



ACT
Government



ACT AIR QUALITY REPORT 2018

Environment Protection Authority | June 2019

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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
Exceptional event	Exceptional event means a fire or dust occurrence that adversely affects air quality at a particular location, and causes an exceedance of 1 day average standards in excess of normal historical fluctuations and background levels, and is directly related to: bushfire; jurisdiction authorised hazard reduction burning; or continental scale windblown dust
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 micrometres
PM ₁₀	Particles with an equivalent aerodynamic diameter less than or equal to 10 micrometres
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
µg/m ³	micrograms per cubic metre

OVERVIEW

The ACT Air Quality Report 2018 (Report) presents the results of ambient air quality monitoring in the ACT for 2018 and assesses the results in accordance with the requirements of the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) made by the National Environment Protection Council on 26 June 1998.

Air quality in this Report is assessed against the AAQ NEPM standards shown in Table 3. In accordance with its agreed policy position, the ACT assesses its compliance for the annual average for particulate matter less than 10 microns (PM₁₀) against a lower standard of 20 µg/m³ rather than the AAQ NEPM standard of 25 µg/m³ from 2016.

The ACT monitors four of the six NEPM pollutants:

- carbon monoxide (CO);
- nitrogen dioxide (NO₂);
- photochemical oxidants as ozone (O₃);
- particulate matter PM₁₀ (particles less than 10 microns in diameter); and
- particulate matter PM_{2.5} (particles less than 2.5 microns in diameter).

The ACT has never monitored sulfur dioxide (SO₂) as it is primarily an industrial pollutant and the ACT does not have a lot of heavy industry. In 2002, lead monitoring ceased with the phase out of leaded petrol.

A summary of the 2018 monitoring results is:

- Canberra's air quality was generally good, with no exceedances of the AAQ NEPM standards for carbon monoxide, nitrogen dioxide or ozone at any of the ACT's monitoring stations;
- the major impacts on Canberra's air quality came from the accumulation of particles from events such as hazard reduction burns and dust storms and human activities such as wood heaters; and
- some significantly high particle levels, PM₁₀ in particular, occurred as a result of more frequent dust storms due to the prolonged drought conditions in 2018.

Exceedances of the PM₁₀ and PM_{2.5} standards are summarised below:

- the 24-hour PM₁₀ standard was exceeded on six days across the ACT. All of the PM₁₀ exceedances occurred outside the winter season and were due to dust storms (refer to Table 14 for details);
- the 24-hour PM_{2.5} standard was exceeded on five days. The PM_{2.5} exceedance which occurred at Monash on 27 May 2018 was attributed to emissions from domestic wood heaters in winter. The other exceedances were primarily due to dust storms (refer to Table 16 for details); and

- The pie chart below shows the causes (in percentage) of PM_{2.5} exceedances.

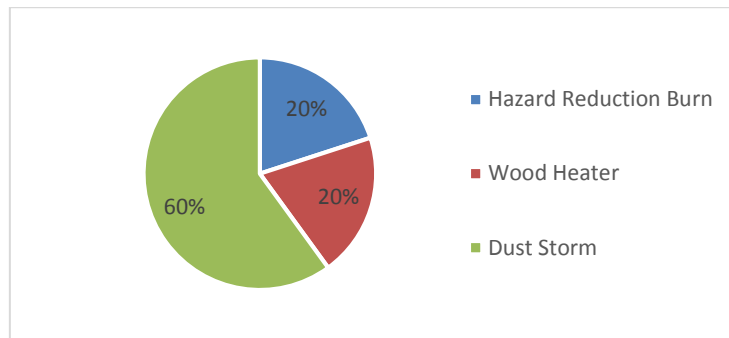


Figure 1: Causes of PM_{2.5} exceedances

- In the case of PM₁₀ and PM_{2.5}, all exceedances associated with an exceptional event as defined in the AAQ NEPM (e.g. bushfire smoke or dust storm) were not considered when determining compliance with the relevant 24-hour goal.

MONITORING SUMMARY

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 (EPA) 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 consists of three monitoring stations located at:

- Monash – approximately 300 metres west of Cockcroft Avenue in the Monash district playing fields
- Civic – at the northern end of the carpark on the western side of the Olympic swimming pool adjacent to Allara Street
- Florey – at the end of Neumann Place, on public land.

The compliance and non-compliance criteria for the monitoring stations against the siting standard AS/NZS 3580.1.1:2008 are listed in Table 1 below.

Table 1: Summary of stations' siting compliance with AS 3580.1.1:2008

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	☑	☑	☑	☑	☑	☑	☑

The Monash and Florey stations contain instrumentation that continuously monitors carbon monoxide, nitrogen dioxide, ozone and particles as PM₁₀ and PM_{2.5}. Following the establishment of the Florey station on 28 February 2014, the Civic station only monitors ozone and particles as PM₁₀ 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 3580.6.1-2016	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 3580.9.12:2013	Methods for sampling and analysis of ambient air - Method 9.12: Determination of suspended particulate matter - PM _{2.5} beta attenuation monitors	BAM

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 ($\mu\text{g}/\text{m}^3$) (refer to Table 3, column 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 exceedances for each standard (shown in column 4, Table 3). For $\text{PM}_{2.5}$, there is an additional goal to further reduce concentrations to below a daily concentration of $20 \mu\text{g}/\text{m}^3$ and an annual concentration of $7 \mu\text{g}/\text{m}^3$ by 2025.

Table 3: AAQ NEPM standards and goals

Pollutant	Averaging Period	Maximum concentration	Maximum allowable exceedances	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	$0.50 \mu\text{g}/\text{m}^3$	None	Not monitored
Particles as PM_{10}	1 day 1 year	$50 \mu\text{g}/\text{m}^3$ $25 \mu\text{g}/\text{m}^3$	None None	Monash Florey Civic
Particles as $\text{PM}_{2.5}$	1 day 1 year	$25 \mu\text{g}/\text{m}^3$ $8 \mu\text{g}/\text{m}^3$	None None	Monash Florey Civic

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 exceedances is no more than the number specified in Table 3 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 exceedances specified in Table 3. For the purpose of reporting compliance against PM₁₀ and PM_{2.5} 1 day average standards, monitoring data that has been determined as being directly associated with an exceptional event has been excluded.

Air quality is assessed as '*NOT DEMONSTRATED*' (i.e. '*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 Tables 4 to 8 on the following pages.

Carbon monoxide

During 2018, no exceedances of the carbon monoxide standard were recorded and compliance was demonstrated at Monash and Florey.

Table 4: 2018 compliance summary for CO

AAQ NEPM standard - 9.0 ppm (8-hour average)

Performance monitoring station	Data availability rates (% of hours)					Number of exceedances (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Monash	95.8	94.6	95.0	83.8	92.3	0	MET
Florey	93.6	95.5	94.1	95.7	94.7	0	MET

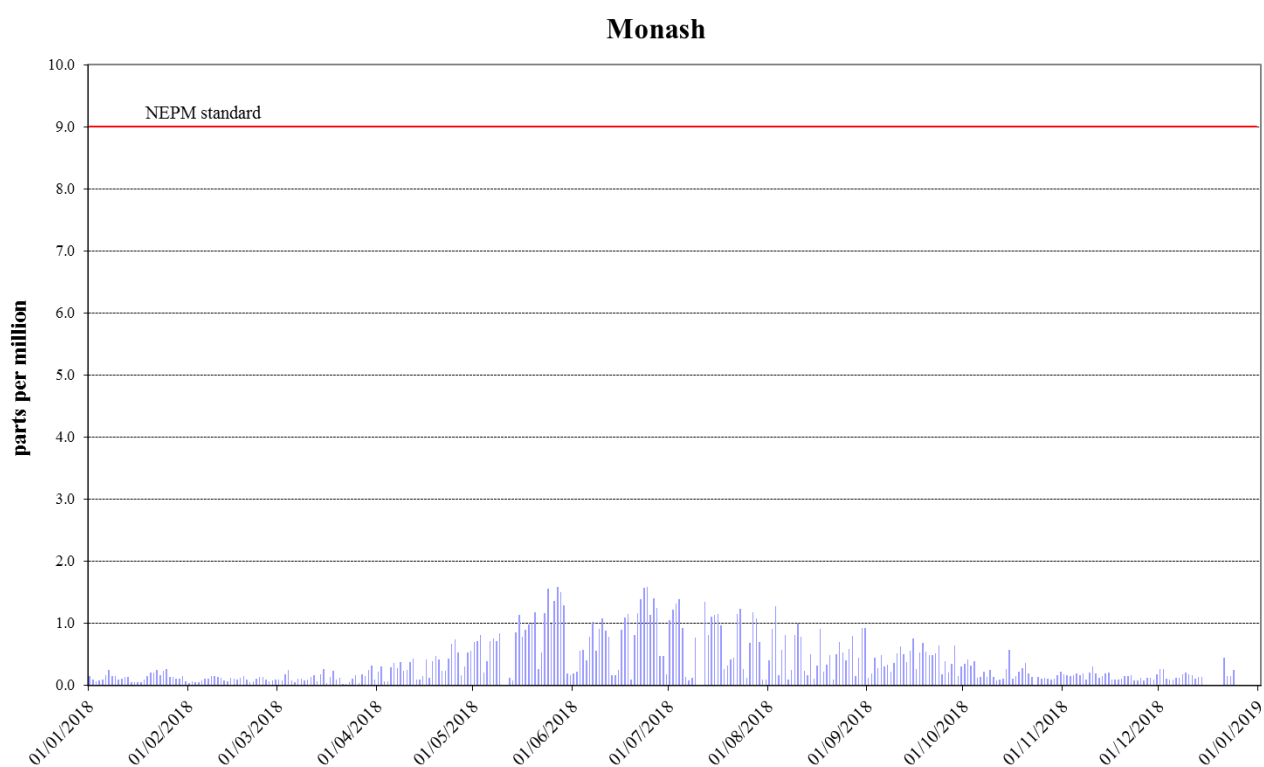


Figure 2: Daily maximum for CO 8-hour average – Monash

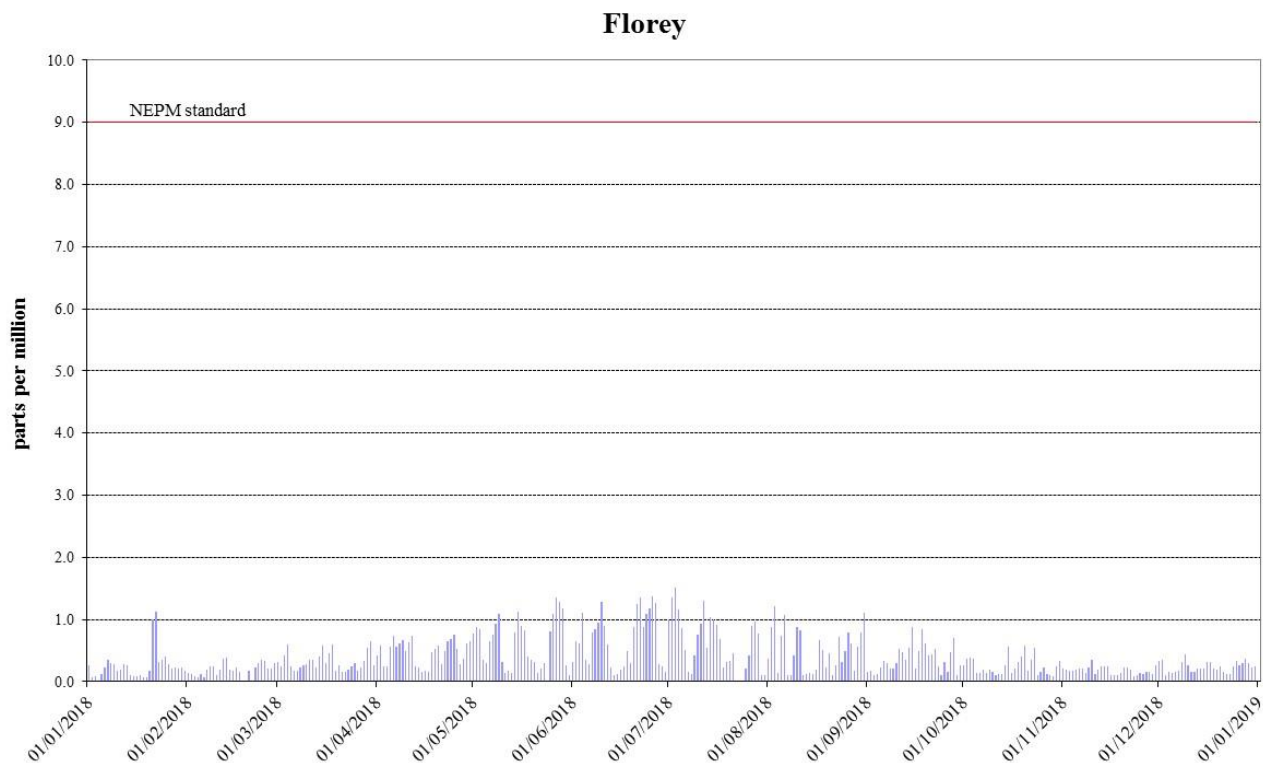


Figure 3: Daily maximum for CO 8-hour average – Florey

Nitrogen dioxide

During 2018, no exceedances of the nitrogen dioxide standards were recorded and compliance was demonstrated at Monash and Florey.

Table 5: 2018 compliance summary for NO₂

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 exceedances (days)	Performance against the standards and goal	
								1 hour	1 year
	Q1	Q2	Q3	Q4	Annual				
Monash	95.8	95.7	95.0	95.6	95.5	0.004	0	MET	MET
Florey	90.2	94.7	93.5	94.7	93.3	0.005	0	MET	MET

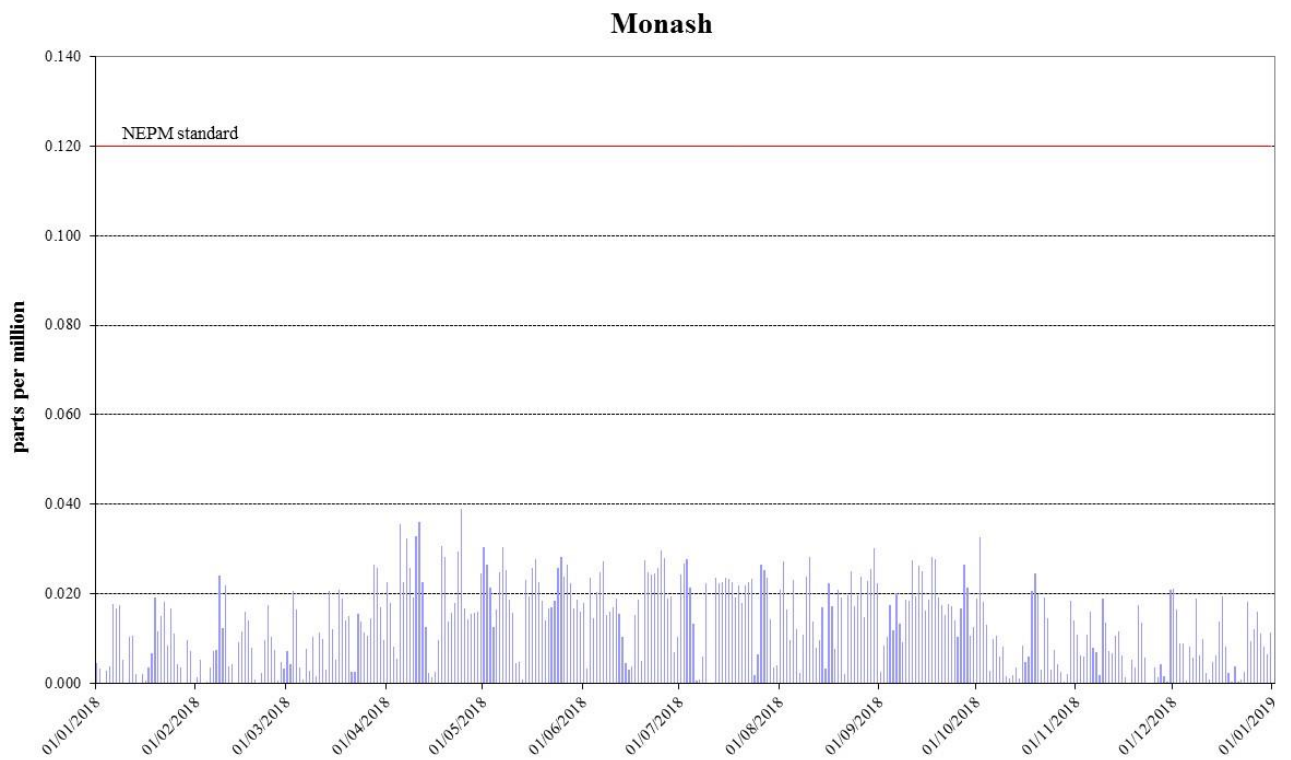


Figure 4: Daily maximum for NO₂ – Monash

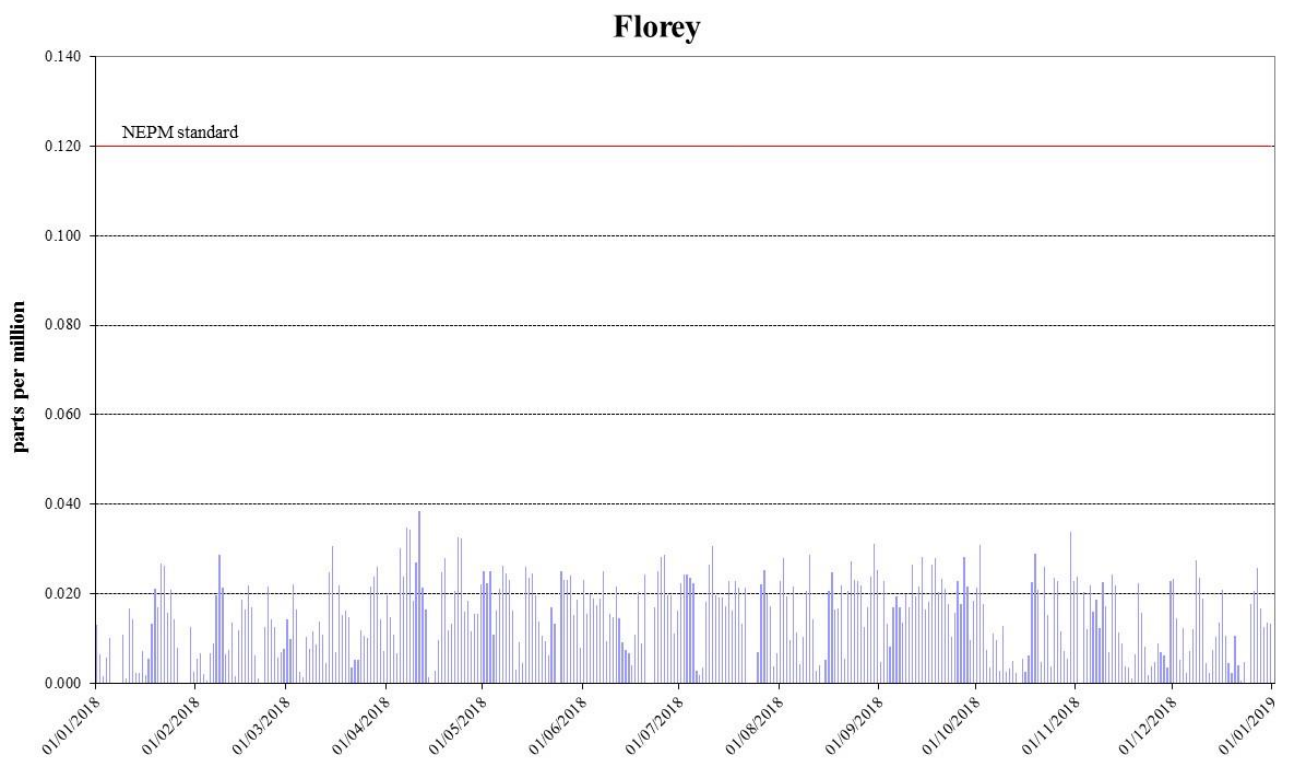


Figure 5: Daily maximum for NO₂ – Florey

Ozone

During 2018, no exceedances of the 1-hour and 4-hour standards for ozone were recorded and compliance was demonstrated at all monitoring stations.

Table 6: 2018 compliance summary for O₃

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 exceedances (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	95.8	95.6	95.8	0	0	MET	MET
Civic	95.7	95.8	95.8	93.3	95.2	0	0	MET	MET
Florey	95.3	95.6	94.1	95.7	95.2	0	0	MET	MET

Monash

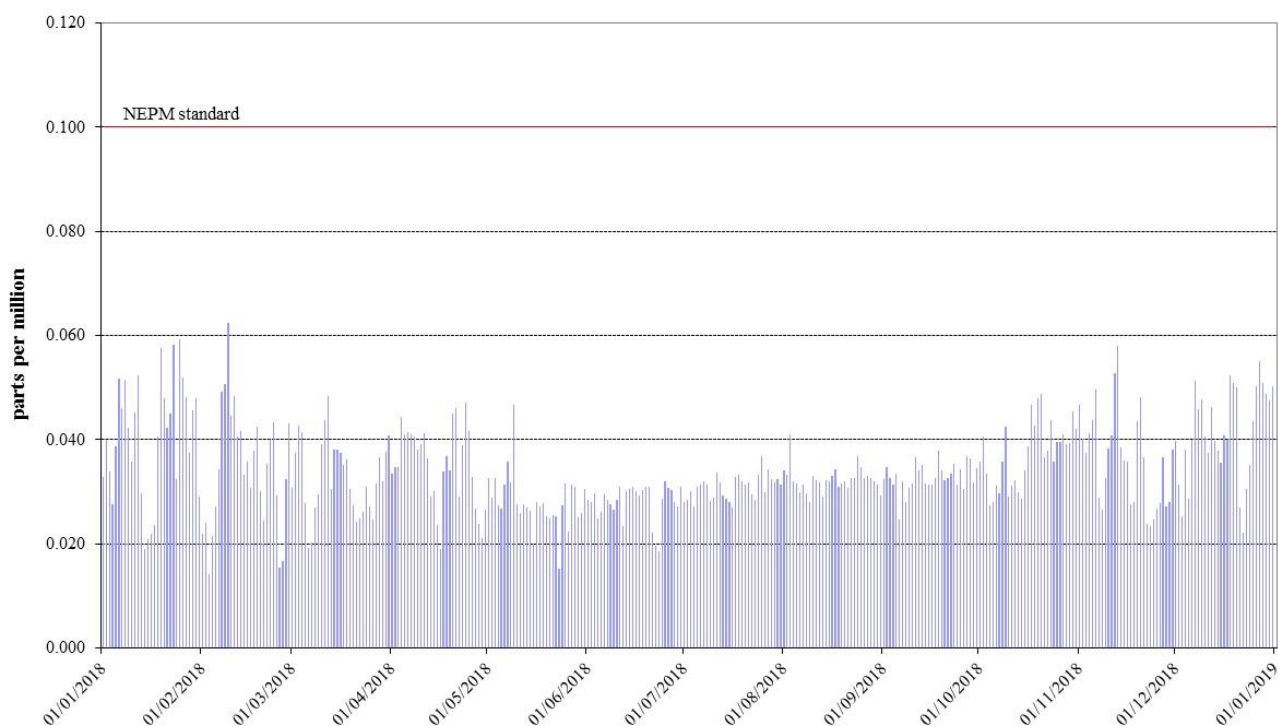


Figure 6: Daily maximum for 1 hour O₃ – Monash

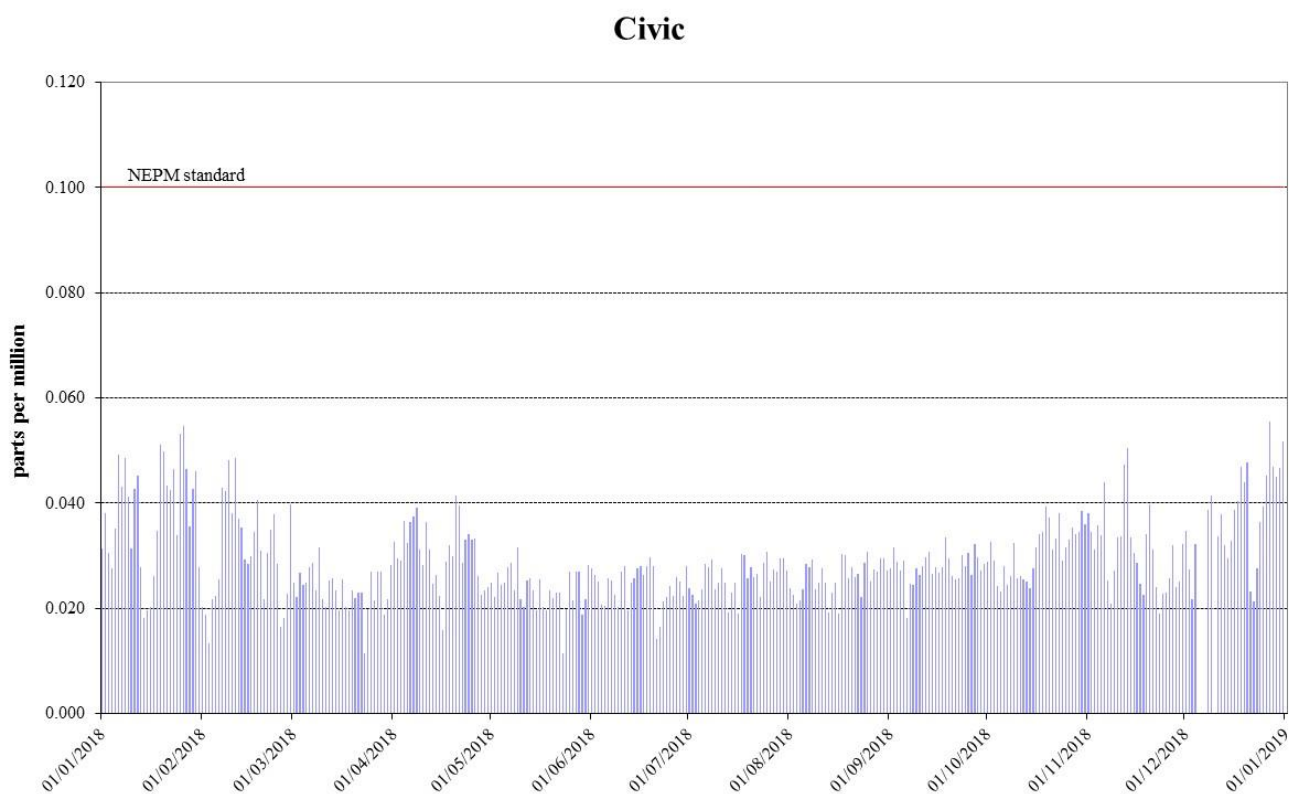


Figure 7: Daily maximum for 1 hour O_3 – Civic

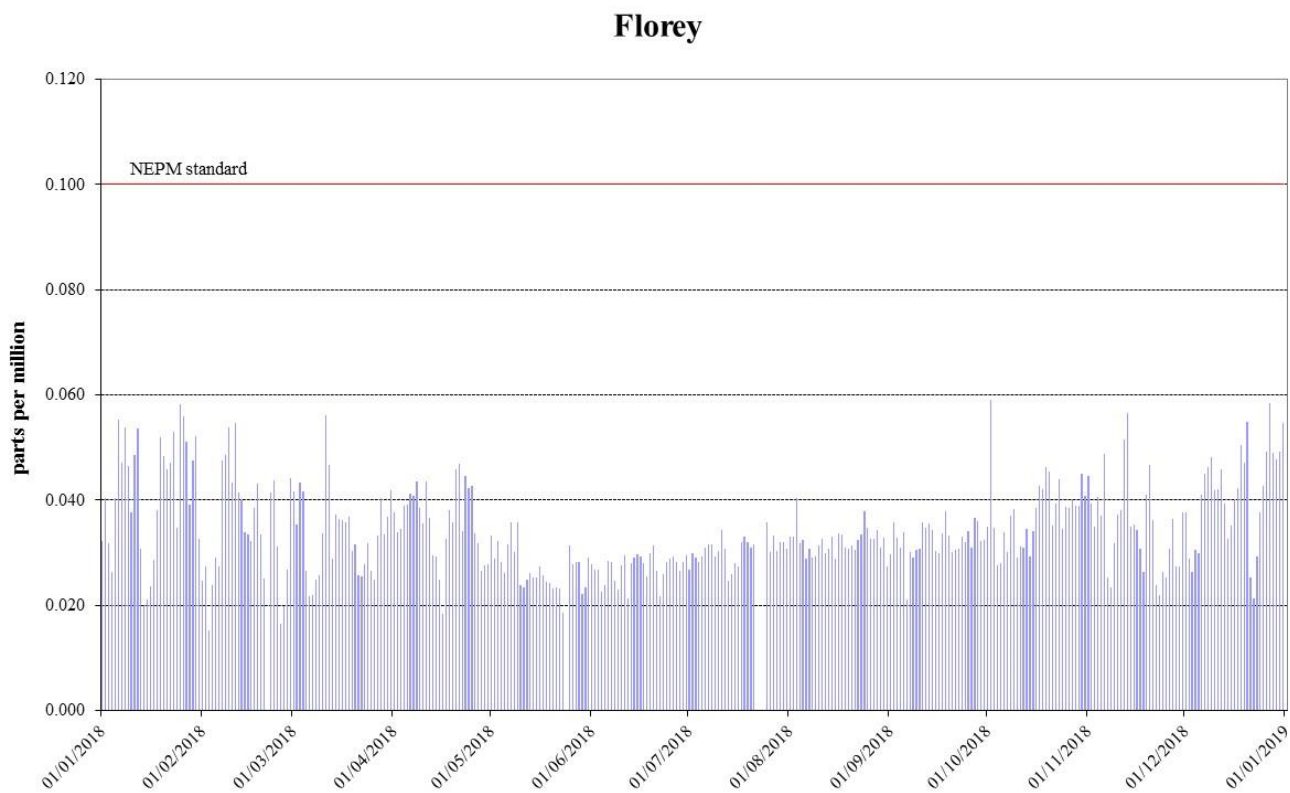


Figure 8: Daily maximum for 1 hour O_3 – Florey

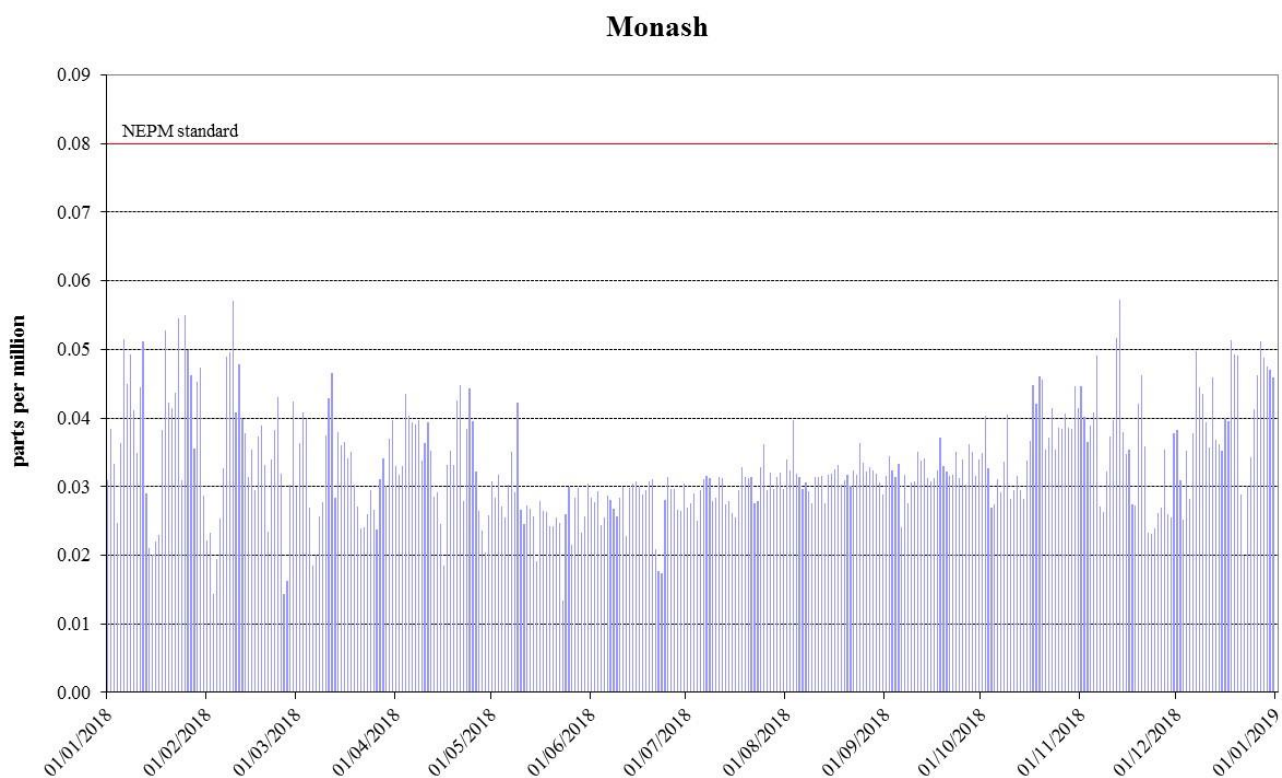


Figure 9: Daily maximum for 4 hours O₃ - Monash

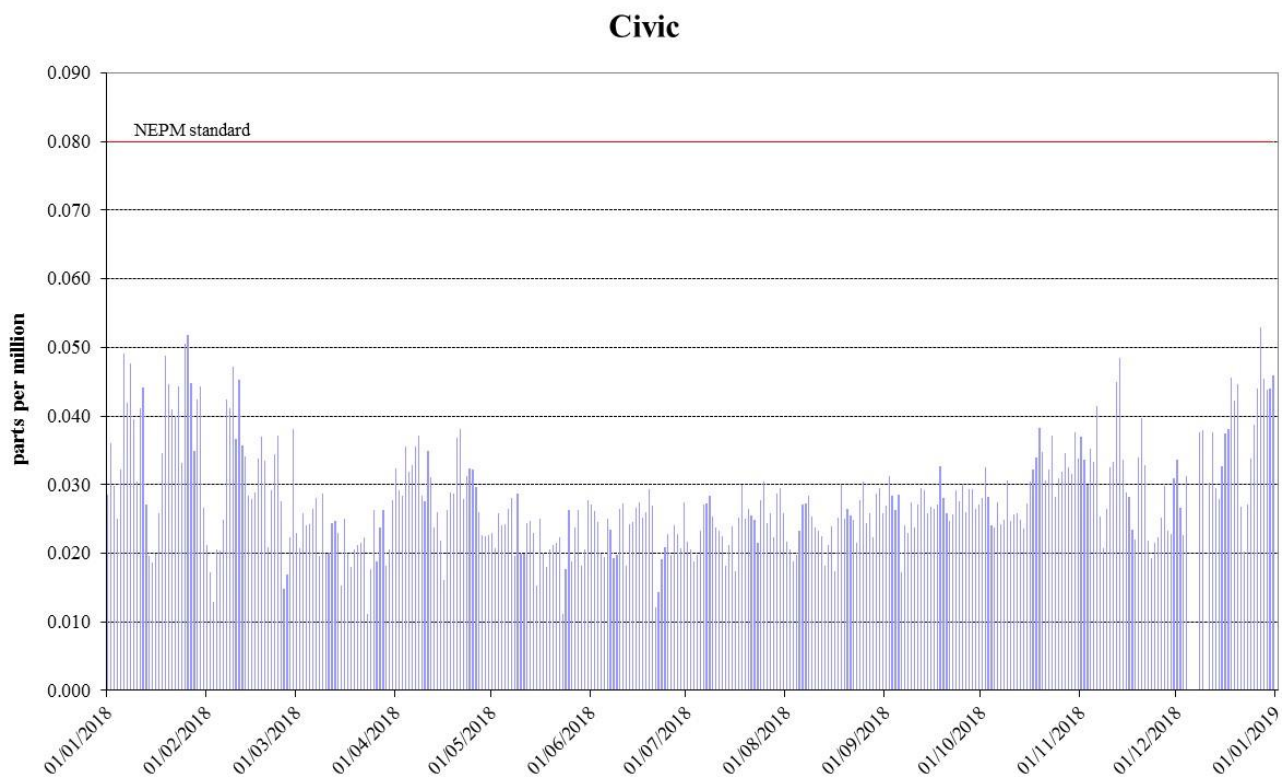


Figure 10: Daily maximum for 4 hours O₃ – Civic

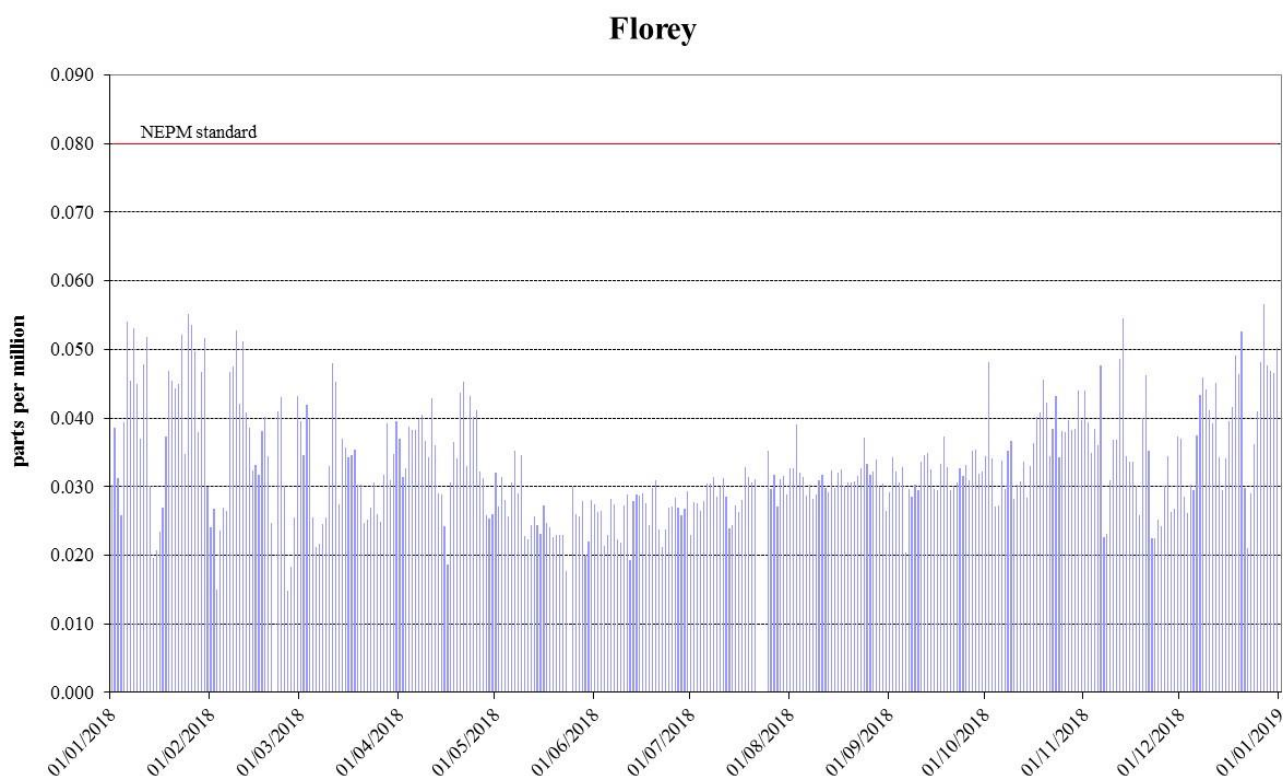


Figure 11: Daily maximum for 4 hours O₃ – Florey

PM₁₀

During 2018, there were 13 exceedances of the 24-hour PM₁₀ standard recorded in the ACT, which occurred outside the winter season and were due to dust storms^{**}. Compliance against the AAQ NEPM PM₁₀ standard was demonstrated at all stations, when the exceedances were removed as exceptional events.

Table 7: 2018 compliance summary for PM₁₀

AAQ NEPM standard 50 µg/m³ 1-day average, 20 µg/m³ (1-year average)*

Performance monitoring station	Data availability rates (% of days)					Annual mean Concentration (µg/m ³)	Number of exceedances (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual			
Monash	98.9	100	100	97.8	99.2	11.8	4	MET ^{**}
Civic	93.3	100	100	97.8	97.8	13.5	6	MET ^{**}
Florey	90.0	87.9	87.0	94.6	89.9	12.0	3	MET ^{**}

* ACT policy position 20 µg/m³ not AAQ NEPM standard of 25 µg/m³

^{**} monitoring data that has been determined as being directly associated with an exceptional events such as hazard reduction burn or dust storm is excluded for the purpose of reporting compliance.

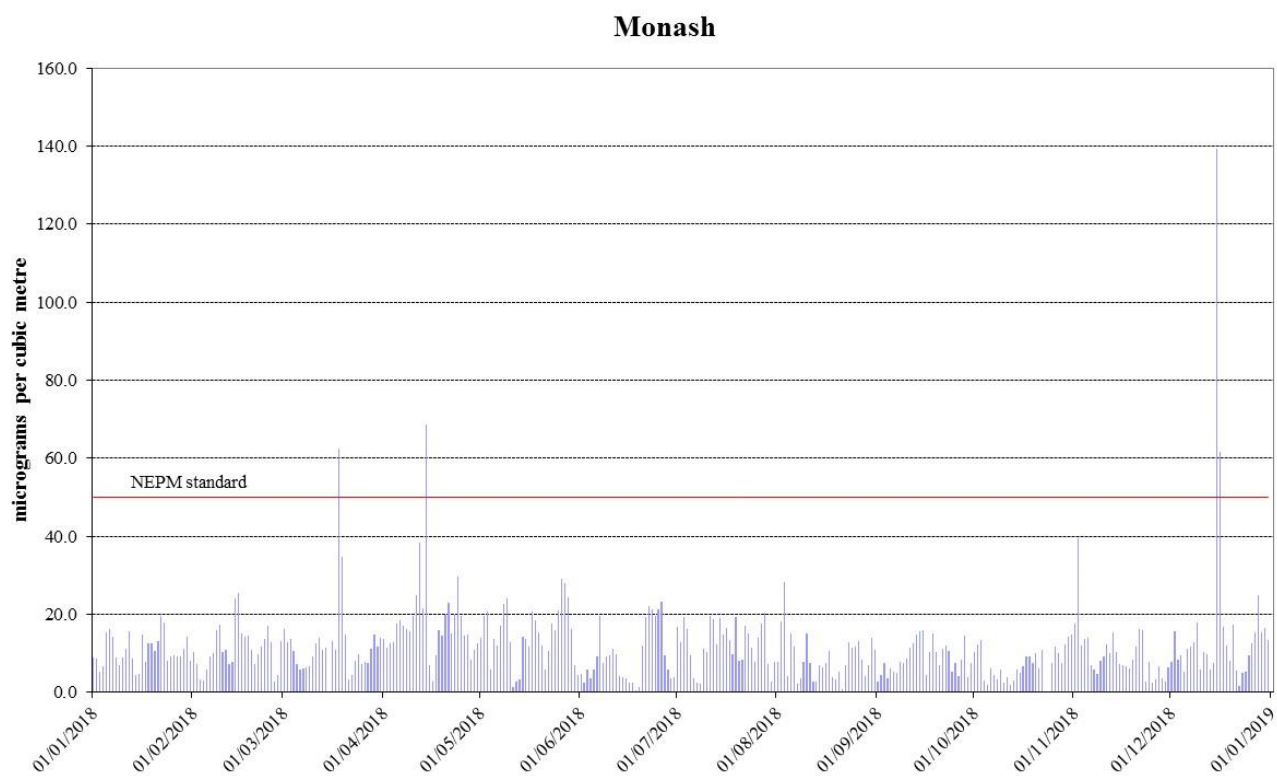


Figure 12: Daily maximum for PM₁₀ – Monash

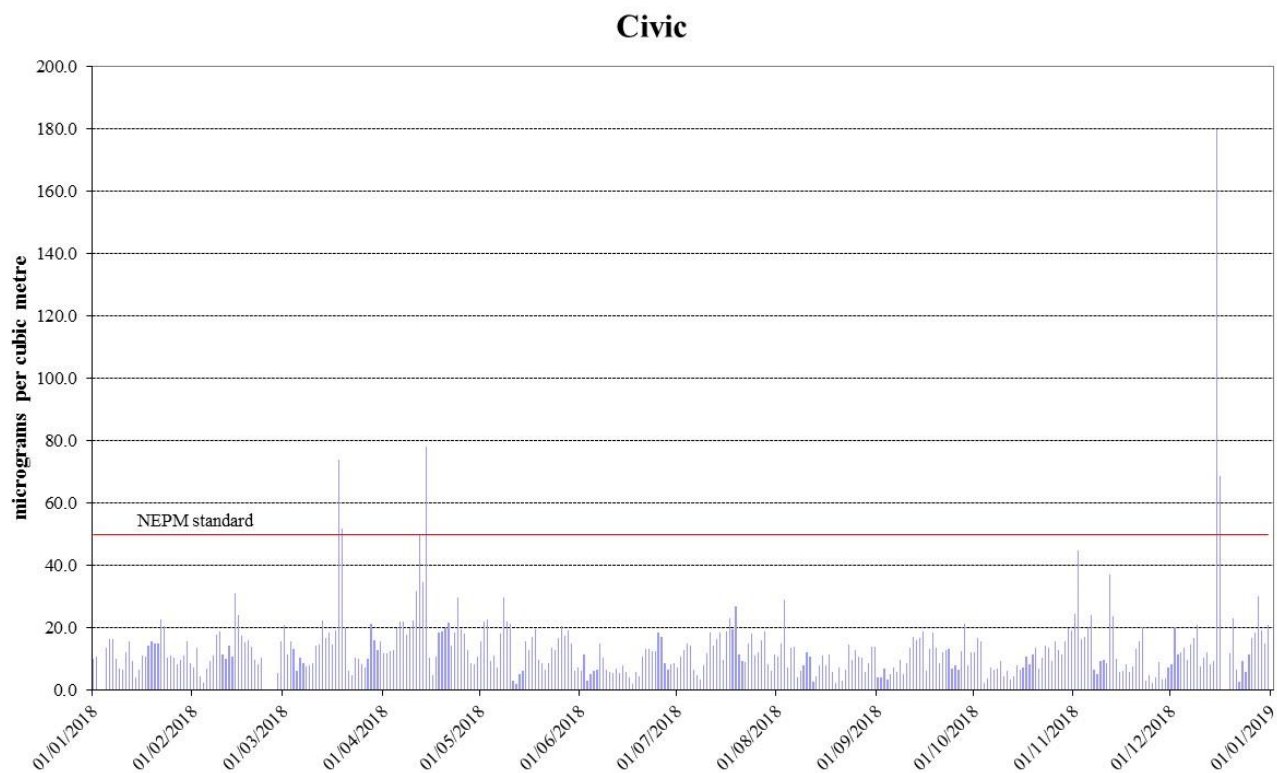


Figure 13: Daily maximum for PM₁₀ – Civic

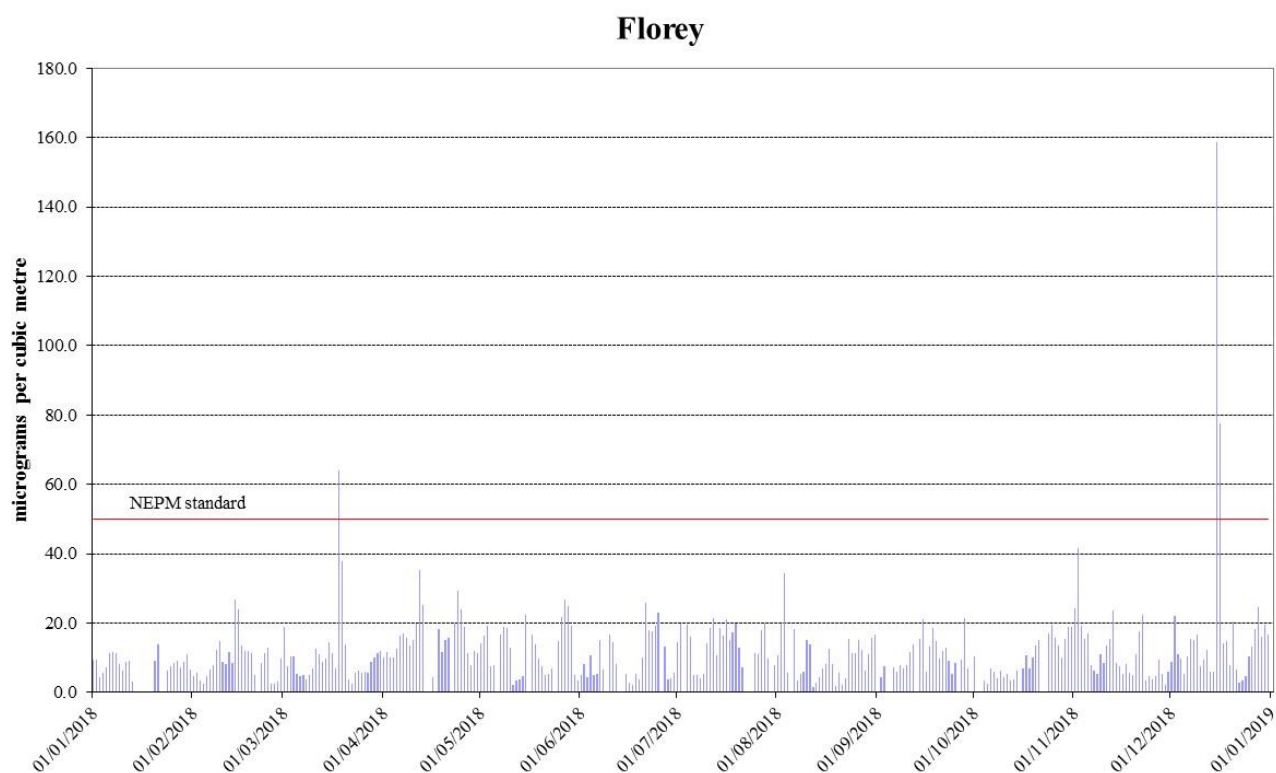


Figure 14: Daily maximum for PM₁₀ – Florey

PM_{2.5}

During 2018, there were four exceedances of the 24-hour PM_{2.5} standard which were attributed to hazard reduction burns (1) and dust storms (3) and therefore were excluded when assessing compliance against the daily goal. Compliance against the AAQ NEPM PM_{2.5} standards was met at Civic and Florey. The goal was not met at Monash due to one wood heater related exceedance on 27 May 2018.

Table 8: 2018 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/m ³)	Number of exceedances (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual			
Monash	100	98.9	97.8	100	99.2	6.8	2	NOT MET
Civic	100	100	100	94.6	98.6	6.5	1	MET**
Florey	98.9	98.9	94.6	96.7	97.3	7.1	2	MET**

** monitoring data that has been determined as being directly associated with an exceptional events such as hazard reduction burn or dust storm is excluded for the purpose of reporting compliance.

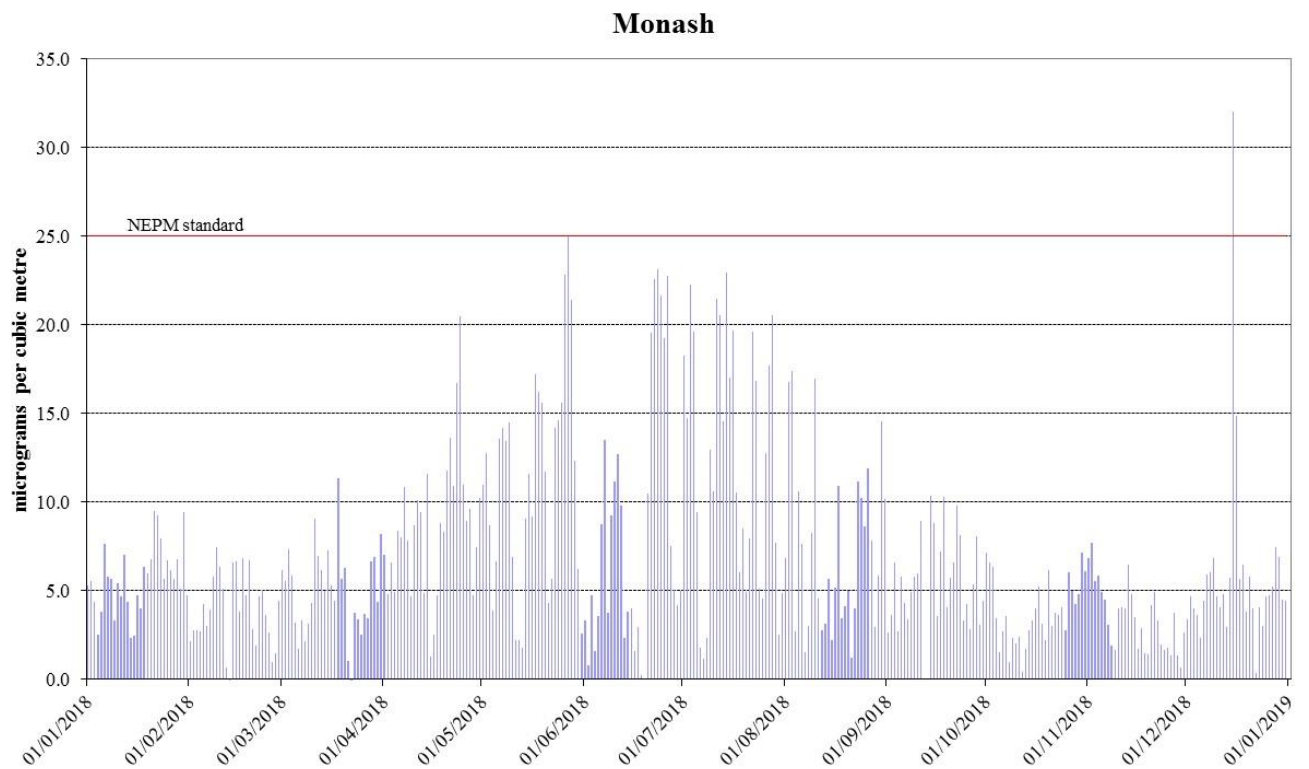


Figure 15: Daily maximum for PM_{2.5} – Monash

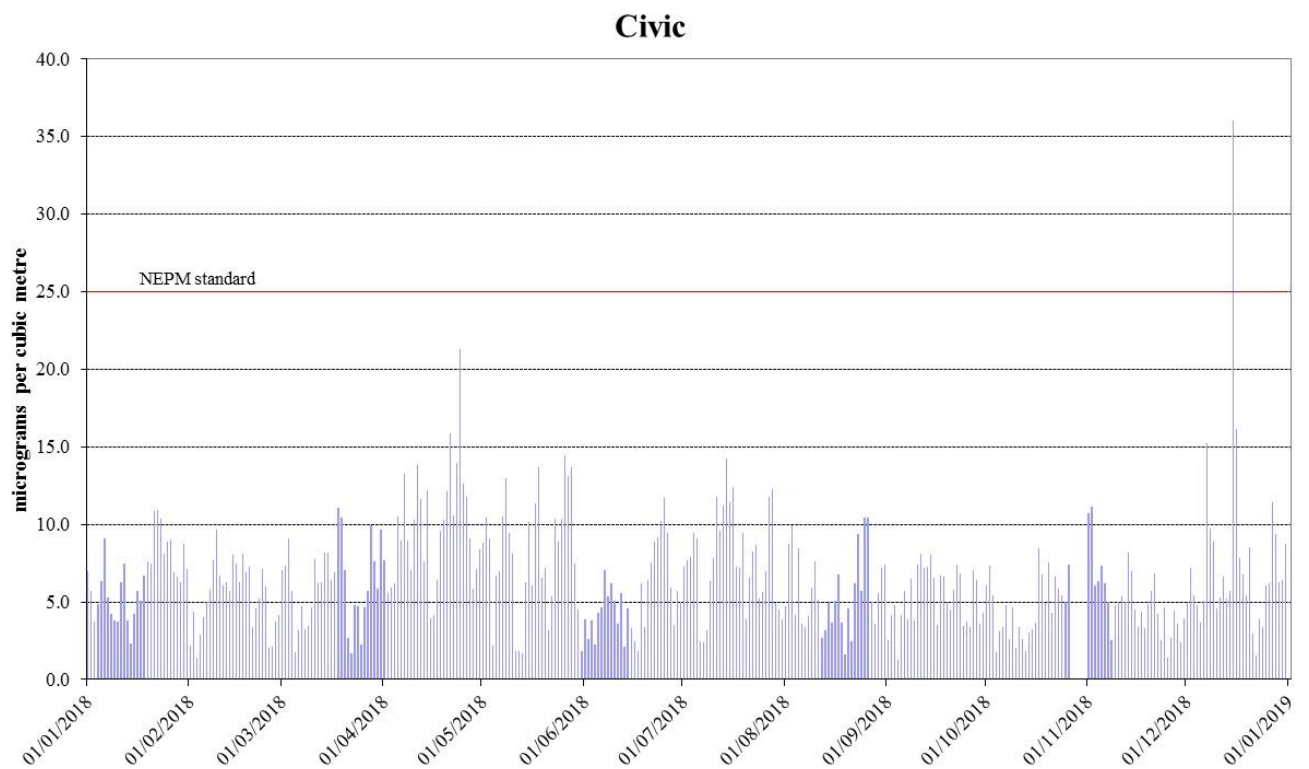


Figure 16: Daily maximum for PM_{2.5} – Civic

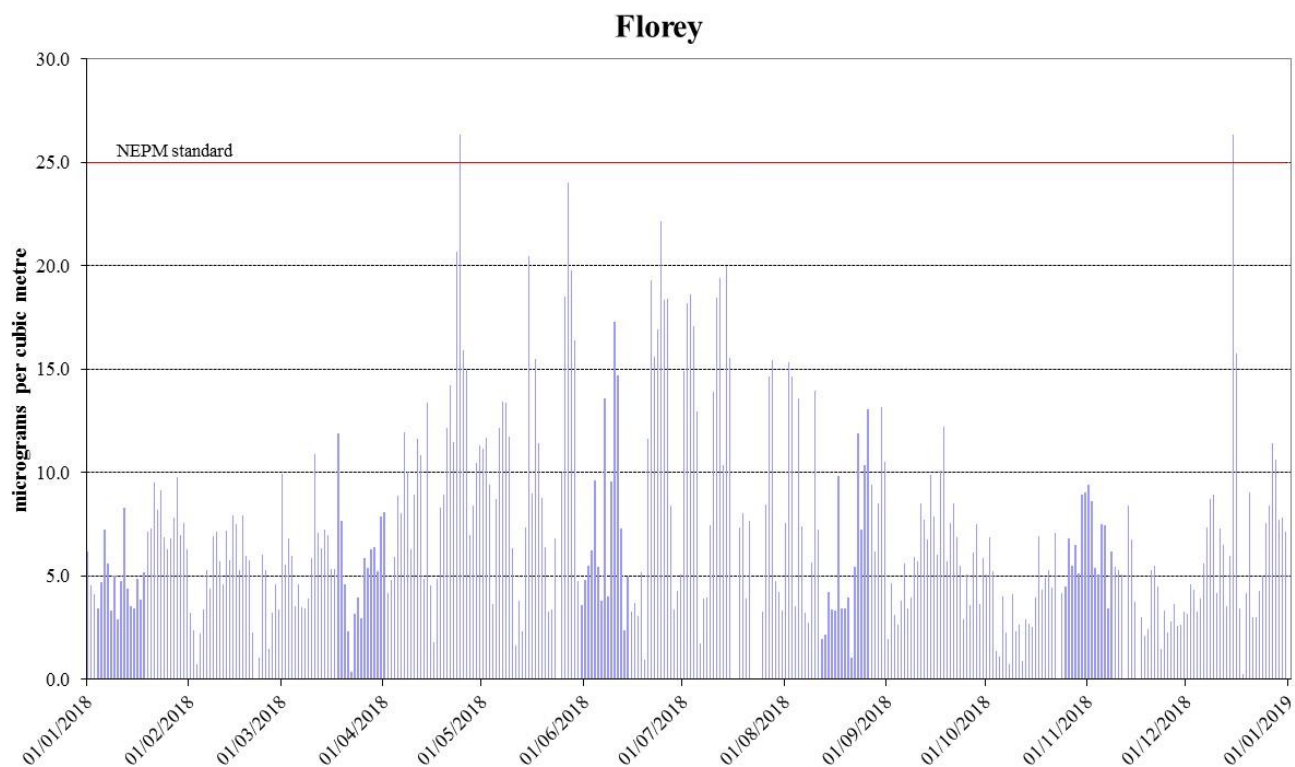


Figure 17: Daily maximum for PM_{2.5} – Florey

ANALYSIS OF AIR QUALITY MONITORING

Annual summary statistics contained in Table 9 to Table 15 below assess air quality against the standards and the extent of compliance with the goal. Instances where the standard has been exceeded are highlighted in bold.

Carbon monoxide

Table 9: 2018 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)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	347	1.6	27 May 04:00	1.6	24 Jun 06:00
Florey	358	1.5	03 Jul 03:00	1.4	26 Jun 03:00

Carbon monoxide levels are well below the AAQ NEPM standard at all monitoring stations. The highest recorded value in the ACT during 2018 was 1.6 ppm at Monash, which is 18% of the standard.

Nitrogen dioxide

Table 10: 2018 summary statistics for daily peak 1-hour NO₂

AAQ NEPM standard 0.12 ppm (1-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	363	0.039	24 Apr 19:00	0.036	11 Apr 20:00
Florey	349	0.039	11 Apr 19:00	0.035	07 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 2018 was 0.039 ppm at both Monash and Florey, which is only 32.5% of the standard. The highest recorded annual average in 2018 was 0.005ppm at Florey (refer to Table 5). This is 17% of the annual standard 0.03ppm.

Ozone

Table 11: 2018 summary statistics for daily peak 1-hour O₃

AAQ NEPM standard 0.10 ppm (1-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	365	0.062	09 Feb 11:00	0.059	25 Jan 17:00
Civic	361	0.056	27 Dec 12:00	0.055	26 Jan 11:00
Florey	360	0.059	02 Oct 13:00	0.058	27 Dec 12:00

Table 12: 2018 summary statistics for daily peak 4-hour O₃

AAQ NEPM standard 0.08 ppm (4-hour average)

Performance monitoring station	Number of valid days	Highest (ppm)	Highest (date/time)	2 nd Highest (ppm)	2 nd Highest (date/time)
Monash	365	0.057	13 Nov 14:00	0.057	09 Feb 13:00
Civic	361	0.053	27 Dec 19:00	0.052	26 Jan 14:00
Florey	360	0.057	27 Dec 13:00	0.055	25 Jan 18:00

Ozone levels are below the AAQ NEPM standard. The highest recorded 1-hour value in the ACT during 2018 was 0.062 ppm at Monash, which is 62% of the standard. The highest recorded 4-hour value in the ACT during 2018 was 0.057 ppm at Monash and Florey, which is 71% of the standard.

PM₁₀

Table 13: 2018 summary statistics for daily PM₁₀

AAQ NEPM daily standard 50 µg/m³

Performance monitoring station	Number of valid days	Highest (µg/m ³)	Highest (date)
Monash	362	139.2	15 December
Civic	357	179.8	15 December
Florey	328	158.6	15 December

Table 14: 2018 PM₁₀ exceedances

Date	Monitoring Station			Inferred Cause	Exceptional Event
	Monash (µg/m ³)	Civic (µg/m ³)	Florey (µg/m ³)		
18 March	62.4	74.0	64.1	Dust Storm	Yes
19 March		52.0		Dust Storm	Yes
12 April		50.2		Dust Storm	Yes
14 April	68.6	78.2		Dust Storm	Yes
15 December	139.2	179.8	158.6	Dust Storm	Yes
16 December	61.7	68.6	77.6	Dust Storm	Yes

While there were 13 exceedances of the standard recorded in the ACT during 2018, these were attributed to dust storms and were excluded when assessing compliance against the daily goal.

The highest daily PM₁₀ level was recorded at Civic on 15 December 2018, with the concentration of 179.8µg/m³.

The highest recorded annual average in 2018 was 13.5µg/m³ at Civic (refer to Table 7). This is 67.5% of the policy standard annual of 20µg/m³.

PM_{2.5}

Table 15: 2018 summary statistics for daily PM_{2.5}

AAQ NEPM daily standard 25 µg/m³

Performance monitoring station	Number of valid days	Highest (µg/m ³)	Highest (date)
Monash	362	32.0	15 December
Civic	357	36.1	15 December
Florey	328	26.4	15 December

Table 16: 2018 PM_{2.5} exceedances

Date	Monitoring Station			Inferred Cause	Exceptional Event
	Monash (µg/m ³)	Civic (µg/m ³)	Florey (µg/m ³)		
24 April			26.4	Controlled Burn	Yes
27 May	25.1			Wood Heater	No
15 December	32.0	36.1	26.4	Dust Storm	Yes

The daily reporting standard for PM_{2.5} was exceeded five times. Only one of the exceedances at Monash (27 May 2018) was a result of increased domestic wood heater emissions during the winter months. The other four exceedances were due to hazard reduction burns and dust storms.

The highest daily PM₁₀ level was recorded at Civic on 15 December 2018, with the concentration of 36.1µg/m³.

The highest recorded annual average in 2018 was 7.1µg/m³ at Florey (refer to Table 8). This is 89% of the annual standard 8µg/m³.

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 in 1998.

Historical monitoring results indicate that the only AAQ NEPM pollutant of concern in the ACT air shed is particulate matter, which increases significantly during winter because of emissions from domestic wood heaters, especially in the Tuggeranong Valley. Levels are exacerbated by the topography of the valley which is subject to temperature inversions and poor pollution dispersion.

In more recent years exceedances of the particulate matter standards have also been attributed to dust storms and smoke from controlled burns. During 2018, while there were 13 PM₁₀ exceedances and five PM_{2.5} exceedances, only one PM_{2.5} exceedance was related to emissions from domestic wood heaters.

PM_{2.5} is the pollutant most affected by woodsmoke as the majority of particles are less than 1 micron in diameter. Figure 15 to Figure 17 clearly show that PM_{2.5} levels increase significantly during the cooler months of the year. In the last few years the annual average PM_{2.5} readings for Monash and Florey have also increased and are now approaching the NEPM standard. Excluding temporal variation, this rise is more than likely because of an increase in wood heater use and/or installation as a result of the increasing cost of gas and electricity.

The ACT Government acknowledges that woodsmoke is a problem and will continue to implement an integrated program to address this including:

- the 'Burn Right Tonight' public education campaign;
- regulating of the sale of firewood and wood heaters, including the introduction of stricter emission and efficiency standards in September 2019; and
- administering the Wood Heater Replacement Program.

The Environment, Planning and Sustainable Development Directorate undertook a review of the efficacy of the Government's woodsmoke programs. The review found that there had been a steady decline in applications for the Wood Heater Replacement Program. As a result, the Minister for Climate Change and Sustainability approved an increase of the rebate for the removal of a wood heater for a trial period from 1 April and 30 June 2019. It is expected that more wood heaters will be replaced during this trial period.

In 2019, there will be an increased emphasis on how to clean and correctly operate wood heaters so they can perform efficiently and reduce air emissions.

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 in the past ten years. Percentiles for daily maximum values are presented.

Carbon monoxide

Table 17: Statistical summary for daily maximum 8-hour CO Monash 2009 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2009	96.4	0	2.0	1.4	0.6	0.3
2010	99.2	0	1.8	1.4	0.6	0.3
2011	98.6	0	2.2	1.5	0.5	0.2
2012	99.7	0	1.8	1.2	0.6	0.3
2013	95.9	0	2.1	1.5	0.6	0.3
2014	94.0	0	1.8	1.4	0.7	0.4
2015	94.8	0	1.9	1.4	0.6	0.3
2016	95.8	0	1.7	1.0	0.4	0.2
2017	95.4	0	1.6	1.2	0.6	0.2
2018	92.3	0	1.5	1.2	0.5	0.2

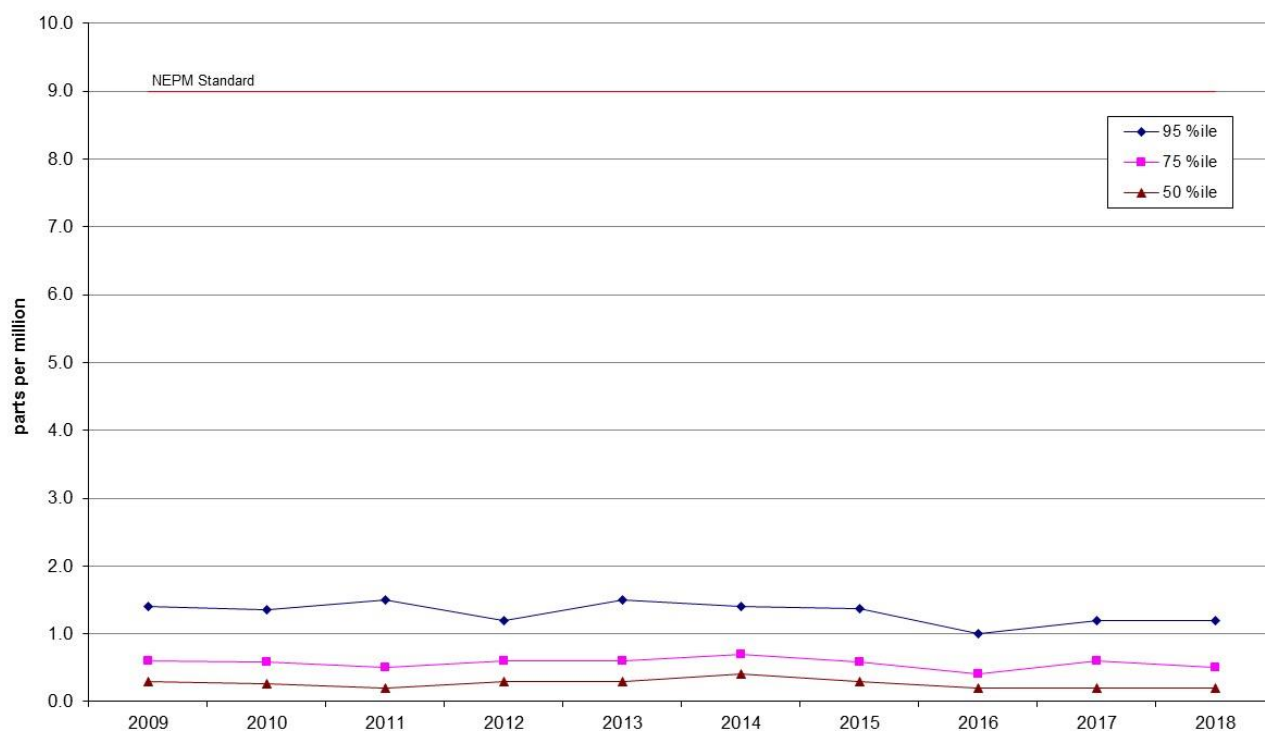


Figure 18: Statistical summary for daily maximum 8-hour CO Monash 2009 – 2018

Table 18: Statistical summary for daily maximum 8-hour CO Florey 2014 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2014	79.2	0	2.2	1.4	0.7	0.3
2015	94.9	0	2.0	1.5	0.6	0.3
2016	95.5	0	1.9	1.2	0.5	0.3
2017	94.7	0	1.8	1.4	0.5	0.2
2018	94.7	0	1.5	1.1	0.5	0.3

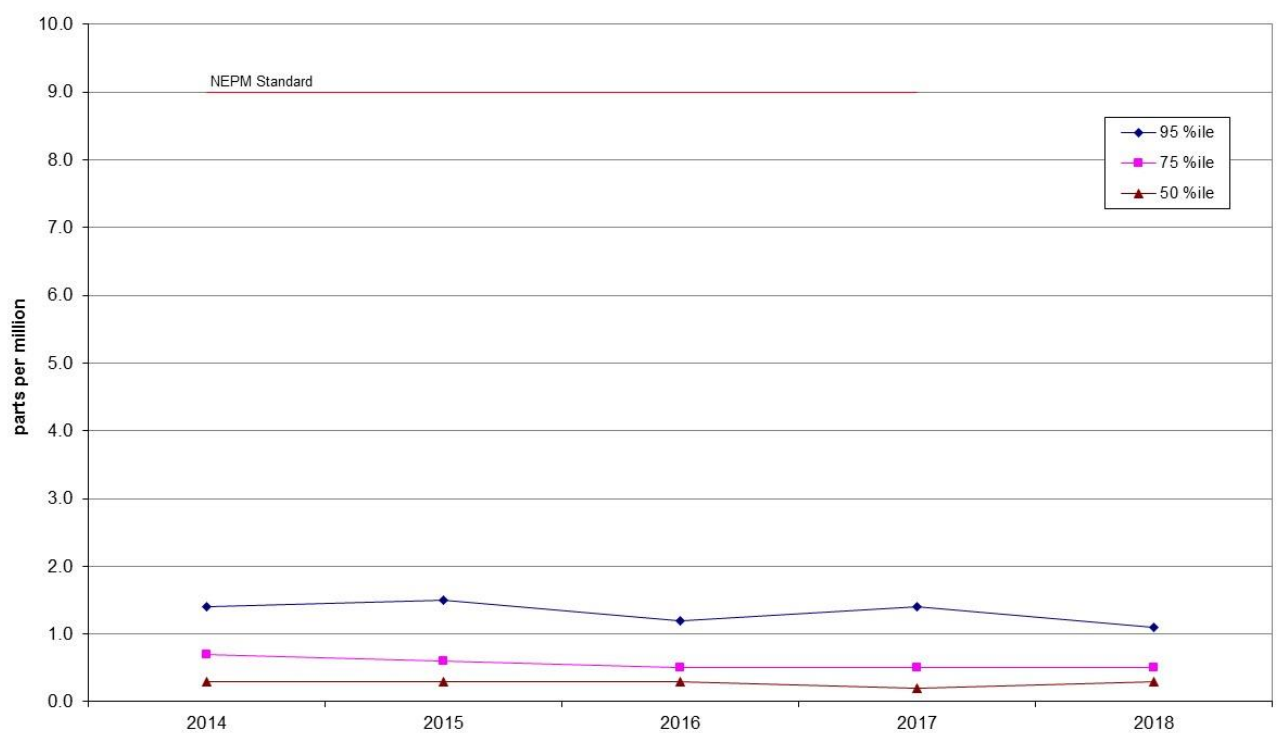


Figure 19: Statistical summary for daily maximum 8-hour CO Florey 2014 – 2018

Nitrogen dioxide

Table 19: Statistical summary for daily maximum 1-hour NO₂ Monash 2009 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	Annual average (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2009	92.6	0	0.041	0.008	0.029	0.023	0.019
2010	89.1	0	0.037	0.006	0.025	0.021	0.017
2011	96.7	0	0.043	0.005	0.029	0.022	0.015
2012	97.5	0	0.033	0.006	0.026	0.021	0.014
2013	97.5	0	0.037	0.005	0.027	0.021	0.014
2014	94.1	0	0.036	0.005	0.027	0.020	0.015
2015	94.8	0	0.032	0.004	0.026	0.020	0.014
2016	95.6	0	0.036	0.004	0.027	0.019	0.012
2017	95.6	0	0.031	0.004	0.027	0.021	0.013
2018	95.5	0	0.039	0.004	0.028	0.020	0.014

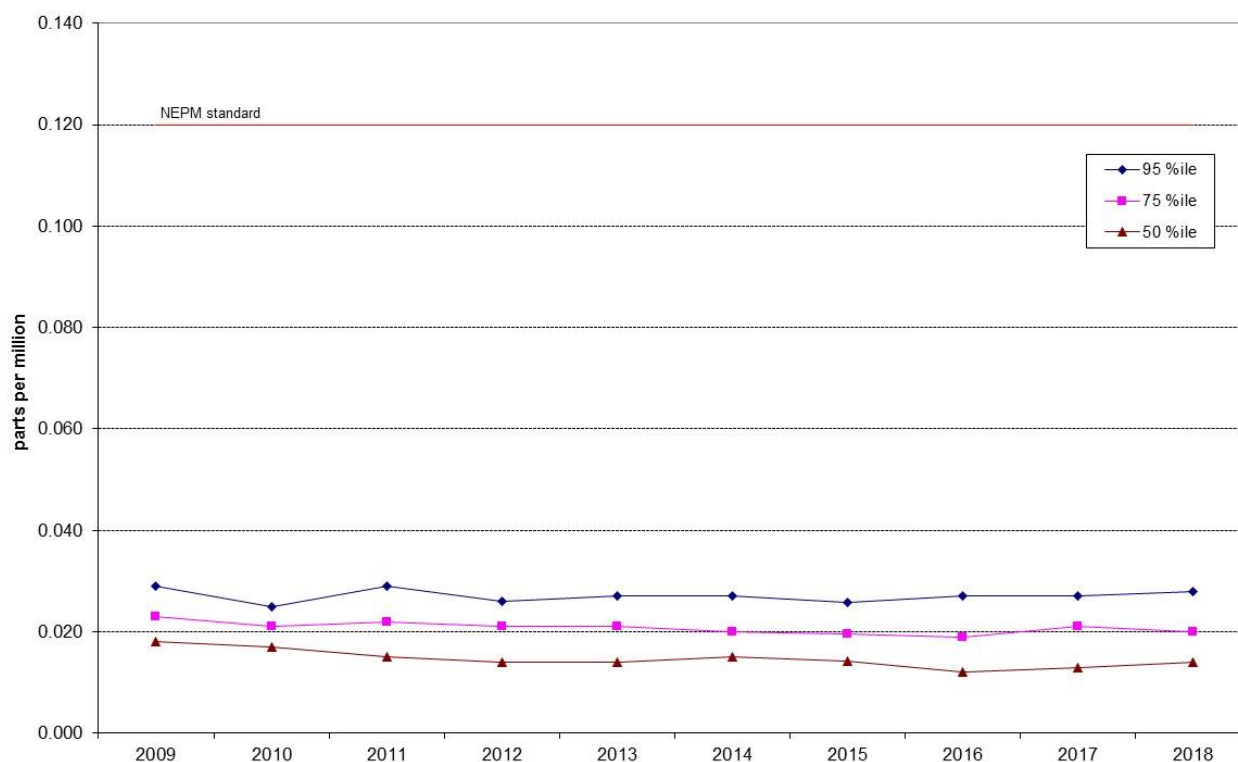


Figure 20: Statistical summary for daily maximum 1-hour NO₂ Monash 2009 – 2018

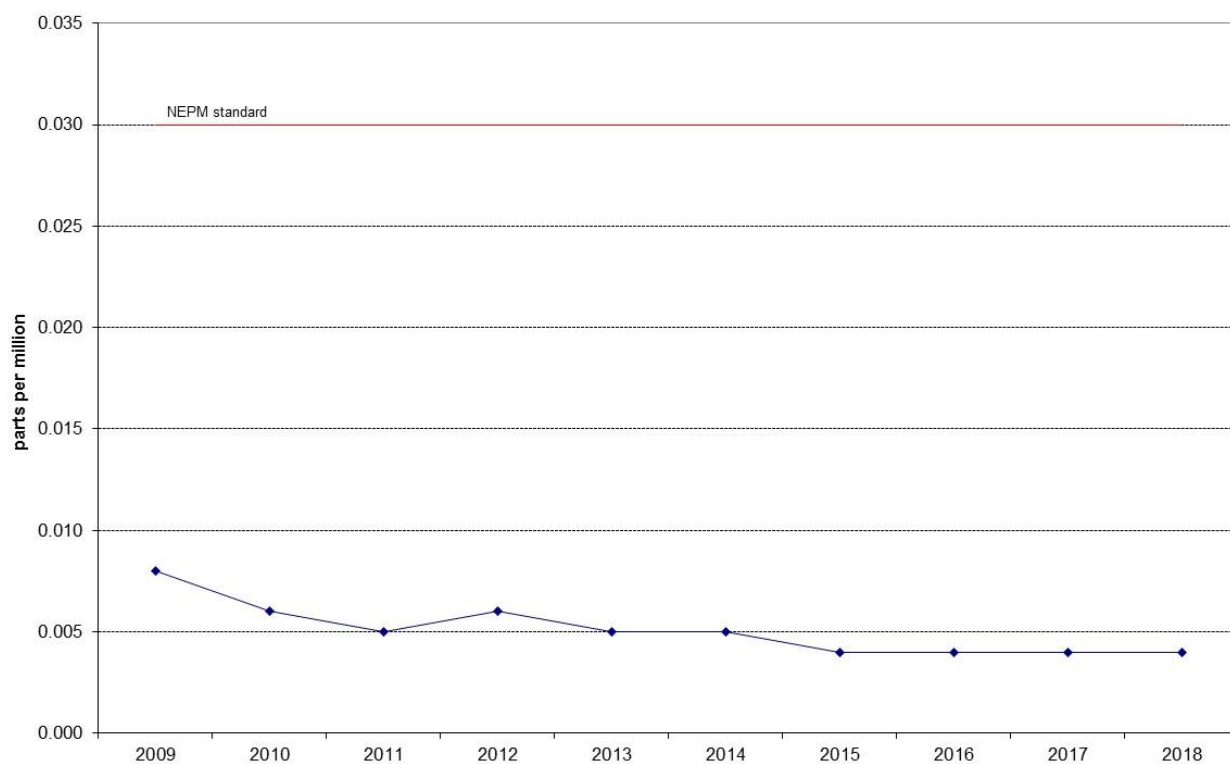


Figure 21: Annual average 1-hour NO₂ Monash 2009 – 2018

Table 20: Statistical summary for daily maximum 1-hour NO₂ Florey 2014 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	Annual average (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2014	78.3	0	0.045	0.006	0.027	0.020	0.015
2015	91.5	0	0.033	0.005	0.027	0.020	0.014
2016	94.7	0	0.034	0.004	0.027	0.019	0.013
2017	93.7	0	0.033	0.005	0.025	0.020	0.015
2018	93.3	0	0.039	0.005	0.028	0.022	0.015

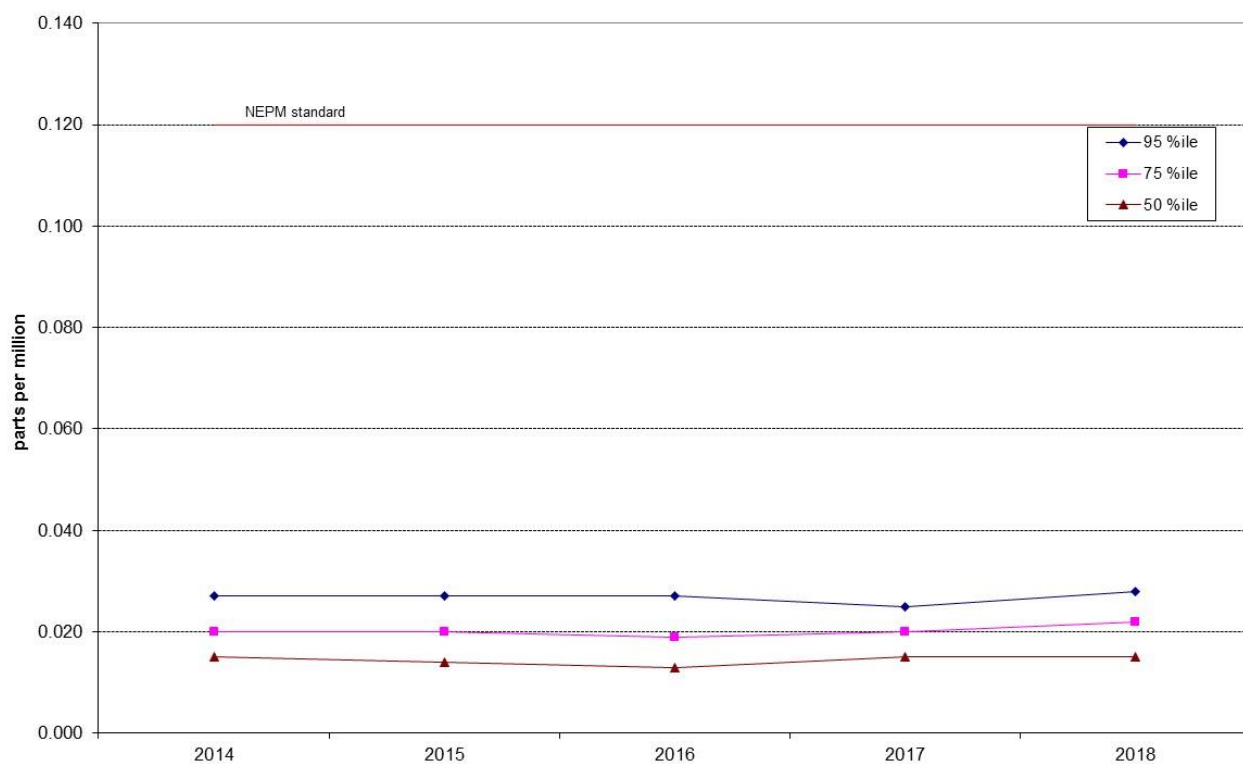


Figure 22: Statistical summary for daily maximum 1-hour NO₂ Florey 2014 – 2018

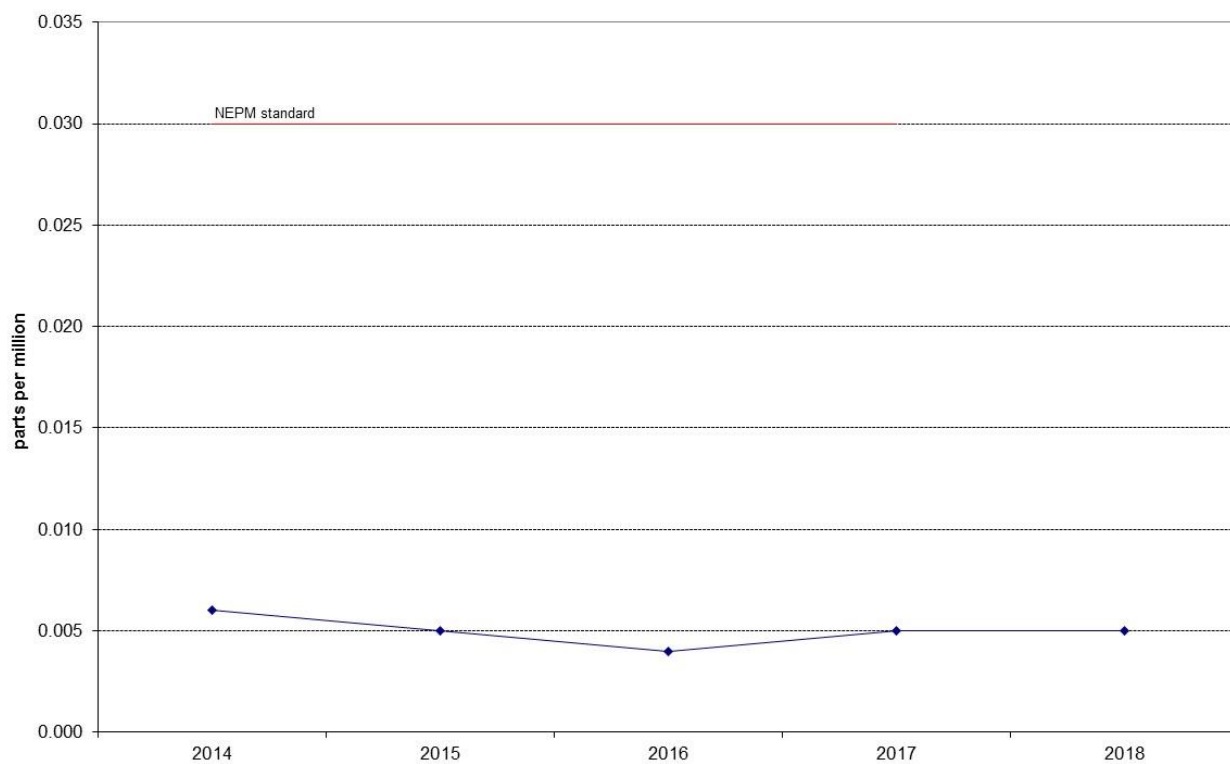


Figure 23: Annual average 1-hour NO₂ Florey 2014 – 2018

Ozone

Table 21: Statistical summary for daily maximum 1-hour O₃ Monash 2009 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2009	96.4	0	0.073	0.052	0.038	0.030
2010	86.6	0	0.051	0.042	0.033	0.030
2011	99.2	0	0.056	0.044	0.033	0.028
2012	100	0	0.055	0.043	0.034	0.029
2013	97.8	0	0.062	0.045	0.035	0.029
2014	94.8	0	0.087	0.050	0.036	0.030
2015	92.8	0	0.065	0.044	0.034	0.026
2016	95.2	0	0.057	0.044	0.032	0.026
2017	95.5	0	0.060	0.049	0.038	0.032
2018	95.8	0	0.062	0.050	0.039	0.032

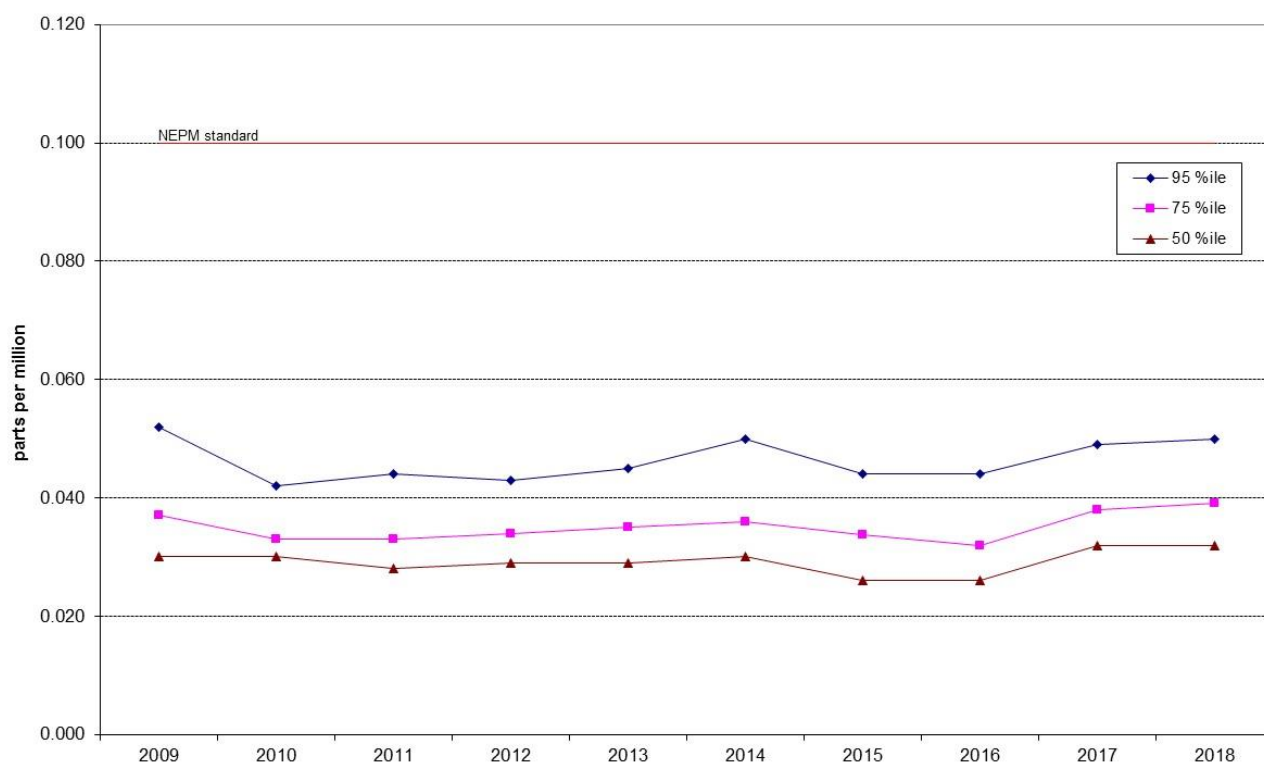


Figure 24: Statistical summary for daily maximum 1-hour O₃ Monash 2009 – 2018

Table 22: Statistical summary for daily maximum 1-hour O₃ Civic 2009 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2009	97.8	0	0.060	0.044	0.031	0.024
2010	99.2	0	0.058	0.040	0.029	0.025
2011	96.4	0	0.052	0.041	0.030	0.026
2012	100	0	0.053	0.034	0.024	0.020
2013	92.1	0	0.060	0.036	0.028	0.024
2014	94.0	0	0.060	0.039	0.028	0.022
2015	89.0	0	0.042	0.034	0.026	0.022
2016	95.8	0	0.047	0.036	0.028	0.024
2017	95.8	0	0.053	0.045	0.034	0.028
2018	95.2	0	0.056	0.046	0.032	0.028

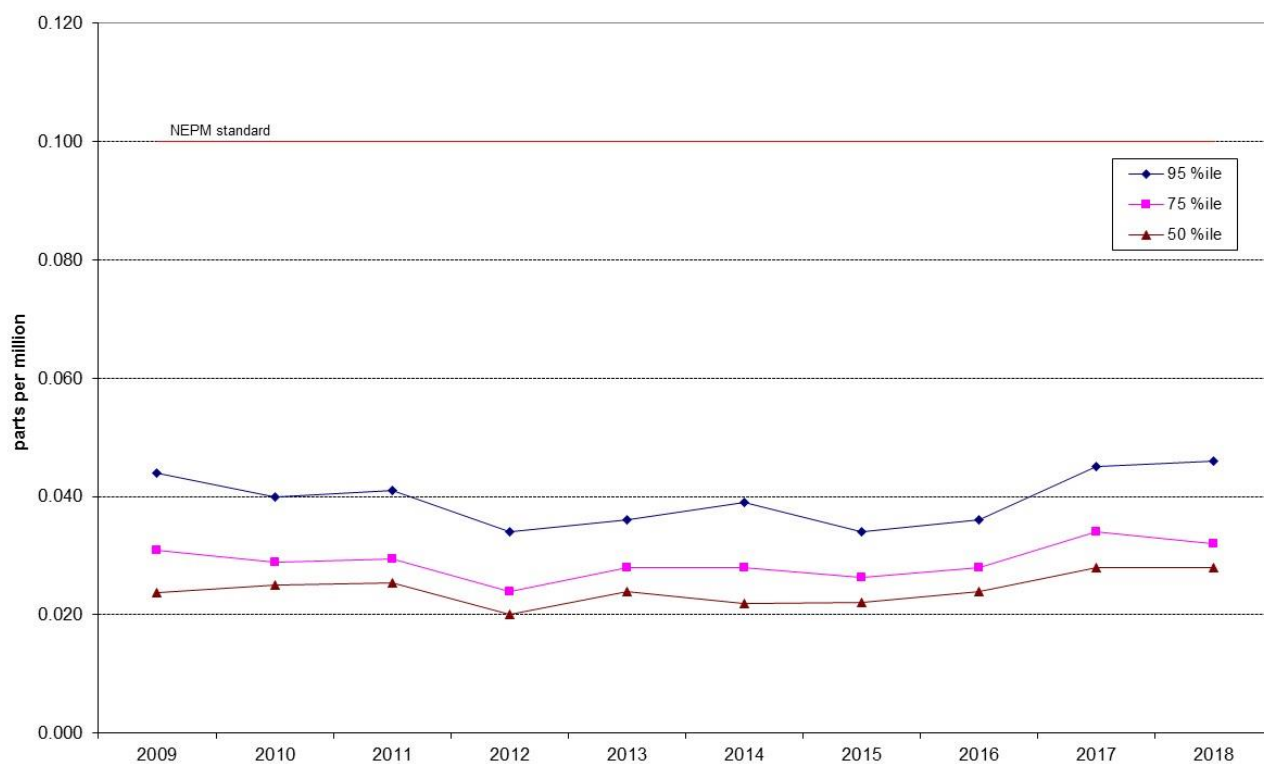


Figure 25: Statistical summary for daily maximum 1-hour O₃ Civic 2009 – 2018

Table 23: Statistical summary for daily maximum 1-hour O₃ Florey 2014 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2014	79.4	0	0.074	0.034	0.027	0.023
2015	94.2	0	0.040	0.032	0.025	0.021
2016	95.8	0	0.050	0.040	0.031	0.027
2017	95.5	0	0.057	0.048	0.038	0.032
2018	95.2	0	0.059	0.050	0.038	0.032

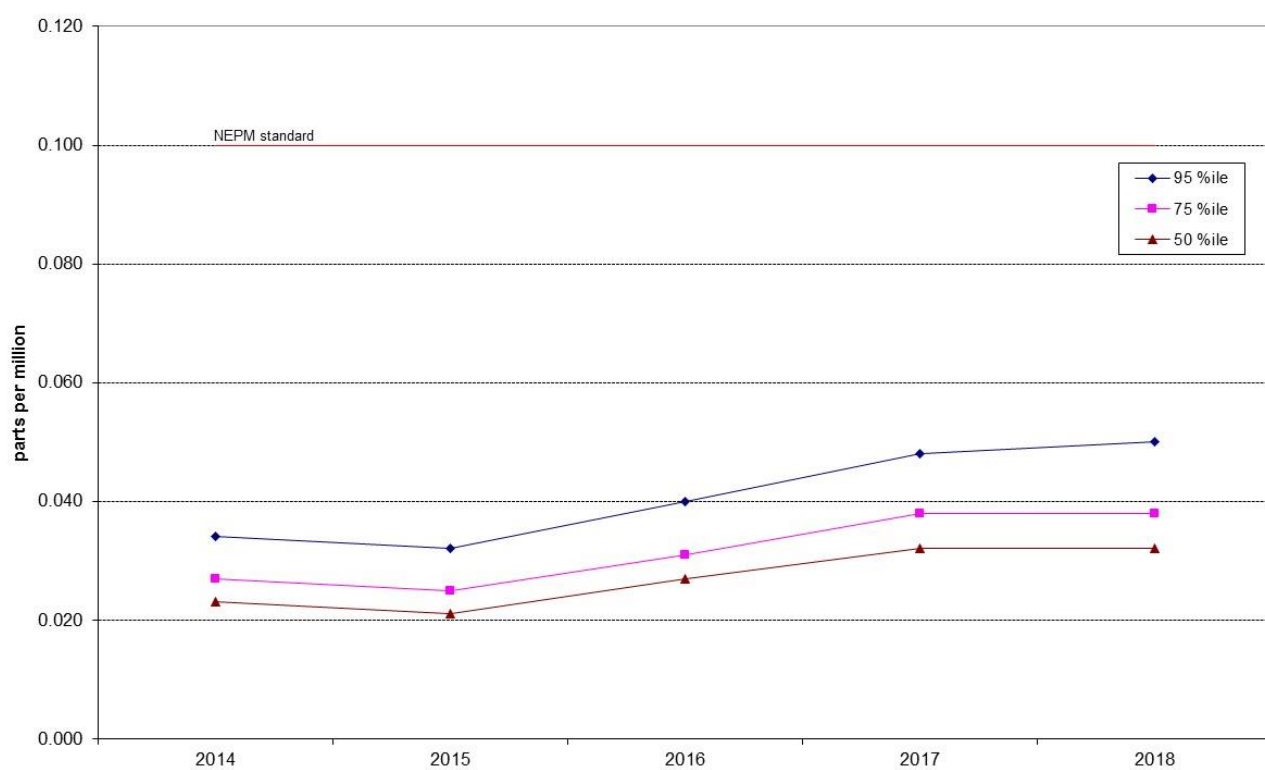


Figure 26: Statistical summary for daily maximum 1-hour O₃ Florey 2014 – 2018

Table 24: Statistical summary for daily maximum 4-hour O₃ Monash 2009 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2009	96.2	0	0.068	0.048	0.036	0.029
2010	86.6	0	0.049	0.040	0.032	0.029
2011	98.9	0	0.054	0.041	0.032	0.027
2012	99.7	0	0.052	0.043	0.034	0.029
2013	97.8	0	0.059	0.042	0.033	0.028
2014	94.8	0	0.060	0.046	0.034	0.029
2015	92.8	0	0.050	0.041	0.033	0.025
2016	95.2	0	0.055	0.042	0.030	0.025
2017	95.5	0	0.055	0.047	0.036	0.031
2018	95.8	0	0.057	0.049	0.038	0.032

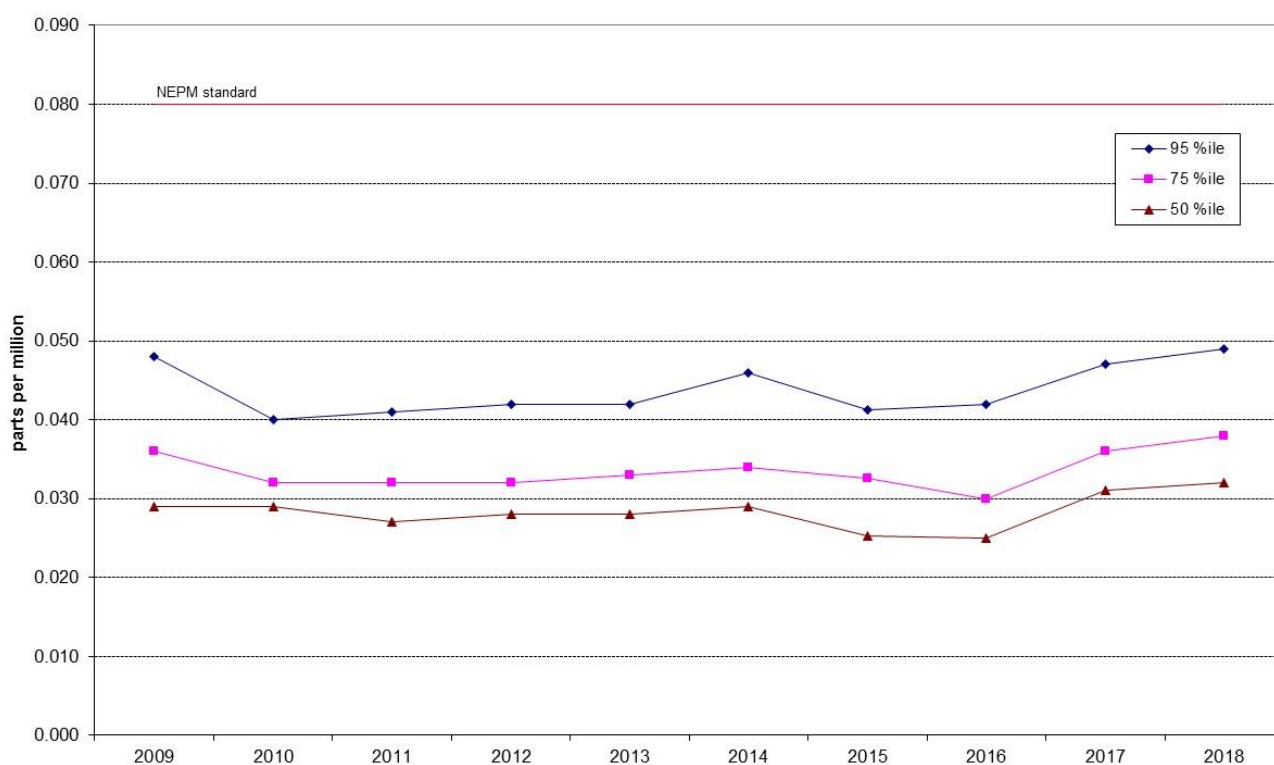


Figure 27: Statistical summary for daily maximum 4-hour O₃ Monash 2009 – 2018

Table 25: Statistical summary for daily maximum 4-hour O₃ Civic 2009 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2009	97.8	0	0.059	0.041	0.030	0.023
2010	99.2	0	0.056	0.037	0.028	0.024
2011	96.4	0	0.050	0.038	0.029	0.025
2012	100	0	0.042	0.032	0.023	0.019
2013	91.8	0	0.057	0.034	0.027	0.023
2014	94.0	0	0.047	0.036	0.026	0.020
2015	89.0	0	0.041	0.031	0.025	0.021
2016	95.8	0	0.045	0.035	0.027	0.023
2017	95.8	0	0.049	0.042	0.033	0.027
2018	95.2	0	0.053	0.044	0.031	0.026

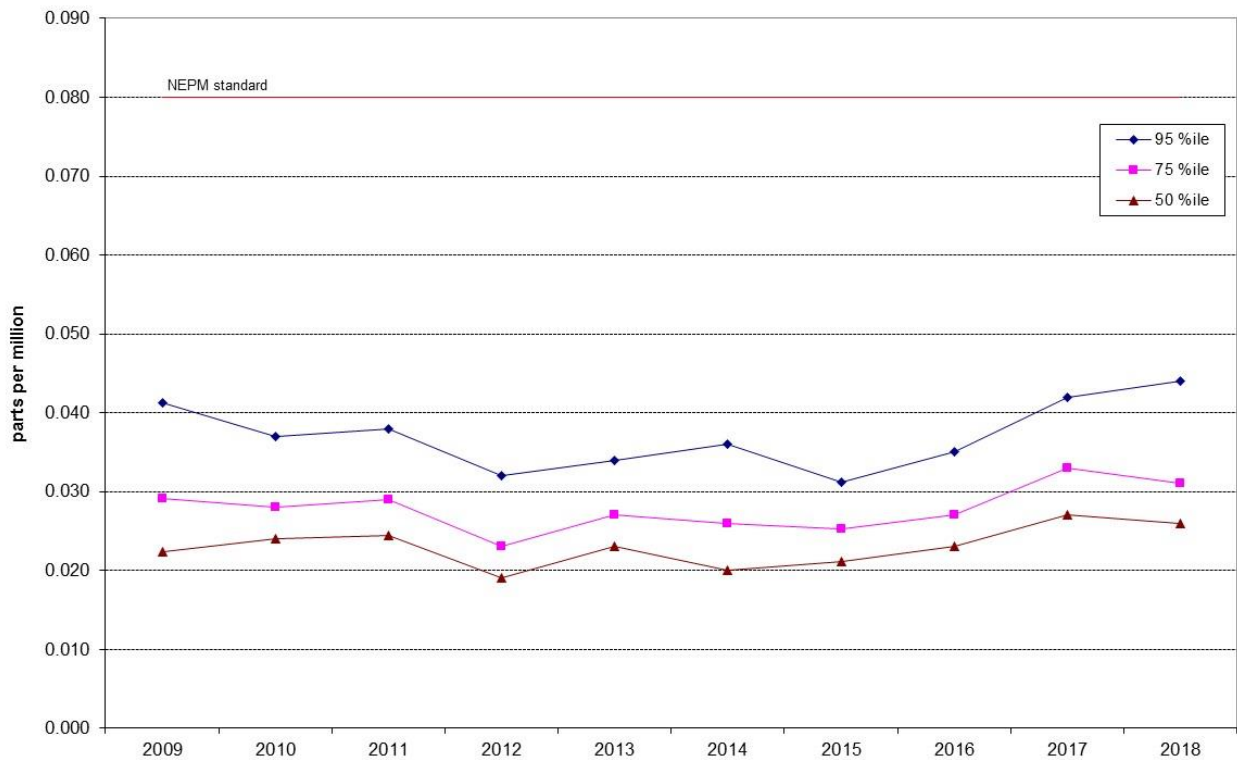


Figure 28: Statistical summary for daily maximum 4-hour O₃ Civic 2009 – 2018

Table 26: Statistical summary for daily maximum 4-hour O₃ Florey 2014 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (ppm)	95 th percentile (ppm)	75 th percentile (ppm)	50 th percentile (ppm)
2014	79.4	0	0.040	0.031	0.026	0.022
2015	94.2	0	0.037	0.031	0.025	0.020
2016	95.8	0	0.050	0.038	0.029	0.026
2017	95.5	0	0.054	0.046	0.037	0.031
2018	95.2	0	0.057	0.048	0.037	0.031

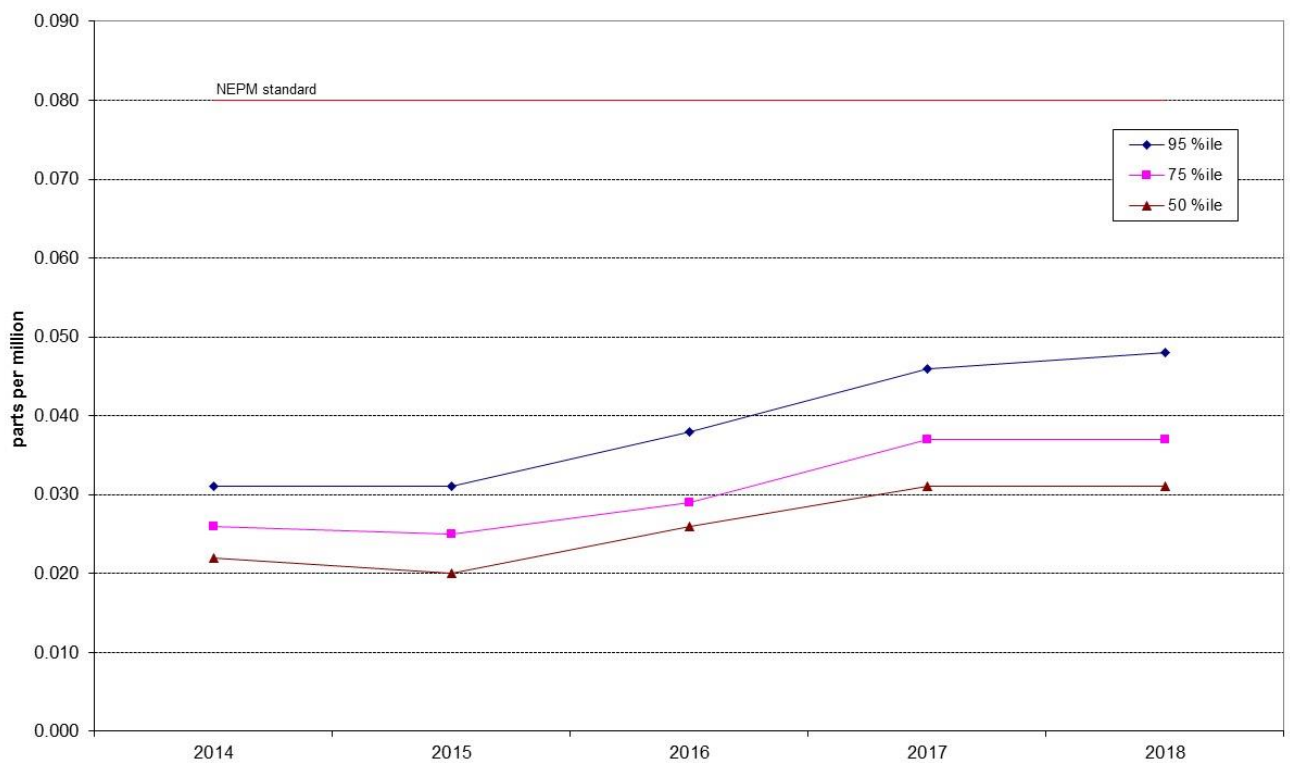


Figure 29: Statistical summary for daily maximum 4-hour O₃ Florey 2014 – 2018

PM₁₀

Table 27: Statistical summary for daily maximum daily PM₁₀ Monash 2009 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m ³)	Annual average (µg/m ³)	95 th percentile (µg/m ³)	75 th percentile (µg/m ³)	50 th percentile (µg/m ³)
2009	42.3	9	210.0	20.3	50.5	25.5	15.2
2010	95.4	0	48.4	11.1	23.5	14.7	10.0
2011	99.2	0	40.0	10.4	22.8	13.2	8.7
2012	98.6	0	41.0	10.4	19.7	13.7	9.7
2013	95.6	0	43.5	9.8	20.2	13.1	8.9
2014	97.8	0	39.3	10	19.1	12.9	9.6
2015	98.4	0	49.4	9.9	19.5	13.1	9.5
2016	99.5	0	31.9	9.7	21.5	12.7	9.0
2017	98.9	0	28.3	9.8	20.5	12.3	9.0
2018	99.2	4	139.2	11.8	23.0	14.8	10.4

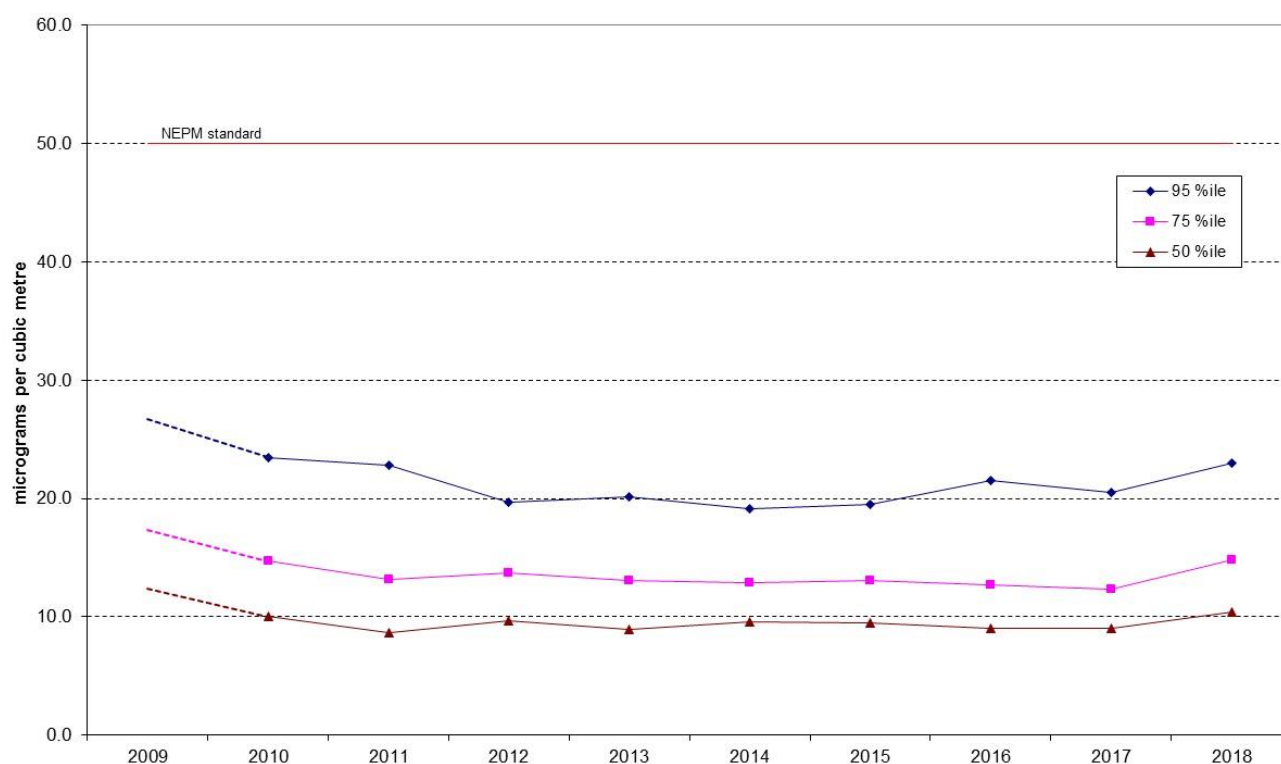


Figure 30: Statistical summary for daily PM₁₀ Monash 2009 – 2018

Note: 2009 data has not been included in Figure 30 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.

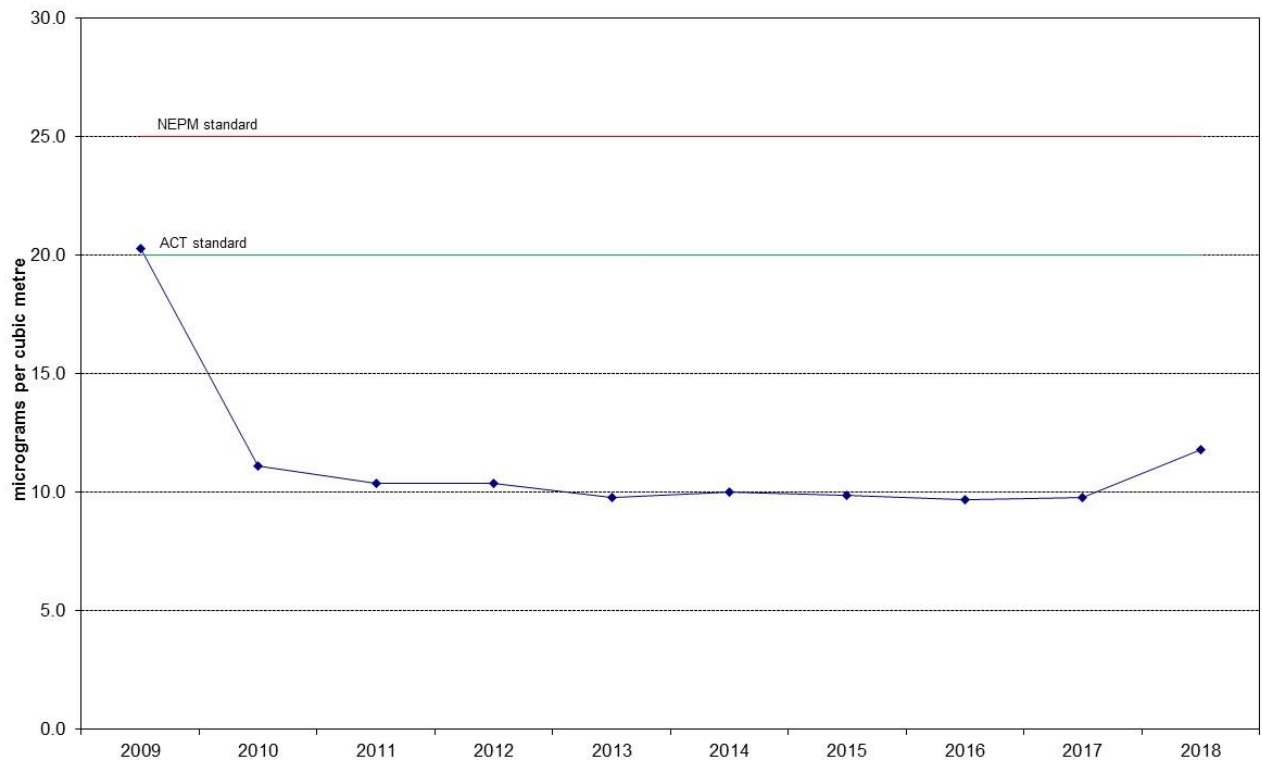


Figure 31: Annual average daily PM₁₀ Monash 2009 – 2018

Table 28: Statistical summary for daily maximum daily PM₁₀ Civic 2010 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m ³)	Annual average (µg/m ³)	95 th percentile (µg/m ³)	75 th percentile (µg/m ³)	50 th percentile (µg/m ³)
2010	57.6	0	23.8	8.5	14.7	11.1	8.4
2011	97.0	0	29.2	8.7	16.9	11.0	7.9
2012	95.1	0	49.5	9.4	17.0	12.1	8.7
2013	92.9	1	57.8	9.7	19.9	12.0	8.6
2014	95.1	0	31.4	9.8	17.7	12.6	9.3
2015	97.5	1	64.3	11.1	20.9	14.1	10.4
2016	100	0	36.6	10.7	20.6	14.3	9.7
2017	83.6	1	53.0	9.68	10.8	7.1	5.2
2018	97.8	1	179.8	13.5	24.1	16.1	11.3

Note: No PM₁₀ monitoring was conducted at Civic in 2009.



Figure 32: Statistical summary for daily PM₁₀ Civic 2010 – 2018

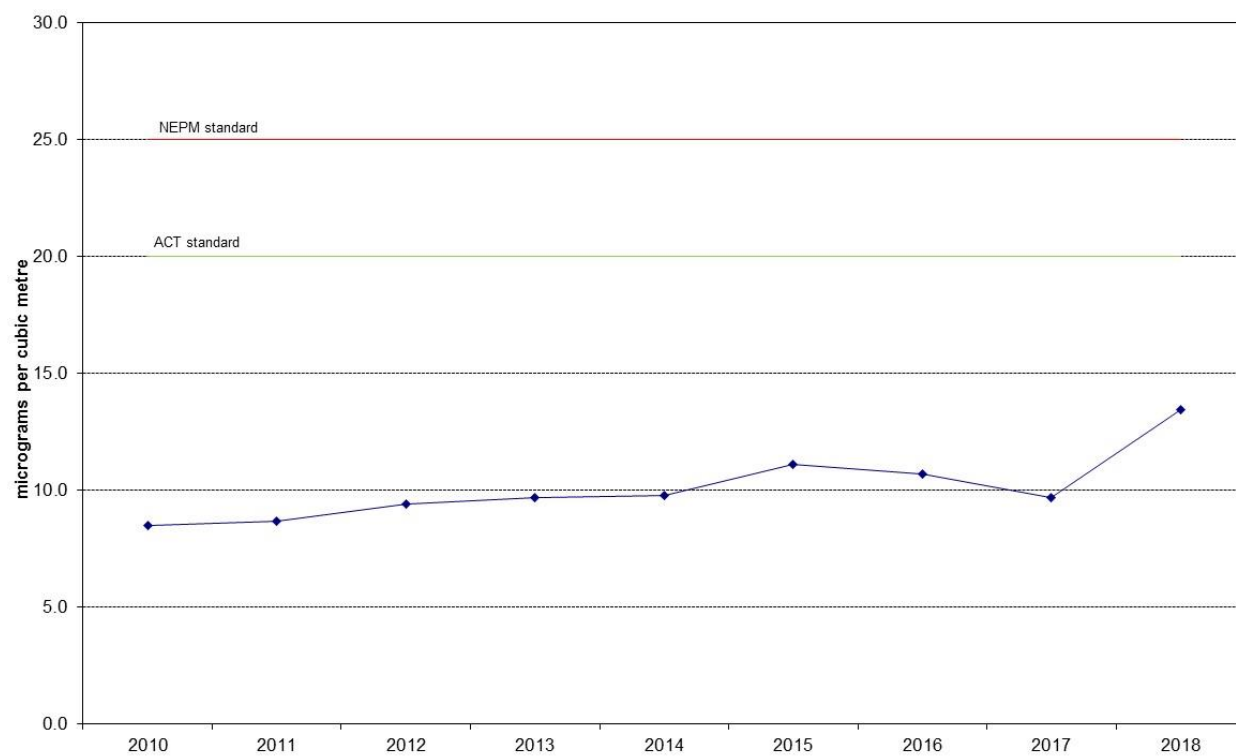


Figure 33: Annual average daily PM₁₀ Civic 2010 – 2018

Table 29: Statistical summary for daily maximum daily PM₁₀ Florey 2014 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m ³)	Annual average (µg/m ³)	95 th percentile (µg/m ³)	75 th percentile (µg/m ³)	50 th percentile (µg/m ³)
2014	83.3	0	30.2	10.4	21.5	13.0	9.4
2015	95.6	0	70.8	10.7	21.8	13.7	9.4
2016	98.9	0	28.8	10.1	20.6	13.1	9.2
2017	98.4	0	28.1	9.84	21.8	12.8	8.5
2018	89.9	3	158.6	12.0	23.8	15.3	10.1

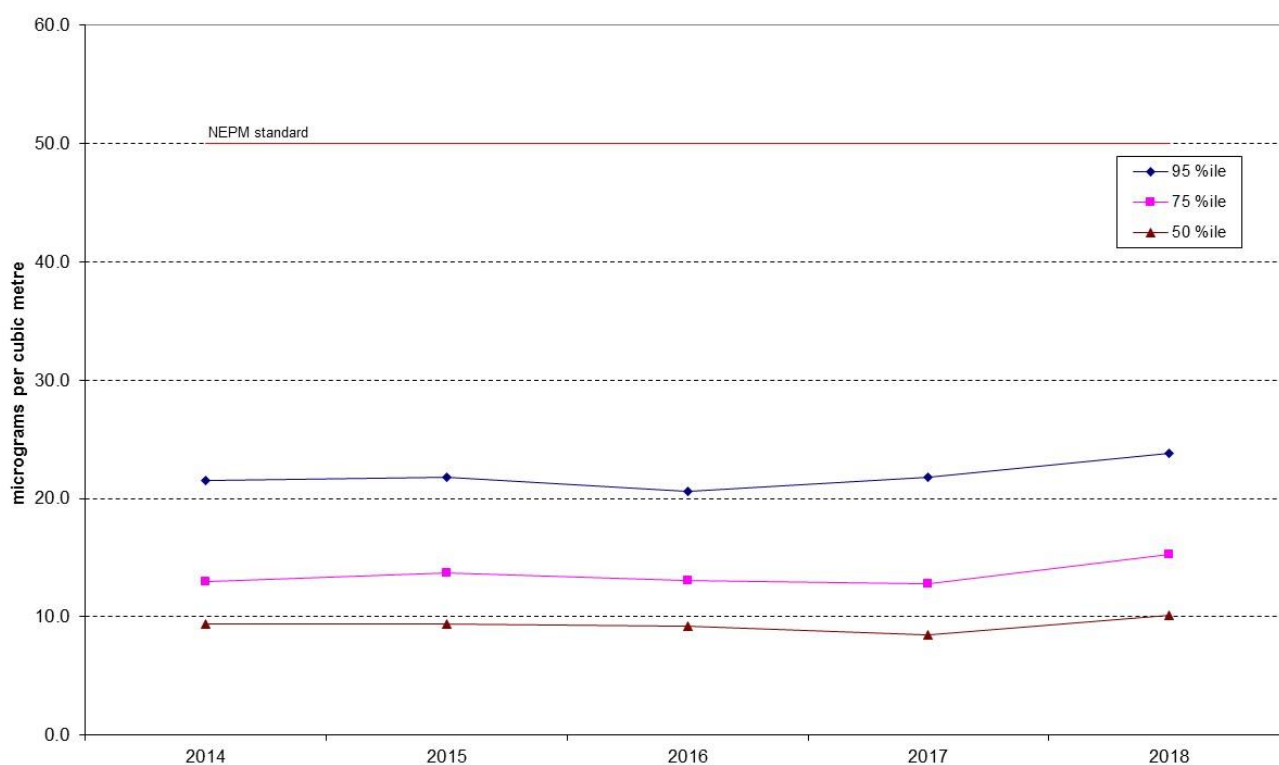


Figure 34: Statistical summary for daily PM₁₀ Florey 2014 – 2018

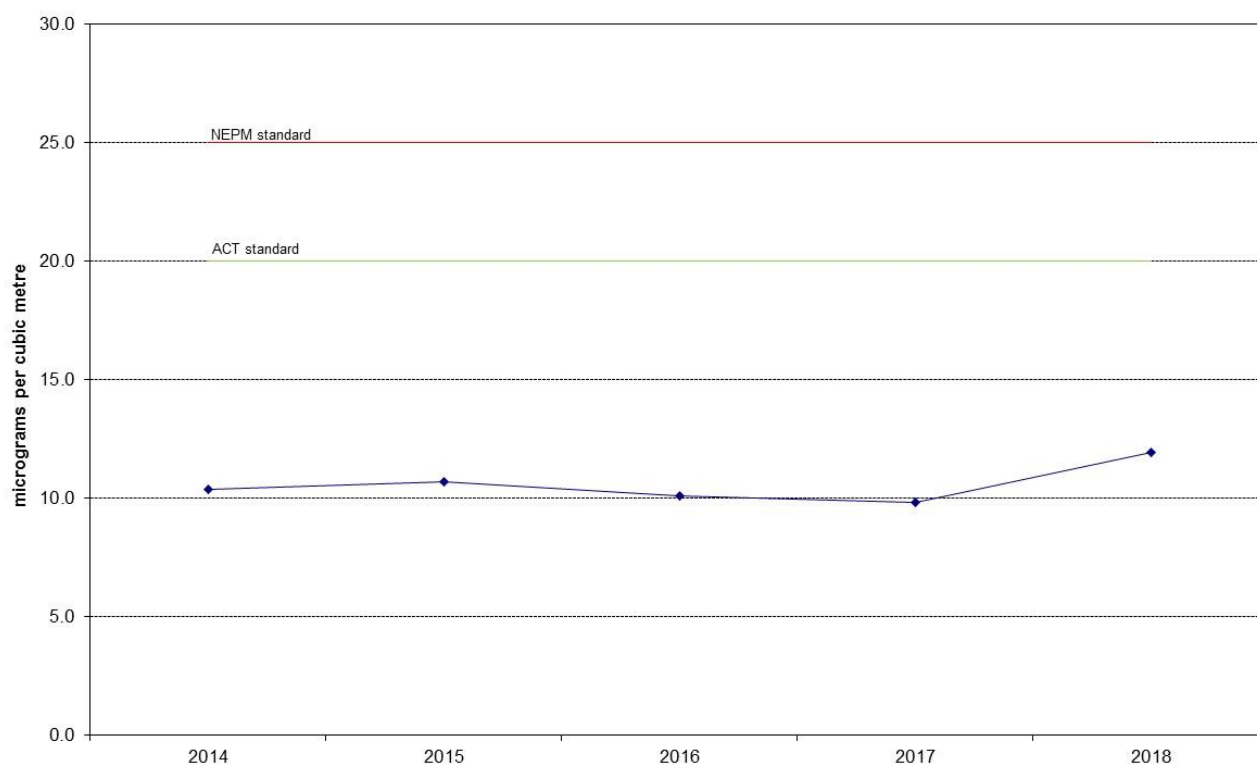


Figure 35: Annual average daily PM₁₀ Florey 2009 – 2018

PM_{2.5}

Table 30: Statistical summary for daily maximum daily PM_{2.5} Monash 2009 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m³)	Annual average (µg/m³)	95 th percentile (µg/m³)	75 th percentile (µg/m³)	50 th percentile (µg/m³)
2009	64.5	2	33.5	6.2	14.6	7.6	5.0
2010	95.1	2	52.4	6.7	17.4	7.8	4.4
2011	92.1	4	32.8	6.5	20.0	7.0	4.5
2012	95.1	3	29.2	7.1	16.5	8.3	5.0
2013	98.6	6	38.4	6.9	19.2	8.1	5.2
2014	87.7	4	31.5	6.8	18.7	8.6	5.6
2015	96.4	6	33.8	7.4	19.0	8.2	5.6
2016	98.1	8	32.7	7.4	20.7	8.2	5.4
2017	98.6	12	35.2	7.7	22.5	9.3	5.3
2018	99.2	2	32.0	6.8	19.2	8.6	5.3

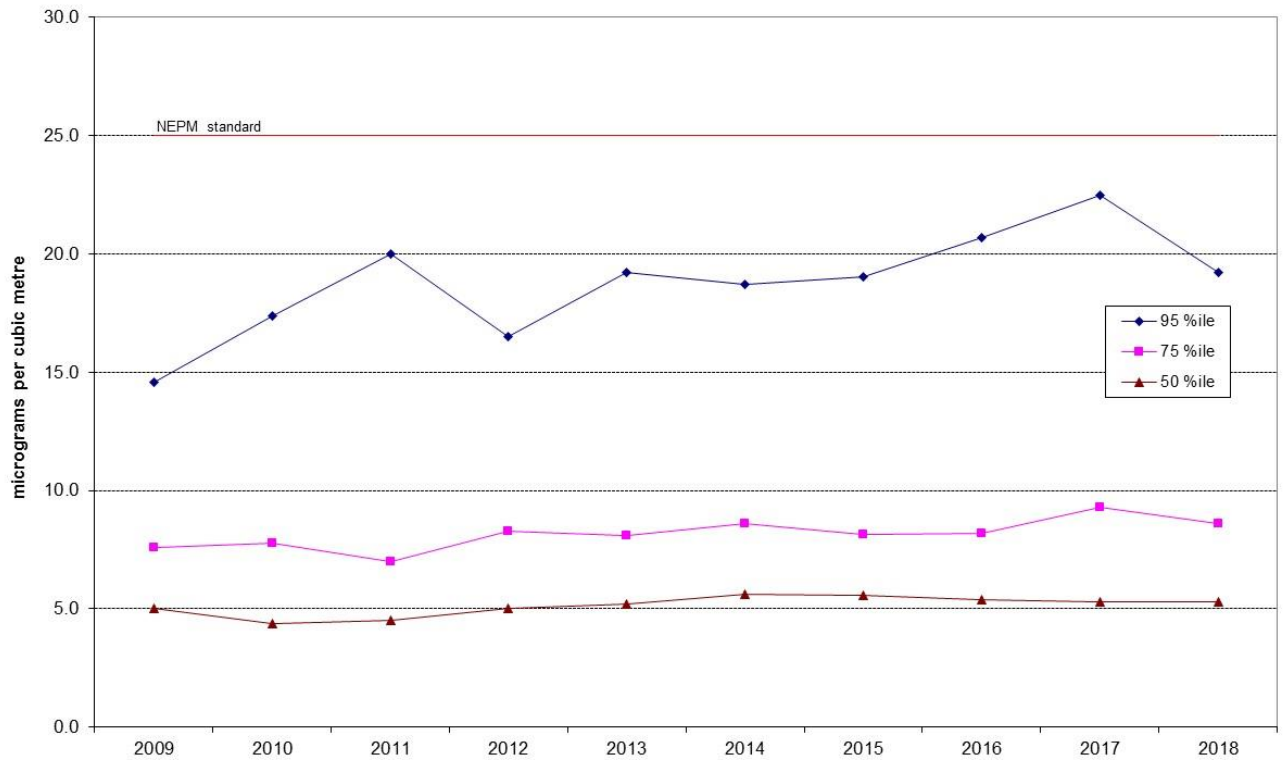


Figure 36: Statistical summary for daily PM_{2.5} Monash 2009 – 2018

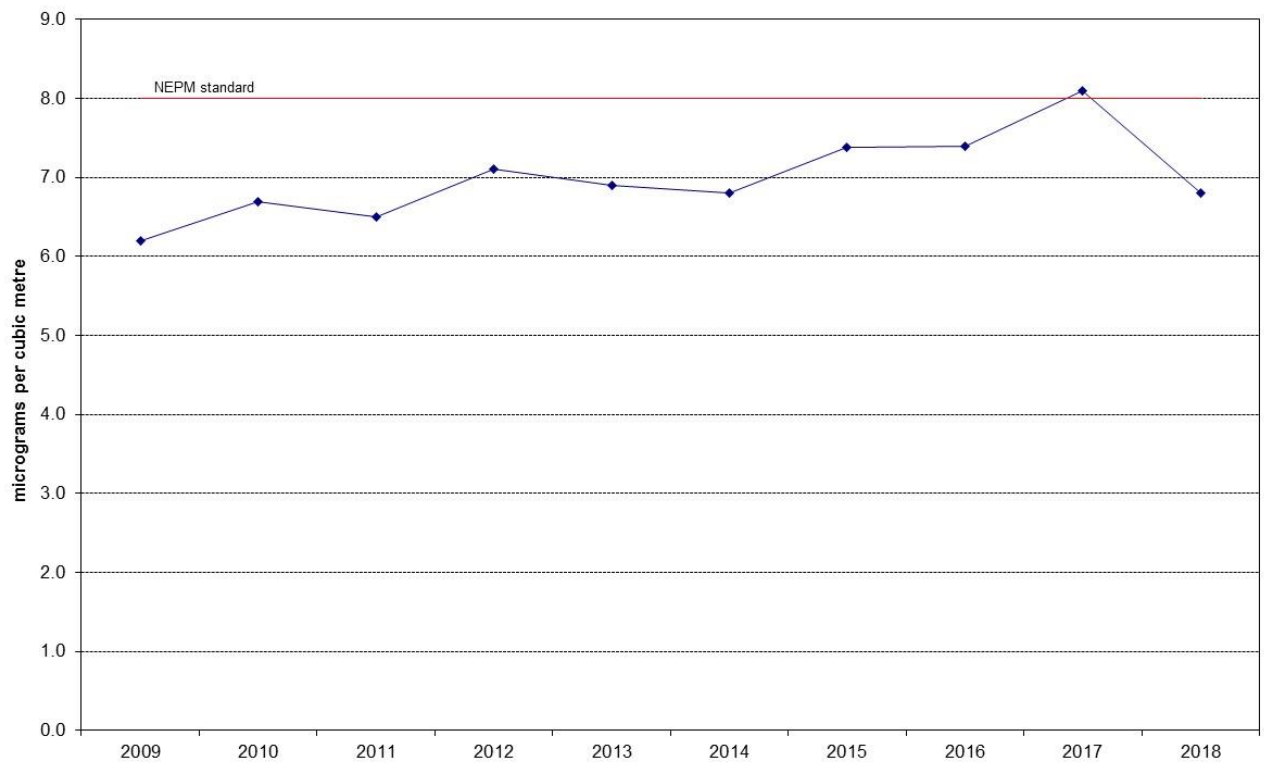


Figure 37: Annual average daily PM_{2.5} Monash 2009 – 2018

Table 31: Statistical summary for daily maximum daily PM_{2.5} Civic 2016 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m ³)	Annual average (µg/m ³)	95 th percentile (µg/m ³)	75 th percentile (µg/m ³)	50 th percentile (µg/m ³)
2016	98.6	0	22.1	5.5	11.0	7.1	4.8
2017	94.2	1	53.8	5.9	10.8	7.1	5.2
2018	98.6	1	36.1	6.5	12.1	8.1	6.1

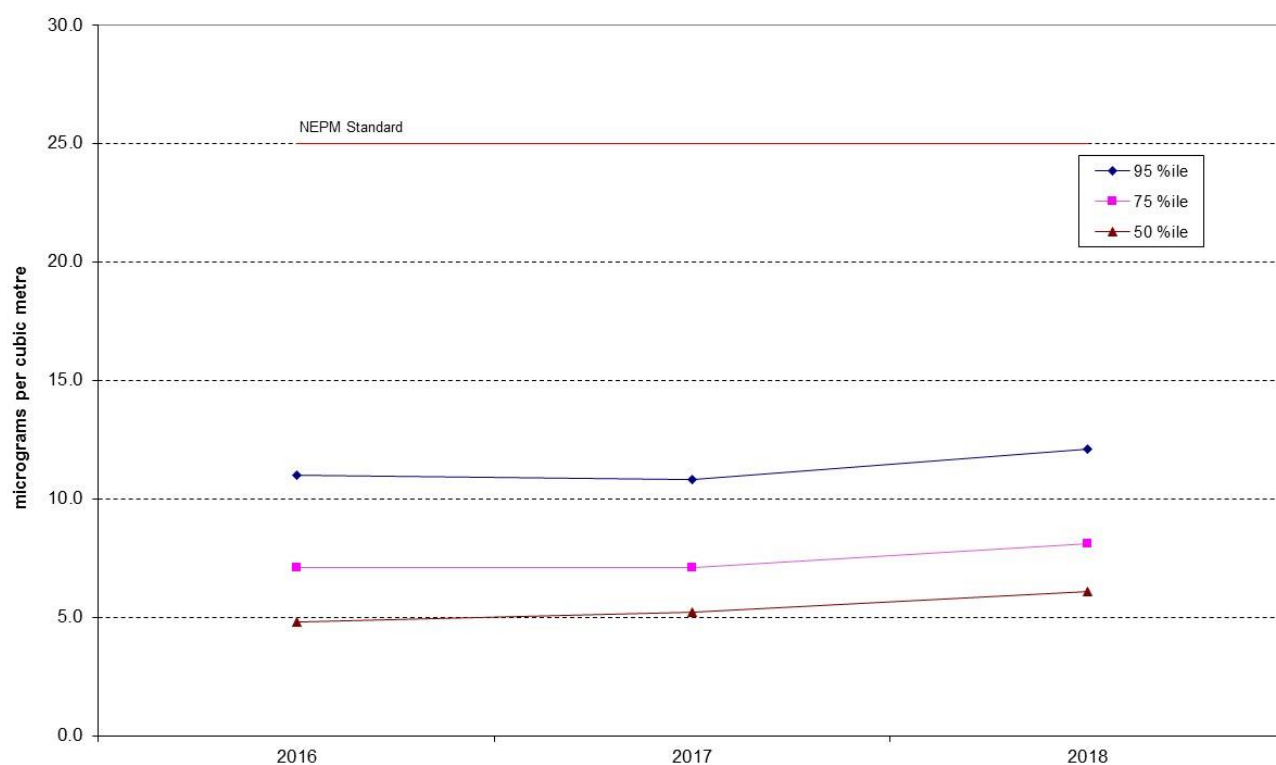


Figure 38: Statistical summary for daily PM_{2.5} Civic 2016 – 2018

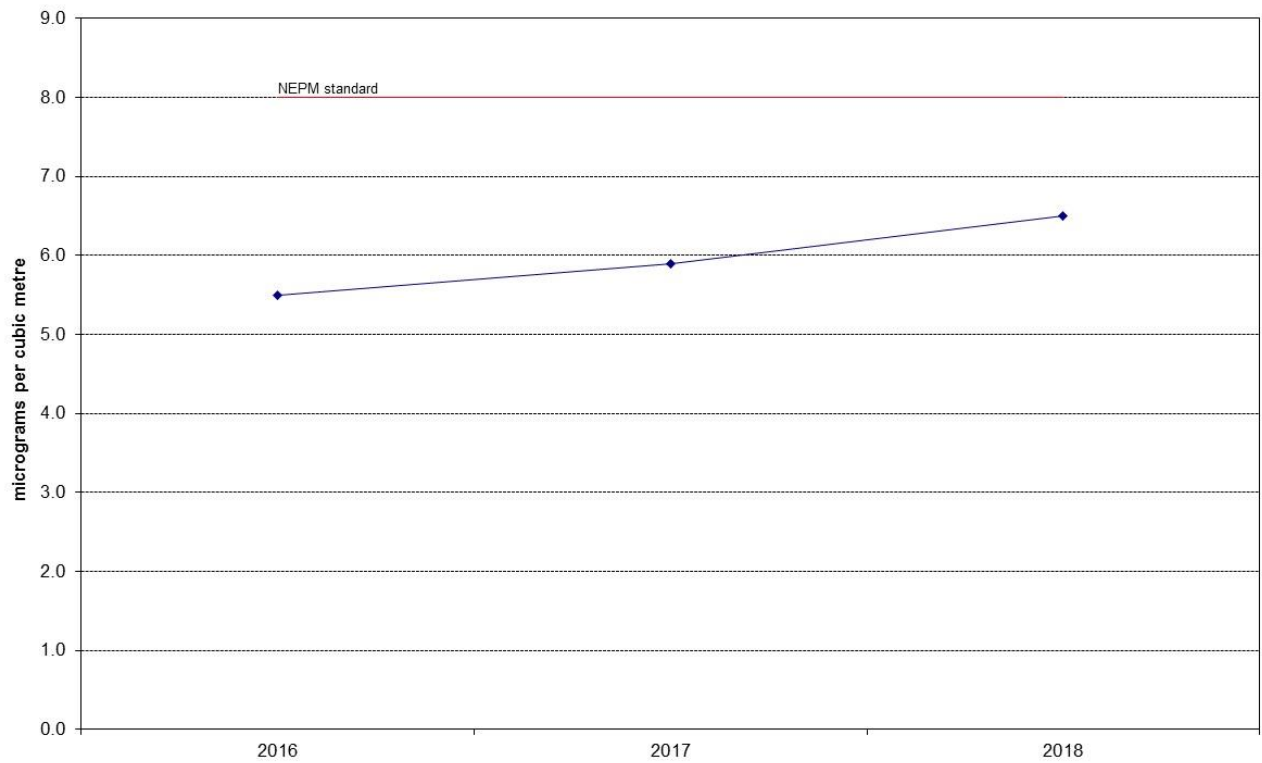


Figure 39: Annual average daily PM_{2.5} Civic 2016 – 2018

Table 32: Statistical summary for daily maximum daily PM_{2.5} Florey 2014 – 2018

Year	Data Availability (%)	No. of Exceedances (days)	Max conc. (µg/m³)	Annual average (µg/m³)	95 th percentile (µg/m³)	75 th percentile (µg/m³)	50 th percentile (µg/m³)
2014	74.2	0	22.8	5.8	15.0	7.1	4.9
2015	96.2	0	24.3	6.5	17.1	7.4	4.8
2016	98.6	1	27.2	7.3	17.4	8.6	5.8
2017	94.2	0	23.8	7.2	17.9	8.7	5.6
2018	97.3	2	26.4	7.4	17.0	8.7	5.9

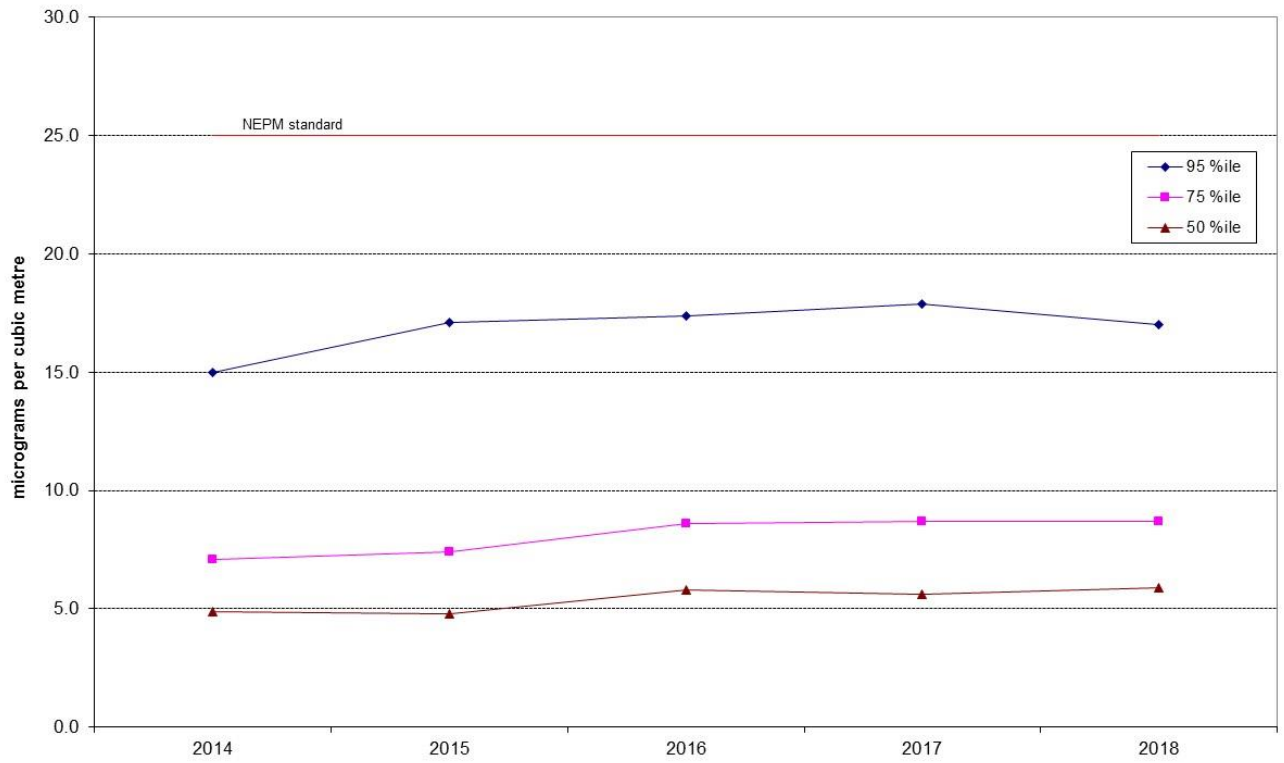


Figure 40: Statistical summary for daily PM_{2.5} Florey 2014 – 2018

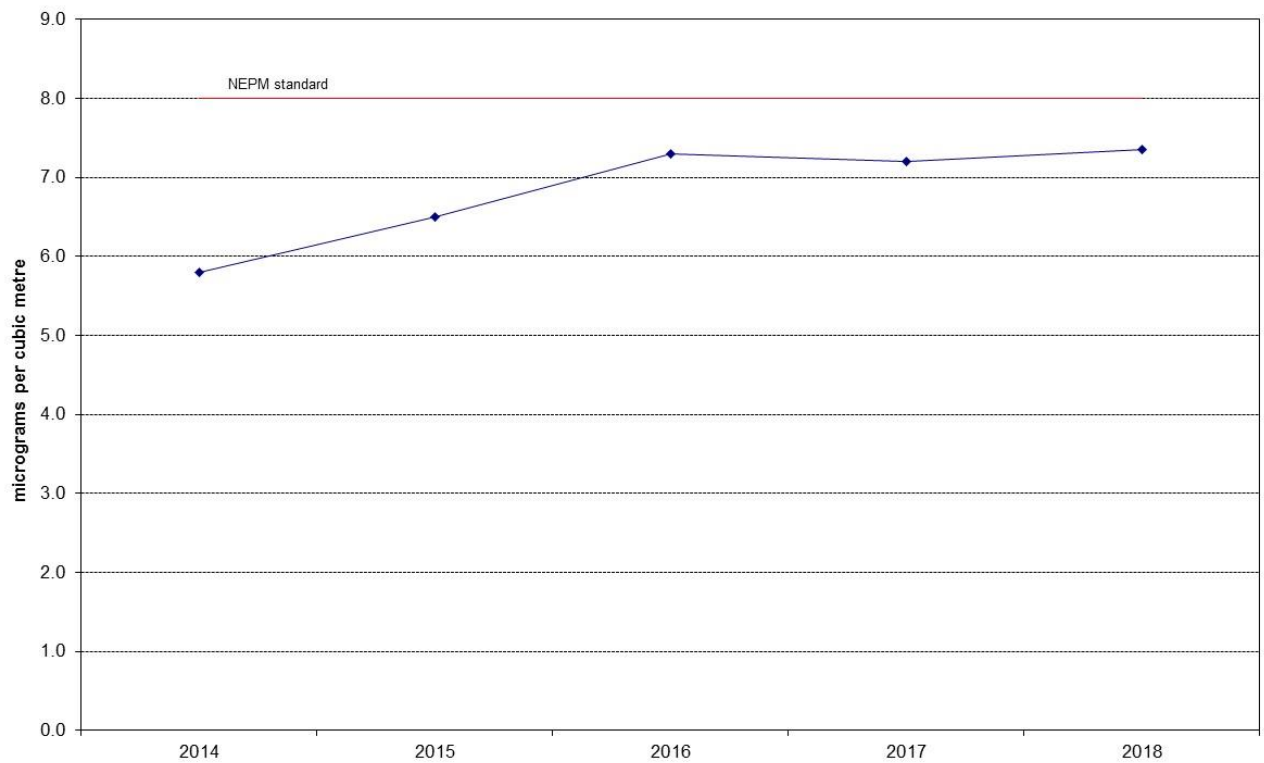


Figure 41: Annual average daily PM_{2.5} Florey 2014 – 2018