Government of **Western Australia**
Department of **Environment Regulation**

REPORT

2013 Western Australia Air Monitoring Report

Written to comply with the National Environment Protection (Ambient Air Quality) Measure

Produced and published by

Department of Environment Regulation
168 St Georges Terrace
Perth WA 6000

May 2014

Enquiries

Phone: +61 8 6467 5000
Fax: +61 8 6467 5562
Email: info@der.wa.gov.au
www.der.wa.gov.au

Questions regarding this document should be directed to:

Department of Environment Regulation
Locked Bag 33 Cloisters Square
PERTH 6850

Accessibility

This document is available in alternative formats and languages on request to the Department of Environment Regulation.

Contents

List of figures

List of tables

Section A – Monitoring summary

Current monitoring stations

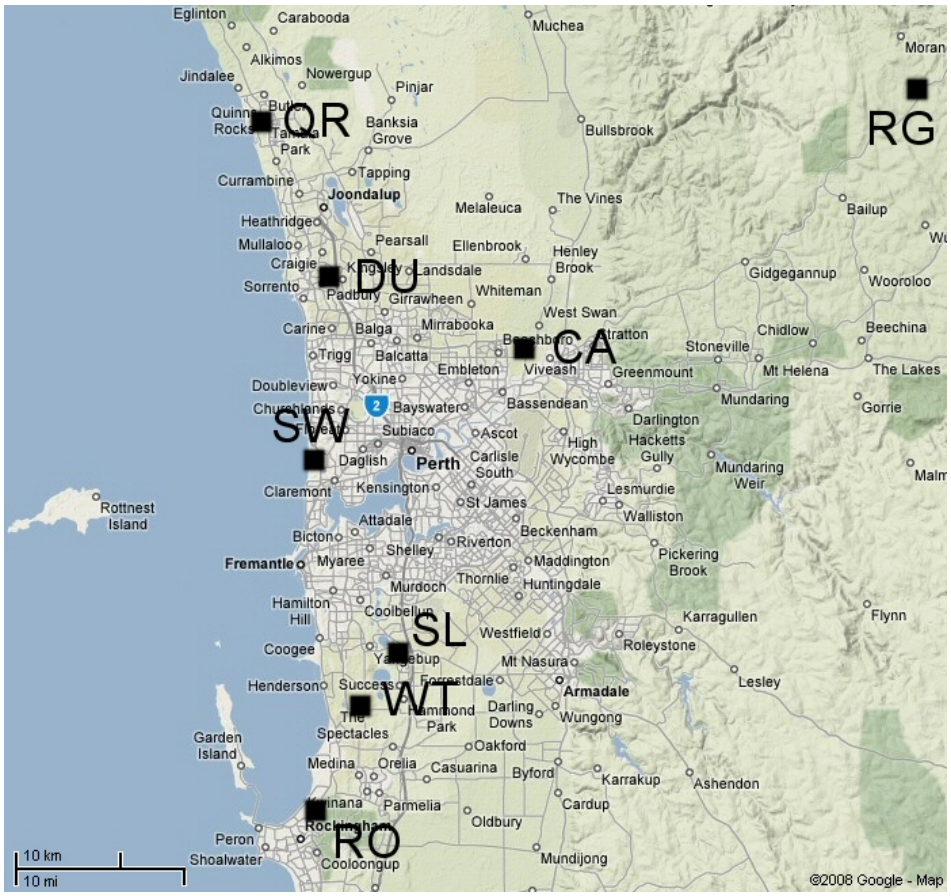
The Department of Environment Regulation (DER) monitoring network shown in Figure A1 was the subject of careful design for the purposes of the Perth Photochemical Smog Study, the Perth Haze Study and the management of sulfur dioxide in the Kwinana area.

The network's design was based on the knowledge of emissions sources, pollutant chemistry and important features of the meteorology.

CSIRO (Commonwealth Scientific and Industrial Research Organisation) Atmospheric Research provided advice on monitoring site locations for the Perth Photochemical Smog Study and Perth Haze Study.

The Bunbury station shown in Figure A2 was established in the south-west of the state to monitor fuel reduction burns, and stations in Busselton and Collie are also in operation for that purpose.

The Geraldton station shown in Figure A3 was established in the mid-west of the state to monitor windblown crustal material and smoke from bushfires, hazard reduction or stubble burning and possibly wood-fired home heaters. A particle monitoring station was also established in Albany (Figure A4). Table A1 indicates the pollutants monitored at each site.



CA Caversham	QR Quinns Rock	RG Rolling Green	SW Swanbourne
DU Duncraig	RO Rockingham	SL South Lake	WT Wattleup

Figure A1 - DER air quality monitoring stations operating in the Perth metropolitan region.

Figure A2 - DER air quality monitoring stations operating in Bunbury, Busselton and Collie

Figure A3 - DER air quality monitoring station operating in Geraldton

Figure A4 - DER air quality monitoring station operating in Albany

Table A1. Air quality parameters measured at DER monitoring stations.

Monitoring site	CO	O_3	NO_2	SO_2	PM_{10} TEOM	$PM_{2.5}$ TEOM
AL Albany					07/06 to present	
BN Bunbury					06/99 to present	04/97 to present
BS Busselton						11/06 to present
CA Caversham	08/93 to present	11/89 to present	09/90 to present		01/04 to present	03/94 to present
CO Collie					02/08 to present	
DU Duncraig	08/95 to present		08/95 to present		06/96 to present	01/95 to present
GE Geraldton					09/05 to present	
QR Quinns Rock		11/92 to present	11/92 to present			07/06 to present
RO Rockingham		12/95 to present	12/95 to present	07/88 to present		
RG Rolling Green		01/93 to present	01/93 to present			
SL South Lake	03/00 to present	03/00 to present	03/00 to present	03/00 to present	03/00 to present	04/06 to present
SW Swanbourne		01/93 to present	03/93 to present			
WT Wattleup				01/88 to present		

DER has from time to time performed campaign monitoring for various projects. While these short-term projects are not reported within this document, detailed reports and/or data can be obtained from www.der.wa.gov.au, by emailing airquality@der.wa.gov.au or telephoning (08) 6467 5000.

Table A2. Methods used to monitor air quality at DER monitoring stations.

Pollutant	Standard	Method
Carbon monoxide	AS 3580.7.1 1992 – Methods for sampling and analysis of ambient air – Determination of carbon monoxide – Direct-reading instrumental method	Gas filter correlation spectrophotometry
Ozone	AS 3580.6.1 1990 – Methods for sampling and analysis of ambient air – Determination of ozone – Direct-reading instrumental method	Ultraviolet absorption
Nitrogen dioxide	AS 3580.5.1 1993 – Methods for sampling and analysis of ambient air – Determination of oxides of nitrogen – Chemiluminescence method	Chemiluminescence
Sulfur dioxide	AS 3580.4.1 2008 – Methods for sampling and analysis of ambient air – Determination of sulfur dioxide – Direct-reading instrumental method	Ultraviolet fluorescence
Particles as PM_{10}	AS 3580.9.8 2008 – Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser	Tapered element oscillating microbalance
Particles as $PM_{2.5}$		Tapered element oscillating microbalance

Table A3. Monitoring in Western Australia.

Site	CO	O_3	NO_2	SO_2	PM_{10}	$PM_{2.5}$
AL – Albany					M	
BN – Bunbury					M	DER
BS – Busselton						DER
CA – Caversham	DER	T	T		P	DER
CO - Collie					DER	
DU - Duncraig	T		DER		T	DER
GE – Geraldton					M	
QR - Quinns Rock		DER	DER			DER
RG - Rolling Green		DER	DER			
RO - Rockingham		DER	DER	DER		
SL - South Lake	P	T	P	T	P	DER
SW - Swanbourne		T	P		DER	
WT - Wattleup				DER		

Key to symbols:

P Performance monitoring station

P(1) Performance monitoring for lead was removed on 31 December 2001 after the annual average concentration reduced to less than 10 per cent of the Ambient Air Quality (AAQ) National Environment Protection Measure (NEPM) standard in accordance with the WA monitoring plan

M Campaign monitoring

T Trend performance monitoring station

DER Station will be maintained by DER for the foreseeable future

Table A4. Screening procedures used to demonstrate whether pollutants are consistently below standards.

Screening procedures
A. Campaign monitoring at a Generally Representative Upper Bound (GRUB) monitoring location (with no significant deterioration expected over 5-10 years).
B. Use of historical data within a region which will contain one or more GRUB monitoring stations to demonstrate that the full number of stations (according to 14(1)) is not required, either to detect exceedences or gain a more representative depiction of pollutant distribution.
C. Use of modelling within a region which will contain one or more GRUB monitoring stations to demonstrate that the full number of stations (according to 14(1)) is not required, either to detect exceedences or gain a more representative depiction of pollutant distribution.
D. In a region with no performance monitoring, use of validated (1) modelling with detailed and reliable estimates of emissions and meteorological data.
E. In a region with no performance monitoring, and in the absence of emissions and detailed meteorological data, use of generic model results based on gross emissions estimates, 'worst case' meteorology estimates and other conservative assumptions.
F. In a region with no performance monitoring, comparison with a NEPM compliant region with greater population, emissions and pollution potential.
P. Performance monitoring.
T. Trend monitoring.
M. Campaign monitoring.

Table A5. Screening procedures satisfied at each station.

Site	Pop'n[a]	CO	O_3	NO_2	SO_2	Pb	PM_{10}
Perth and Rockingham	1,740,000				B&C	A	
Mandurah[b]	74,127	P	P	P	F	F	P
Albany	36,551						
Bunbury	35,242	A&F	E&F	E&F	D&F	F	
Kalgoorlie-Boulder[c]	33,092	M	E&F	E&F	T	F	P
Geraldton	39,404	F	E&F	E&F	D&F	F	M

Grey shaded cells represent Performance, Trend or Campaign sites where monitoring is currently underway.

a – 2011 data (www.abs.gov.au)

b – Mandurah station has yet to be established

c – Kalgoorlie station has yet to be established

Details of screening procedures are given in the monitoring plan available at http://www.scew.gov.au/sites/www.scew.gov.au/files/resources/9947318f-af8c-0b24-d928-04e4d3a4b25c/files/aaqprctp04screeningprocedures200705final.pdf

Table A6. Stations site compliance with AS 2922 - 1987

	Height above ground	Min. distance to support structures	Clear sky angle of 120°	Unrestricted airflow of 270°/360°	20m from trees	No boilers or incinerators nearby	Minimum distance from road or traffic	Sample line material	Sample line length	Comments
Perth region										
Caversham	☑	☑	☑	☑	☑	☑	☑	☑	☑	
Duncraig	☑	☑	☒	☑	☒	☑	☑	☑	☑	6 metres to medium sized trees and presence of power pole.
Quinns Rocks	☑	☑	☑	☑	☒	☑	☑	☑	☑	15 metres to small to medium size trees. Surrounding area dominated by low scrub.
Rockingham	☑	☑	☑	☑	☒	☑	☑	☑	☑	12 metres to trees. Northern vector dominated by grain storage facility.
Rolling Green	☑	☑	☑	☑	☑	☑	☑	☑	☑	
South Lake	☑	☑	☑	☑	☑	☑	☑	☑	☑	
Swanbourne	☑	☑	☑	☑	☑	☑	☑	☑	☑	
Wattleup	☑	☑	☑	☑	☒	☑	☑	☑	☑	10 metres to medium to large eucalyptus trees.
Southwest region										
Albany	☑	☑	☑	☑	☑	☑	☑	☑	☑	
Bunbury	☑	☑	☑	☑	☒	☑	☑	☑	☑	15 metres to small to medium eucalyptus trees.
Busselton	☑	☑	☑	☑	☒	☑	☑	☑	☑	5 metres to small to medium eucalyptus trees.
Collie	☑	☑	☒	☑	☒	☑	☑	☑	☑	Some trees and containers nearby
Midwest region										
Geraldton	☑	☑	☑	☑	☑	☑	☑	☑	☑	

Carbon monoxide

Duncraig monitoring station is an upper bound site for monitoring the combined effects of emissions from vehicles on the nearby Mitchell Freeway, and from domestic wood fires.

The site is about 200 metres from the freeway, so it is well beyond the distance of roadside measurement. By Perth's standards the site is representative of dense population, and lies in a dunal depression through which the freeway passes, hence the effect of stable air pooling in the depression is likely to lead to elevated concentrations. This feature would be found in many other places across the coastal plain.

South Lake monitoring station lies in a growing urban area and is likely to see increasing levels of CO from wood fires in particular. It is not as close to major roads

as the Duncraig site, and is therefore more typical of a population-average site.

Caversham monitoring station is located in a region of low population density and is therefore not considered a performance monitoring station.

In summary, WA maintained performance monitoring of CO at nominated trend stations of Duncraig and South Lake.

Photochemical oxidants as ozone

Statistics for the coastal sites of Quinns Rocks, Swanbourne and Rockingham indicate there is little difference between each station over the long term. Swanbourne was selected as a performance monitoring station, while monitoring stations at Quinns Rocks and at or near Rockingham were maintained.

Given its location, there is reason to be confident that Caversham monitoring station represents an upper bound, middle distance, inland site. Accordingly Caversham was selected as a performance monitoring station site.

A third performance monitoring station was located at South Lake. It has the following desirable attributes:

- it provides spatial spread of stations (it will measure ozone returning on shore in the southern part of the metropolitan area);
- it is a moderate distance inland in a growing urban area, hence it is well classed as a population average station;
- it may occasionally detect the interactions of O_3-rich air with the NO_x-rich plumes from Kwinana industry (potentially giving elevated NO_2 concentrations);

Caversham, Swanbourne and South Lake sites are all nominated as trend stations.

DER will continue to maintain the stations at Rockingham, Quinns Rocks and Rolling Green as part of its wider ozone network.

Nitrogen dioxide

Owing to the close chemical reactivity relationship, NO_2 is currently being monitored at all stations where O_3 is monitored. Caversham, Swanbourne and South Lake sites were chosen as performance monitoring stations for NO_2 as these provide a good spatial distribution.

Caversham, Swanbourne and South Lake sites are also trend stations.

DER will continue to measure NO_2 at Quinns Rocks, Rolling Green and Duncraig as part of its wider network.

Sulfur dioxide

DER operates one performance monitoring station at South Lake for sulfur dioxide, while maintaining a source management network which includes Wattleup and Rockingham monitoring stations.

South Lake site is an upper bound performance monitoring station for sulfur dioxide, and a trend station. South Lake is near the southern extent of the main urban population and downwind of Kwinana in sea breeze conditions.

Lead

Since 1995, lead levels within the Perth CBD have been below 60% of the 0.5 µg/m^3 annual NEPM standard. In 2001, the average lead level in Perth was 0.022 µg/m^3, less than 5% of the NEPM standard.

In accordance with National Environment Protection (Ambient Air Quality) Measure Technical Paper No. 4, Screening Procedures, and the WA Monitoring Plan, a performance monitoring station for lead has not been maintained since 2001.

Particles as PM_{10}

Duncraig site is an upper-bound performance monitoring station site for PM_{10}. High levels of PM_{10} here are caused by a combination of vehicle and domestic wood heater emissions during strongly stable meteorological conditions.

Likewise, the site at South Lake measures significant PM_{10} concentrations arising from wood fires.

Duncraig and South Lake sites are both nominated as trend stations.

Campaign monitoring stations were established at Geraldton in September 2005, Albany in July 2006 and Collie in February 2008.

All Tapered Element Oscillating Microbalances (TEOMs) used by DER are operated continuously (unadjusted for temperature). All TEOM data presented in this report has the manufacturers recommended equivalency factor of 1.03x + 3.00 applied.

Particles as $PM_{2.5}$

To make assessments against the advisory standard, four $PM_{2.5}$ TEOMs were installed in the greater Perth metropolitan area at Quinns Rocks, Caversham, Duncraig and South Lake and one each in Bunbury and Busselton. All will remain in use at these locations indefinitely with the intention of developing trend data.

All Tapered Element Oscillating Microbalances (TEOMs) used by DER are operated continuously (unadjusted for temperature).

All TEOM data presented in this report has the manufacturers recommended equivalency factor of 1.03x + 3.00 applied.

Exceedence Summary

In 2013 there were a number of exceedences of the NEPM PM_{10} and O_3 standards. The NEPM goals were not met at the Collie site for $PM_{10,}$ and at Caversham and Quinns Rocks sites for O_3 averaged over four hours.

All other sites met the NEPM goal.

Table A7. Air NEPM exceedences recorded during 2013[1]

Site	Pollutant	Concentration[1]	Date / Time	Reason
Albany	PM_{10} – 24 hour	96.3 µg/m^3	07/04/2013	Crustal
Albany	PM_{10} – 24 hour	110.8 µg/m^3	08/04/2013	Crustal
Albany	PM_{10} – 24 hour	51.0 µg/m^3	09/11/2013	Indeterminate
Bunbury	$PM_{2.5}$ – 24 hour	38.3 µg/m^3	08/11/2013	Smoke Haze
Caversham	O_3 – 1 hour	0.101 ppm	16/12/2013	Inland Event
Caversham	PM_{10} – 24 hour	62.4 µg/m^3	06/01/2013	Smoke Haze
Collie	PM_{10} – 24 hour	52.2 µg/m^3	14/02/2013	Indeterminate
Collie	PM_{10} – 24 hour	61.6 µg/m^3	25/03/2013	Crustal
Collie	PM_{10} – 24 hour	56.3 µg/m^3	30/04/2013	Smoke Haze
Geraldton	PM_{10} – 24 hour	63.1 µg/m^3	18/02/2013	Smoke Haze
Geraldton	PM_{10} – 24 hour	56.5 µg /m^3	12/11/2013	Crustal
Rolling Green	O_3 – 4 hour	0.083 ppm	08/01/2013	Inland Event

1. All Tapered Element Oscillating Microbalances (TEOMs) used by DER are operated continuously (unadjusted for temperature) and has the manufacturers recommended equivalency factor of 1.03x + 3.00 applied.

Key

Crustal	A small proportion of $PM_{2.5}$ within PM_{10}. Possibly due to moderate winds and/or human activity around the site.
Indeterminate	The cause was unknown due to a lack of confirming data or observations.
Smoke Haze	A high proportion of $PM_{2.5}$ within PM_{10}.
Inland Event	High concentrations of ozone due to ENE light winds before a change to SW with a slow passage inland of the west coast trough. There is no indication of any contribution from other than urban emissions and normal biogenic background.

[1] Refer to tables D52 to D58 for daily peak concentrations 2004–13

Section B – Assessment of compliance with standards and goals

Table B1. 2013 compliance summary for carbon monoxide

AAQ NEPM Standard
9.0 ppm (8-hour average)

Regional Performance Monitoring Station	Data availability rates (% of hours)					Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Perth region							
Caversham (North East Metro)	96.8	98.9	97.6	96.8	97.5	0	met
Duncraig (North Metro)	99.6	99.7	98.7	99.9	99.5	0	met
South Lake (South East Metro)	97.9	99.9	97.2	99.1	98.5	0	met

Performance against the standards and goal: “met”, “not met”, “not demonstrated”

Table B2. 2013 compliance summary for nitrogen dioxide

AAQ NEPM Standard
0.12 ppm (1-hour average)
0.03 ppm (1-year average)

Regional Performance Monitoring Station	Data availability rates (% of hours)					Annual mean (ppm)	Number of exceedences (days)	Performance against the standards and goal	
	Q1	Q2	Q3	Q4	Annual			1-hour	1-year
Perth region									
Caversham (North East Metro)	96.8	98.9	97.6	96.7	97.5	0.006	0	met	met
Duncraig (North Metro)	98.2	97.2	98.4	97.8	97.9	0.006	0	met	met
Quinns Rocks (Outer North Coast)	96.6	99.8	98.9	96.4	97.9	0.003	0	met	met
Rockingham (South Coast)	99.4	97.5	96.2	98.1	97.8	0.005	0	met	met
Rolling Green (Outer East Rural)	99.7	90.7	97.1	98.6	96.5	0.002	0	met	met
South Lake (South East Metro)	97.7	99.9	90.9	99.8	97.1	0.007	0	met	met
Swanbourne (Inner West Coast)	99.4	99.9	99.4	99.9	99.6	0.005	0	met	met

Performance against the standards and goal: “met”, “not met”, “not demonstrated”

Table B3. 2013 compliance summary for ozone

AAQ NEPM Standard
0.10 ppm (1-hour average)
0.08 ppm (4-hour average)

Regional 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-hour	1-hour	4-hour
Perth region									
Caversham (North East Metro)	95.9	93.4	96.8	96.5	95.7	1	0	met	met
Quinns Rocks (Outer North Coast)	98.1	100	98.9	99.6	99.2	0	0	met	met
Rockingham (South Coast)	97.6	98.4	99.9	99.3	98.8	0	0	met	met
Rolling Green (Outer East Rural)	99.8	90.7	97.3	99.5	96.8	0	1	met	met
South Lake (South East Metro)	97.9	99.8	97.2	99.5	98.6	0	0	met	met
Swanbourne (Inner West Coast)	99.9	100	99.7	99.7	99.8	0	0	met	met

Performance against the standards and goal: “met”, “not met”, “not demonstrated”

Table B4. 2013 compliance summary for sulfur dioxide

AAQ NEPM Standard
0.20 ppm (1-hour average)
0.08 ppm (24-hour average)
0.02 ppm (1-year average)

Regional Performance Monitoring Station	Data availability rates (% of hours)					Annual mean	Number of exceedences (days)		Performance against the standards and goal		
	Q1	Q2	Q3	Q4	Annual	(ppm)	1-hour	24-hour	1-hour	24-hour	1-year
Perth region											
Rockingham (South Coast)	94.6	94	95.7	93.8	94.5	0.001	0	0	met	met	met
South Lake (South East Metro)	93.2	95.1	92.9	91.8	93.3	0.001	0	0	met	met	met
Wattleup (South Metro)	95.0	94.9	90.9	89.2	92.5	0.002	0	0	met	met	met

Performance against the standards and goal: “met”, “not met”, “not demonstrated”

Table B5. 2013 compliance summary for particles as PM10

AAQ NEPM Standard
50 µg/m^3 (24-hour average)

Regional Performance Monitoring Station	Data availability rates (% of days)					Number of exceedences (days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Perth region							
Caversham (North East Metro)	96.8	98.9	97.4	96.7	97.4	1	met
Duncraig (North Metro)	99.5	99.5	98.7	99.6	99.3	0	met
South Lake (South East Metro)	97.8	99.7	97.1	99.7	98.6	0	met
Southwest region							
Albany	96.3	97.7	99.3	99	98.1	3	met
Bunbury	99.8	99.8	98.1	98	98.9	0	met
Collie	99.7	99.7	99.2	97.6	99	3	met
Midwest region							
Geraldton	98.4	99.7	99.3	99.7	99.3	2	met

Performance against the standards and goal: "met", "not met", "not demonstrated"

Table B6. 2013 compliance summary for particles as PM2.5

AAQ NEPM Advisory Standard
25 µg/m^3 (24-hour average)

Regional Performance Monitoring Station	Data availability rates (% of days)					Number of exceedences (Days)	Performance against the standards and goal
	Q1	Q2	Q3	Q4	Annual		
Perth region							
Caversham (North East Metro)	96.7	98.9	97.4	96.8	97.4	0	n/a
Duncraig (North Metro)	97.2	99.5	98.7	98.7	98.5	0	n/a
Quinns Rocks (Outer North Coast)	98.1	99.5	97.4	99.1	98.5	0	n/a
South Lake (South East Metro)	97.8	99.6	97.2	99.8	98.6	0	n/a
Southwest region							
Bunbury	99.7	99.8	99.7	98.1	99.3	1	n/a
Busselton	99.4	99.8	99.5	95.6	98.6	0	n/a

Section C – Analysis of air quality monitoring

Carbon monoxide

The NEPM standard for carbon monoxide of 9.0 ppm averaged over eight hours was not exceeded at any site during 2013. The NEPM goal of no more than one exceedence at each site was met. Table C1 contains the summary statistics for daily peak eight-hour CO in Western Australia.

Table C1. 2013 summary statistics for daily peak eight-hour carbon monoxide

AAQ NEPM Standard
9.0 ppm (8-hour average)

Regional Performance Monitoring Station	Data recovery rates (%)	Highest (ppm)	Highest (date)	Highest (time)	2nd highest (ppm)	2nd highest (date)	2nd highest (time)
Perth region							
Caversham (North East Metro)	97.5	0.9	18/05/2013	1100	0.8	30/06/2013	0400
Duncraig (North Metro)	99.5	2.1	13/07/2013	0500	1.9	01/07/2013	0400
South Lake (South East Metro)	98.5	1.7	29/06/2013	0200	1.4	22/06/2013	0300

Nitrogen dioxide

The NEPM standard for nitrogen dioxide of 0.12 ppm averaged over one hour and the 0.03 ppm annual average were not exceeded at any site during 2013. The NEPM goal of no more than one exceedence at each site was met. Table C2 contains the summary statistics for daily peak 1-hour NO_2 in Western Australia.

Table C2. 2013 summary statistics for daily peak one-hour nitrogen dioxide

AAQ NEPM Standard
0.12 ppm (one-hour average)

Regional Performance Monitoring Station	Data recovery rates (%)	Highest (ppm)	Highest (date)	Highest (time)	2nd highest (ppm)	2nd highest (date)	2nd highest (time)
Perth region							
Caversham (North East Metro)	97.5	0.043	10/04/2013	2200	0.039	03/04/2013	2100
Duncraig (North Metro)	97.9	0.040	10/04/2013	2000	0.033	08/04/2013	2100
Quinns Rocks (Outer North Coast)	97.9	0.032	08/04/2013	2100	0.027	03/08/2013	2100
Rockingham (South Coast)	97.8	0.035	20/08/2013	0900	0.033	04/11/2013	0800
Rolling Green (Outer East Rural)	96.5	0.030	14/01/2013	2100	0.019	06/01/2013	2000
South Lake (South East Metro)	97.1	0.043	13/12/2013	1600	0.040	16/12/2013	2100
Swanbourne (Inner West Coast)	99.6	0.037	08/04/2013	2100	0.035	07/06/2013	2200

Photochemical smog as ozone

The NEPM standard for ozone of 0.10 ppm averaged over one hour was exceeded at Caversham in 2013. The NEPM goal of no more than one exceedence at each site was met. Table C3 contains the summary statistics for daily peak one-hour O_3 in Western Australia.

Table C3. 2013 summary statistics for daily peak 1-hour ozone

AAQ NEPM Standard
0.10 ppm (1-hour average)

Regional Performance Monitoring Station	Data recovery rates (%)	Highest (ppm)	Highest (date)	Highest (time)	2nd highest (ppm)	2nd highest (date)	2nd highest (time)
Perth region							
Caversham (North East Metro)	95.7	0.101	16/12/2013	1400	0.082	08/01/2013	1300
Quinns Rocks (Outer North Coast)	99.2	0.087	21/02/2013	1400	0.082	07/01/2013	1700
Rockingham (South Coast)	98.8	0.084	21/02/2013	1500	0.078	12/02/2013	1300
Rolling Green (Outer East Rural)	96.8	0.099	08/01/2013	1500	0.081	16/12/2013	1600
South Lake (South East Metro)	98.6	0.087	16/12/2013	1400	0.078	14/12/2013	1200
Swanbourne (Inner West Coast)	99.8	0.083	21/02/2013	1500	0.072	20/02/2013	1600

The NEPM standard for ozone of 0.08 ppm averaged over four hours was exceeded at Rolling Green site. The NEPM goal of no more than one exceedence at each site was met. Table C4 contains the summary statistics for daily peak four-hour O_3 in Western Australia.

Table C4. 2013 summary statistics for daily peak 4-hour ozone

AAQ NEPM Standard
0.08 ppm (4-hour average)

Regional Performance Monitoring Station	Data recovery rates (%)	Highest (ppm)	Highest (date)	Highest (time)	2nd highest (ppm)	2nd highest (date)	2nd highest (time)
Perth region							
Caversham (North East Metro)	95.7	0.075	16/12/2013	1500	0.069	08/01/2013	1400
Quinns Rocks (Outer North Coast)	99.2	0.079	07/01/2013	1900	0.077	21/02/2013	1700
Rockingham (South Coast)	98.8	0.075	21/02/2013	1700	0.067	30/10/2013	1600
Rolling Green (Outer East Rural)	96.8	0.083	08/01/2013	1700	0.071	30/12/2013	1800
South Lake (South East Metro)	98.6	0.074	14/12/2013	1500	0.069	16/12/2013	1500
Swanbourne (Inner West Coast)	99.8	0.068	21/02/2013	1600	0.065	03/02/2013	1500

Sulfur dioxide

The NEPM standard for sulfur dioxide of 0.20 ppm averaged over one hour was not exceeded at any site during 2013. The NEPM goal of no more than one exceedence at each site was met. Table C5 contains the summary statistics for daily peak one-hour SO_2 in Western Australia.

Table C5. 2013 summary statistics for daily peak 1-hour sulfur dioxide

AAQ NEPM Standard
0.20 ppm (1-hour average)

Regional Performance Monitoring Station	Data recovery rates (%)	Highest (ppm)	Highest (date)	Highest (time)	2nd highest (ppm)	2nd highest (date)	2nd highest (time)
Perth region							
Rockingham (South Coast)	94.5	0.037	01/07/2013	1000	0.030	23/06/2013	1000
South Lake (South East Metro)	93.3	0.044	29/01/2013	1600	0.041	30/01/2013	1600
Wattleup (South Metro)	92.5	0.090	09/11/2013	1500	0.067	12/12/2013	1500

The NEPM standard for sulfur dioxide of 0.08 ppm averaged over 24 hours was not exceeded at any site during 2013. The NEPM goal of no more than one exceedence at each site was met. Table C6 contains the summary statistics for daily peak 24-hour SO_2 in Western Australia.

Table C6. 2013 summary statistics for 24-hour sulfur dioxide

AAQ NEPM Standard
0.08 ppm (24-hour average)

Regional Performance Monitoring Station	Data recovery rates (%)	Highest (ppm)	Highest (date)	Highest (time)	2nd highest (ppm)	2nd highest (date)	2nd highest (time)
Perth region							
Rockingham (South Coast)	94.5	0.007	22/06/2013	2400	0.007	14/07/2013	2400
South Lake (South East Metro)	93.3	0.014	26/05/2013	2400	0.005	18/03/2013	2400
Wattleup (South Metro)	92.5	0.010	09/11/2013	2400	0.009	13/12/2013	2400

The NEPM advisory standard for sulfur dioxide of 0.02 ppm averaged over one year was not exceeded at any site during 2013. Table C7 contains the summary statistics for annual SO_2 in Western Australia.

Table C7. 2013 summary statistics for annual sulfur dioxide

AAQ NEPM Advisory Standard
0.02 ppm (annual average)

Regional Performance Monitoring Station	Data recovery rates (%)	Annual average (ppm)
Perth region		
Rockingham (South Coast)	94.5	0.001
South Lake (South East Metro)	93.3	0.001
Wattleup (South Metro)	92.5	0.002

Particles as PM_{10}

The NEPM standard for particles as PM_{10} of 50 µg/m^3 averaged over 24 hours was exceeded once at Caversham, three times at Collie, twice at Geraldton and three times at Albany during 2013. The NEPM goal of no more than five exceedences was met. Table C8 contains the summary statistics for daily peak 24-hour PM_{10} in Western Australia.

Table C8. 2013 summary statistics for 24-hour particles as PM_{10}

AAQ NEPM Standard
50 µg/m3 (24-hour average)

Regional Performance Monitoring Station	Data recovery rates (%)	Highest (µg/m^3)	Highest (date)	Highest (time)	6th Highest (µg/m^3)	6th Highest (date)	6th Highest (time)
Perth region							
Caversham[1] (North East Metro)	97.4	62.4	06/01/2013	2400	31.3	14/02/2013	2400
Duncraig[1] (North Metro)	99.3	37.6	01/09/2013	2400	31.1	05/01/2013	2400
South Lake[1] (South East Metro)	98.6	38.8	04/01/2013	2400	34.0	05/01/2013	2400
Southwest region							
Albany [1]	98.1	110.8	08/04/2013	2400	38.1	20/01/2013	2400
Bunbury [1]	98.9	46.8	08/11/2013	2400	36.8	06/01/2013	2400
Collie [1]	99.0	61.6	25/03/2013	2400	44.4	23/12/2013	2400
Midwest region							
Geraldton [1]	99.3	63.1	18/02/2013	2400	44.5	06/12/2013	2400

1 – Tapered Element Oscillating Microbalance (TEOM) operating continuously (unadjusted for temperature) and includes the manufacturers recommended equivalency factor of 1.03x + 3.00.

Particles as $PM_{2.5}$

The NEPM advisory standard for particles as $PM_{2.5}$ of 25 micrograms per cubic metre averaged over 24 hours was exceeded once at Bunbury during 2013. Table C9 contains the summary statistics for daily peak 24-hour $PM_{2.5}$ in Western Australia.

Table C9. 2013 summary statistics for 24-hour particles as $PM_{2.5}$

AAQ NEPM Advisory Standard
25 µg/m3 (24-hour average)

Regional Performance Monitoring Station	Data recovery rates (%)	Highest ($\mu g/m^3$)	Highest (date)	Highest (time)	6th highest ($\mu g/m^3$)	6th highest (date)	6th highest (time)
Perth region							
Caversham[1] (North East Metro)	97.4	22.6	18/05/2013	2400	16.6	24/09/2013	2400
Duncraig[1] (North Metro)	98.5	18.7	29/06/2013	2400	15.1	01/07/2013	2400
Quinns Rocks[1] (Outer North Coast)	98.5	19.3	01/09/2013	2400	15.9	05/01/2013	2400
South Lake[1] (South East Metro)	98.6	17.1	10/04/2013	2400	15.1	08/11/2013	2400
Southwest region							
Bunbury[1]	99.3	38.3	08/11/2013	2400	16.4	30/04/2013	2400
Busselton[1]	98.6	17.9	23/09/2013	2400	16.1	25/05/2013	2400

1 - Tapered Element Oscillating Microbalance (TEOM) operating continuously (unadjusted for temperature) and includes the manufacturers recommended equivalency factor of 1.03x + 3.00.

The NEPM advisory standard for particles as $PM_{2.5}$ of 8 micrograms per cubic metre averaged over one year was met during 2013. Table C10 contains the summary statistics for annual $PM_{2.5}$ in Western Australia.

Table C10. 2013 summary statistics for annual particles as $PM_{2.5}$

AAQ NEPM Advisory Standard
8 µg/m3 (annual average)

Regional Performance Monitoring Station	Data recovery rates (%)	Annual average ($\mu g/m^3$)
Perth region		
Caversham[1] (North East Metro)	97.4	7.9
Duncraig[1] (North Metro)	98.5	7.6
Quinns Rocks[1] (Outer North Coast)	98.5	7.8
South Lake[1] (South East Metro)	98.6	8.0
Southwest region		
Bunbury[1]	99.3	7.8
Busselton[1]	98.6	7.7

1 - Tapered Element Oscillating Microbalance (TEOM) operating continuously (unadjusted for temperature) and includes the manufacturers recommended equivalency factor of 1.03x + 3.00.

Section D – Data analysis

Maxima and percentiles by pollutant in 2013

Table D1. 2013 percentiles of daily peak 8-hour carbon monoxide concentrations

AAQ NEPM Standard
9.0 ppm (8-hour average)

Regional Performance Monitoring Station	Data availability rates (%)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
Perth region								
Caversham (North East Metro)	97.5	0.9	0.7	0.6	0.5	0.4	0.2	0.1
Duncraig (North Metro)	99.5	2.1	1.8	1.6	1.2	0.8	0.4	0.3
South Lake (South East Metro)	98.5	1.7	1.3	1.2	1.0	0.6	0.4	0.2

Table D2. 2013 percentiles of daily peak 1-hour nitrogen dioxide concentrations

AAQ NEPM Standard
0.12 ppm (one-hour average)

Regional Performance Monitoring Station	Data availability rates (%)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
Perth region								
Caversham (North East Metro)	97.5	0.043	0.034	0.032	0.029	0.025	0.020	0.015
Duncraig (North Metro)	97.9	0.040	0.031	0.030	0.028	0.026	0.022	0.017
Quinns Rocks (Outer North Coast)	97.9	0.032	0.026	0.026	0.023	0.020	0.015	0.009
Rockingham (South Coast)	97.8	0.035	0.031	0.029	0.027	0.025	0.018	0.011
Rolling Green (Outer East Rural)	96.5	0.030	0.018	0.017	0.015	0.013	0.010	0.006
South Lake (South East Metro)	97.1	0.043	0.037	0.033	0.031	0.027	0.023	0.019
Swanbourne (Inner West Coast)	99.6	0.037	0.033	0.031	0.027	0.025	0.018	0.012

Table D3. 2013 percentiles of daily peak 1-hour ozone concentrations

AAQ NEPM Standard
0.10 ppm (1-hour average)

Regional Performance Monitoring Station	Data availability rates (%)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
Perth region								
Caversham (North East Metro)	95.7	0.101	0.074	0.070	0.056	0.051	0.037	0.032
Quinns Rocks (Outer North Coast)	99.2	0.087	0.077	0.066	0.058	0.050	0.038	0.033
Rockingham (South Coast)	98.8	0.084	0.068	0.065	0.052	0.044	0.035	0.032
Rolling Green (Outer East Rural)	96.8	0.099	0.078	0.071	0.061	0.049	0.038	0.033
South Lake (South East Metro)	98.6	0.087	0.074	0.062	0.054	0.043	0.035	0.031
Swanbourne (Inner West Coast)	99.8	0.083	0.069	0.064	0.052	0.045	0.036	0.033

Table D4. 2013 percentiles of daily peak 4-hour ozone concentrations

AAQ NEPM Standard
0.08 ppm (4-hour average)

Regional Performance Monitoring Station	Data availability rates (%)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
Perth region								
Caversham (North East Metro)	95.7	0.075	0.065	0.060	0.049	0.044	0.035	0.031
Quinns Rocks (Outer North Coast)	99.2	0.079	0.068	0.061	0.051	0.045	0.036	0.032
Rockingham (South Coast)	98.8	0.075	0.064	0.057	0.047	0.042	0.034	0.031
Rolling Green (Outer East Rural)	96.8	0.083	0.065	0.059	0.051	0.045	0.036	0.032
South Lake (South East Metro)	98.6	0.074	0.063	0.057	0.048	0.039	0.033	0.029
Swanbourne (Inner West Coast)	99.8	0.068	0.063	0.056	0.048	0.042	0.035	0.031

Table D5. 2013 percentiles of daily peak 1-hour sulfur dioxide concentrations

AAQ NEPM Standard
0.20 ppm (1-hour average)

Regional Performance Monitoring Station	Data availability rates (%)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
Perth region								
Rockingham (South Coast)	94.5	0.037	0.028	0.022	0.016	0.011	0.004	0.002
South Lake (South East Metro)	93.3	0.044	0.034	0.031	0.020	0.015	0.007	0.003
Wattleup (South Metro)	92.5	0.090	0.059	0.047	0.037	0.027	0.014	0.005

Table D6. 2013 percentiles of daily peak 24-hour sulfur dioxide concentrations

AAQ NEPM Standard
0.08 ppm (24-hour average)

Regional Performance Monitoring Station	Data availability rates (%)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)	75th percentile (ppm)	50th percentile (ppm)
Perth region								
Rockingham (South Coast)	94.5	0.007	0.005	0.004	0.003	0.002	0.001	0.001
South Lake (South East Metro)	93.3	0.014	0.005	0.004	0.003	0.002	0.002	0.001
Wattleup (South Metro)	92.5	0.010	0.008	0.006	0.005	0.004	0.003	0.001

Table D7. 2013 percentiles of daily peak 24-hour particles as PM_{10} concentrations

AAQ NEPM Standard
50 µg/m^3 (24-hour average)

Regional Performance Monitoring Station	Data availability rates (%)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)	75th percentile (µg/m^3)	50th percentile (µg/m^3)
Perth region								
Caversham (North East Metro)	97.4	62.4	34.4	30.7	26.2	23.6	18.8	14.3
Duncraig (North Metro)	99.3	37.6	32.1	28.1	25.6	22.8	18.3	14.8
South Lake (South East Metro)	98.6	38.8	34.4	32.3	28.9	25.9	19.6	15.3
Southwest region								
Albany	98.1	110.8	43.3	36.0	29.1	23.8	18.1	13.3
Bunbury	98.9	46.8	38.1	33.5	26.8	22.6	19.7	16.5
Collie	99	61.6	46.0	41.3	36.0	32.0	25.0	18.6
Midwest region								
Geraldton	99.3	63.1	45.9	42.1	38.9	34.6	27.3	18.0

Table D8. 2013 percentiles of daily peak 24-hour particles as $PM_{2.5}$ concentrations

AAQ NEPM Advisory Standard
25 µg/m^3 (24-hour average)

Regional Performance Monitoring Station	Data availability rates (%)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)	75th percentile (µg/m^3)	50th percentile (µg/m^3)
Perth region								
Caversham (North East Metro)	97.4	22.6	17.2	16.4	13.6	11.6	8.8	7.3
Duncraig (North Metro)	98.5	18.7	15.6	14.4	12.7	11.4	9.1	7.3
Quinns Rocks (Outer North Coast)	98.5	19.3	16.6	15.0	13.1	10.9	8.9	7.4
South Lake (South East Metro)	98.6	17.1	15.2	14.9	14.0	11.7	9.9	7.5
Southwest region								
Bunbury	99.3	38.3	16.6	15.7	14.0	11.5	9.4	7.3
Busselton	98.6	17.9	16.6	15.5	12.9	10.9	9.0	7.3

Maxima and percentiles by site 2004 to 2013

Table D9. Daily peak 8-hour carbon monoxide at Caversham (2004-2013)

Trend station/region: Caversham

AAQ NEPM Standard
9.0 ppm (8-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	96.2	0	1.3	0.9	0.9	0.7	0.5
2005	98.3	0	1.3	0.9	0.8	0.7	0.6
2006	99.7	0	1.8	0.9	0.9	0.6	0.5
2007	98.2	0	0.9	0.6	0.6	0.5	0.4
2008	99.5	0	0.8	0.7	0.7	0.6	0.5
2009	99.2	0	1.0	0.6	0.5	0.4	0.4
2010	85.0	0	1.6	0.8	0.7	0.6	0.5
2011	98.2	0	1.5	1.2	1.0	0.6	0.5
2012	98.0	0	0.9	0.7	0.6	0.5	0.4
2013	97.5	0	0.9	0.7	0.6	0.5	0.4

Table D10. Daily peak 8-hour carbon monoxide at Duncraig (2004-2013)

Trend station/region: Duncraig

AAQ NEPM Standard
9.0 ppm (8-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.1	0	4.5	3.2	2.7	2.1	1.2
2005	98.5	0	3.3	2.7	2.2	1.7	1.2
2006	99.3	0	3.4	2.8	2.3	1.8	1.3
2007	99.5	0	2.0	1.6	1.4	1.2	0.8
2008	99.0	0	3.1	1.9	1.7	1.4	1.0
2009	98.2	0	2.6	1.7	1.4	1.0	0.7
2010	87.5	0	2.3	2.0	1.8	1.5	1.1
2011	99.3	0	1.9	1.3	1.2	1.0	0.7
2012	99.5	0	2.4	1.9	1.5	1.1	0.9
2013	99.5	0	2.1	1.8	1.6	1.2	0.8

Table D11. Daily peak 8-hour carbon monoxide at South Lake (2004-2013)

Trend station/region: South Lake

AAQ NEPM Standard
9.0 ppm (8-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.5	0	3.5	2.3	2.1	1.5	1.0
2005	96.9	0	2.9	2.5	2.0	1.6	1.1
2006	98.6	0	2.5	2.4	2.2	1.6	1.0
2007	99.3	0	1.7	1.4	1.2	1.0	0.8
2008	99.6	0	2.0	1.6	1.4	1.2	0.9
2009	99.3	0	1.8	1.4	1.1	0.9	0.7
2010	87.8	0	2.2	1.6	1.5	1.2	0.9
2011	98.3	0	1.7	1.5	1.3	1.0	0.8
2012	98.9	0	2.2	1.6	1.4	1.0	0.8
2013	98.5	0	1.7	1.3	1.2	1.0	0.6

Table D12. Daily peak 1-hour nitrogen dioxide at Caversham (2004-2013)

Trend station/region: Caversham

AAQ NEPM Standard 0.12 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	98.9	0	0.046	0.036	0.033	0.029	0.028
2005	98.3	0	0.048	0.040	0.034	0.031	0.027
2006	98.3	0	0.084	0.037	0.034	0.031	0.028
2007	98.5	0	0.044	0.037	0.033	0.028	0.026
2008	99.5	0	0.036	0.033	0.032	0.028	0.026
2009	99.3	0	0.044	0.034	0.033	0.028	0.026
2010	84.9	0	0.054	0.040	0.037	0.032	0.029
2011	99.5	0	0.035	0.031	0.029	0.027	0.025
2012	97.0	0	0.037	0.033	0.032	0.029	0.025
2013	97.5	0	0.043	0.034	0.032	0.029	0.025

Table D13. Daily peak 1-hour nitrogen dioxide at Duncraig (2004-2013)

Trend station/region: Duncraig

AAQ NEPM Standard 0.12 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	94.5	0	0.043	0.037	0.035	0.031	0.029
2005	96.7	0	0.051	0.039	0.036	0.032	0.030
2006	99.5	0	0.056	0.037	0.036	0.032	0.030
2007	99.6	0	0.053	0.034	0.032	0.030	0.028
2008	97.7	0	0.038	0.034	0.030	0.029	0.027
2009	98.5	0	0.042	0.037	0.034	0.030	0.027
2010	87.5	0	0.038	0.035	0.033	0.030	0.028
2011	99.3	0	0.035	0.032	0.030	0.028	0.027
2012	96.8	0	0.047	0.037	0.033	0.030	0.027
2013	97.9	0	0.040	0.031	0.030	0.028	0.026

Table D14. Daily peak 1-hour nitrogen dioxide at Quinns Rocks (2004-2013)

Trend station/region: Quinns Rocks

AAQ NEPM Standard 0.12 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	90.8	0	0.041	0.032	0.030	0.028	0.025
2005	96.9	0	0.041	0.031	0.030	0.027	0.024
2006	96.9	0	0.065	0.051	0.042	0.035	0.029
2007	99.5	0	0.035	0.031	0.029	0.028	0.025
2008	96.1	0	0.037	0.033	0.032	0.028	0.025
2009	99.0	0	0.034	0.032	0.031	0.027	0.024
2010	88.8	0	0.040	0.032	0.032	0.030	0.027
2011	99.0	0	0.031	0.028	0.027	0.025	0.022
2012	97.3	0	0.041	0.032	0.031	0.027	0.024
2013	97.9	0	0.032	0.026	0.026	0.023	0.020

Table D15. Daily peak 1-hour nitrogen dioxide at Rockingham (2004-2013)

Trend station/region: Rockingham

AAQ NEPM Standard

0.12 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.4	0	0.055	0.043	0.039	0.035	0.031
2005	99.1	0	0.045	0.038	0.036	0.032	0.030
2006	98.9	0	0.054	0.040	0.036	0.034	0.031
2007	99.4	0	0.040	0.034	0.030	0.028	0.025
2008	99.3	0	0.031	0.028	0.027	0.025	0.024
2009	98.6	0	0.031	0.029	0.028	0.026	0.024
2010	88.7	0	0.036	0.032	0.030	0.028	0.026
2011	96.6	0	0.034	0.028	0.027	0.025	0.022
2012	96.4	0	0.053	0.030	0.030	0.027	0.024
2013	97.8	0	0.035	0.031	0.029	0.027	0.025

Table D16. Daily peak 1-hour nitrogen dioxide at Rolling Green (2004-2013)

Trend station/region: Rolling Green *AAQ NEPM Standard*

0.12 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	95.6	0	0.025	0.023	0.021	0.018	0.016
2005	97.9	0	0.029	0.025	0.023	0.020	0.017
2006	98.0	0	0.026	0.020	0.019	0.017	0.015
2007	98.8	0	0.020	0.019	0.018	0.016	0.014
2008	99.3	0	0.023	0.020	0.019	0.016	0.015
2009	99.5	0	0.035	0.023	0.019	0.017	0.015
2010	87.5	0	0.030	0.022	0.019	0.017	0.016
2011	97.1	0	0.023	0.019	0.018	0.015	0.013
2012	91.9	0	0.029	0.019	0.017	0.016	0.014
2013	96.5	0	0.030	0.018	0.017	0.015	0.013

Table D17. Daily peak 1-hour nitrogen dioxide at South Lake (2004-2013)

Trend station/region: South Lake *AAQ NEPM Standard*

0.12 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	98.4	0	0.043	0.038	0.036	0.032	0.029
2005	87.1	0	0.052	0.043	0.039	0.033	0.028
2006	98.0	0	0.045	0.039	0.037	0.032	0.029
2007	99.1	0	0.057	0.041	0.038	0.032	0.029
2008	99.6	0	0.044	0.040	0.038	0.033	0.030
2009	99.3	0	0.048	0.039	0.036	0.033	0.029
2010	87.8	0	0.058	0.045	0.040	0.036	0.030
2011	96.1	0	0.041	0.033	0.032	0.030	0.028
2012	98.7	0	0.046	0.038	0.035	0.031	0.028
2013	97.1	0	0.043	0.037	0.033	0.031	0.027

Table D18. Daily peak 1-hour nitrogen dioxide at Swanbourne (2004-2013)

Trend station/region: Swanbourne

AAQ NEPM Standard
0.12 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	70.2	0	0.042	0.039	0.035	0.032	0.028
2005	96.2	0	0.039	0.037	0.033	0.029	0.026
2006	99.5	0	0.043	0.034	0.033	0.031	0.028
2007	98.7	0	0.038	0.033	0.032	0.030	0.027
2008	98.2	0	0.035	0.034	0.033	0.031	0.029
2009	99.2	0	0.037	0.034	0.032	0.028	0.026
2010	86.6	0	0.038	0.033	0.032	0.031	0.029
2011	99.4	0	0.032	0.029	0.028	0.026	0.024
2012	98.4	0	0.045	0.033	0.032	0.030	0.027
2013	99.6	0	0.037	0.033	0.031	0.027	0.025

Table D19. Daily peak 1-hour ozone at Caversham (2004-2013)

Trend station/region: Caversham

AAQ NEPM Standard
0.10 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	98.9	0	0.079	0.070	0.062	0.052	0.045
2005	99.3	0	0.094	0.078	0.063	0.054	0.043
2006	99.6	0	0.080	0.072	0.067	0.058	0.049
2007	98.6	0	0.085	0.073	0.066	0.059	0.047
2008	99.5	0	0.083	0.067	0.066	0.053	0.046
2009	99.3	1	0.104	0.072	0.067	0.056	0.050
2010	84.5	0	0.082	0.069	0.059	0.055	0.046
2011	99.2	0	0.077	0.070	0.067	0.054	0.045
2012	97.5	0	0.098	0.078	0.064	0.052	0.047
2013	95.7	1	0.101	0.074	0.070	0.056	0.051

Table D20. Daily peak 1-hour ozone at Quinns Rocks (2004-2013)

Trend station/region: Quinns Rocks

AAQ NEPM Standard
0.10 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	97.9	0	0.079	0.064	0.060	0.056	0.046
2005	98.0	0	0.095	0.068	0.063	0.055	0.045
2006	99.0	0	0.085	0.065	0.063	0.052	0.045
2007	98.8	0	0.081	0.061	0.057	0.050	0.045
2008	99.4	0	0.083	0.073	0.060	0.052	0.043
2009	94.3	0	0.070	0.063	0.061	0.053	0.045
2010	88.7	0	0.091	0.061	0.058	0.054	0.048
2011	99.1	0	0.083	0.068	0.057	0.051	0.045
2012	95.7	1	0.130	0.073	0.069	0.058	0.048
2013	99.2	0	0.087	0.077	0.066	0.058	0.050

Table D21. Daily peak 1-hour ozone at Rockingham (2004-2013)

Trend station/region: Rockingham

AAQ NEPM Standard
0.10 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.1	1	0.102	0.067	0.059	0.048	0.040
2005	99.1	0	0.081	0.064	0.056	0.044	0.040
2006	98.9	0	0.072	0.061	0.056	0.050	0.041
2007	99.5	0	0.084	0.065	0.056	0.049	0.042
2008	99.4	0	0.077	0.063	0.053	0.045	0.038
2009	99.0	0	0.078	0.064	0.054	0.048	0.041
2010	88.2	0	0.067	0.060	0.057	0.052	0.044
2011	94.9	0	0.065	0.062	0.057	0.048	0.043
2012	99.0	0	0.095	0.073	0.064	0.053	0.044
2013	98.8	0	0.084	0.068	0.065	0.052	0.044

Table D22. Daily peak 1-hour ozone at Rolling Green (2004-2013)

Trend station/region: Rolling Green

AAQ NEPM Standard
0.10 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	97.9	1	0.101	0.076	0.071	0.060	0.049
2005	97.9	0	0.079	0.071	0.064	0.058	0.050
2006	98.6	0	0.093	0.075	0.072	0.060	0.053
2007	98.9	0	0.095	0.081	0.078	0.062	0.053
2008	99.5	0	0.087	0.080	0.071	0.056	0.047
2009	99.5	1	0.103	0.081	0.069	0.059	0.052
2010	85.6	0	0.088	0.077	0.070	0.056	0.046
2011	95.9	0	0.073	0.068	0.060	0.052	0.043
2012	91.8	1	0.103	0.074	0.066	0.055	0.045
2013	96.8	0	0.099	0.078	0.071	0.061	0.049

Table D23. Daily peak 1-hour ozone at South Lake (2004-2013)

Trend station/region: South Lake

AAQ NEPM Standard
0.10 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.0	0	0.076	0.061	0.057	0.047	0.041
2005	97.0	0	0.080	0.062	0.056	0.049	0.041
2006	99.6	0	0.066	0.057	0.054	0.045	0.040
2007	99.4	0	0.067	0.056	0.053	0.047	0.040
2008	99.6	0	0.082	0.061	0.056	0.044	0.037
2009	99.4	0	0.065	0.057	0.053	0.045	0.039
2010	88.0	0	0.070	0.067	0.062	0.052	0.045
2011	99.4	0	0.076	0.064	0.057	0.050	0.044
2012	98.2	0	0.085	0.065	0.062	0.051	0.041
2013	98.6	0	0.087	0.074	0.062	0.054	0.043

Table D24. Daily peak 1-hour ozone at Swanbourne (2004-2013)

Trend station/region: Swanbourne

AAQ NEPM Standard 0.10 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.4	0	0.077	0.065	0.059	0.049	0.042
2005	96.4	0	0.076	0.066	0.061	0.051	0.043
2006	99.7	0	0.075	0.066	0.060	0.050	0.044
2007	99.3	0	0.077	0.064	0.057	0.051	0.044
2008	98.2	0	0.076	0.067	0.060	0.048	0.042
2009	99.6	0	0.068	0.063	0.059	0.053	0.044
2010	86.6	0	0.066	0.059	0.056	0.050	0.044
2011	99.6	0	0.085	0.069	0.061	0.051	0.046
2012	98.2	1	0.128	0.074	0.067	0.056	0.047
2013	99.8	0	0.083	0.069	0.064	0.052	0.045

Table D25. Daily peak 4-hour ozone at Caversham (2004-2013)

Trend station/region: Caversham

AAQ NEPM Standard 0.08 ppm (4-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	98.9	0	0.067	0.057	0.052	0.047	0.040
2005	99.3	0	0.069	0.055	0.052	0.046	0.039
2006	99.6	0	0.072	0.063	0.058	0.049	0.043
2007	98.6	0	0.073	0.062	0.058	0.049	0.042
2008	99.5	0	0.076	0.061	0.056	0.047	0.041
2009	99.3	1	0.092	0.067	0.057	0.051	0.043
2010	84.5	0	0.072	0.056	0.052	0.047	0.041
2011	99.2	0	0.063	0.061	0.056	0.049	0.041
2012	97.5	2	0.086	0.070	0.056	0.047	0.041
2013	95.7	0	0.075	0.065	0.060	0.049	0.044

Table D26. Daily peak 4-hour ozone at Quinns Rocks (2004-2013)

Trend station/region: Quinns Rocks

AAQ NEPM Standard 0.08 ppm (4-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	97.9	0	0.068	0.059	0.055	0.048	0.041
2005	98.0	0	0.070	0.058	0.057	0.047	0.041
2006	99.0	0	0.074	0.059	0.055	0.046	0.041
2007	98.8	0	0.075	0.056	0.053	0.046	0.041
2008	99.4	0	0.073	0.061	0.055	0.046	0.041
2009	94.3	0	0.062	0.056	0.054	0.048	0.040
2010	88.7	0	0.065	0.056	0.052	0.048	0.042
2011	99.1	0	0.075	0.060	0.052	0.047	0.041
2012	95.7	2	0.108	0.065	0.061	0.051	0.043
2013	99.2	0	0.079	0.068	0.061	0.051	0.045

Table D27. Daily peak 4-hour ozone at Rockingham (2004-2013)

Trend station/region: Rockingham

AAQ NEPM Standard 0.08 ppm (4-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.1	0	0.079	0.060	0.052	0.045	0.038
2005	99.1	0	0.075	0.061	0.052	0.042	0.038
2006	98.9	0	0.067	0.056	0.051	0.046	0.038
2007	99.5	0	0.079	0.057	0.052	0.046	0.038
2008	99.4	0	0.072	0.058	0.049	0.042	0.036
2009	99.0	0	0.066	0.058	0.051	0.045	0.039
2010	88.2	0	0.064	0.054	0.053	0.046	0.041
2011	94.9	0	0.061	0.058	0.053	0.045	0.040
2012	99.0	0	0.079	0.065	0.060	0.048	0.040
2013	98.8	0	0.075	0.064	0.057	0.047	0.042

Table D28. Daily peak 4-hour ozone at Rolling Green (2004-2013)

Trend station/region: Rolling Green

AAQ NEPM Standard 0.08 ppm (4-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	97.9	0	0.077	0.064	0.061	0.051	0.042
2005	97.9	0	0.068	0.060	0.058	0.049	0.044
2006	98.6	0	0.079	0.065	0.059	0.053	0.046
2007	98.9	0	0.080	0.070	0.066	0.053	0.046
2008	99.5	0	0.075	0.065	0.062	0.051	0.043
2009	99.5	2	0.083	0.064	0.057	0.051	0.043
2010	85.6	0	0.080	0.065	0.056	0.049	0.042
2011	95.9	0	0.061	0.055	0.051	0.045	0.040
2012	91.8	1	0.081	0.064	0.058	0.049	0.042
2013	96.8	1	0.083	0.065	0.059	0.051	0.045

Table D29. Daily peak 4-hour ozone at South Lake (2004-2013)

Trend station/region: South Lake

AAQ NEPM Standard 0.08 ppm (4-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.0	0	0.064	0.053	0.049	0.042	0.035
2005	97.0	0	0.070	0.053	0.052	0.042	0.037
2006	99.6	0	0.063	0.051	0.049	0.041	0.036
2007	99.4	0	0.059	0.051	0.048	0.042	0.037
2008	99.6	0	0.067	0.051	0.046	0.040	0.034
2009	99.4	0	0.057	0.053	0.048	0.040	0.036
2010	88.0	0	0.061	0.055	0.053	0.046	0.042
2011	99.4	0	0.064	0.056	0.051	0.046	0.039
2012	98.2	0	0.080	0.060	0.054	0.046	0.037
2013	98.6	0	0.074	0.063	0.057	0.048	0.039

Table D30. Daily peak 4-hour ozone at Swanbourne (2004-2013)

Trend station/region: Swanbourne

AAQ NEPM Standard
0.10 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.4	0	0.067	0.057	0.054	0.044	0.038
2005	96.4	0	0.066	0.058	0.052	0.044	0.039
2006	99.7	0	0.069	0.060	0.052	0.045	0.040
2007	99.3	0	0.067	0.054	0.051	0.048	0.042
2008	98.2	0	0.070	0.060	0.053	0.045	0.039
2009	99.6	0	0.063	0.058	0.054	0.046	0.039
2010	86.6	0	0.055	0.053	0.050	0.044	0.040
2011	99.6	0	0.073	0.059	0.056	0.047	0.043
2012	98.2	1	0.108	0.064	0.061	0.051	0.042
2013	99.8	0	0.068	0.063	0.056	0.048	0.042

Table D31. Daily peak 1-hour sulfur dioxide at Rockingham (2004-2013)

Trend station/region: Rockingham

AAQ NEPM Standard
0.20 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.4	0	0.039	0.021	0.018	0.011	0.006
2005	99.2	0	0.041	0.024	0.022	0.017	0.010
2006	98.9	0	0.040	0.031	0.022	0.013	0.008
2007	98.6	0	0.041	0.025	0.020	0.013	0.008
2008	98.3	0	0.079	0.026	0.019	0.015	0.008
2009	98.7	0	0.032	0.022	0.017	0.010	0.007
2010	89.9	0	0.037	0.022	0.019	0.013	0.009
2011	93.7	0	0.040	0.029	0.024	0.017	0.010
2012	94.4	0	0.040	0.020	0.018	0.011	0.008
2013	94.5	0	0.037	0.028	0.022	0.016	0.011

Table D32. Daily peak 1-hour sulfur dioxide at South Lake (2004-2013)

Trend station/region: South Lake

AAQ NEPM Standard
0.20 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.5	0	0.042	0.028	0.024	0.019	0.013
2005	96.9	0	0.046	0.033	0.030	0.022	0.017
2006	99.5	0	0.060	0.044	0.032	0.028	0.022
2007	99.4	0	0.040	0.032	0.028	0.019	0.012
2008	99.6	0	0.046	0.025	0.020	0.014	0.010
2009	98.4	0	0.036	0.033	0.029	0.018	0.015
2010	87.8	0	0.073	0.036	0.033	0.025	0.017
2011	95.7	0	0.044	0.029	0.026	0.017	0.012
2012	94.0	0	0.039	0.027	0.019	0.014	0.010
2013	93.3	0	0.044	0.034	0.031	0.020	0.015

Table D33. Daily peak 1-hour sulfur dioxide at Wattleup (2004-2013)

Trend station/region: Wattleup

AAQ NEPM Standard
0.20 ppm (1-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	97.7	0	0.076	0.044	0.041	0.030	0.021
2005	99.7	0	0.120	0.058	0.045	0.037	0.026
2006	99.0	0	0.062	0.046	0.043	0.035	0.028
2007	93.3	0	0.060	0.045	0.040	0.034	0.025
2008	89.6	0	0.077	0.034	0.028	0.022	0.016
2009	95.6	0	0.059	0.039	0.036	0.029	0.022
2010	86.8	0	0.057	0.049	0.043	0.036	0.023
2011	94.3	0	0.067	0.049	0.042	0.032	0.026
2012	94.7	0	0.043	0.039	0.034	0.025	0.017
2013	92.5	0	0.090	0.059	0.047	0.037	0.027

Table D34. Daily peak 24-hour sulfur dioxide at Rockingham (2004-2013)

Trend station/region: Rockingham

AAQ NEPM Standard
0.08 ppm (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.4	0	0.006	0.003	0.003	0.002	0.001
2005	99.2	0	0.009	0.006	0.004	0.003	0.002
2006	98.9	0	0.007	0.004	0.004	0.002	0.002
2007	98.6	0	0.012	0.005	0.004	0.003	0.002
2008	98.3	0	0.007	0.005	0.004	0.002	0.001
2009	98.7	0	0.008	0.003	0.002	0.001	0.001
2010	89.9	0	0.007	0.004	0.003	0.002	0.002
2011	93.7	0	0.008	0.006	0.006	0.003	0.002
2012	94.4	0	0.006	0.005	0.003	0.002	0.002
2013	94.5	0	0.007	0.005	0.004	0.003	0.002

Table D35. Daily peak 24-hour sulfur dioxide at South Lake (2004-2013)

Trend station/region: South Lake

AAQ NEPM Standard
0.08 ppm (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	99.5	0	0.005	0.004	0.004	0.003	0.002
2005	96.9	0	0.007	0.006	0.004	0.004	0.002
2006	99.5	0	0.009	0.006	0.005	0.004	0.003
2007	99.4	0	0.006	0.004	0.003	0.002	0.002
2008	99.6	0	0.005	0.003	0.003	0.002	0.001
2009	98.4	0	0.006	0.005	0.003	0.003	0.002
2010	87.8	0	0.009	0.005	0.004	0.003	0.002
2011	95.7	0	0.006	0.004	0.003	0.002	0.002
2012	94.0	0	0.006	0.004	0.003	0.003	0.002
2013	93.3	0	0.014	0.005	0.004	0.003	0.002

Table D36. Daily peak 24-hour sulfur dioxide at Wattleup (2004-2013)

Trend station/region: Wattleup

AAQ NEPM Standard 0.08 ppm (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (ppm)	99th percentile (ppm)	98th percentile (ppm)	95th percentile (ppm)	90th percentile (ppm)
2004	97.7	0	0.009	0.007	0.005	0.004	0.003
2005	99.7	0	0.014	0.008	0.006	0.005	0.004
2006	99.0	0	0.009	0.007	0.006	0.004	0.004
2007	93.3	0	0.010	0.008	0.007	0.005	0.004
2008	89.6	0	0.011	0.005	0.004	0.003	0.002
2009	95.6	0	0.008	0.005	0.005	0.004	0.003
2010	86.8	0	0.010	0.008	0.006	0.005	0.003
2011	94.3	0	0.008	0.006	0.005	0.004	0.003
2012	94.7	0	0.008	0.005	0.004	0.003	0.002
2013	92.5	0	0.010	0.008	0.006	0.005	0.004

Table D37. Daily peak 24-hour particles as PM10 at Caversham (2004-2013)

Trend station/region: Caversham

AAQ NEPM Standard 50 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004	93.2	1	58.0	39.0	34.4	29.7	25.4
2005	98.2	1	76.8	41.4	37.1	32.2	28.1
2006	97.3	0	42.6	38.4	35.3	29.3	26.4
2007	98.4	1	58.8	39.7	35.9	30.3	26.1
2008	99.3	0	39.1	37.0	32.5	26.1	22.5
2009	99.4	0	45.7	37.2	32.4	29.0	25.8
2010	99.5	1	63.4	40.7	36.1	30.5	26.3
2011	99.1	1	76.1	33.2	30.2	27.3	23.8
2012	97.8	4	68.7	49.2	36.7	27.2	24.4
2013	97.4	1	62.4	34.4	30.7	26.2	23.6

Table D38. Daily peak 24-hour particles as PM10 at Duncraig (2004-2013)

Trend station/region: Duncraig

AAQ NEPM Standard 50 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004	99.0	0	45.1	30.9	30.2	27.6	24.1
2005	98.5	1	59.2	34.8	30.7	26.7	23.9
2006	99.1	0	40.6	32.9	30.5	27.3	24.0
2007	99.7	0	40.3	31.8	29.4	25.8	22.0
2008	99.2	0	46.9	34.4	31.1	25.8	21.9
2009	99.2	0	45.5	36.2	30.4	24.5	22.6
2010	99.4	0	47.9	33.1	30.8	25.1	22.7
2011	99.3	1	65.9	30.1	29.5	25.7	23.2
2012	99.4	2	89.5	35.5	28.3	26.1	23.0
2013	99.3	0	37.6	32.1	28.1	25.6	22.8

Table D39. Daily peak 24-hour particles as PM10 at South Lake (2004-2013)

Trend station/region: South Lake

AAQ NEPM Standard
50 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004	98.8	1	50.5	35.8	32.8	30.2	26.2
2005	98.8	3	98.8	46.1	39.6	33.6	28.7
2006	97.0	0	45.3	39.8	37.0	34.4	29.0
2007	97.9	1	56.7	37.7	36.0	32.9	26.7
2008	99.6	1	55.0	39.9	36.1	30.3	25.8
2009	99.5	0	49.0	38.7	34.3	30.8	27.5
2010	99.7	4	61.0	46.7	39.8	33.9	28.5
2011	99.2	1	66.2	35.8	31.5	28.1	24.8
2012	99.1	2	81.5	36.6	30.3	28.5	24.1
2013	98.6	0	38.8	34.4	32.3	28.9	25.9

Table D40. Daily peak 24-hour particles as PM_{10} at Bunbury (2004-2013)

Trend station/region: Bunbury

AAQ NEPM Standard
50 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004	92.4	4	99.5	51.8	38.2	29.9	26.3
2005	99.1	3	63.3	37.9	33.3	27.5	24.9
2006	99.2	3	123.5	45.6	38.8	28.3	25.8
2007	99.6	0	46.5	32.8	29.6	27.1	24.5
2008	99.4	0	39.1	31.4	30.3	27.3	23.7
2009	99.5	1	53.8	40.3	36.0	29.5	25.4
2010	99.1	2	134.0	37.6	36.0	29.3	25.3
2011	99.6	2	68.4	39.3	33.8	28.0	23.8
2012	99.5	2	53.5	40.0	32.9	26.5	24.1
2013	98.9	0	46.8	38.1	33.5	26.8	22.6

Table D41. Daily peak 24-hour particles as PM_{10} at Albany (2006-2013)

Trend station/region: Albany

AAQ NEPM Standard
50 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004							
2005							
2006	52.4	0	39.4	35.4	33.0	26.6	24.6
2007	99.8	1	55.7	31.3	28.0	24.7	22.1
2008	99.2	2	56.3	34.1	32.8	26.1	22.7
2009	97.7	0	36.7	32.3	28.7	24.5	21.4
2010	99.8	1	52.5	36.1	33.2	27.3	25.3
2011	99.3	0	37.3	33.6	30.6	26.3	22.0
2012	99.5	0	37.0	34.6	31.1	27.4	23.6
2013	98.1	3	110.8	43.3	36.0	29.1	23.8

Table D42. Daily peak 24-hour particles as PM_{10} at Geraldton (2005-2013)

Trend station/region: Geraldton

AAQ NEPM Standard
50 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004							
2005	27.7	2	61.3	52.9	47.0	34.8	31.6
2006	99.4	4	78.0	48.6	45.8	40.0	35.4
2007	99.7	10	116.3	87.2	67.9	44.7	36.4
2008	98.9	10	150.7	105.2	58.1	45.9	38.6
2009	99.6	14	128.9	69.2	58.6	48.5	40.3
2010	97.7	4	55.6	49.3	47.8	41.6	37.9
2011	98.6	3	63.0	45.4	40.2	35.8	32.2
2012	99.6	3	61.5	47.0	45.3	40.2	33.8
2013	99.3	2	63.1	45.9	42.1	38.9	34.6

Table D43. Daily peak 24-hour particles as PM_{10} at Collie (2008-2013)

Trend station/region: Collie

AAQ NEPM Standard
50 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004							
2005							
2006							
2007							
2008	87.6	7	85.9	56.7	50.1	37.4	30.5
2009	99.5	3	80.4	47.3	46.2	38.0	31.3
2010	99.7	16	163.0	86.7	67.3	46.1	34.9
2011	97.6	4	61.5	52.1	40.4	32.0	29.2
2012	99.4	6	91.7	54.9	46.9	35.1	30.1
2013	99.0	3	61.6	46.0	41.3	36.0	32.0

Table D44. Daily peak 24-hour particles as $PM_{2.5}$ at Caversham (2006-2013)

Trend station/region: Caversham

AAQ NEPM Advisory Standard
25 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004							
2005							
2006	63.8	1	34.0	18.6	15.6	13.4	12.0
2007	98.4	0	24.5	15.1	14.0	12.1	10.7
2008	99.4	1	26.3	15.2	14.0	11.7	10.6
2009	99.5	2	25.5	19.4	17.3	12.9	11.0
2010	99.1	3	45.2	21.9	16.2	13.7	12.1
2011	99.4	1	41.5	12.4	11.7	10.8	9.8
2012	96.9	3	45.9	19.2	15.9	12.3	10.6
2013	97.4	0	22.6	17.2	16.4	13.6	11.6

Table D45. Daily peak 24-hour particles as $PM_{2.5}$ at Duncraig (2004-2013)

Trend station/region: Duncraig

AAQ NEPM Advisory Standard 25 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004	99.2	0	24.4	17.9	15.6	14.1	11.6
2005	98.6	3	40.6	17.3	15.0	13.1	11.4
2006	99.0	2	33.4	18.7	16.2	13.4	11.9
2007	99.6	0	19.6	14.2	13.5	11.6	10.1
2008	99.3	1	38.3	18.0	15.9	12.6	11.1
2009	99.4	3	32.7	22.1	17.5	13.2	11.5
2010	99.3	3	36.4	20.1	15.9	13.7	12.0
2011	99.4	1	52.1	14.7	13.4	11.5	10.4
2012	97.5	3	77.3	22.0	14.4	12.7	11.0
2013	98.5	0	18.7	15.6	14.4	12.7	11.4

Table D46. Daily peak 24-hour particles as $PM_{2.5}$ at Quinns Rocks (2006-2013)

Trend station/region: Quinns Rocks

AAQ NEPM Advisory Standard 25 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004							
2005							
2006	55.3	1	63.9	17.0	14.3	13.2	11.0
2007	99.7	0	19.9	15.4	13.7	12.1	10.1
2008	99.3	1	53.3	17.3	15.4	12.8	11.3
2009	99.8	2	31.3	20.7	15.2	12.7	11.3
2010	99.6	3	33.7	17.6	14.5	12.0	10.9
2011	99.0	2	43.2	17.3	14.6	11.6	10.1
2012	96.5	4	74.5	22.7	14.3	11.9	10.6
2013	98.5	0	19.3	16.6	15.0	13.1	10.9

Table D47. Daily peak 24-hour particles as $PM_{2.5}$ at South Lake (2006-2013)

Trend station/region: South Lake

AAQ NEPM Advisory Standard 25 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004							
2005							
2006	76.7	1	30.5	21.5	17.2	14.6	12.8
2007	98.9	0	21.2	15.6	12.9	11.8	10.5
2008	99.4	1	45.2	18.2	14.1	12.7	11.2
2009	99.3	3	32.0	22.8	19.1	14.1	11.7
2010	99.5	2	40.0	22.0	19.2	15.9	13.2
2011	99.2	1	48.2	16.2	15.3	13.1	11.5
2012	99.0	4	71.6	25.0	19.3	14.6	13.2
2013	98.6	0	17.1	15.2	14.9	14.0	11.7

Table D48. Daily peak 24-hour particles as $PM_{2.5}$ at Bunbury (2004-2013)

Trend station/region: Bunbury

AAQ NEPM Advisory Standard 25 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004	98.0	5	94.8	31.7	21.5	15.8	13.2
2005	99.0	5	64.2	26.9	19.1	15.4	12.1
2006	99.3	8	113.5	32.4	26.0	14.8	13.0
2007	99.4	3	34.5	21.2	17.8	13.2	10.7
2008	99.7	2	27.8	21.0	18.6	13.2	11.4
2009	99.5	7	40.0	26.6	22.3	16.9	12.6
2010	98.6	7	115.3	28.4	24.2	14.8	12.2
2011	98.9	5	45.5	26.6	18.7	13.2	11.2
2012	99.6	7	43.0	26.3	21.0	14.9	12.8
2013	99.3	1	38.3	16.6	15.7	14.0	11.5

Table D49. Daily peak 24-hour particles as $PM_{2.5}$ at Busselton (2006-2013)

Trend station/region: Busselton

AAQ NEPM Advisory Standard 25 µg/m^3 (24-hour average)

Year	Data recovery (%)	No. of exceedences (days)	Max conc. (µg/m^3)	99th percentile (µg/m^3)	98th percentile (µg/m^3)	95th percentile (µg/m^3)	90th percentile (µg/m^3)
2004							
2005							
2006	16.7	0	12.7	11.9	11.3	10.8	10.1
2007	99.4	2	51.1	15.6	14.3	11.7	9.9
2008	99.3	3	35.6	20.5	15.5	11.9	10.5
2009	99.8	12	69.0	45.0	31.6	17.7	14.0
2010	99.4	7	62.5	31.6	22.9	15.7	11.6
2011	99.8	6	85.2	36.7	20.5	13.9	11.4
2012	99.6	5	78.0	27.1	21.4	13.4	11.8
2013	98.6	0	17.9	16.6	15.5	12.9	10.9

Maxima by pollutant 2004-2013

Table D50. Annual daily peak 8-hour carbon monoxide concentrations (ppm) for 2004-2013

AAQ NEPM Standard
9.0 ppm (8-hour average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Caversham (North East Metro)	1.3	1.3	1.8	0.9	0.8	1.0	1.6	1.5	0.9	0.9
Duncraig (North Metro)	4.5	3.3	3.4	2.0	3.1	2.6	2.3	1.9	2.4	2.1
South Lake (South East Metro)	3.5	2.9	2.5	1.7	2.0	1.8	2.2	1.7	2.2	1.7

Table D51. Annual daily peak 1-hour nitrogen dioxide concentrations (ppm) for 2004-2013

AAQ NEPM Standard
0.12 ppm (1-hour average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Caversham (North East Metro)	0.046	0.048	0.084	0.044	0.036	0.044	0.054	0.035	0.037	0.043
Duncraig (North Metro)	0.043	0.051	0.056	0.053	0.038	0.042	0.038	0.035	0.047	0.040
Quinns Rocks (Outer North Coast)	0.041	0.041	0.065	0.035	0.037	0.034	0.040	0.031	0.041	0.032
Rockingham (South Coast)	0.055	0.045	0.054	0.040	0.031	0.031	0.036	0.034	0.053	0.035
Rolling Green (Outer East Rural)	0.025	0.029	0.026	0.020	0.023	0.035	0.030	0.023	0.029	0.030
South Lake (South East Metro)	0.043	0.052	0.045	0.057	0.044	0.048	0.058	0.041	0.046	0.043
Swanbourne (Inner West Coast)	0.042	0.039	0.043	0.038	0.035	0.037	0.038	0.032	0.045	0.037

.

Table D52. Annual daily peak 1-hour ozone concentrations (ppm) for 2004-2013

AAQ NEPM Standard
0.10 ppm (1-hour average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Caversham (North East Metro)	0.079	0.094	0.080	0.085	0.083	0.104	0.082	0.077	0.098	0.101
Quinns Rocks (Outer North Coast)	0.079	0.095	0.085	0.081	0.083	0.070	0.091	0.083	0.130	0.087
Rockingham (South Coast)	0.102	0.081	0.072	0.084	0.077	0.078	0.067	0.065	0.095	0.084
Rolling Green (Outer East Rural)	0.101	0.079	0.093	0.095	0.087	0.103	0.088	0.073	0.103	0.099
South Lake (South East Metro)	0.076	0.080	0.066	0.067	0.082	0.065	0.070	0.076	0.085	0.087
Swanbourne (Inner West Coast)	0.077	0.076	0.075	0.077	0.076	0.068	0.066	0.085	0.128	0.083

Highlighted cells indicate NEPM exceedences.

For explanation of exceedences in 2013, please see Table A7 on page 11 of this report.
For explanation of exceedences in previous years, please refer to the relevant year report.

Table D53. Annual daily peak 4-hour ozone concentrations (ppm) for 2004-2013

AAQ NEPM Standard
0.08 ppm (4-hour average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Caversham (North East Metro)	0.067	0.069	0.072	0.073	0.076	0.092	0.072	0.063	0.086	0.075
Quinns Rocks (Outer North Coast)	0.068	0.070	0.074	0.075	0.073	0.062	0.065	0.075	0.108	0.079
Rockingham (South Coast)	0.079	0.075	0.067	0.079	0.072	0.066	0.064	0.061	0.079	0.075
Rolling Green (Outer East Rural)	0.077	0.068	0.079	0.080	0.075	0.083	0.080	0.061	0.081	0.083
South Lake (South East Metro)	0.064	0.070	0.063	0.059	0.067	0.057	0.061	0.064	0.080	0.074
Swanbourne (Inner West Coast)	0.067	0.066	0.069	0.067	0.070	0.063	0.055	0.073	0.108	0.068

Highlighted cells indicate NEPM exceedences.

For explanation of exceedences in 2013, please see Table A7 on page 11 of this report.
For explanation of exceedences in previous years, please refer to the relevant year report.

Table D54. Annual daily peak 1-hour sulfur dioxide concentrations (ppm) for 2004-2013

AAQ NEPM Standard
0.20 ppm (1-hour average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Rockingham (South Coast)	0.039	0.041	0.040	0.041	0.079	0.032	0.037	0.040	0.040	0.037
South Lake (South East Metro)	0.042	0.046	0.060	0.040	0.046	0.036	0.073	0.044	0.039	0.044
Wattleup (South Metro)	0.076	0.120	0.062	0.060	0.077	0.059	0.057	0.067	0.043	0.090

Table D55. Annual daily peak 24-hour sulfur dioxide concentrations (ppm) for 2004-2013

AAQ NEPM Standard
0.08 ppm (24-hour average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Rockingham (South Coast)	0.006	0.009	0.007	0.012	0.007	0.008	0.007	0.008	0.006	0.007
South Lake (South East Metro)	0.005	0.007	0.009	0.006	0.005	0.006	0.009	0.006	0.006	0.014
Wattleup (South Metro)	0.009	0.014	0.009	0.010	0.011	0.008	0.010	0.008	0.008	0.010

Table D56. Annual daily peak 24-hour particles as PM10 concentrations (µg/m3) for 2004-2013

AAQ NEPM Standard
50 µg/m^3 (24-hour average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Caversham (North East Metro)	58.0	76.8	42.6	58.8	39.1	45.7	63.4	76.1	68.7	62.4
Duncraig (North Metro)	45.1	59.2	40.6	40.3	46.9	45.5	47.9	65.9	89.5	37.6
South Lake (South East Metro)	50.5	98.8	45.3	56.7	55.0	49.0	61.0	66.2	81.5	38.8
Southwest region										
Bunbury	99.5	63.3	123.5	46.5	39.1	53.8	134.0	68.4	53.5	46.8
Collie	-	-	-	-	85.9	80.4	163.0	61.5	91.7	61.6
Albany	-	-	39.4	55.7	56.3	36.7	52.5	37.3	37.0	110.8
Mid West region										
Geraldton	-	61.3	78.0	116.3	150.7	128.9	55.6	63.0	61.5	63.1

Highlighted cells indicate NEPM exceedences.

For explanation of exceedences in 2013, please see Table A7 on page 11 of this report.
For explanation of exceedences in previous years, please refer to the relevant year report.

Table D57. Annual daily peak 24-hour particles as $PM_{2.5}$ concentrations ($\mu g/m^3$) for 2004-2013

AAQ NEPM Advisory Standard
25 $\mu g/m^3$ (24-hour average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Caversham (North East Metro)	-	-	34.0	24.5	26.3	25.5	45.2	41.5	45.9	22.6
Duncraig (North Metro)	24.4	40.6	33.4	19.6	38.3	32.7	36.4	52.1	77.3	18.7
Quinns Rocks (Outer North Coast)	-	-	63.9	19.9	53.3	31.3	33.7	43.2	74.5	19.3
South Lake (South East Metro)	-	-	30.5	21.2	45.2	32.0	40.0	48.2	71.6	17.1
Southwest region										
Bunbury	94.8	64.2	113.5	34.5	27.8	40.0	115.3	45.5	43.0	38.3
Busselton	-	-	12.7	51.1	35.6	69.0	62.5	85.2	78.0	17.9

Highlighted cells indicate NEPM exceedences.

For explanation of exceedences in 2013, please see Table A7 on page 11 of this report.
For explanation of exceedences in previous years, please refer to the relevant year report.

Table D58. Annual averaged particles as $PM_{2.5}$ concentrations ($\mu g/m^3$) for 2004-2013

AAQ NEPM Advisory Standard
8 $\mu g/m^3$ (annual average)

Regional Performance Monitoring Station	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Perth region										
Caversham (North East Metro)	-	-	8.1	7.5	7.1	7.8	8.2	7.0	7.8	7.9
Duncraig (North Metro)	7.9	7.8	8.2	7.3	7.7	8.2	8.2	7.8	8.2	7.6
Quinns Rocks (Outer North Coast)	-	-	7.8	6.9	7.2	7.8	7.8	7.2	7.9	7.8
South Lake (South East Metro)	-	-	8.7	7.6	7.7	8.2	8.7	7.8	8.9	8.0
Southwest region										
Bunbury	9.2	8.6	8.7	7.8	7.6	8.3	9.2	8.0	8.6	7.8
Busselton	-	-	6.9	7.4	7.3	9.0	8.5	8.5	8.6	7.7

Highlighted cells indicate NEPM exceedences.

For explanation of exceedences in 2013, please see Table A7 on page 11 of this report.
For explanation of exceedences in previous years, please refer to the relevant year report.

Attachment 1 – Graphical trends

This attachment provides graphical representations of tables D8 to D44 of Section D.

Each graph show the maximum, 99th percentile, 98th percentile, 95th percentile and 90th percentile of daily maximum concentration for all pollutants monitored by the Department of Environment Regulation in Western Australia. The nominated percentiles can also be expressed as an Nth highest concentration.

Based on 100 per cent data recovery and a normal year (i.e. 365 days), the following table gives each percentile an equivalent Nth highest ordinal value. The bracketed numbers represent the exact (as calculated) value of the ordinal number.

Percentile	Nth highest
100	1 (maximum)
99	5 (4.65)
98	8 (8.3)
95	19 (19.25)
90	38 (37.5)

Carbon monoxide

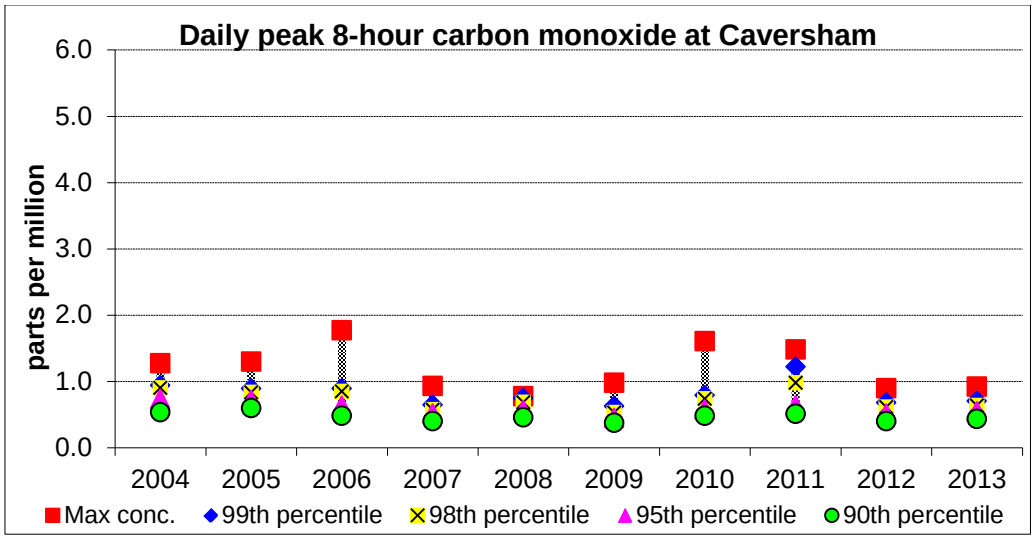


Figure A1-1 - 8-hour carbon monoxide at Caversham

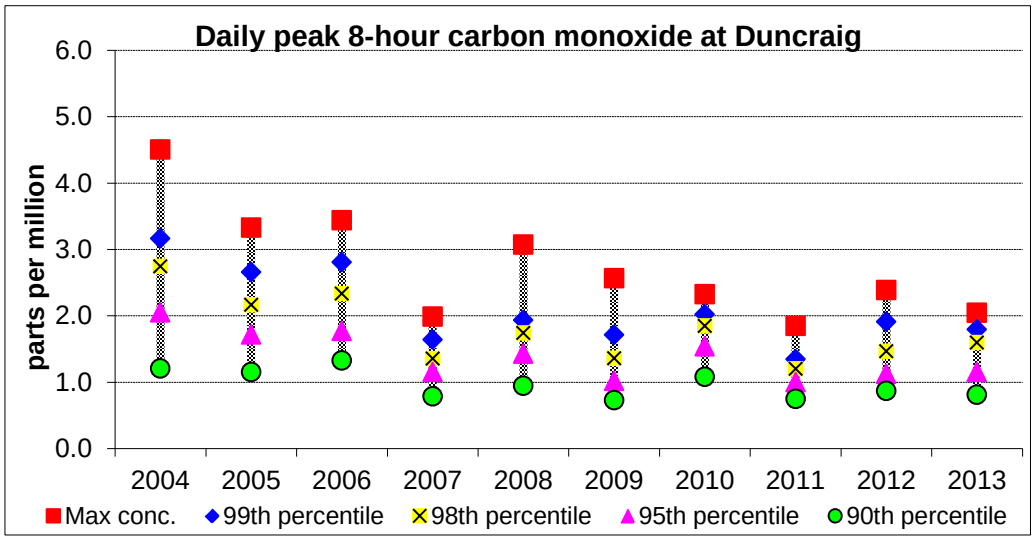


Figure A1-2 - 8-hour carbon monoxide at Duncraig

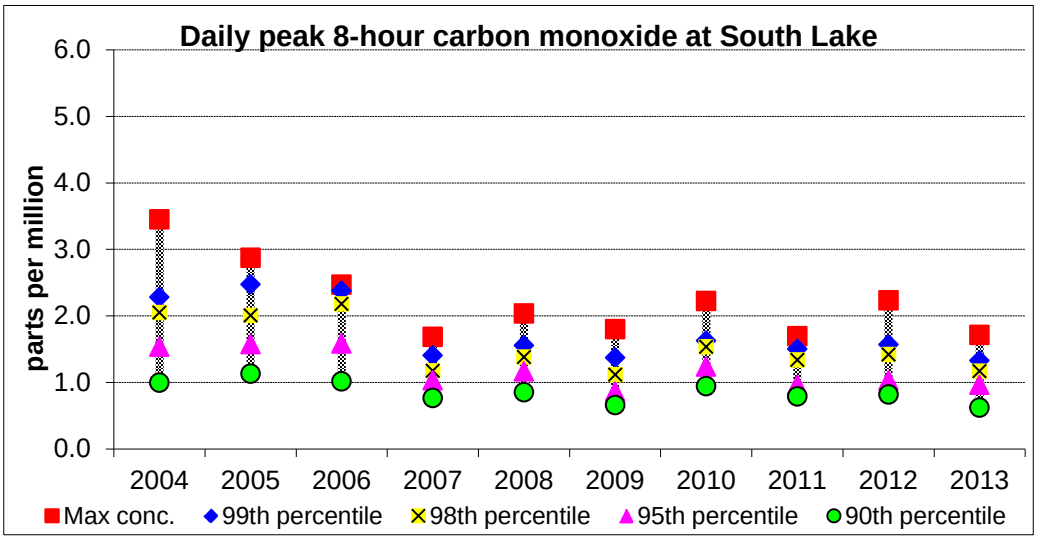


Figure A1-3 - 8-hour carbon monoxide at South Lake

Nitrogen dioxide

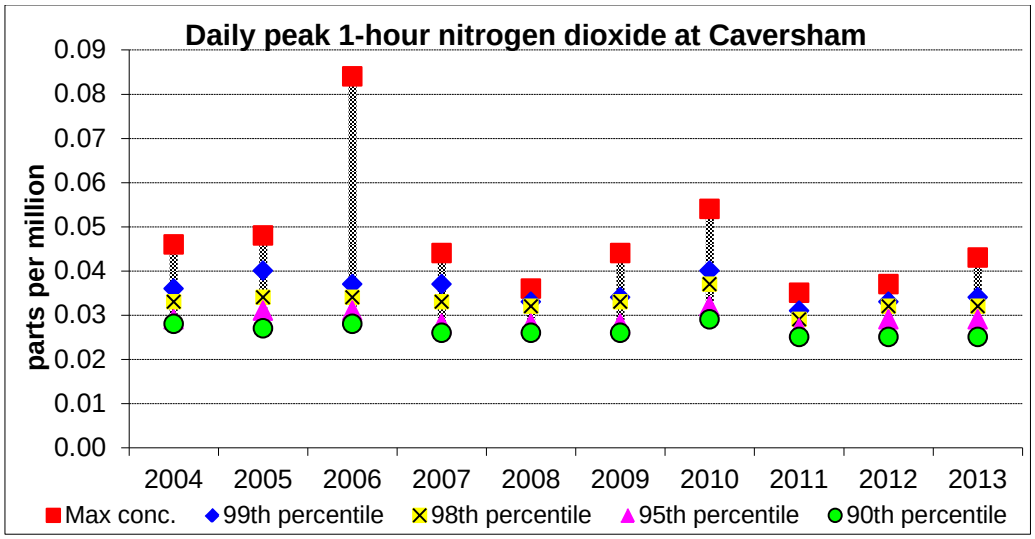


Figure A1-4 - 1-hour nitrogen dioxide at Caversham

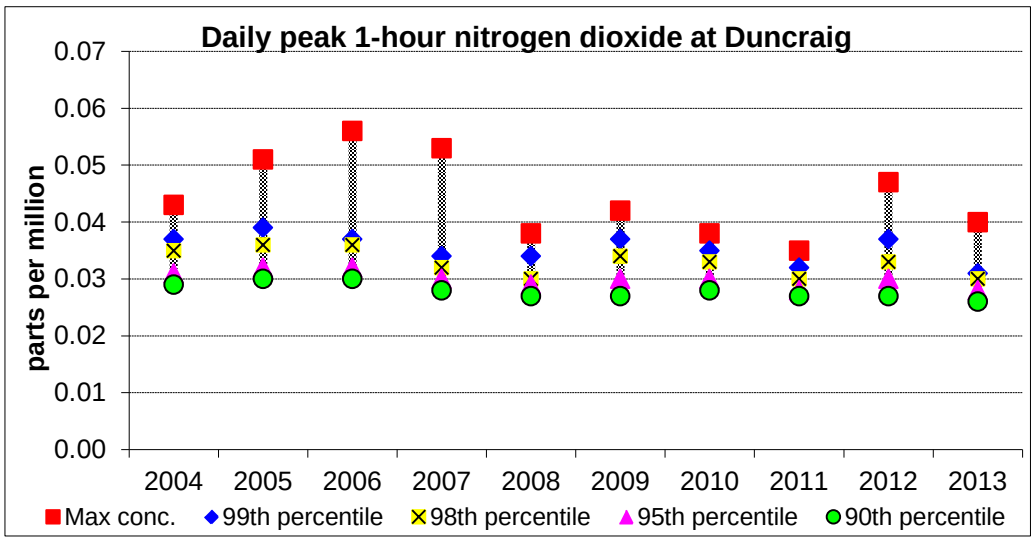


Figure A1-5 - 1-hour nitrogen dioxide at Duncraig

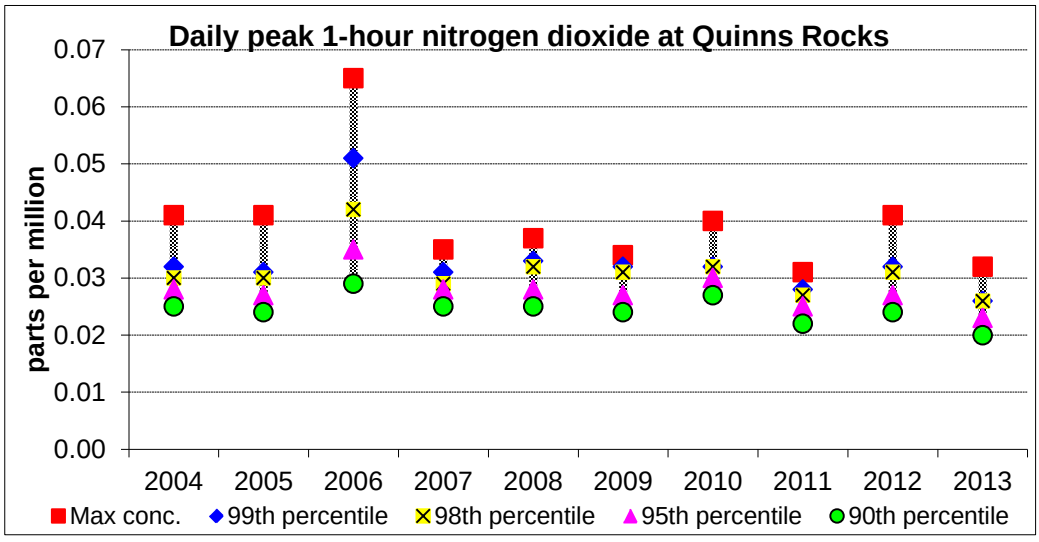


Figure A1-6 - 1-hour nitrogen dioxide at Quinns Rocks

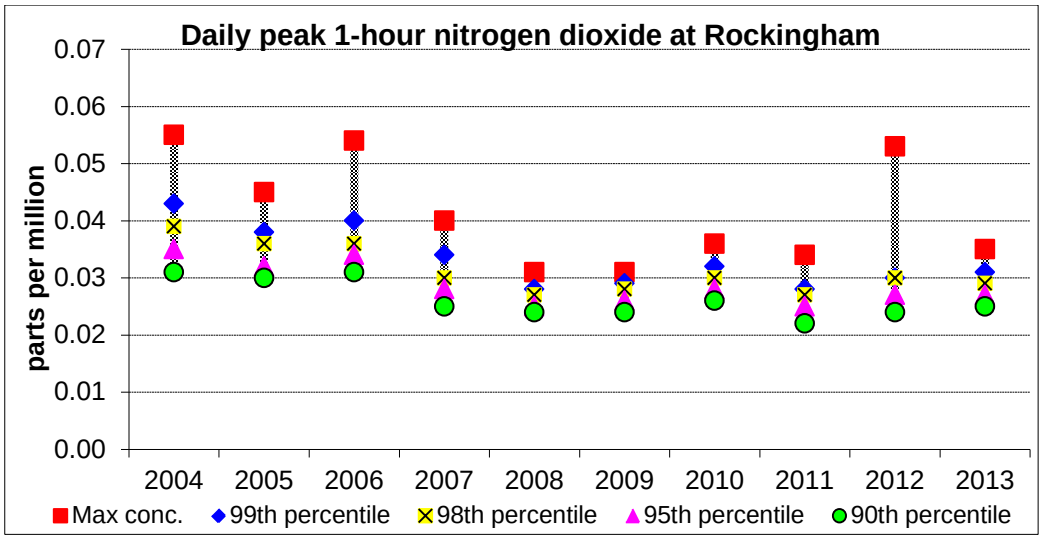


Figure A1-7 - 1-hour nitrogen dioxide at Rockingham

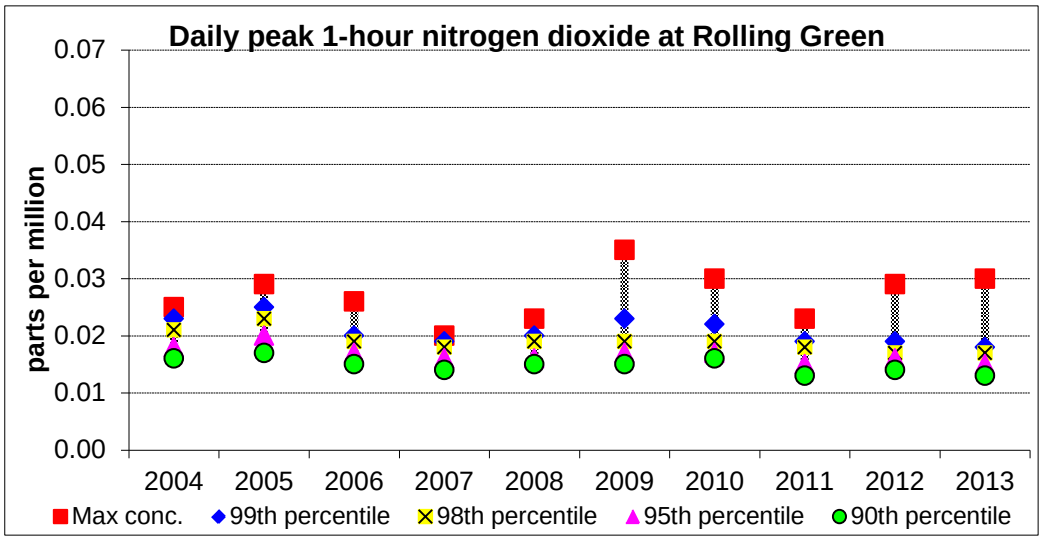


Figure A1-8 - 1-hour nitrogen dioxide at Rolling Green

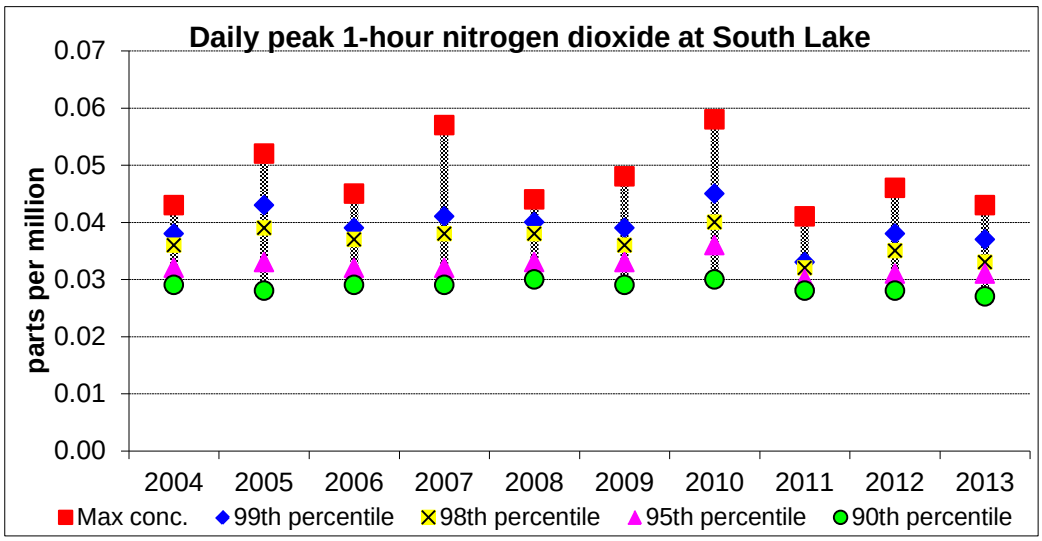


Figure A1-9 - 1-hour nitrogen dioxide at South Lake

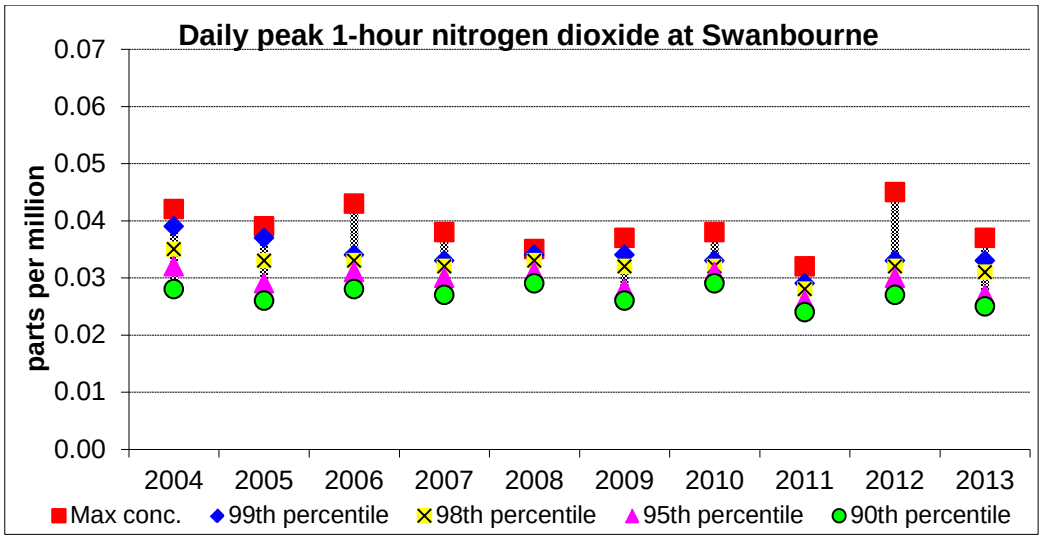


Figure A1-10 - 1-hour nitrogen dioxide at Swanbourne

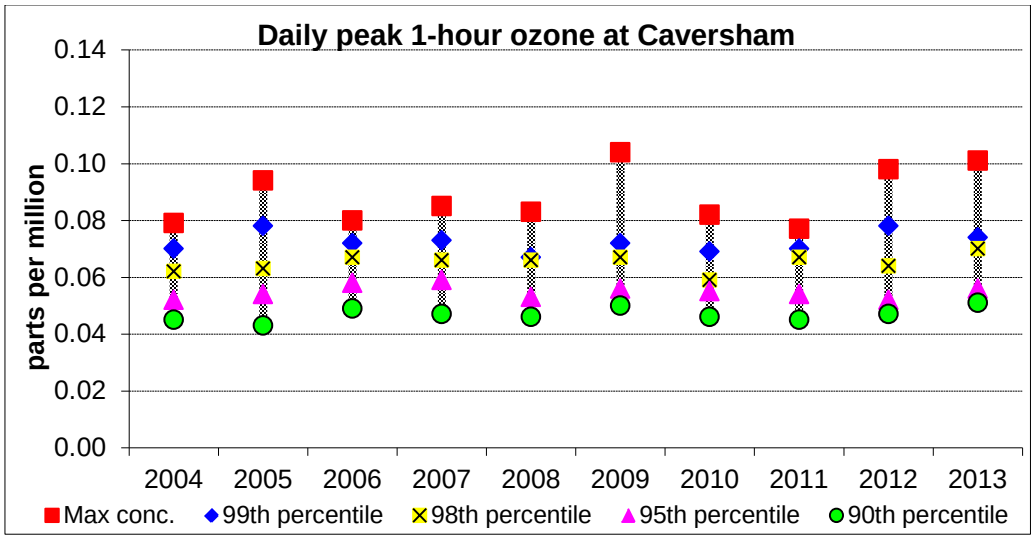


Figure A1-11 - 1-hour ozone at Caversham

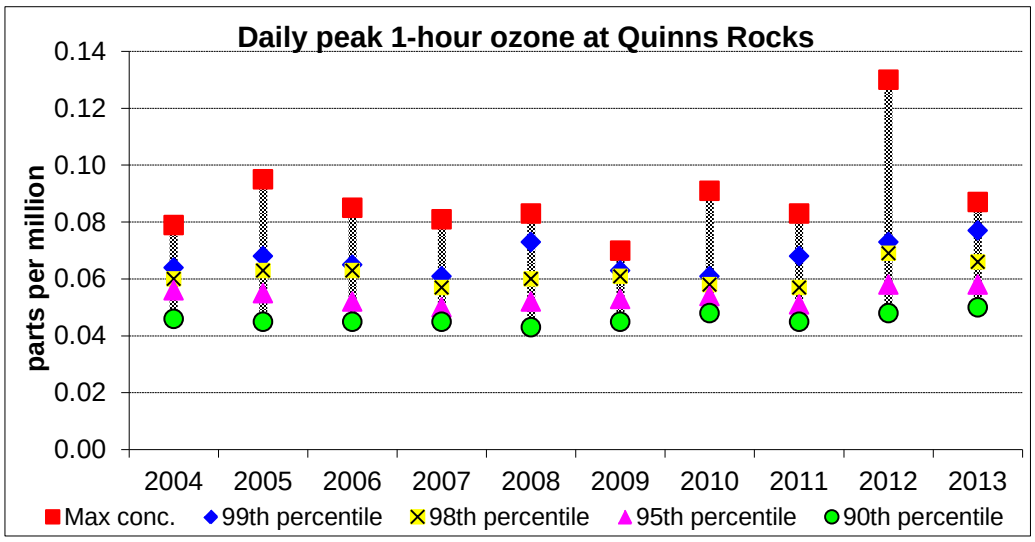


Figure A1-12 - 1-hour ozone at Quinns Rocks

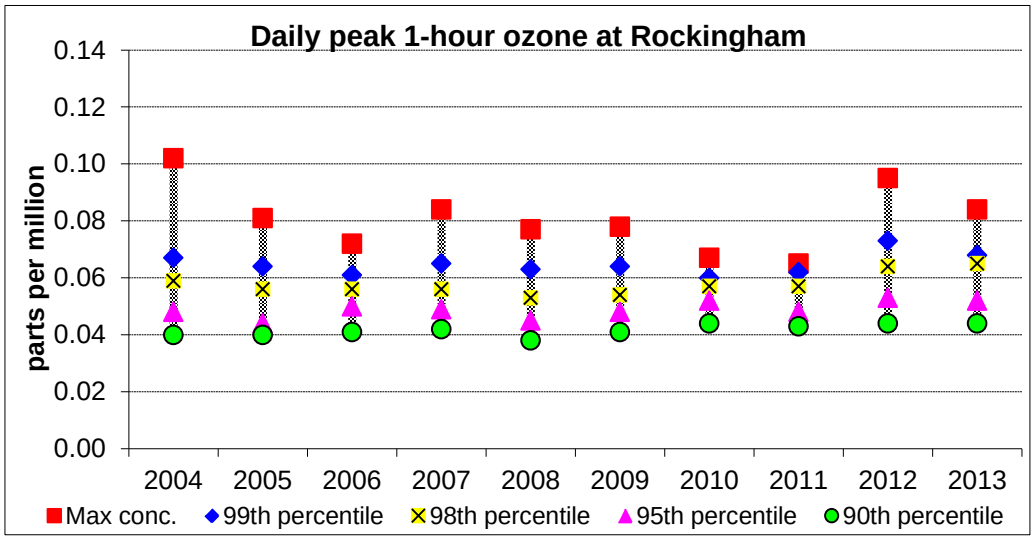


Figure A1-13 - 1-hour ozone at Rockingham

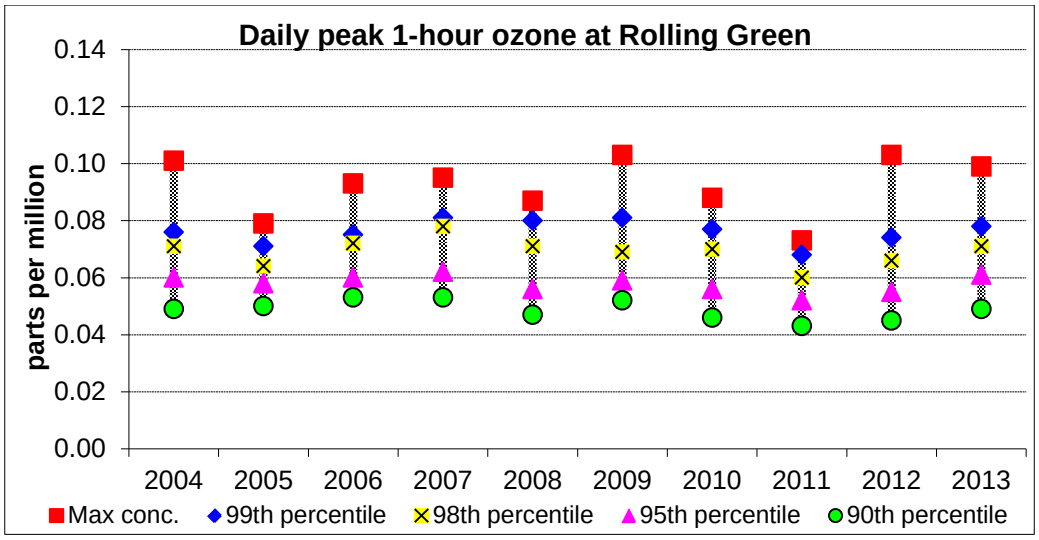


Figure A1-14 - 1-hour ozone at Rolling Green

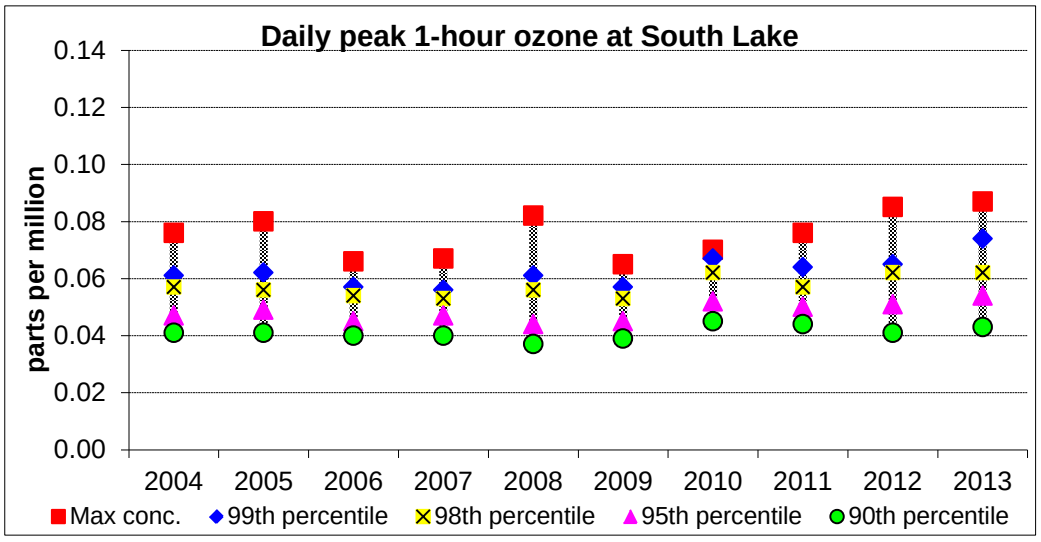


Figure A1-15 - 1-hour ozone at South Lake

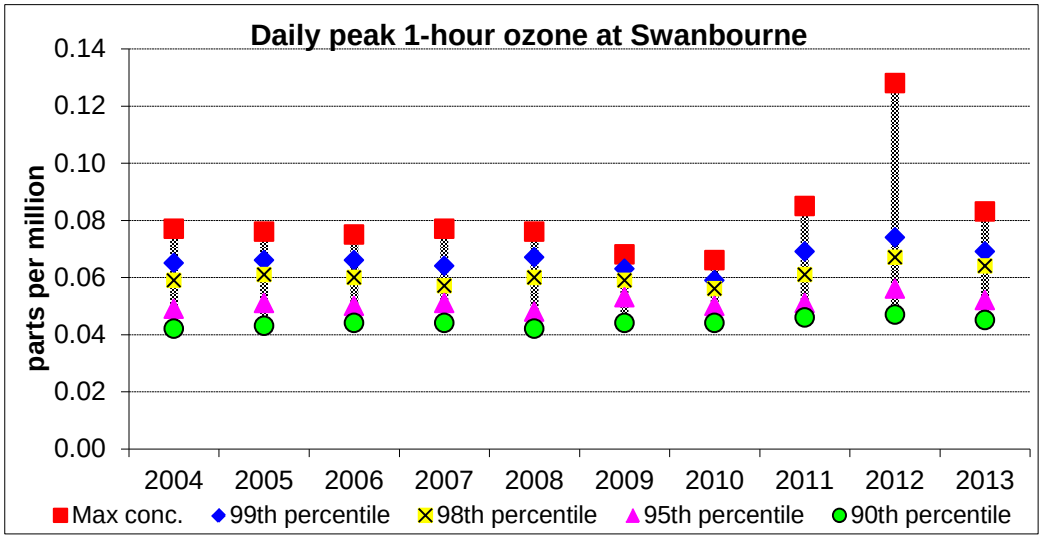


Figure A1-16 - 1-hour ozone at Swanbourne

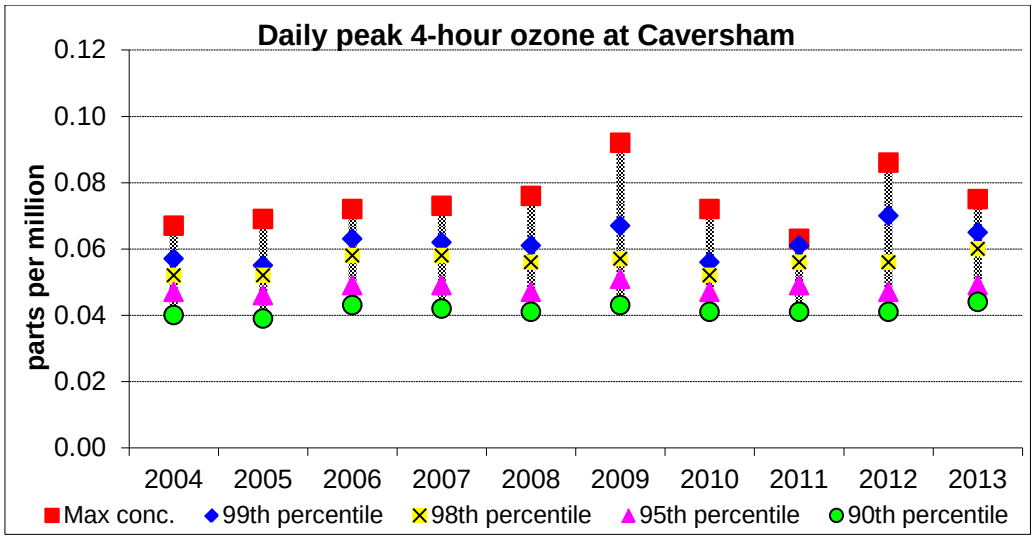


Figure A1-17 - 4-hour ozone at Caversham

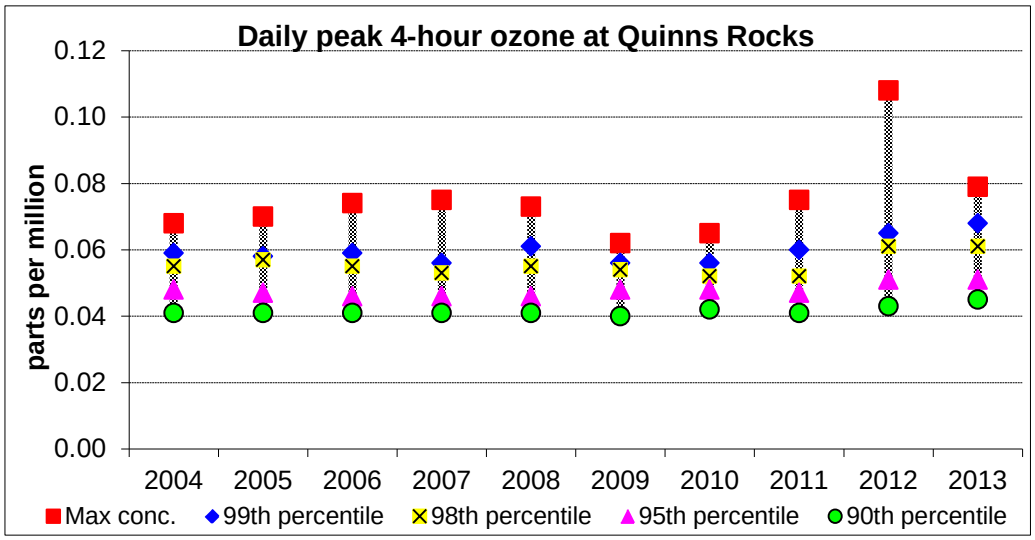


Figure A1-18 - 4-hour ozone at Quinns Rocks

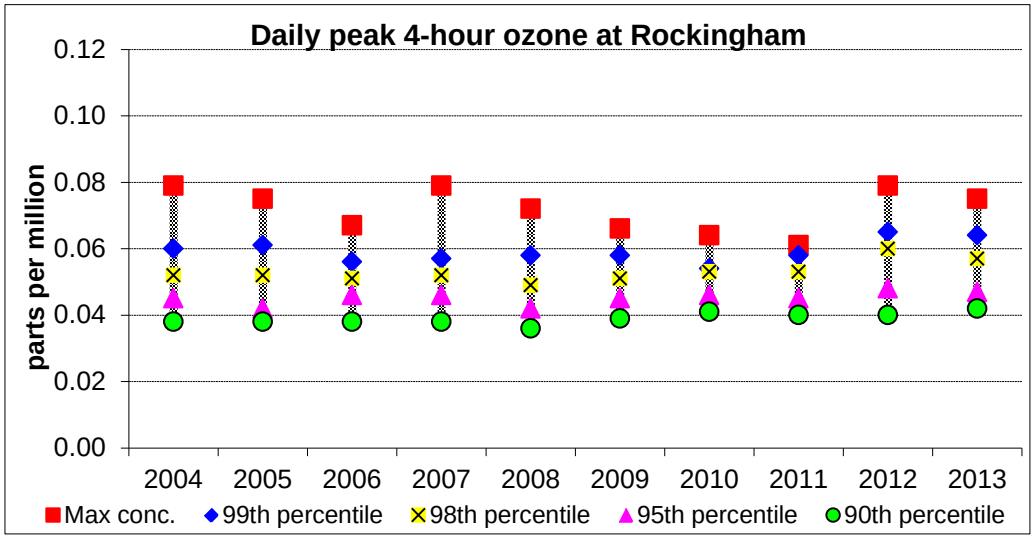


Figure A1-19 - 4-hour ozone at Rockingham

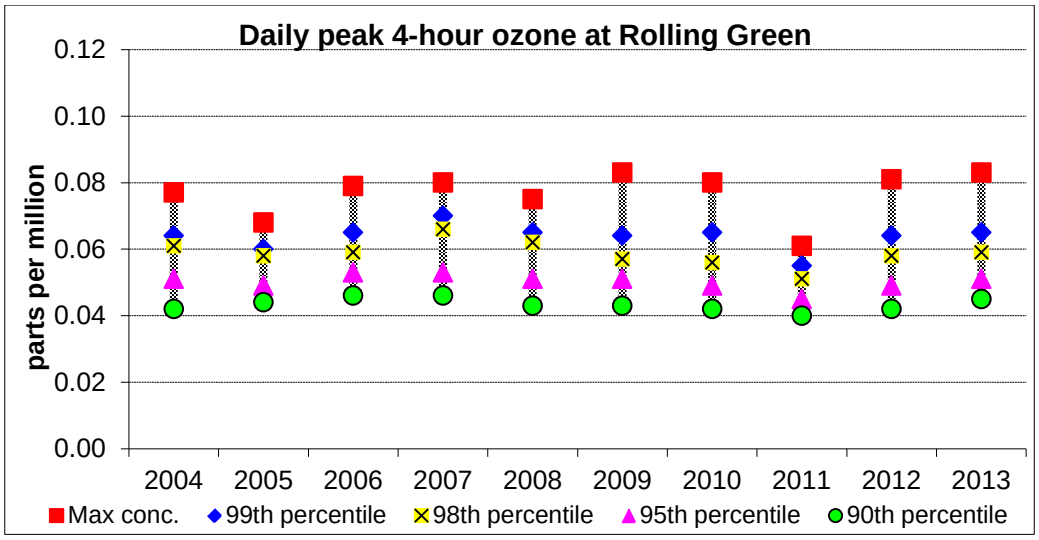


Figure A1-20 - 4-hour ozone at Rolling Green

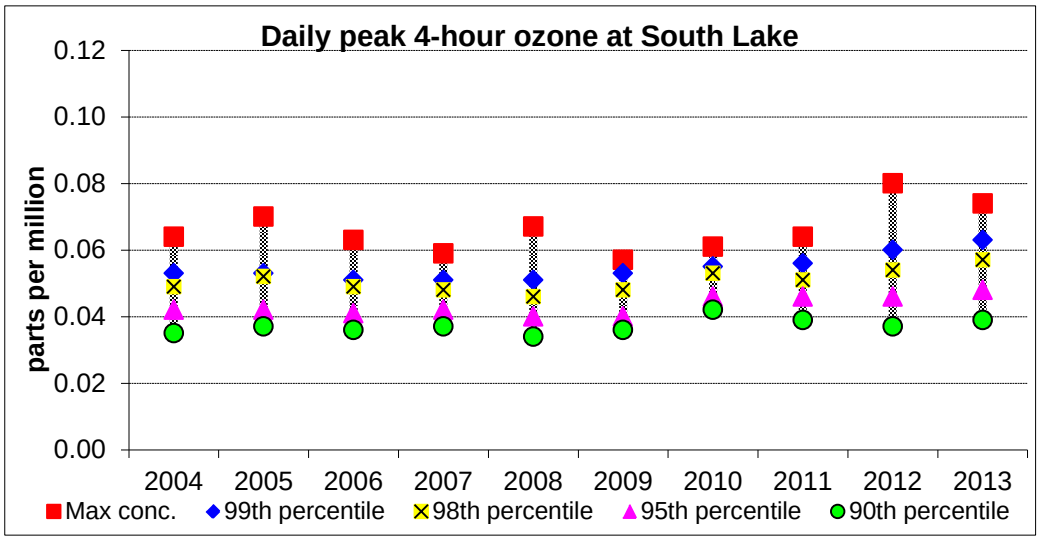


Figure A1-21 - 4-hour ozone at South Lake

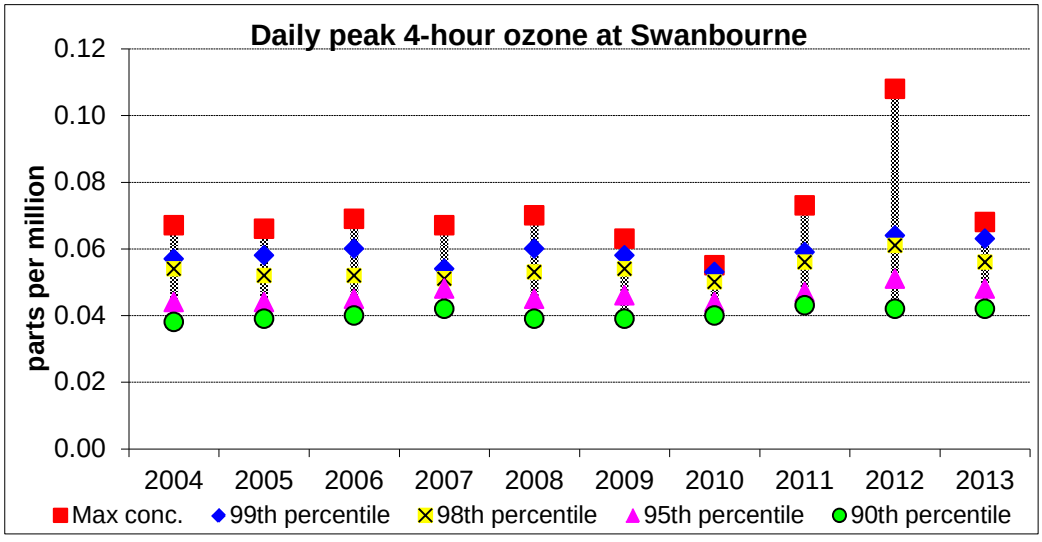


Figure A1-22 - 4-hour ozone at Swanbourne

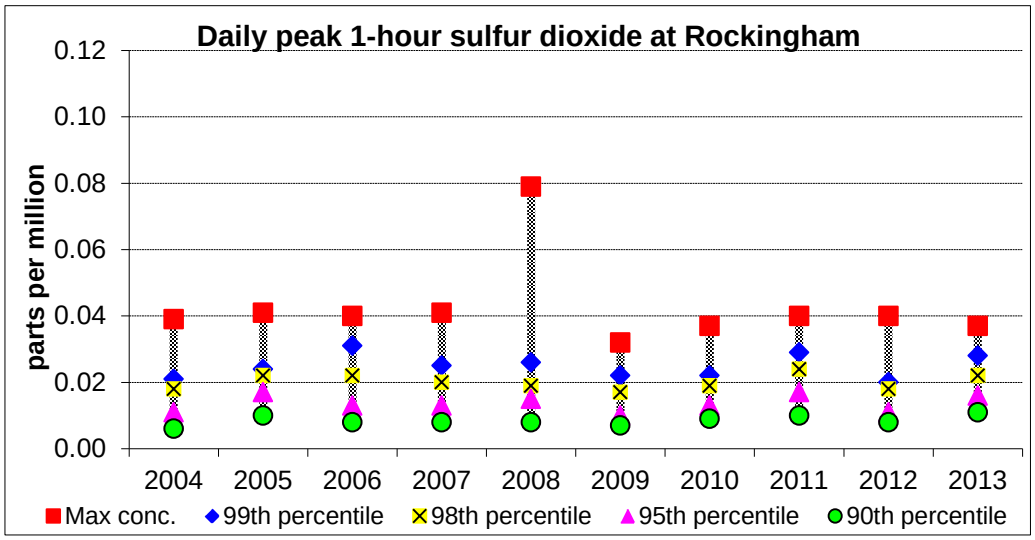


Figure A1-23 - 1-hour sulfur dioxide at Rockingham

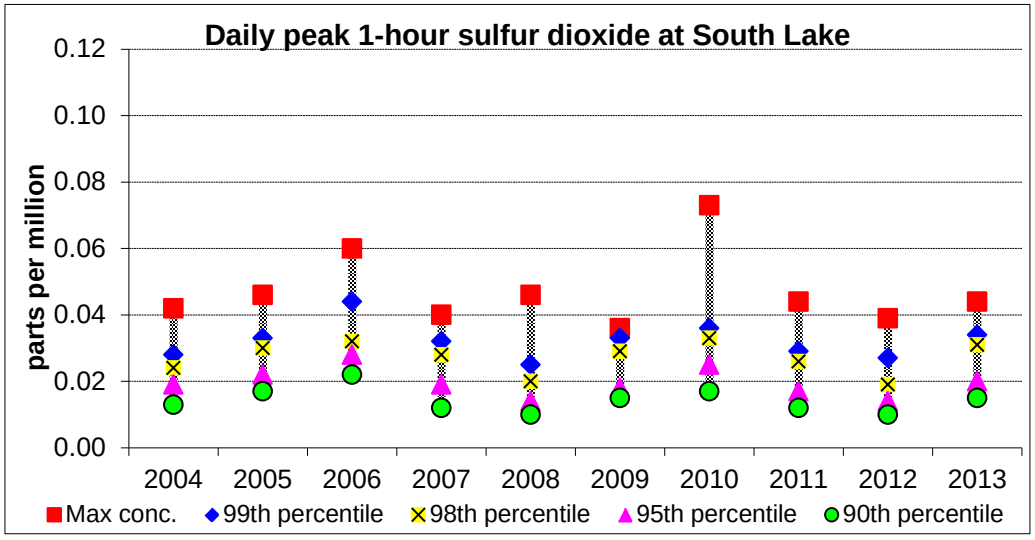


Figure A1-24 - 1-hour sulfur dioxide at South Lake

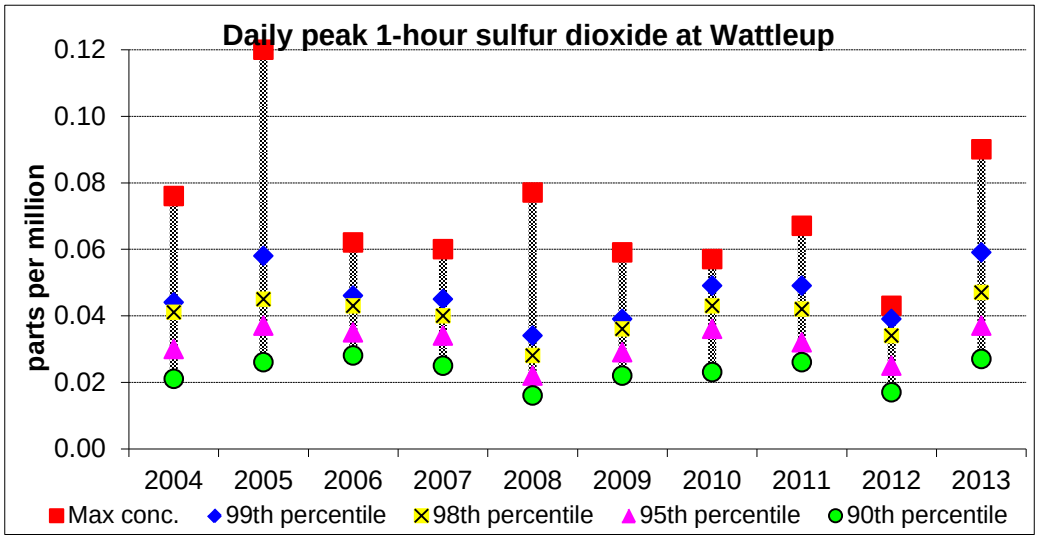


Figure A1-25 - 1-hour sulfur dioxide at Wattleup

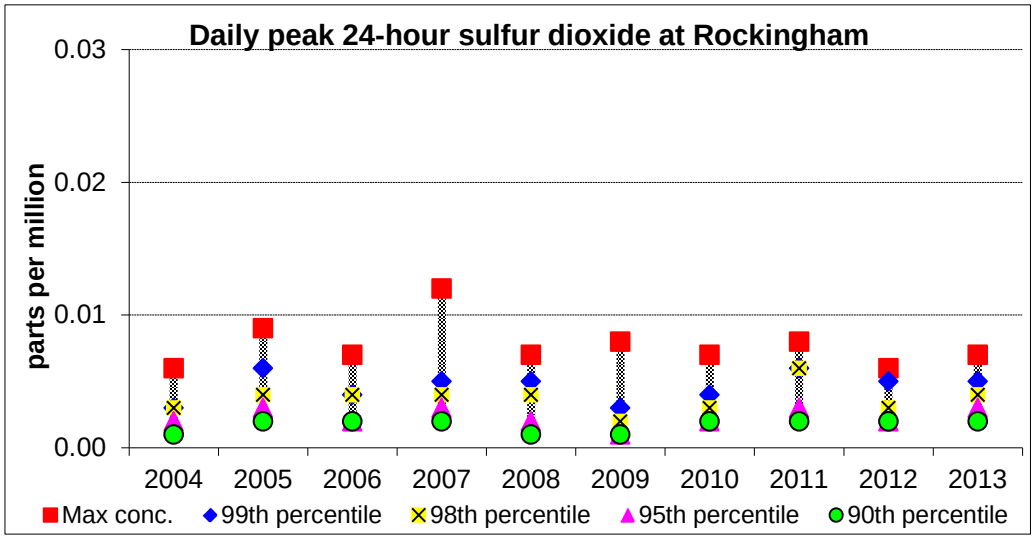


Figure A1-26 - 24-hour sulfur dioxide at Rockingham

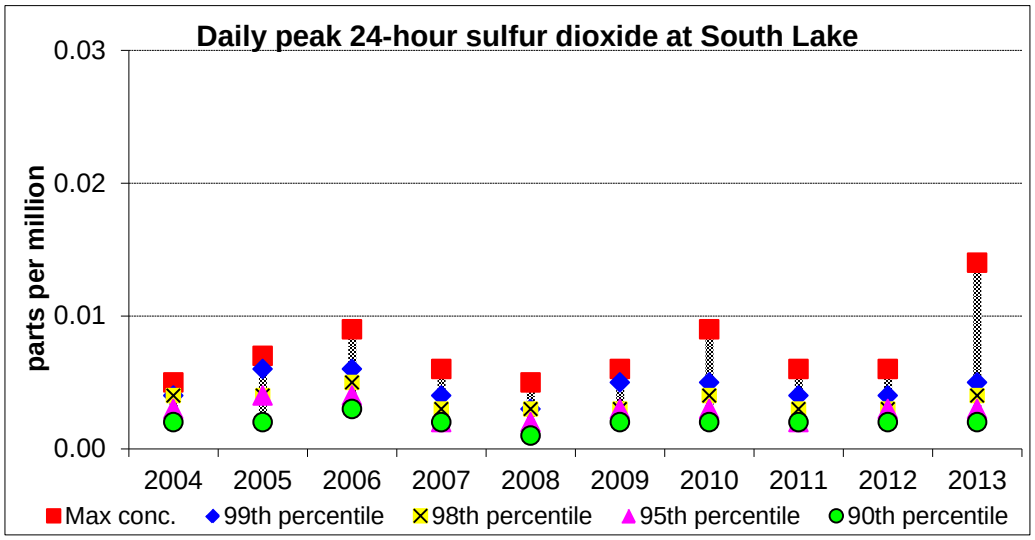


Figure A1-27 - 24-hour sulfur dioxide at South Lake

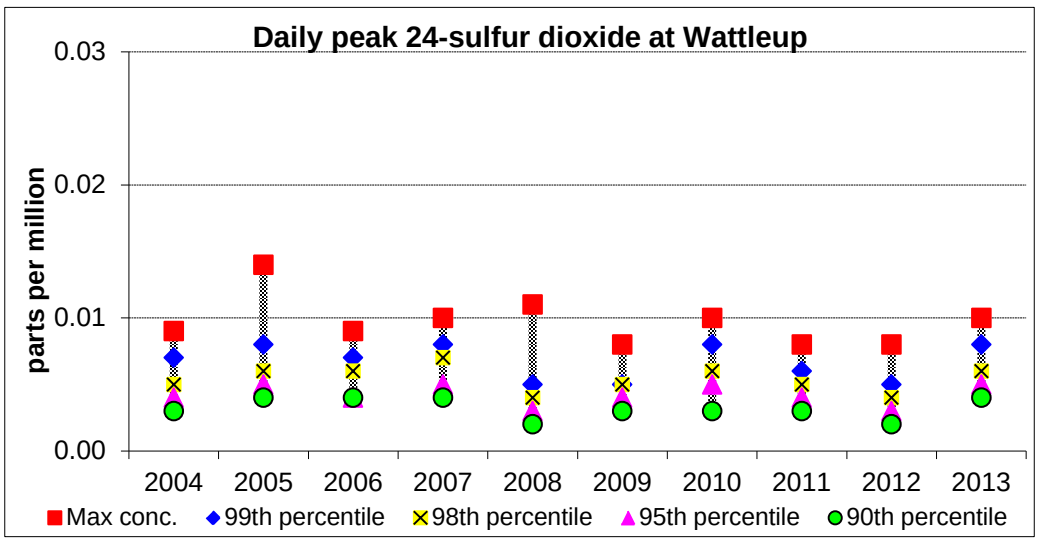


Figure A1-28 - 24-hour sulfur dioxide at Wattleup

Particles as PM_{10}

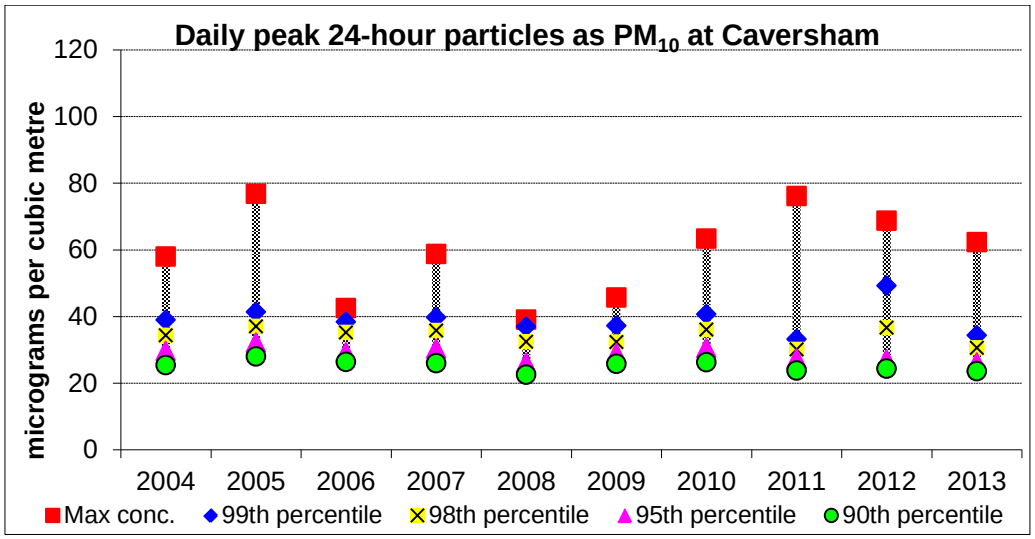


Figure A1-29 - 24-hour PM_{10} at Caversham

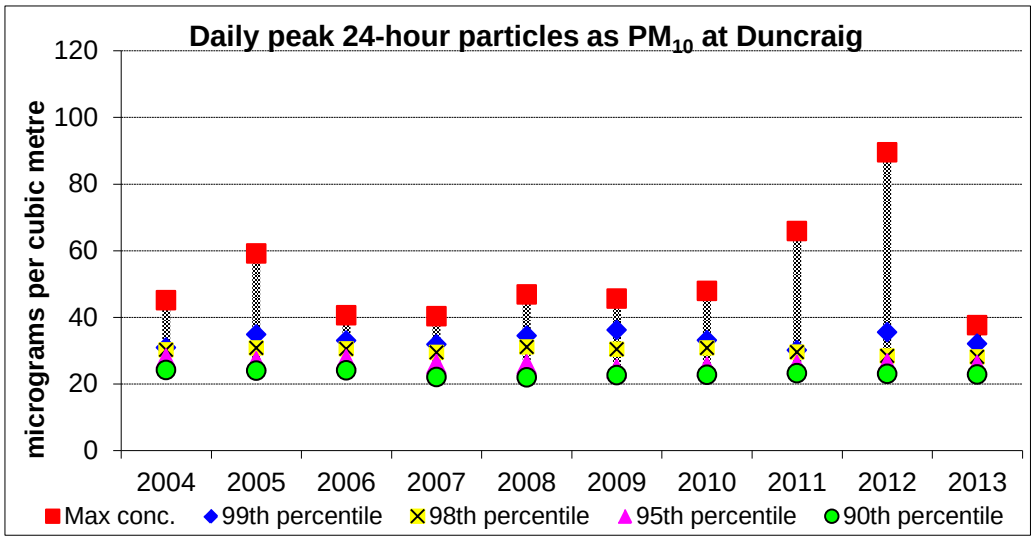


Figure A1-30 - 24-hour PM_{10} at Duncraig

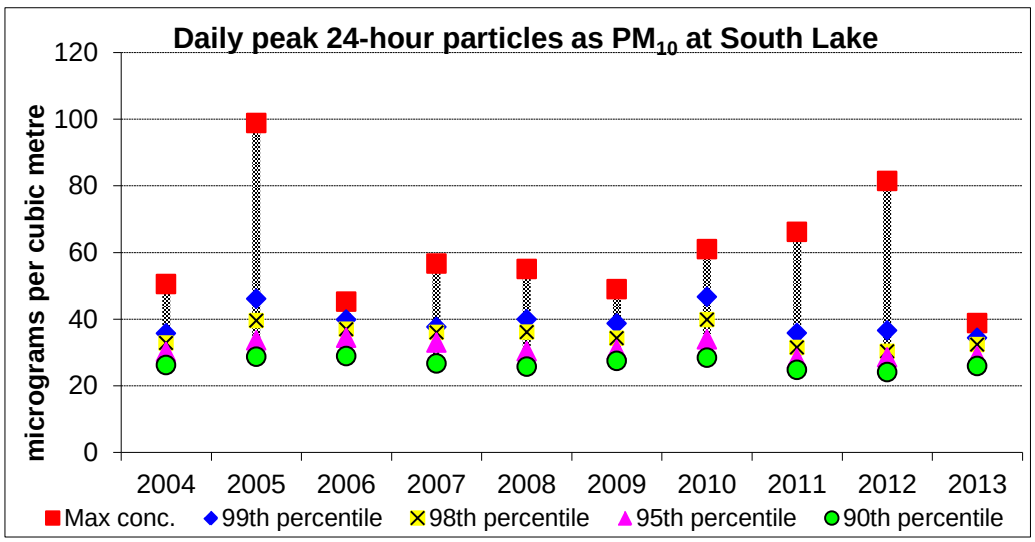


Figure A1-31 - 24-hour PM_{10} at South Lake

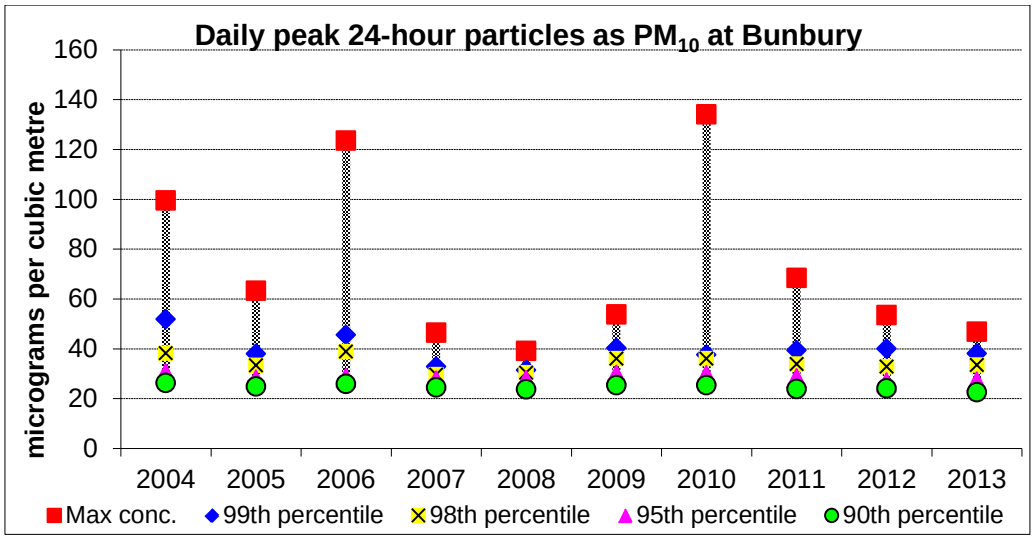


Figure A1-32 - 24-hour PM_{10} at Bunbury

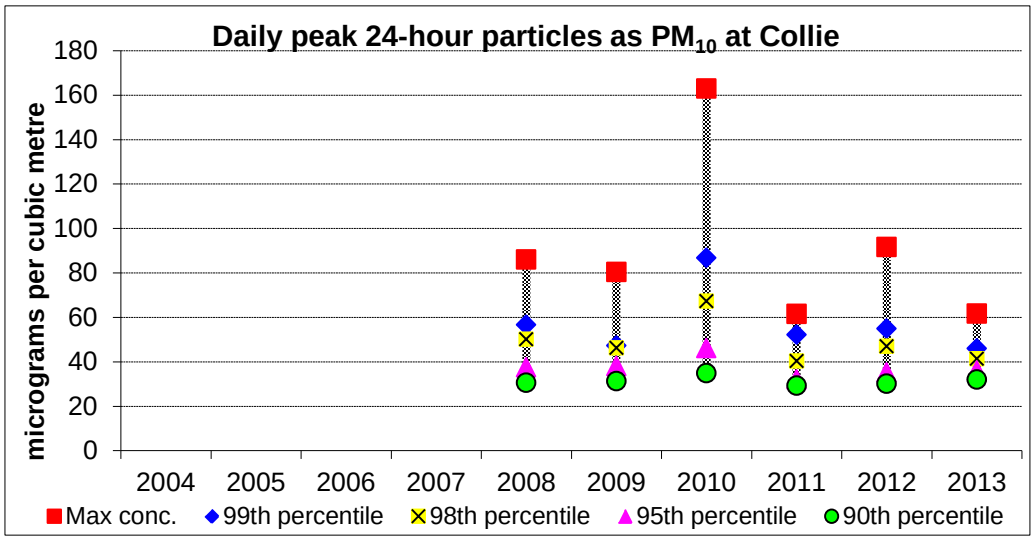


Figure A1-33 - 24-hour PM_{10} at Collie

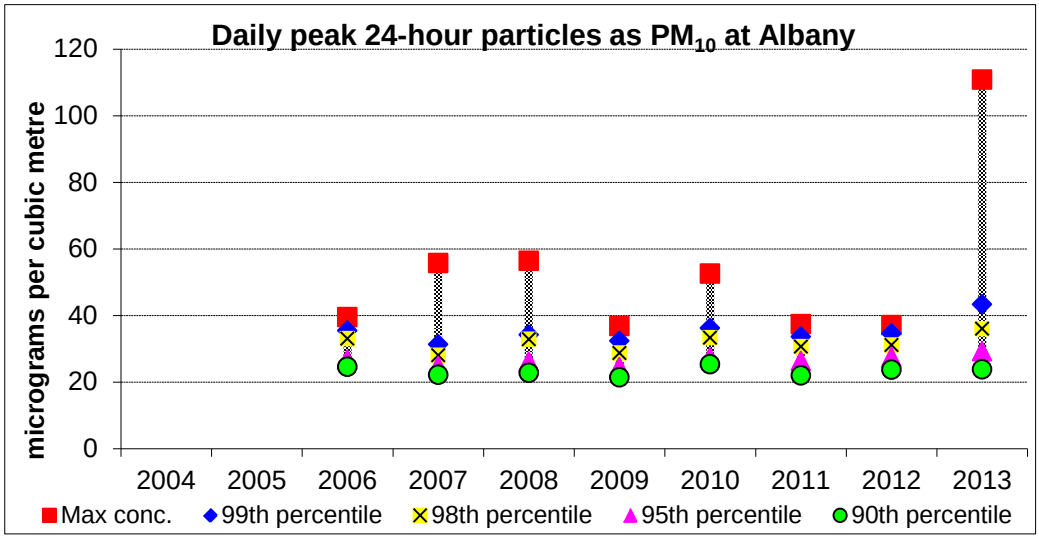


Figure A1-34 - 24-hour PM_{10} at Albany

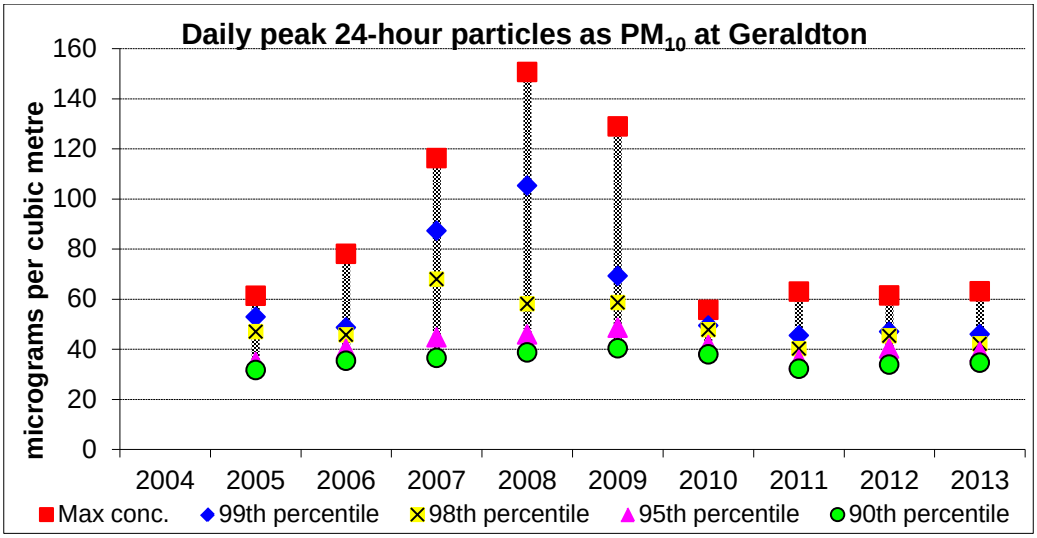


Figure A1-35 - 24-hour PM_{10} at Geraldton

Particles as $PM_{2.5}$

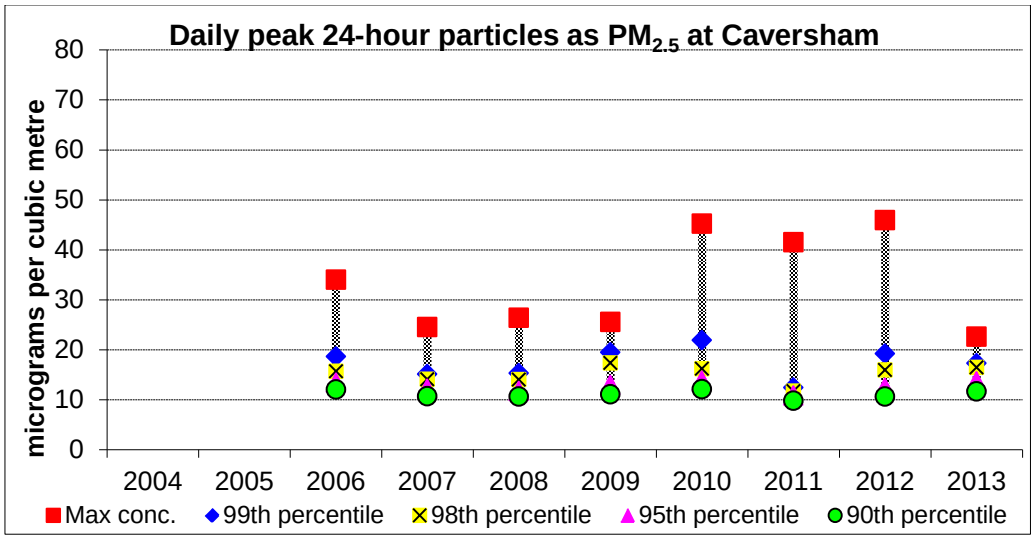


Figure A1-36 - 24-hour $PM_{2.5}$ at Caversham

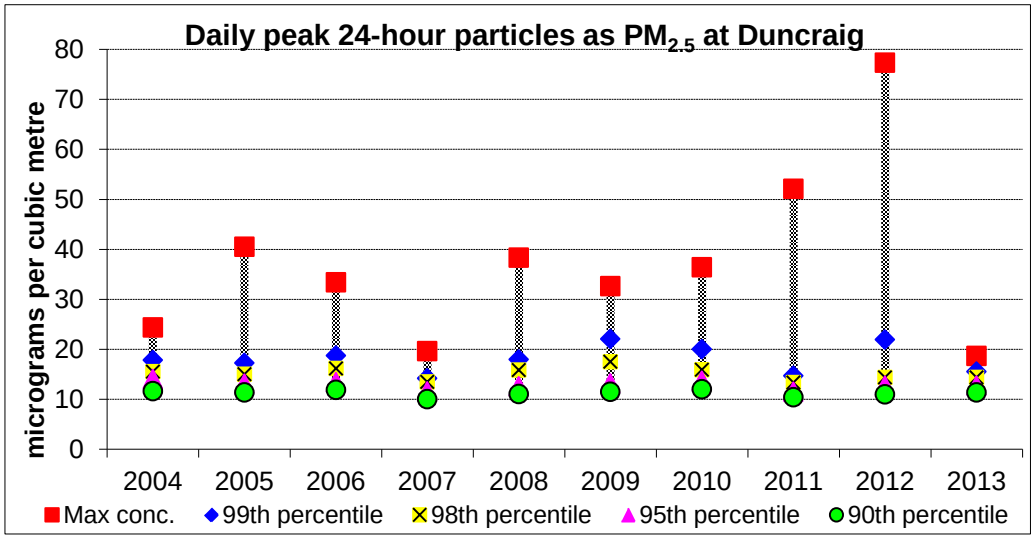


Figure A1-37 - 24-hour $PM_{2.5}$ at Duncraig

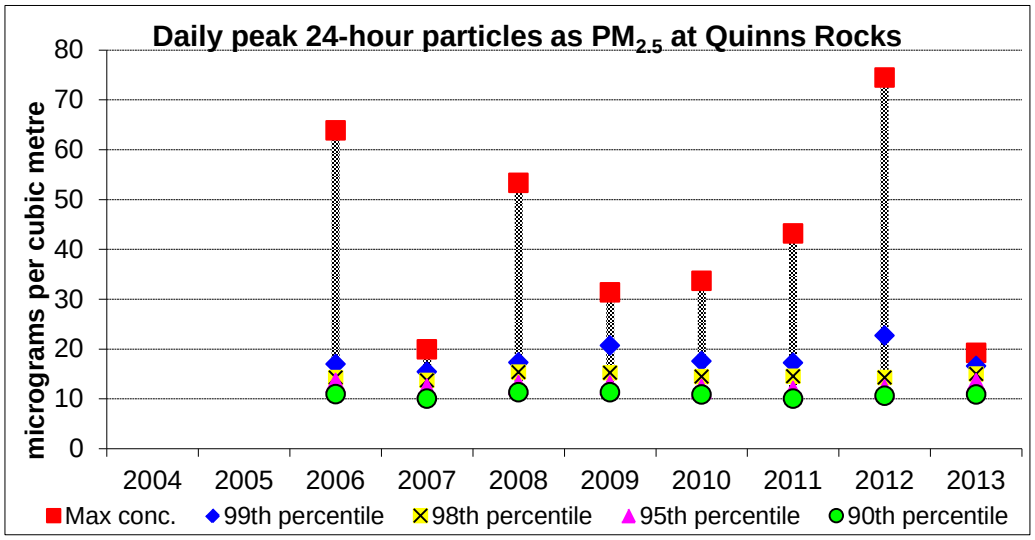


Figure A1-38 - 24-hour $PM_{2.5}$ at Quinns Rocks

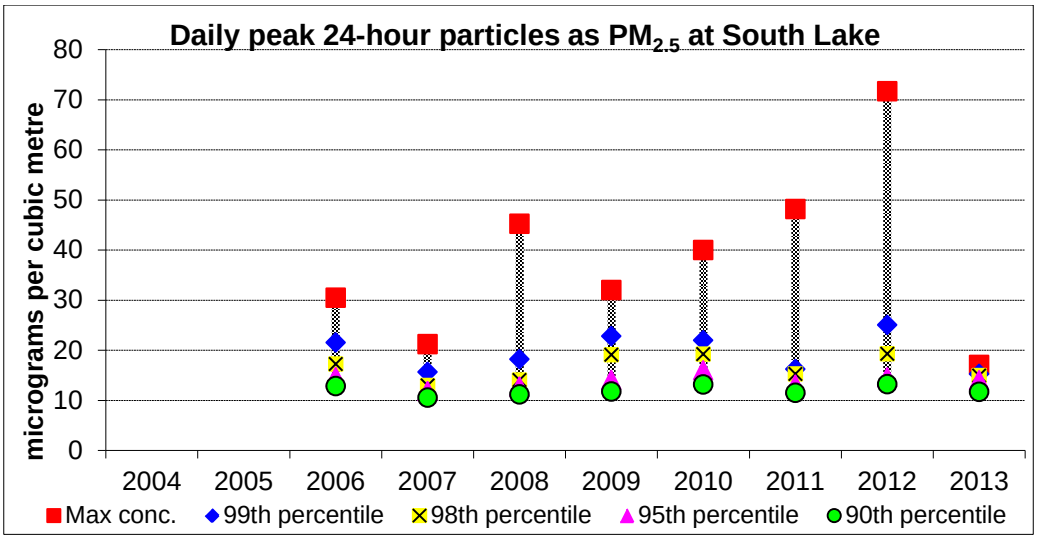


Figure A1-39 - 24-hour $PM_{2.5}$ at South Lake

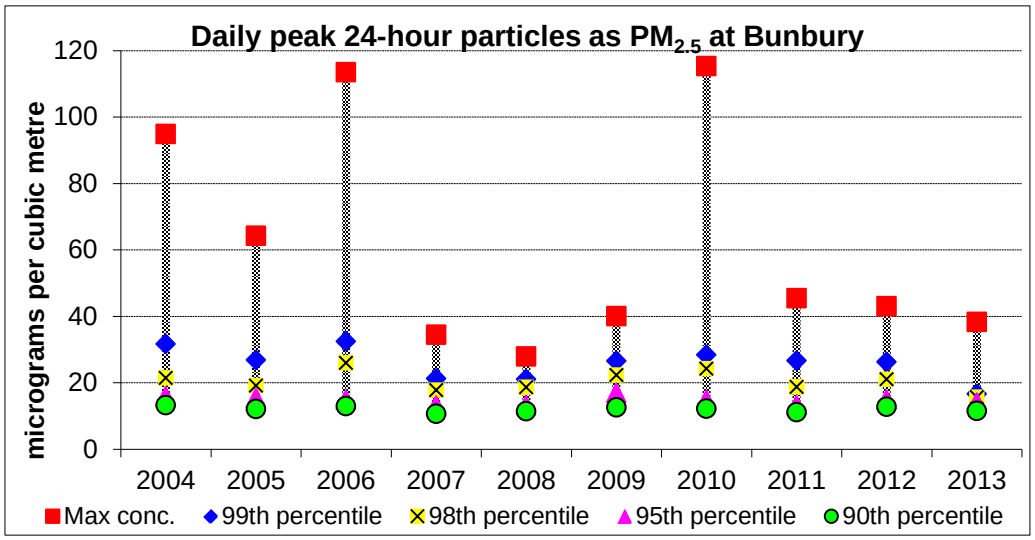


Figure A1-40 - 24-hour $PM_{2.5}$ at Bunbury

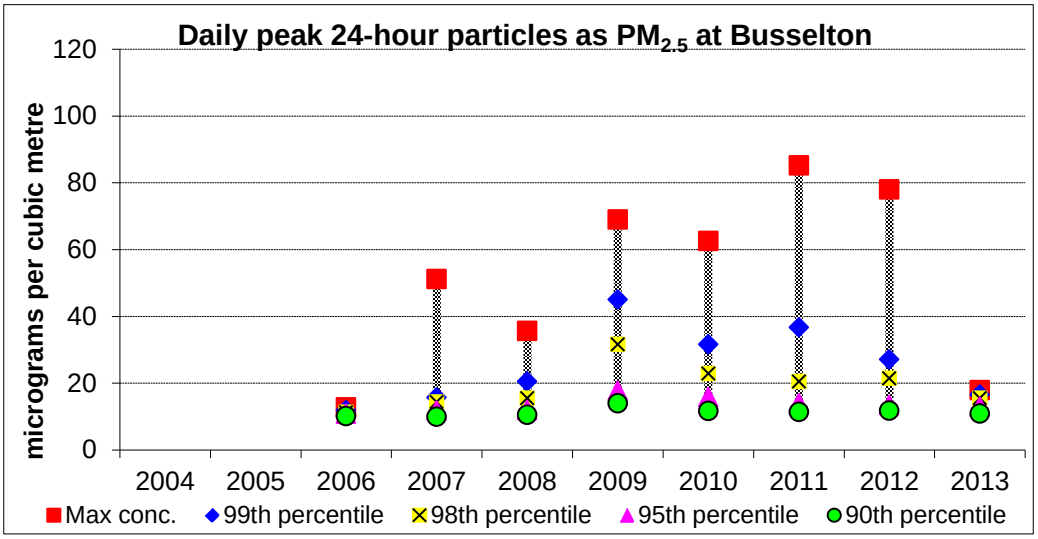


Figure A1-41 - 24-hour $PM_{2.5}$ at Busselton