 2016

Table 24: Statistical summary for daily maximum 4-hour O_3 Florey 2014 – 2016

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)
2014	79.4	0	0.040	0.037	0.035	0.031	0.029	0.026	0.022
2015	94.2	0	0.037	0.036	0.034	0.031	0.028	0.025	0.020
2016	95.8	0	0.050	0.044	0.043	0.038	0.035	0.029	0.026

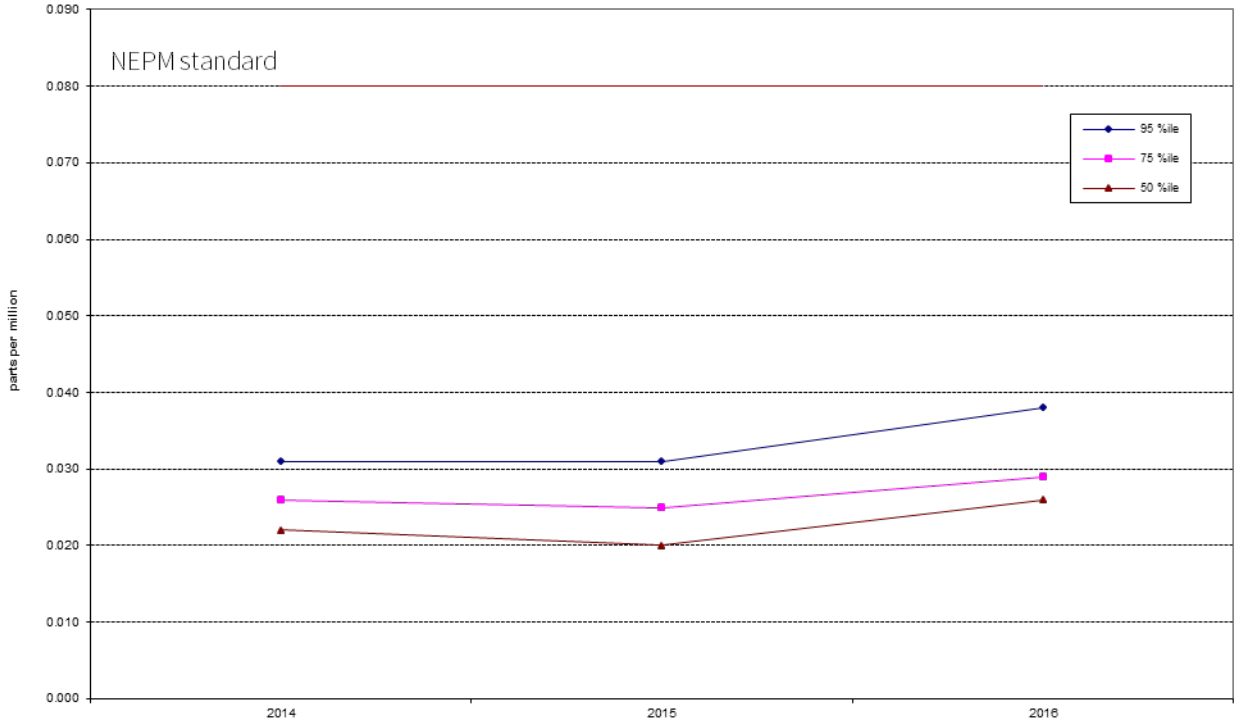

Figure 28: Statistical summary for daily maximum 4-hour O_3 Florey 2014 – 2016

PM_{10}

Table 25: Statistical summary for daily maximum daily PM_{10} Monash 2007 – 2016

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)
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
2014	97.8	0	39.3	27.1	23.1	19.1	16.4	12.9	9.6
2015	98.4	0	49.4	25.3	23.3	19.5	17.3	13.1	9.5
2016	99.5	0	31.9	28.0	24.9	21.5	17.8	12.7	9.0

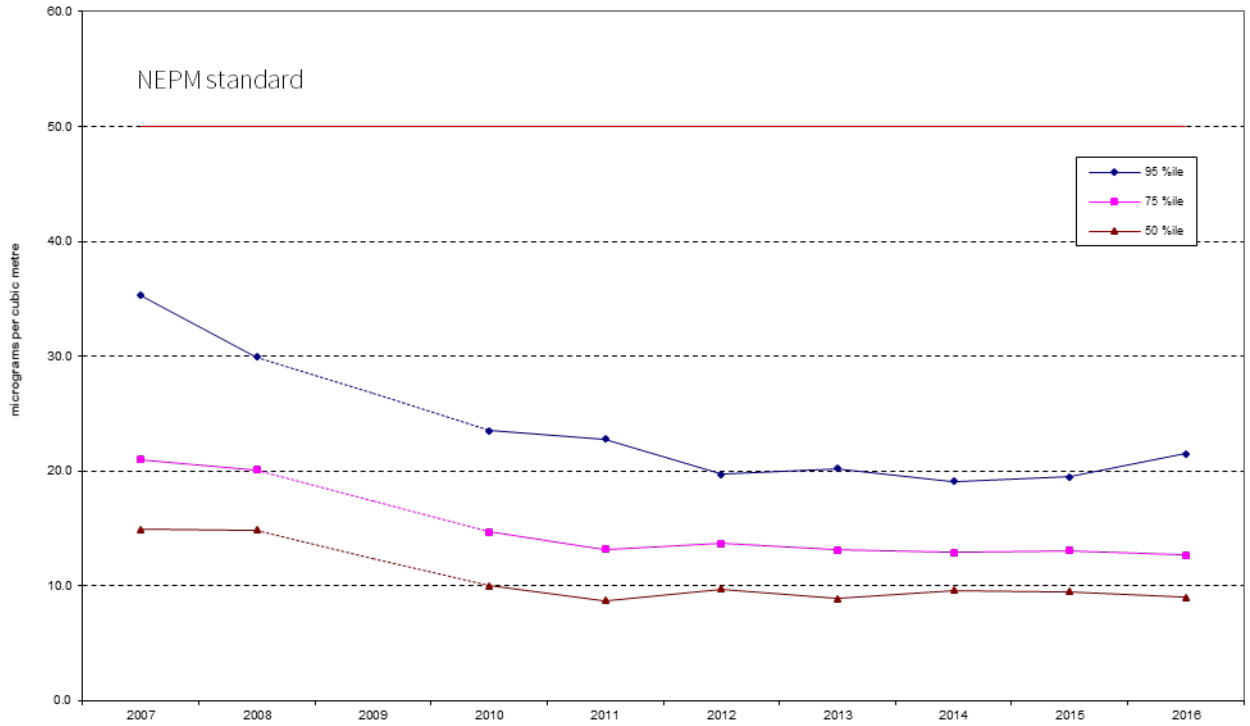

Figure 29: Statistical summary for daily maximum daily PM_{10} Monash 2007 – 2016

Note: 2009 data has not been included in Figure 29 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.

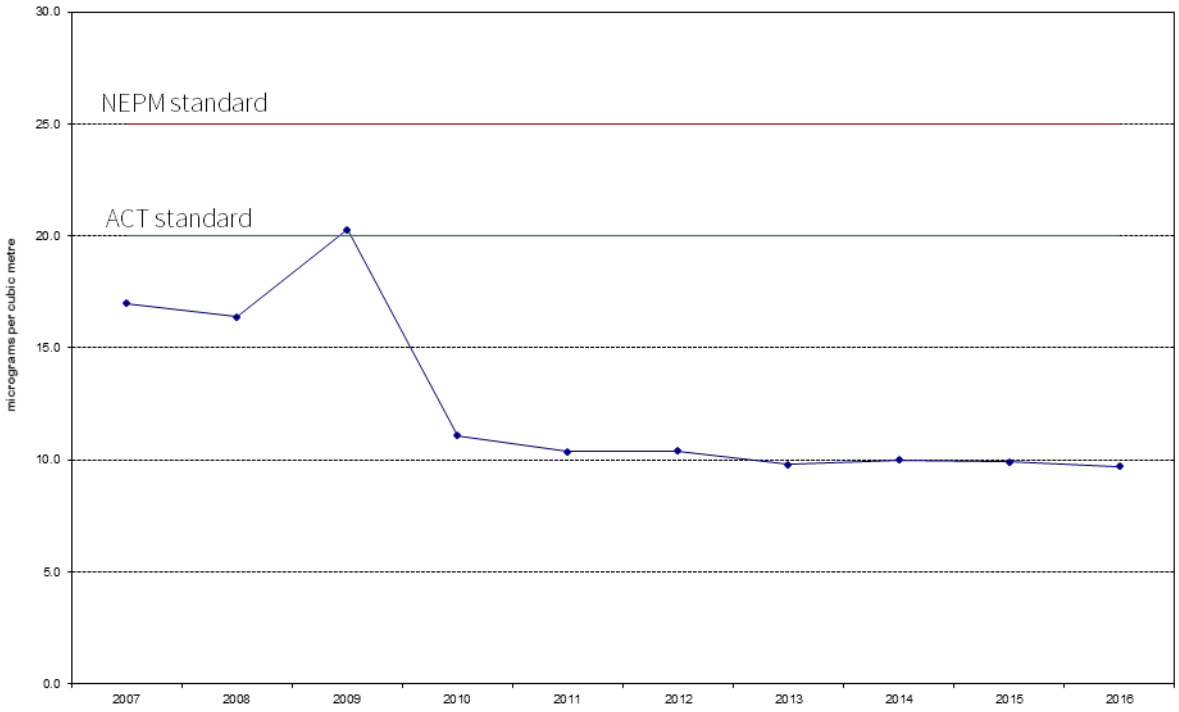

Figure 30: Annual average daily PM_{10} Monash 2007 – 2016

Table 26: Statistical summary for daily maximum daily PM_{10} Civic 2007 – 2016

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)
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
2014	95.1	0	31.4	24.2	22.1	17.7	15.1	12.6	9.3
2015	97.5	1	64.3	27.9	25.0	20.9	17.6	14.1	10.4
2016	100	0	36.6	28.8	24.1	20.6	18.7	14.3	9.7

Figure 31: Statistical summary for daily maximum daily PM_{10} Civic 2007 – 2016

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

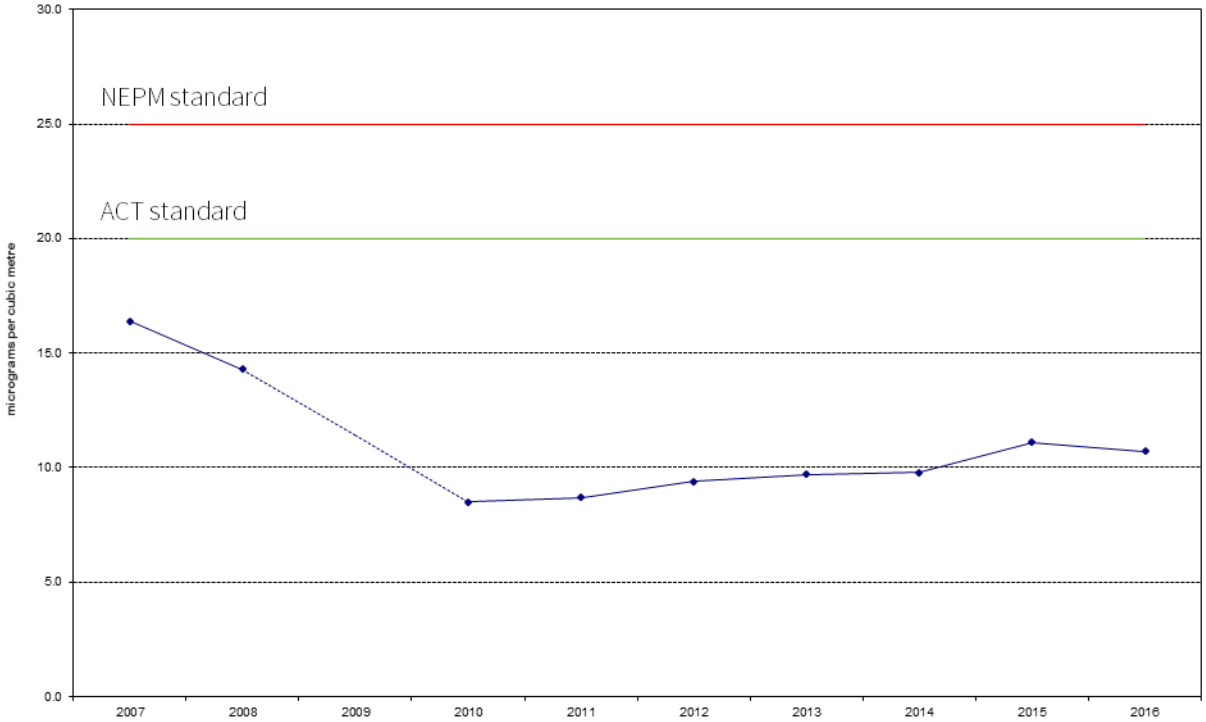

Figure 32: Annual average daily PM_{10} Civic 2007 – 2016

Table 27: Statistical summary for daily maximum daily PM_{10} Florey 2014 – 2016

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)
2014	83.3	0	30.2	24.7	24.2	21.5	18.2	13.0	9.4
2015	95.6	0	70.8	27.2	24.6	21.8	19.4	13.7	9.4
2016	98.9	0	28.8	24.4	23.1	20.6	18.2	13.1	9.2

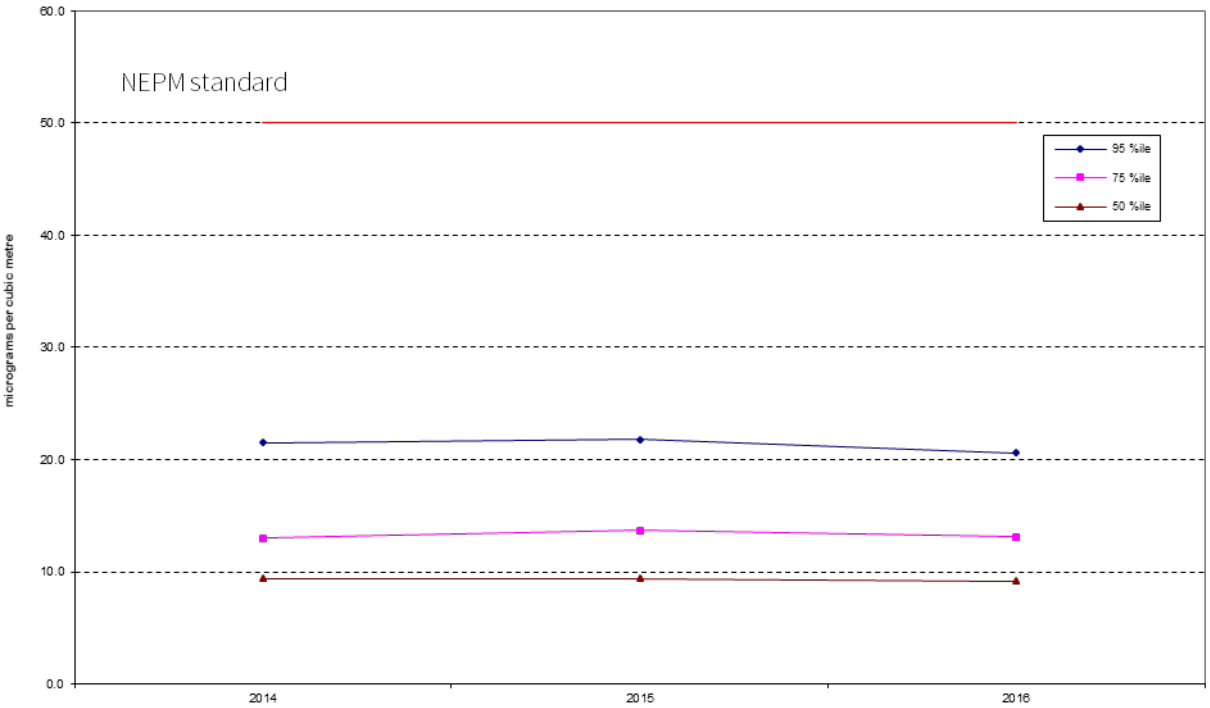

Figure 33: Statistical summary for daily maximum daily PM_{10} Florey 2014 – 2016

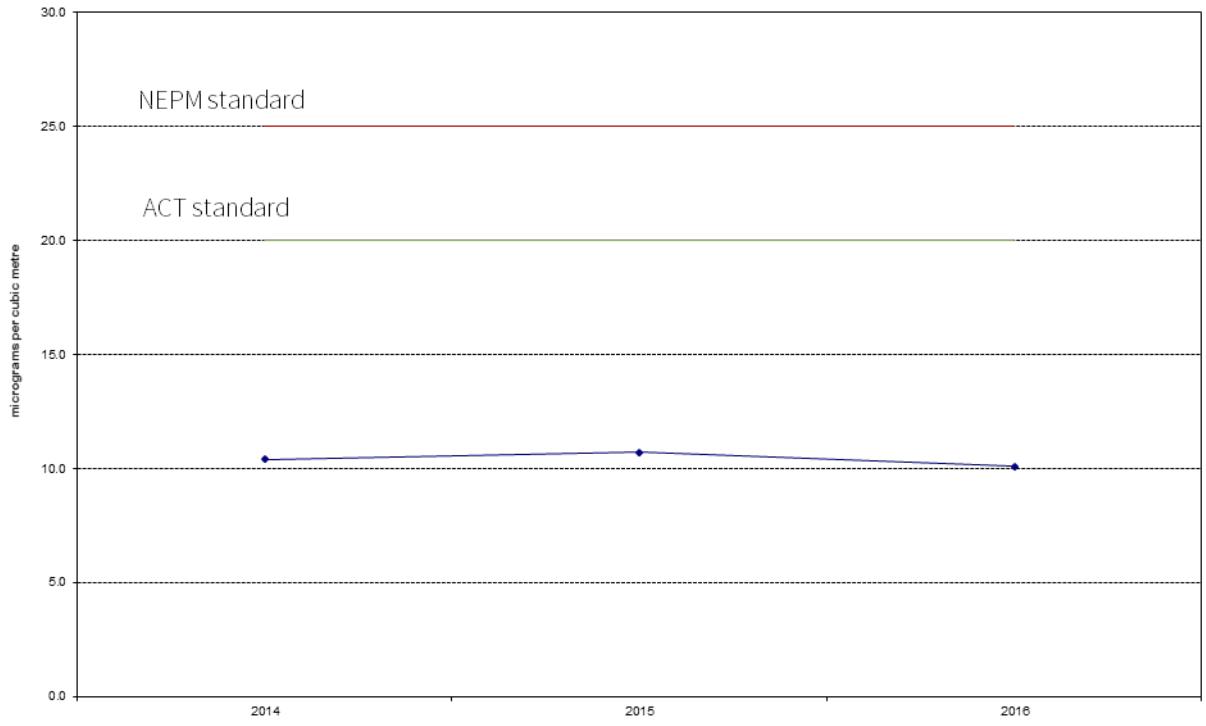

Figure 34: Annual average daily PM_{10} Florey 2007 – 2016

$PM_{2.5}$

Table 28: Statistical summary for daily maximum daily $PM_{2.5}$ Monash 2007 – 2016

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)
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
2014	87.7	4	31.5	25.7	21.6	18.7	14.4	8.6	5.6
2015	96.4	6	33.8	26.9	23.3	19.0	14.6	8.2	5.6
2016	98.1	8	32.7	27.5	25.1	20.7	15.4	8.2	5.4

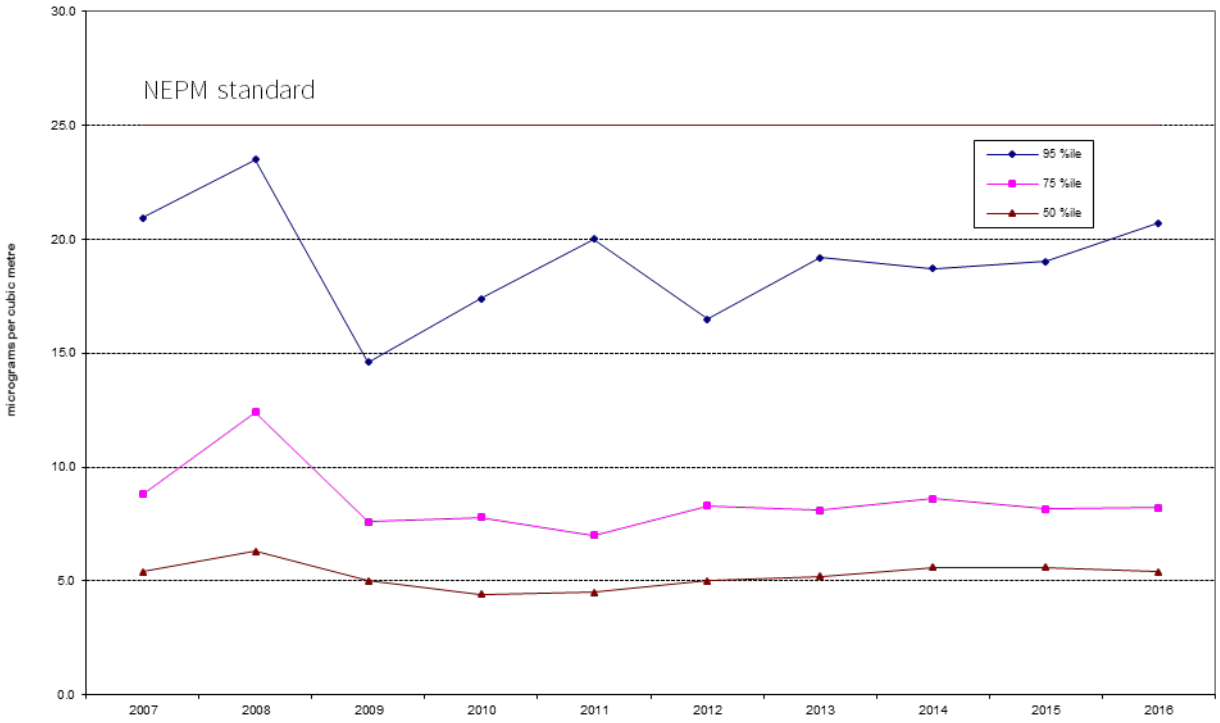

Figure 35: Statistical summary for daily maximum daily $PM_{2.5}$ Monash 2007 – 2016

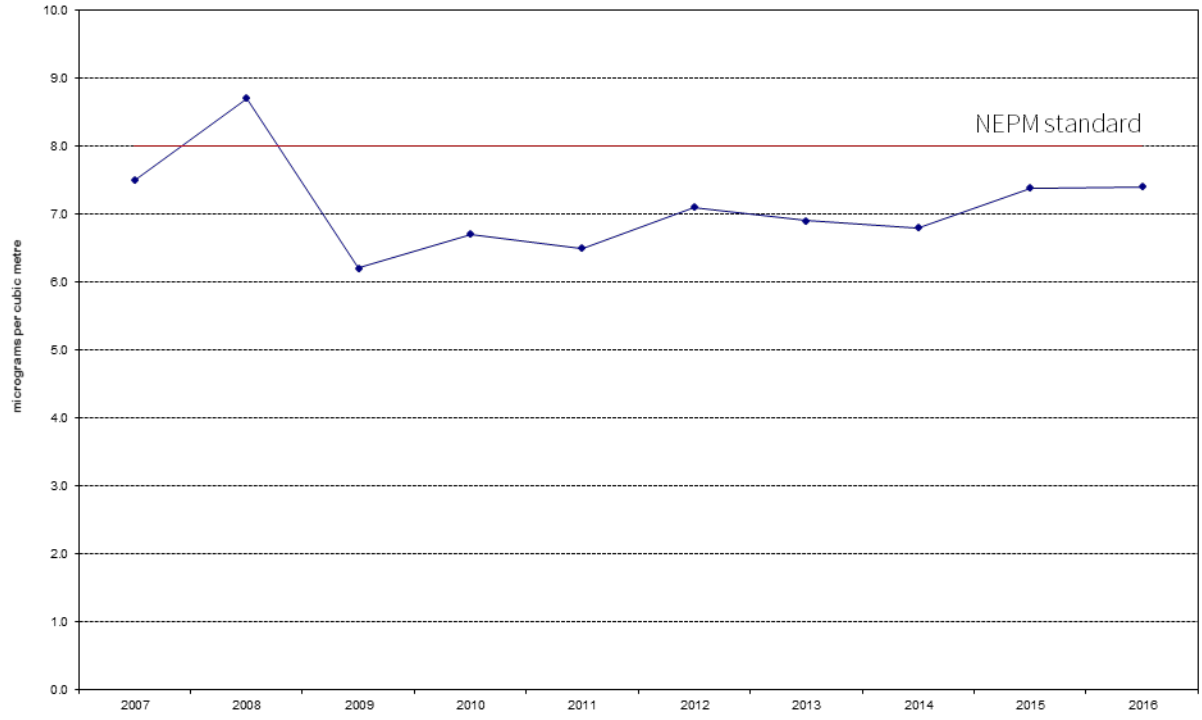

Figure 36: Annual average daily $PM_{2.5}$ Monash 2007 – 2016

Table 29: Statistical summary for daily maximum daily $PM_{2.5}$ Florey 2014 – 2016

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)
2014	74.2	0	22.8	18.0	17.2	15.0	12.3	7.1	4.9
2015	96.2	0	24.3	20.5	19.3	17.1	12.6	7.4	4.8
2016	98.6	1	27.2	22.9	20.0	17.4	13.1	8.6	5.8

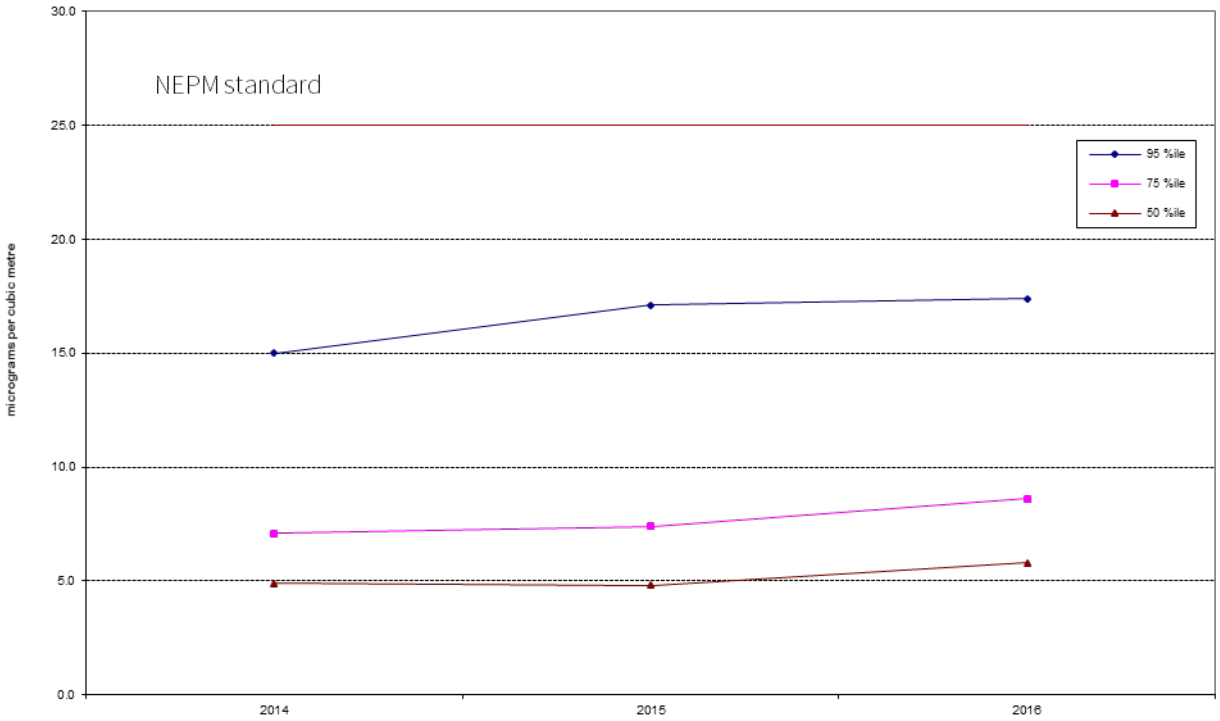

Figure 37: Statistical summary for daily maximum daily $PM_{2.5}$ Florey 2014 – 2016

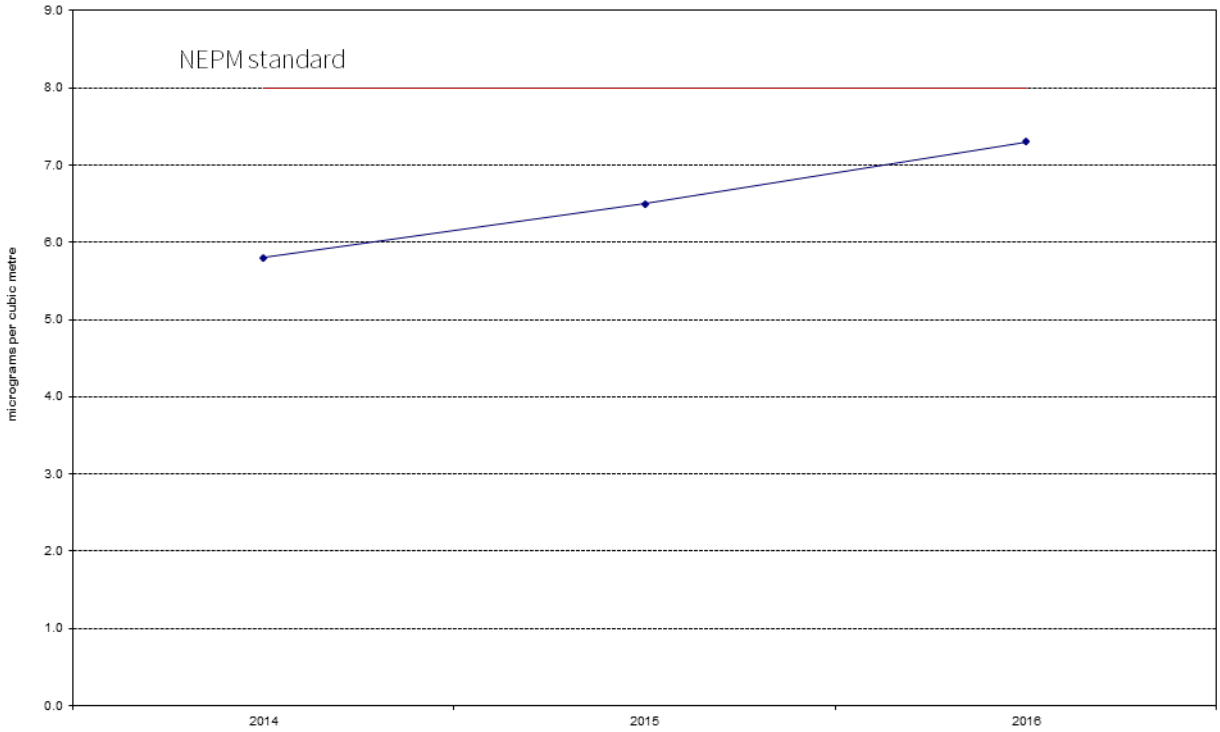

Figure 38: Annual average daily $PM_{2.5}$ Florey 2014 – 2016