VICTORIA'S AIR QUALITY – 2003

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OVERVIEW

- Air quality across Victoria in 2003 was adversely affected by drought related dust storms and the north-east Victorian bushfires, leading to high particle levels.
- Aside from these drought related impacts, Victoria's air was generally clean. In an international context Melbourne's air quality (compared to similar urban centres) remains relatively good, consistent with results from recent years.
- Carbon monoxide, nitrogen dioxide, sulfur dioxide and lead levels met the environmental air quality objectives designed to protect human health.
- The 2008 goal for particles (as PM_{10}, particles smaller than 10 micrometre) was not met. Most exceedences were caused by drought or bushfire related impacts. The 2008 goal would have been met without these exceedences. PM_{10}, however, continues to require on-going management in Victoria.
- The 2008 goal for visibility was not met. While many exceedences were a result of the drought related impacts, smoke from local sources such as domestic wood heaters remains the greatest contributor to visibility reduction during autumn and winter.
- The 2008 goal for ozone was not met, with again the north-east Victorian bushfires contributing to a greater number of ozone exceedences than has typically occurred in recent years.
- Due to the drought related impacts, the Melbourne-Geelong airshed experienced an abnormally high number (20) of pollution events.
- In 2003, EPA undertook a range of activities targeted at transport, domestic and industry sources to further promote improvements in Victoria's air quality.

AIR QUALITY IN DETAIL

Why EPA Monitors

EPA monitors air quality in order to ensure that the health and well-being of Victorians are maintained. Monitoring provides information on the concentration of pollutants in the air. This enables assessment of air quality relative to objectives; informs the development of air quality management strategies; and allows evaluation of the effectiveness of air quality management activities.

What EPA Monitors

EPA monitors a range of pollutants with known health impacts. Air quality objectives are set in the *State Environment Protection Policy - Ambient Air Quality* (SEPP (AAQ)) for seven common pollutants. Health objectives are set for:

- ***carbon monoxide (CO)*** – a gas readily absorbed into the bloodstream that affects transport of

oxygen through the body. People suffering from cardiovascular disease are particularly sensitive.

- ***ozone (O_3)*** – an oxidant that impacts on the respiratory system. Exposure to ozone can result in increases in asthma attacks and hospitalisations for heart and lung conditions.
- ***nitrogen dioxide (NO_2)*** – affects the respiratory system and the body's defence mechanisms. This can lead to increases in hospitalisations and respiratory infection, particularly in children.
- ***sulfur dioxide (SO_2)*** – an irritant gas that affects the respiratory system. Asthmatics are particularly sensitive to sulfur dioxide.
- ***lead (Pb)*** – long term exposure can affect development in children.
- ***particles smaller than 10 micrometre (PM_{10})*** – these particles (less than 1/10th the width of human hair) can exacerbate existing respiratory and cardiovascular disease. This can lead to increases in hospitalisations and premature mortality.

These health objectives are consistent with the National Environment Protection Measure (NEPM) – Ambient Air Quality.

An aesthetic objective is also set in the SEPP (AAQ) for:

- ***Visibility reducing particles*** - these particles reduce visual distance and aesthetic enjoyment. Reduction in visibility is typically associated with particles less than 2.5 micrometre ($PM_{2.5}$). These particles can penetrate deeply into the lungs.

EPA also measures $PM_{2.5}$, oxides of nitrogen, methane and non-methane hydrocarbons to develop further understanding of the sources of air pollutants and their behaviour in the environment.

How does EPA assess the air monitoring results?

Air quality for 2003 has been assessed against the SEPP (AAQ). The SEPP specifies both objectives and goals. Objectives are a quantifiable characteristic of the air against which air quality can be assessed (typically a pollutant concentration). The objectives are set at levels that protect beneficial uses, including:

- human health and well-being;
- visibility; and
- aesthetic enjoyment and local amenity.

The goals in the SEPP specify the maximum permissible number of exceedences of the objectives per year and a timeframe in which this goal must be met (by 2008). The goals guide the formulation of strategies for the management of human activities that may affect the environment. The objectives and 2008 goals for the pollutants are shown in Table 1. Each monitoring site is assessed against these objectives and goals.

In addition, the Ambient Air Quality NEPM was modified in 2003 to include an advisory standard for particles as $PM_{2.5}$. As part of this revision, EPA is monitoring $PM_{2.5}$ to collect data that will enable a review of the NEPM to commence in 2005. The advisory reporting standard sets a daily (25μg/m^3) and annual (8μg/m^3) objective.

As the incidence of elevated levels of pollutants is significantly dependent on weather conditions, comparisons in this report with 2002 data are only given where appropriate.

Table 1: SEPP Air Quality Objectives and Goals

Pollutant	Averaging Period	Objective	2008 Goal Maximum Allowable Exceedences
Carbon Monoxide	8 hours	9.0 ppm*	1 day a year
Nitrogen Dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year none
Ozone	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
Sulfur Dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year none
Lead	1 year	0.50 $\mu g/m^3$	none
Particles as PM10	1 day	50 $\mu g/m^3$	5 days a year
Visibility Reducing Particles	1 hour	20 km	3 days a year

* ppm = parts per million

Where EPA Monitors

In 2003, EPA Victoria's air monitoring program recorded air quality measurements from 21 sites (both permanent and short-term), with:

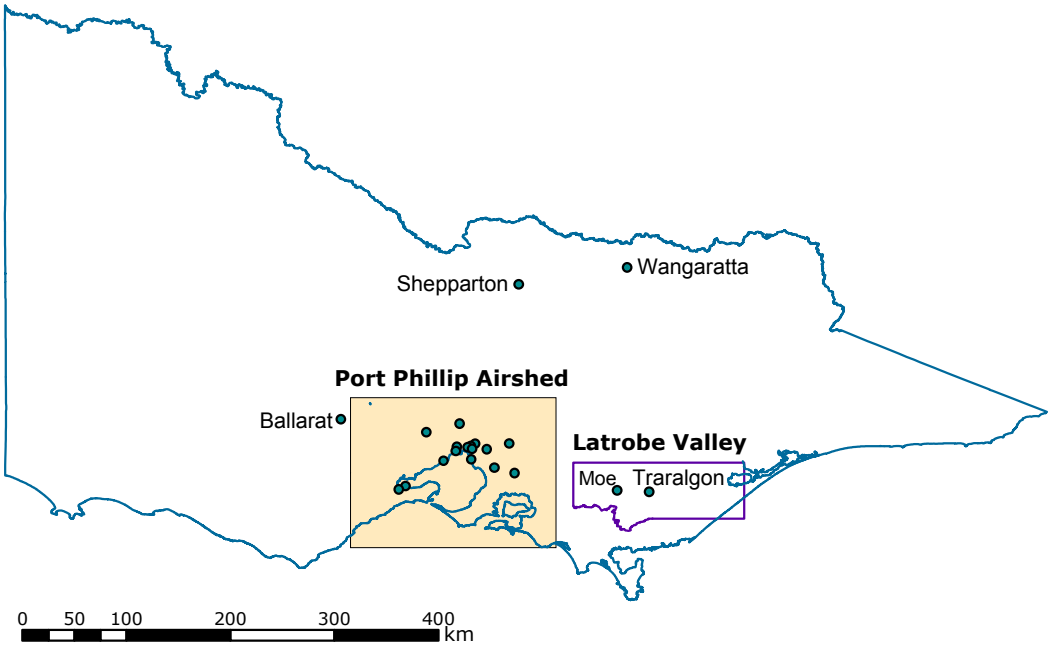
- 14 in metropolitan Melbourne (stations are assigned to regions in the City, East and West – see Figure 1);
- two in Geelong;
- two in the Latrobe Valley; and
- three in country Victoria (Ballarat, Wangaratta and Shepparton).

Monitoring stations are sited to give generally representative air quality measurements around Victoria.

EPA continued to update the air monitoring network during 2003, with:

- Monitoring for PM_{10} at Wangaratta in January to March 2003, to detect the effects of the north-east Victorian bushfires;
- Monitoring for ozone commencing in October 2003 at a site in Craigieburn for a period of eight months;
- Monitoring for PM_{10} commencing at Shepparton in December 2003 for a period of 12 months;
- Monitoring for ozone concluding in June 2003 at a site in Pakenham, after a period of ten months; and
- Monitoring for PM10 concluding at Ballarat in September 2003, after a period of 19 months.

a) Air Monitoring Stations across Victoria



b) Air Monitoring Stations in the Port Phillip Airshed

Figure 1: EPA Air Monitoring Stations in 2003

In addition, with the introduction of $PM_{2.5}$ advisory reporting standards, EPA reconfigured its monitoring network in 2003 to meet the goal to gather sufficient data to facilitate a review of these standards, commencing in 2005. Monitoring against the standards was performed at Alphington and Footscray using the reference method (Partisol samplers on a one day in three basis). As part of the $PM_{2.5}$ Equivalence Program, continuous monitoring (using a TEOM – tapered element oscillating microbalance) was also performed at these sites.

Predominant Types of Pollution

While 2003's air quality was adversely affected by drought and bushfires, typically the two predominant types of pollution events in Victoria are summer and winter smog.

Summer smog

Summer smog contains chemicals called oxidants, the main one being ozone. Ozone is formed from complex reactions of pollutants such as hydrocarbons and oxides of nitrogen, with strong sunlight. Due to Melbourne's topography (a trapped water body with surrounding low mountains), high ozone levels can occur when light winds and temperature inversions in the morning are followed by afternoon sea breezes. Emissions from motor vehicles, notably from cold engines during short trips, are the greatest single contributor to ozone formation.

Winter smog

Winter smog generally occurs when there is a build up of particles from combustion sources. These particles are trapped in the atmosphere under still weather conditions, mainly during autumn and winter. EPA monitors a number of different indicators of these particles. One method measures visibility reduction, which is expressed as an Airborne Particle Index (API). Studies show a reasonable agreement between API and concentration of particles smaller than 2.5 micrometre ($PM_{2.5}$). The API is related to Local Visual Distance by a simple inverse ratio. The SEPP objective for visibility states that Local Visual Distance should not be below 20km (equivalent to 2.35 API units).

Air Quality In 2003 [1]

Bushfires and dust storms had a detrimental effect on Victoria's air quality in 2003

In 2003, Victoria experienced a number of days of extreme air pollution as a result of drought and bushfires.

Major dust storms affected widespread areas of Victoria in March 2003 and June 2003. They were primarily a result of substantial drought in Victoria and southern NSW with consequent loss of soil under high winds.

In January and February 2003, severe bushfires in north-east Victoria and NSW also caused high particle levels (both PM_{10} and visibility reduction), and generated significant community concern about air quality. Particle readings show the highest levels ever measured by EPA Victoria.

[1] The 2003 air monitoring data can be downloaded from the EPA website at http://www.epa.vic.gov.au/air/air_monitoring_report_2003/

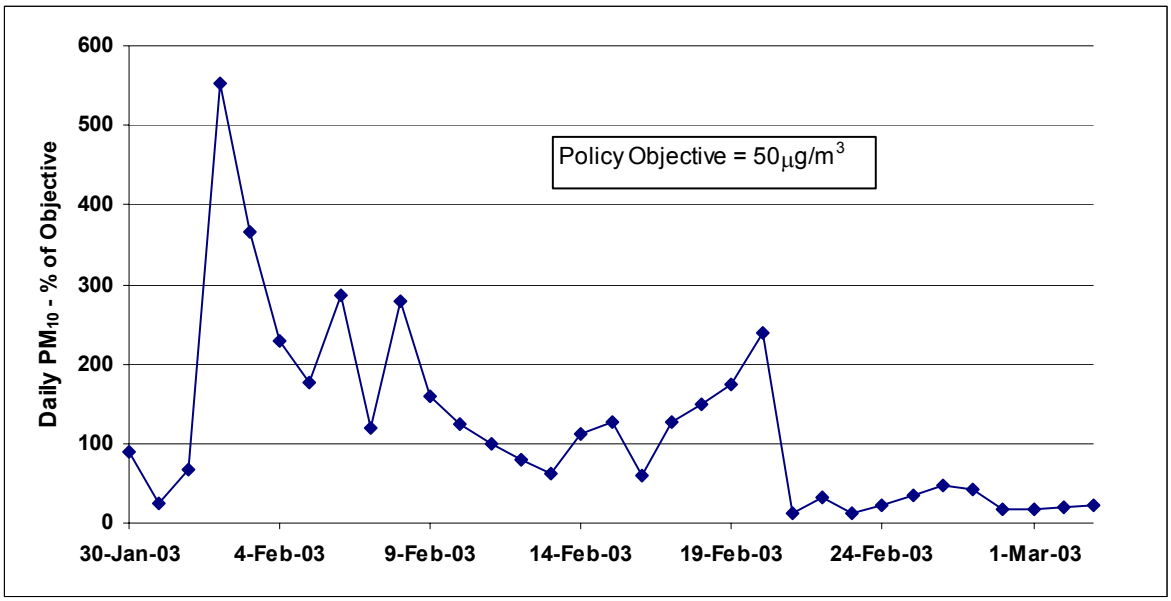


Figure 2: Daily PM_{10} Levels at Wangaratta

To better monitor the effects of the bushfires closer to the source, EPA located a PM_{10} sampler at its Wangaratta office from late January to March 2003. Daily PM_{10} levels at Wangaratta during the peak periods of the bushfires are shown in Figure 2. In addition, on the 19 March 2003, a severe dust storm over Victoria led to a PM_{10} level of 862μg/m³ at Wangaratta (more than 17 times the particles objective).

Ozone did not meet the 2008 goals

In 2003, the SEPP 2008 goals for ozone were not met in metropolitan Melbourne. The 1-hour goal was met at all stations except Brighton and the 4-hour goal was met at three out of the 10 Melbourne stations. Results on a station-by-station basis are shown in Table 2.

Both the Geelong and the Latrobe Valley regions met the 2008 goals. There were no exceedences of the objectives in the Latrobe Valley in 2003 (ozone exceedences are rare in this airshed) and only a single exceedence of the 4-hour objective in Geelong.

Note, that the ozone goals were met in Melbourne in 2002, but in 2003 the north-east Victorian bushfires contributed to an increase in the number of exceedences. The normal mechanisms by which photochemical ozone is formed were enhanced by the presence of additional precursor chemicals (hydrocarbons and nitrogen oxides) from the bushfires.

The 20-year trend for ozone in the Melbourne-Geelong airshed (based on the maximum number of exceedences at a single monitoring site each year), indicates that exceedences are less prevalent than they were in the 1980s (see Figure 3).

Table 2: Assessment of Victoria's Air Quality on a Station-by-Station Basis

Performance against 2008 Goal (Number = exceedences at the station)

Region		Station	Ozone		API	PM_{10}	NO_2	CO	SO_2	Pb
			1-hr	4-hr						
MELBOURNE	City	Collingwood	-	-	-	5*	-		-	
		Richmond	-	-	-	7			-	-
		RMIT		1	16	10				-
	East	Alphington	1	1	30	11				-
		Box Hill		2	24	-				-
		Brighton	2	2	23	8			-	-
		Dandenong		2	18	7			-	-
		Mooroolbark		3	-	13			-	-
	West	Footscray	1	2	19	10				-
		Melton	1	4	-	-	-		-	-
		Paisley		2	20	4*				-
		Pt. Cook		1	14	-			-	-
Geelong		Geelong South			13	10				-
		Pt. Henry		1	-	-	-	-		-
Latrobe Valley		Moe			23	11		-		-
		Traralgon			30	7		-		-

	2008 Goal Met		Likely to have Met ** (data recovery <75%)		2008 Goal Not Met	-	Not instrumented

* Monitoring by High Volume sampler on a one day in six basis

** Compliance with the 2008 goal can only be demonstrated if data capture for each quarter of a year is greater than 75 per cent. For stations where this data capture target was not achieved but, on the basis of available data it is likely that standards would have been met, an assessment of 'likely to have met' has been made.

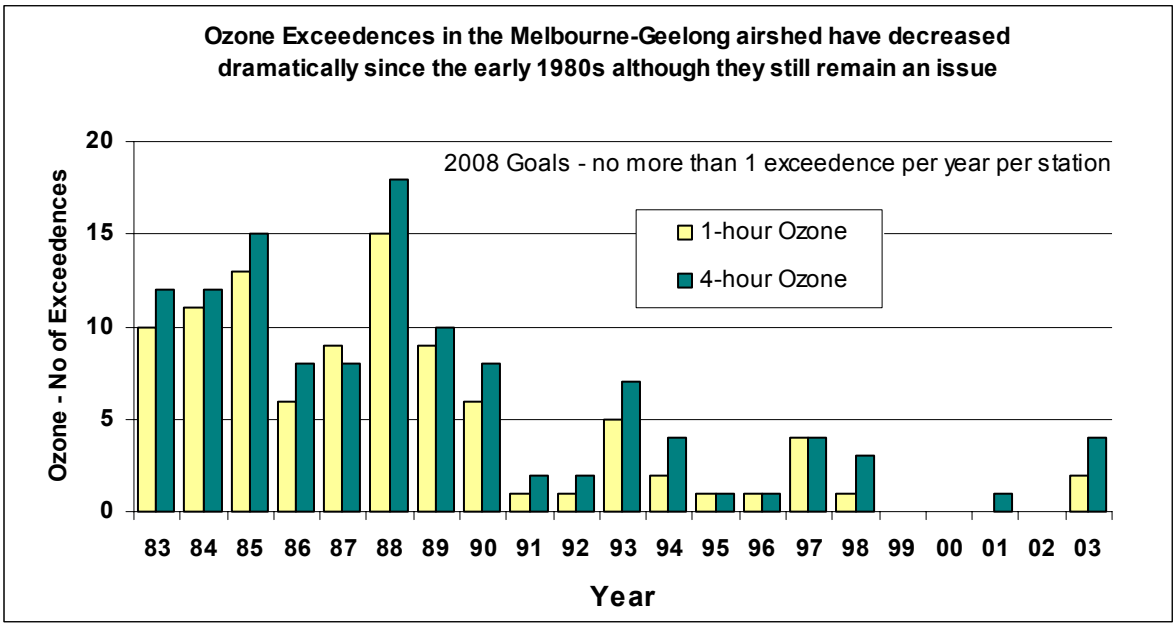


Figure 3: 1-hour and 4-hour Ozone Exceedences
20-year Trend in the Melbourne-Geelong Airshed

The monthly trends in 2003 ozone readings for Melbourne (divided into the regions City, East and West), Geelong and the Latrobe Valley are shown in:

- Figure 4 - maximum 1-hour levels as a percentage of the objective;
- Figure 5 - average 1-hour levels as a percentage of the objective; and
- Figure 6 - maximum 4-hour levels as a percentage of the SEPP objective.

Ozone data can be downloaded from the EPA website.

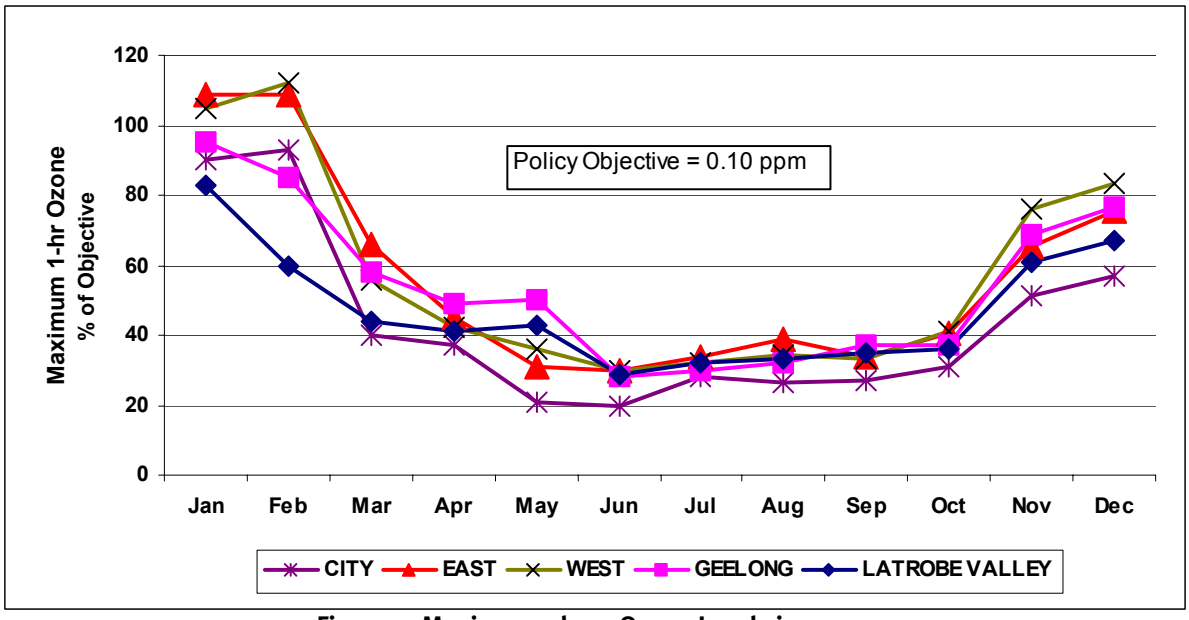


Figure 4: Maximum 1-hour Ozone Levels in 2003

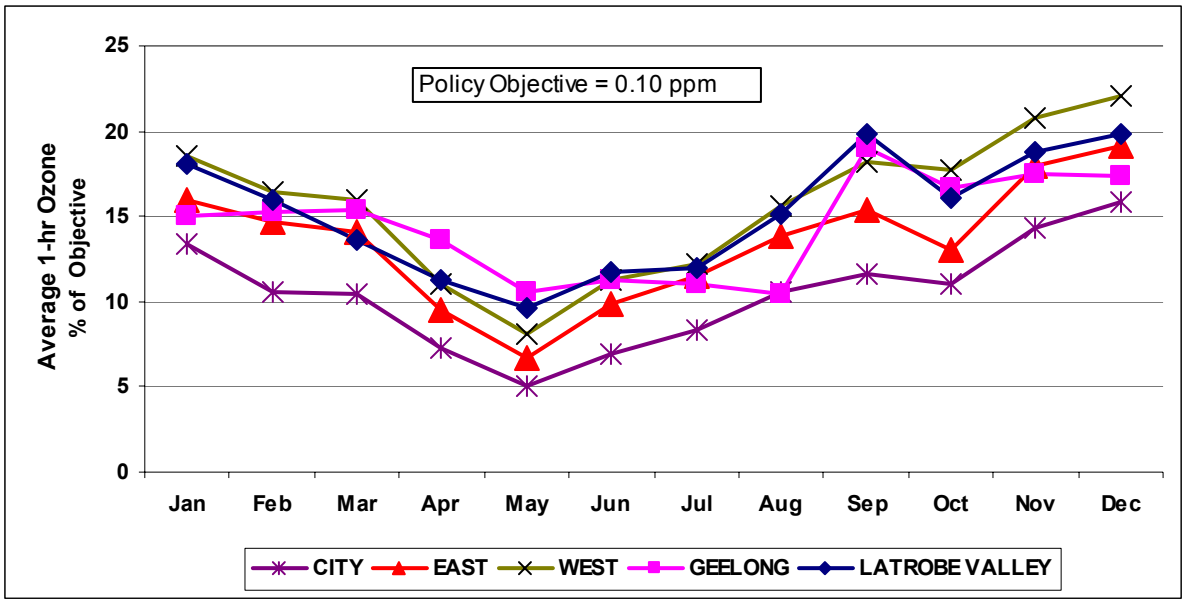


Figure 5: Average 1-hour Ozone Levels in 2003

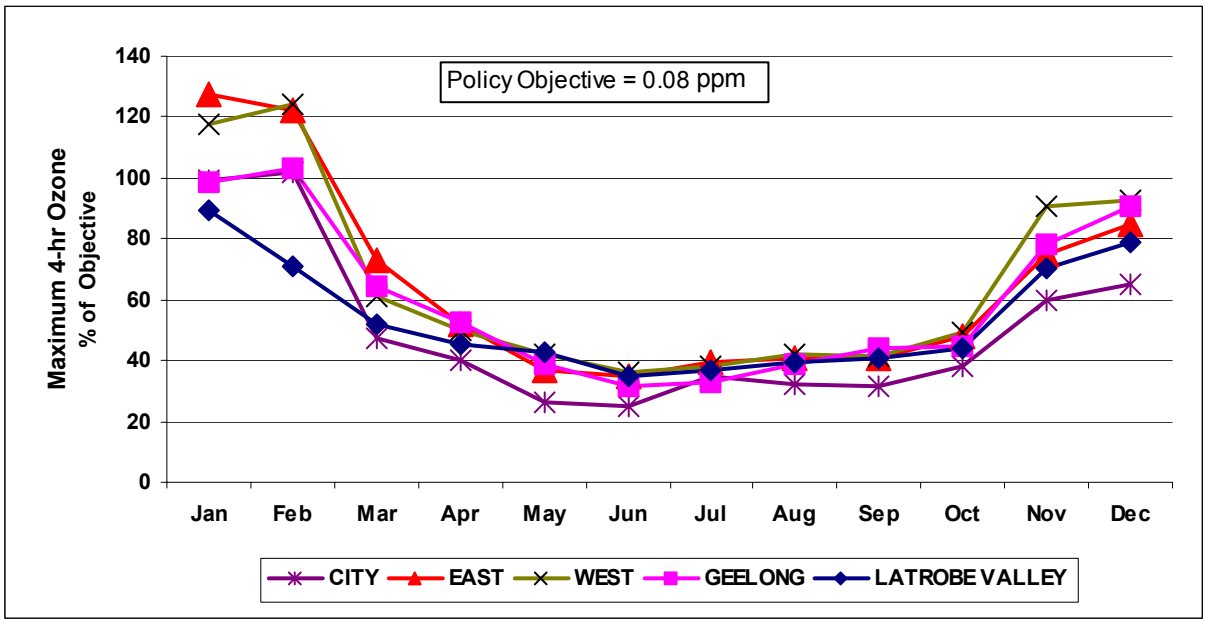


Figure 6: Maximum 4-hour Ozone Levels in 2003

Particles (PM_{10}) did not meet the 2008 goal

The 2003 monitoring data did not comply with the 2008 goal (that is, there should be no more than five exceedences per year at any monitoring site). On a regional basis:

- up to 13 exceedences were recorded at Melbourne stations (compared to three in 2002);
- 10 exceedences were recorded in Geelong (compared to six in 2002); and
- 11 exceedences were recorded in the Latrobe Valley (no exceedences in 2002, but monitoring only commenced in September/October 2002).

Exceedences on a station-by-station basis are shown in Table 2. In 2003, all monitoring sites did not meet the PM_{10} goal. In comparison, in 2002 all monitored sites (other than Geelong) met the goal.

During 2003, drought related impacts (dust storms and bushfires) contributed to the marked increase in the number of poor particles (PM_{10}) days. If the drought impacts were discarded, all monitoring sites would have met the 2008 goal. There were only five PM_{10} exceedences in 2003 that could not be directly attributed to either a dust storm or bushfire impact.

The monthly trends in 2003 PM_{10} readings for Melbourne (divided into the regions City, East and West), Geelong and the Latrobe Valley are shown in:

- Figure 7 - maximum daily levels as a percentage of the SEPP objective; and
- Figure 8 - average daily levels as a percentage of the objective.

PM_{10} data can be downloaded from the EPA website.

In addition to the permanent monitoring sites, in 2003 EPA conducted short-term particles (PM_{10}) monitoring at:

- *Wangaratta* – over late January-March to monitor at a site close to the north-east Victorian bushfires. Seventeen exceedences were recorded during an eight week period;
- *Ballarat* – ceasing in September as part of an 18-month assessment of local air quality (one exceedence was recorded in 2003)[2]; and

Shepparton – commencing in December as part of a 12-month assessment of local air quality (no exceedences were recorded).

Monitoring at Ballarat and Shepparton was by a high volume sampler operating one day in six. The monthly trend in maximum daily PM_{10} levels at these stations is shown in Figure 9.

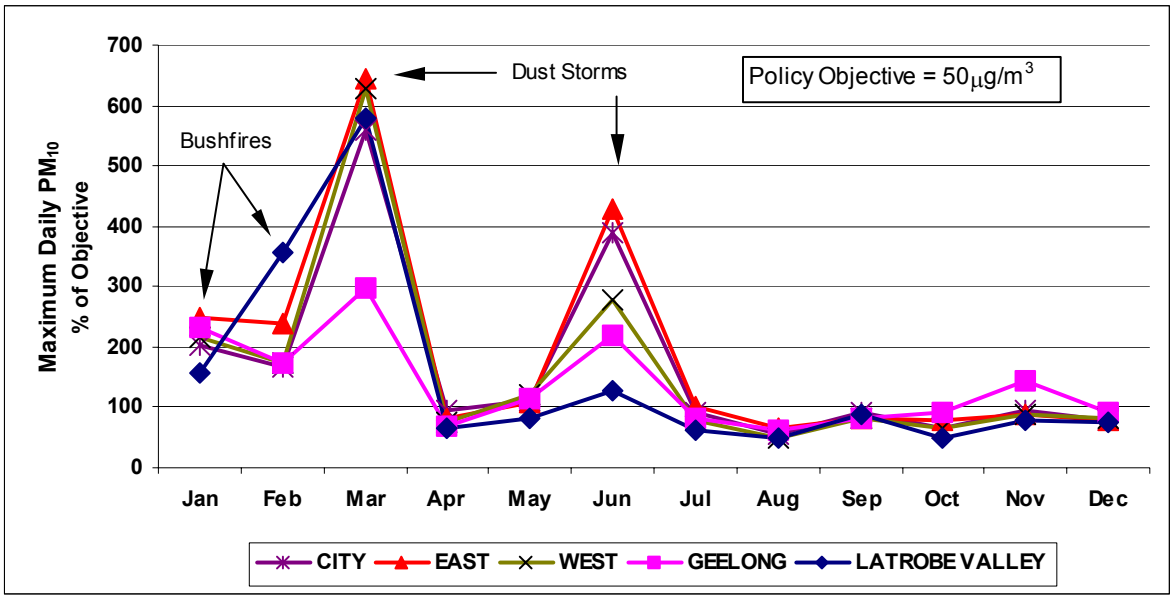


Figure 7: Maximum daily PM_{10} Levels in 2003

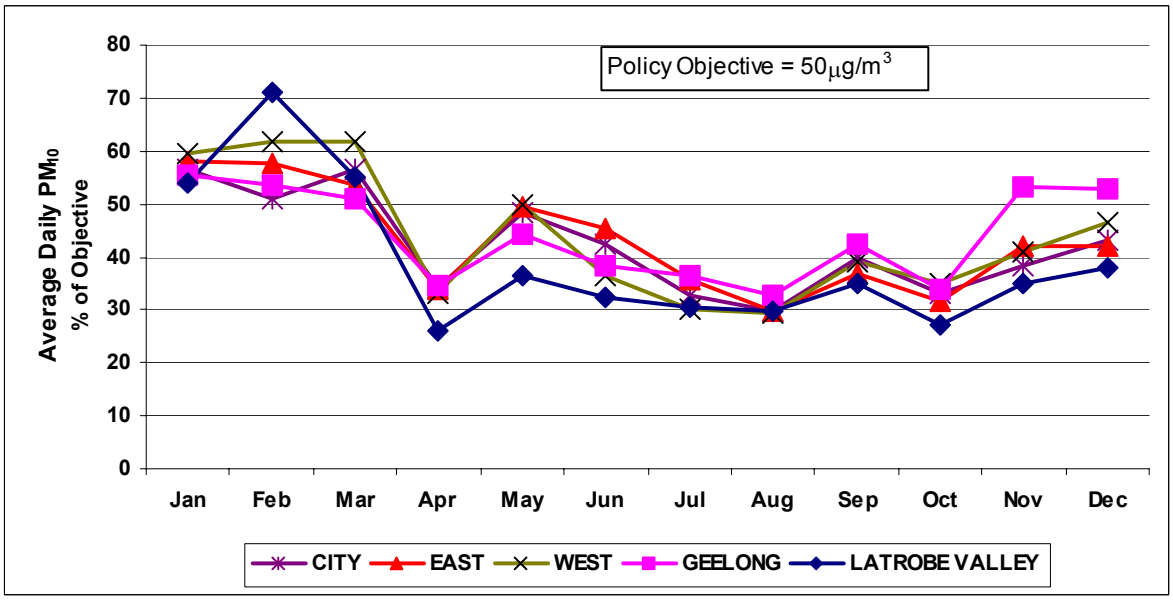


Figure 8: Average daily PM_{10} Levels in 2003

[2] *Airborne Particle Monitoring at Ballarat*, EPA Publication 936, 2004.

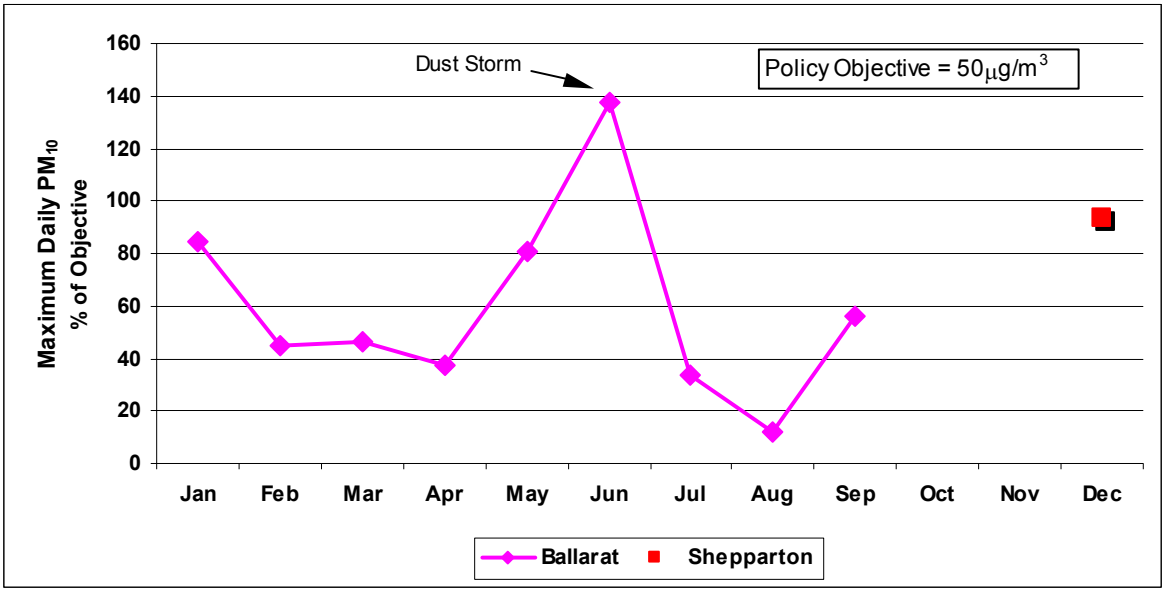


Figure 9: Maximum daily PM_{10} Levels at Short-Term Stations in 2003

Visibility did not meet the 2008 goal

In 2003, the SEPP 2008 goal for the 1-hour visibility objective (no more than three exceedences at an air monitoring site) was not met. On a regional basis:

- up to 30 exceedences were recorded in Melbourne (compared to 13 in 2002);
- 13 in Geelong (compared to no exceedences in 2002); and
- 30 in the Latrobe Valley (compared to 12 in 2002).

Exceedences on a station-by-station basis are shown in Table 2.

Typically visibility problems are mainly a concern in Victoria during autumn and winter, when the use of domestic solid fuel heaters without emission reducing technology (for example old wood heaters) and open fires contribute significantly to elevated particle levels. During 2003, however, drought related impacts (dust storms and bushfires) during the summer contributed to a marked increase in the number of poor visibility days. Typically, summer visibility exceedences are uncommon but in 2003, depending on the station, nine to 13 summer visibility exceedences were reported.

In Figure 10, the long term trend[3] for visibility in the Melbourne-Geelong airshed is presented, indicating that during the last 20 years visibility problems have become less frequent in the Melbourne-Geelong airshed (a similar trend is also found in the Latrobe Valley). Improvements are a direct consequence of controls placed on industry, motor vehicles and backyard burning and the efforts of the community in response to EPA education and communication programs.

[3] Based on the number of exceedences at the worst single monitoring site each year

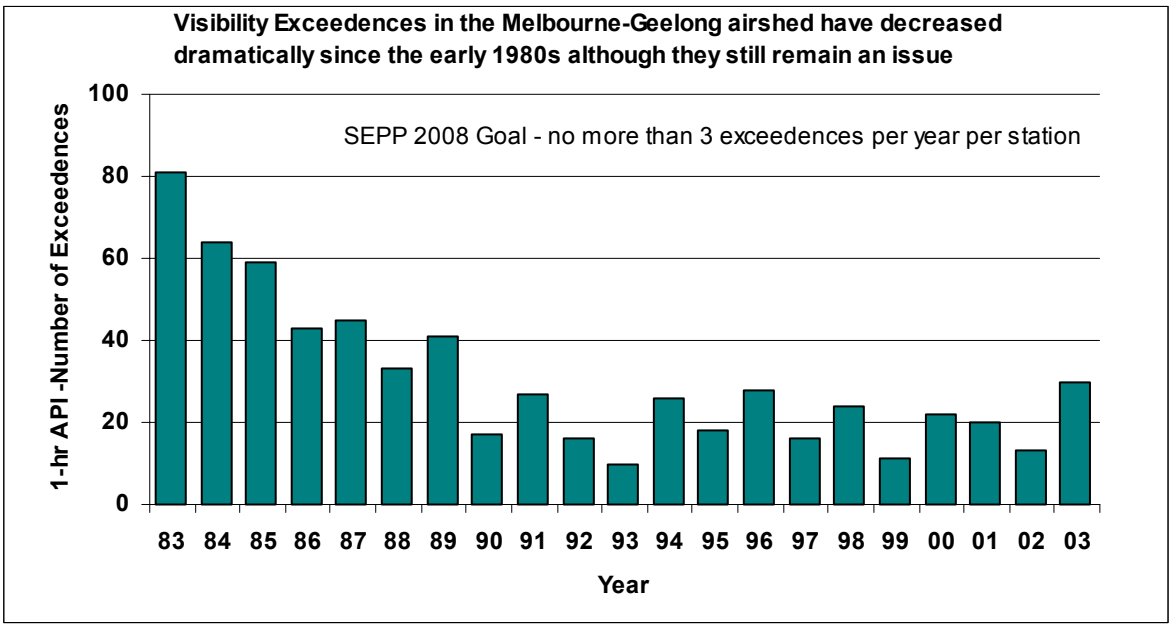


Figure 10: 1-hour API Exceedences

20-year Trend in the Melbourne-Geelong Airshed

The monthly trends in 2003 API readings for Melbourne (divided into the regions City, East and West), Geelong and the Latrobe Valley are shown in:

- Figure 11 - maximum 1-hour levels as a percentage of the SEPP objective; and
- Figure 12 - average 1-hour levels as a percentage of the objective.

API data can be downloaded from the EPA website.

There were exceedences of the $PM_{2.5}$ advisory reporting standard

To assist in the collection of data for the recently introduced NEPM amendments, EPA monitored $PM_{2.5}$ at two sites. Exceedences of the daily $PM_{2.5}$ advisory reporting standard were recorded at:

- Alphington - four exceedences of which one was attributed to bushfire effects; and
- Footscray – three exceedences, of which two were attributed to bushfire effects.

The annual reporting standard was met at both sites.

Details of all measurements are available on the EPA website.

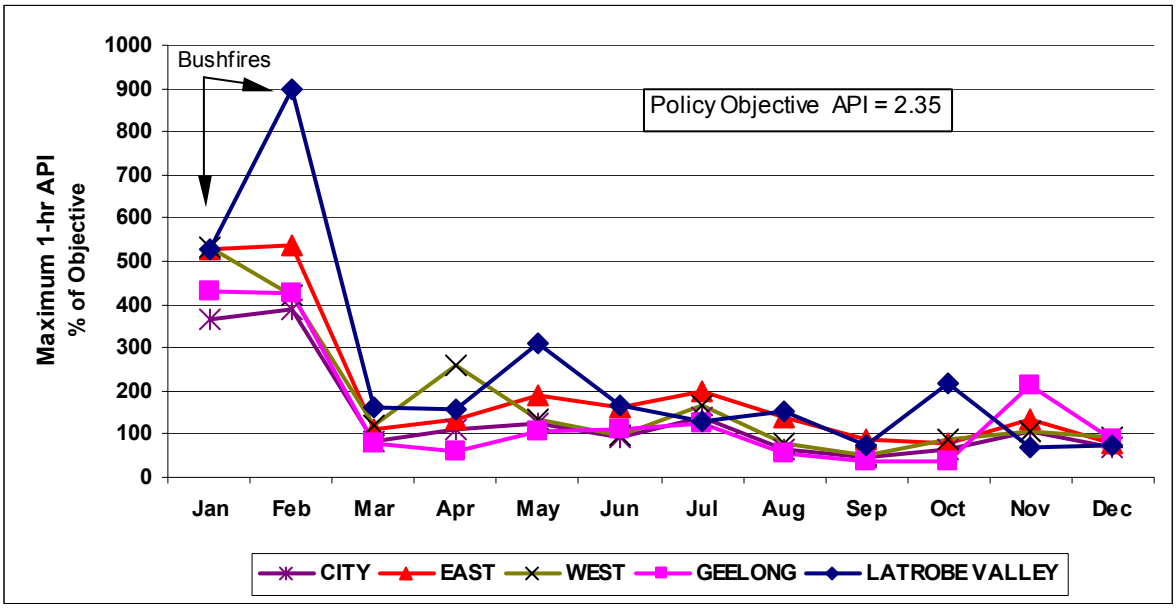


Figure 11: Maximum 1-hour API Levels in 2003

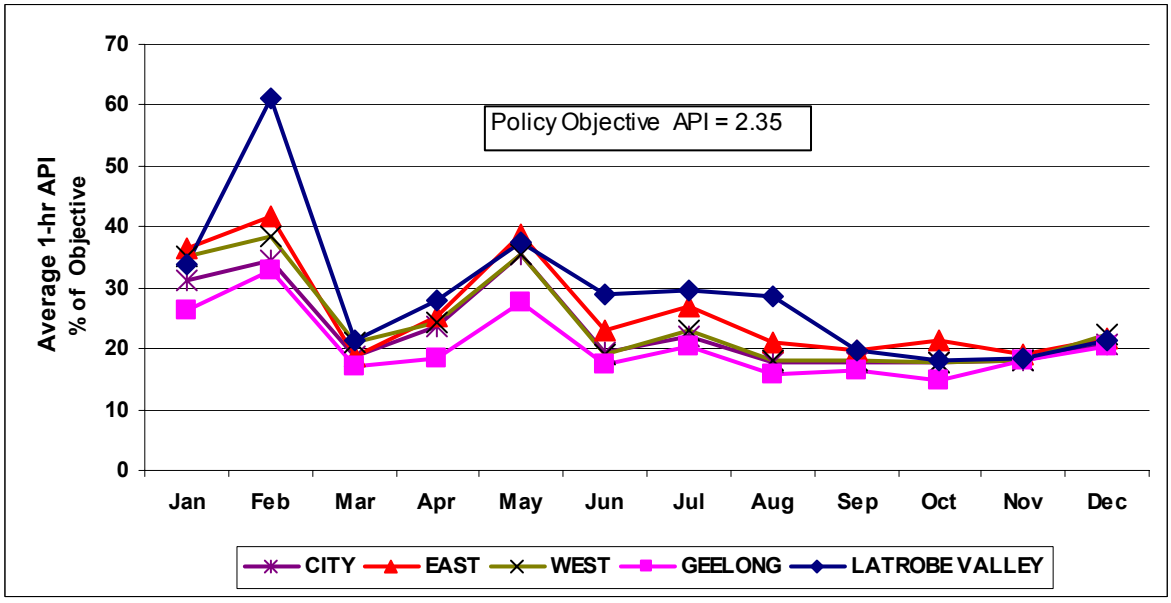


Figure 12: Average 1-hour API Levels in 2003

Other pollutants met the 2008 goals

In 2003, there were no exceedences of the SEPP objectives for carbon monoxide, nitrogen dioxide, sulfur dioxide and lead.

Annual maximum and average levels for these pollutants are shown in Table 3. Details of these measurements are available on the EPA website.

Table 3: Annual Maximum and Average Levels of CO, NO_2, and SO_2 in 2003

Region	Percentage of the Objective					
	8-hr CO		1-hr NO_2		1-hr SO_2	
	Maximum	Average	Maximum	Average	Maximum	Average
City	71	4	58	12	18	<1
East	60	4	62	9	11	<1
West	-	-	66	8	18	<1
Geelong	36	1	42	4	66	<1
Latrobe Valley	-	-	44	6	41	<1

There were 20 pollution events

The impacts of the drought through dust storms and bushfires led to a higher than normal number of pollution events being recorded in the Melbourne-Geelong airshed in 2003. There were 20 pollution events in 2003, of which 14 can be attributed to the drought related impacts. In comparison, there were five pollution events in 2002. A pollution event occurs when:

- visibility becomes less than 20km, for at least one daylight hour, as recorded by at least two monitoring stations; or
- a primary pollutant (carbon monoxide, sulfur dioxide or particles as PM_{10}) exceeds an objective as recorded by at least two monitoring stations; or
- a secondary pollutant (1-hour ozone or nitrogen dioxide) exceeds an objective at any station in the EPA network.

As part of EPA's on-going air quality forecasting, EPA issued smog alerts throughout 2003 to alert the community about days when forecast meteorological conditions were conducive to the build up of pollutants over the Melbourne-Geelong region.

In addition, EPA (in conjunction with the Department of Human Services) issued a number of smoke alerts throughout Victoria, in areas affected by the north-east Victorian bushfires.

Improving Victoria's Air Quality

While Victoria's air quality is considered good in an international context, EPA is undertaking a program of activities to promote further improvements in our air quality. Major programs are targeted at reducing emissions from transport, domestic and industry activities.

Transport Highlights

Motor vehicle emissions are a significant source of air pollution. To address this, EPA contributes to

national processes to improve vehicle emissions and fuels standards and undertakes a range of programs focused on improving emissions from the Victorian vehicle fleet. Highlights for 2003 include:

- the Victorian motor vehicle regulations were updated in 2003 and a new provision will result in reductions in hydrocarbon emissions from petrol during the summer months;
- the motor vehicle regulations also introduced 'in-service' diesel vehicle emission standards, consistent with the National Environment Protection Measure (Diesel Vehicle Emissions);
- the Eco Maintenance program, which included a pilot program of roadside emission testing of diesel commercial vehicles and seminars across Victoria to inform and train diesel mechanics about maintenance practices for compliance with new national diesel vehicle standards;
- the Victorian community reported more than 10,400 smoky vehicles through EPA's smoky vehicle program; and
- EPA ran media campaigns that centred on the improvements motorists can make to air quality by maintaining their cars and driving more efficiently.

Domestic Highlights

Smoke from wood heating is a significant source of air pollution in the winter months. EPA recently joined with the Commonwealth, NSW, SA, WA and Tasmania to conduct audits of wood heaters on sale, to check for compliance with the Australian Standard (AS4013). When operated correctly, Australian Standard compliant wood heaters produce up to 75 per cent less emissions than an open fire place or non-compliant heater. EPA is finalising statutory requirements that will make it mandatory that new heaters sold meet the Australian Standard.

Industry Highlights

EPA continues to work with industry, through our business sustainability programs and regional EPA offices, to promote best practice in all industry activities, including reducing emissions to air. Individual industries continue to investigate initiatives as part of achieving compliance with the State Environment Protection Policy (Air Quality Management). These include:

- All EPA licence holders must assess their greenhouse gas emissions and energy use, with the larger users developing an action plan to reduce their contribution to greenhouse gases; and
- Emitters of highly hazardous emissions must reduce those to the maximum extent achievable. This has resulted in a number of reductions of emissions within some industry sectors and has lead toward actions to eradicate substances that cause those emissions.

Other Programs

- Day to day air quality (as an air quality index) continues to be reported on EPA's website and in *The Age* and *Herald Sun* newspapers. Daily summaries and air quality forecasts were made available through the EPA Pollution Watch Line (03 9695 2777 or 1800 444 051).
- In addition to real time access to air monitoring data from EPA's Melbourne and Geelong air monitoring stations, data from EPA's Latrobe Valley stations (Moe and Traralgon) is now available on EPA's web site.
- A new web site (Air Quality for Kids) will enable direct interrogation of EPA's air quality database. While targeted at school children, it enables easy access to both current and historical data for all members of the public. (www.epa.vic.gov.au/Air/AQ4Kids)
- EPA continued its use of the mobile air monitoring laboratory to facilitate monitoring of 'hot spots'. In 2003, monitoring occurred at Corio (to assess an area impacted by industrial and motor vehicle emissions) and Nunawading (to assess motor vehicle impacts).
- Further development of the Australian Air Quality Forecasting System (AAQFS) occurred in 2003, with on-going collaboration between EPA and the Bureau of Meteorology.
- EPA contributed to the national four-city compositional study, to study the levels, composition and seasonal trends of particles in Melbourne, Sydney, Brisbane and Adelaide during one year.

RELATED EPA PUBLICATIONS

State Environment Protection Policy (Ambient Air Quality), Victorian Government Gazette No. S19, 09/02/1999 (Amended in Dec 2001).

Ambient Air Quality in the Port Phillip Control Region, 1979-1993: Compliance and Observed Trends, Publication 468, EPA 1995.

Air Monitoring Data 1992-95, Publication 584, EPA 1997.

Air Emissions Inventory Port Phillip Region, Publication 632, EPA 1998.

Draft Air Quality Improvement Plan, Publication 707, EPA 2000.

Ambient Air Quality NEPM Monitoring Plan Victoria, Publication 763, EPA 2001

Air Monitoring Report 1999, Publication 773, EPA 2000.

Air Monitoring Report 2000, Publication 778, EPA 2001.

Air Monitoring Report 2001, Publication 852, EPA 2002.

Air Monitoring Report 2002, Compliance with the National Environment Protection (Ambient Air Quality) Measure, Publication 907, EPA 2003.

Victoria's Air Quality 2002, Publication 910, EPA 2003.

Ozone Monitoring at Pakenham, August 2002 to June 2003, Publication 934, EPA 2003

Airborne Particle Monitoring at Ballarat, February 2002 to September 2003, Publication 936, EPA 2004.