VICTORIA'S AIR QUALITY – 2004

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OVERVIEW

Victoria's air was generally clean in 2004. While the air quality objectives were met for most pollutants, particle pollution continues to be an issue needing attention. In an international context Melbourne's air quality (compared to similar urban centres) remains relatively good. There has been little change in air quality over the last decade, with improvements in emissions counteracted by increasing pressures such as population growth.

Particles monitoring in 2004 showed:

- in Melbourne, there are still occurrences where the visibility and particles (as PM_{10}, particles smaller than 10 micrometres) objectives are not met. Figure 1, for example, shows that the number of days when the visibility objective is not met has remained around 20 days for the last ten years. 2004 results were a significant improvement over the drought/bushfire-affected results of 2003
- in Geelong, the PM_{10} objective was exceeded on 11 days, mainly due to windblown dust. The visibility objective was not met on one day
- in the Latrobe Valley, there were 15 days when visibility was poorer than the objective, due predominantly to fuel reduction burning. The PM_{10} objective was not met on one day
- in the rural cities of Shepparton, Bendigo, and Mildura there were some days when the PM_{10} objective was not met.

EPA is developing a program to further investigate and manage particle pollution across Victoria.

The Melbourne/Geelong region remains an area that will at times experience ozone episodes. In 2004, some stations had a single day when levels exceeded the objectives.

The air quality objectives were achieved for carbon monoxide, nitrogen dioxide, sulfur dioxide and lead at all monitoring stations in Victoria. With the introduction of unleaded petrol, lead in Melbourne's air has decreased to the extent that monitoring will cease in 2005 (see Figure 2).

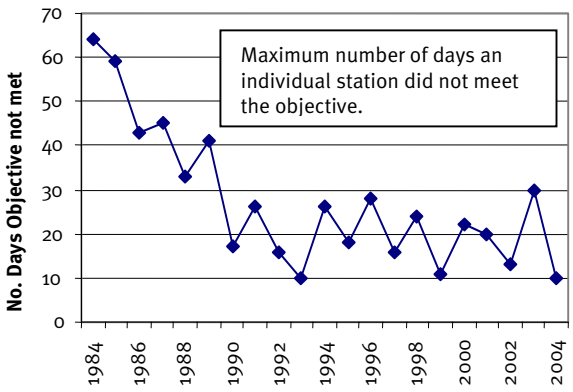


Figure 1: Visibility trend in Melbourne

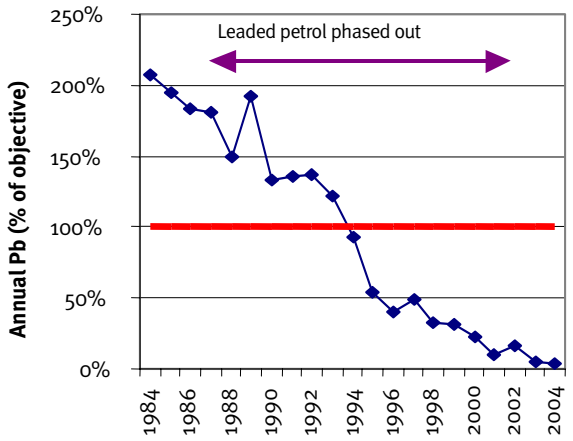


Figure 2: Unleaded petrol has decreased lead levels in Melbourne

The 2008 air quality goals were achieved, with the exception of visibility (at most sites) and PM_{10} (at two sites affected by windblown dust).

Further information on Victoria's air quality can be found on EPA's website (www.epa.vic.gov.au/air)

AIR QUALITY IN GENERAL

Why EPA monitors

EPA monitors air quality in order to ensure that the health and wellbeing 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) for seven common pollutants. Health objectives are set for:

- *particles smaller than 10 micrometres (PM_{10})* – these particles (less than 1/10th the width of human hair) can exacerbate existing respiratory and cardiovascular disease. High levels can lead to increases in hospitalisations and premature mortality
- *ozone (O_3)* – an oxidant that impacts on the respiratory system. Exposure to high levels of 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. At high concentrations, this can lead to increases in hospitalisations and respiratory infection, particularly in children
- *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
- *sulfur dioxide (SO_2)* – an irritant gas that affects the respiratory system at high concentrations. Asthmatics are particularly sensitive to sulfur dioxide
- *lead (Pb)* – long-term exposure can affect development in children.

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

In addition, the Ambient Air Quality NEPM was modified in 2003 to include an advisory standard for:

- *particles smaller than 2.5 micrometres ($PM_{2.5}$)* – these particles can penetrate deeply into the lungs.

An aesthetic objective is also set in the SEPP for:

- *visibility-reducing particles* – these particles reduce visual distance and aesthetic enjoyment.

How does EPA assess the air monitoring results?

Air quality for 2004 has been assessed against the SEPP objectives and goals. Objectives are concentrations, in parts per million (ppm) or micrograms per cubic metre ($\mu g/m^3$) against which air quality can be assessed. Assessments against the objective for visibility reducing particles are in terms of

an airborne particle index (API) based on light scattering measurements. The objectives are set at levels that protect beneficial uses, including:

- human health and wellbeing
- visibility
- aesthetic enjoyment and local amenity.

The goals in the SEPP specify a maximum permissible number of days per year when the objectives can be exceeded 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.

Table 1: SEPP air quality objectives and goals

Pollutant	Averaging period	Objective	2008 goal days exceeded
Visibility-reducing particles	1 hour	20 km	3 days a year
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year
Ozone	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year none
Carbon monoxide	8 hours	9.0 ppm	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 µg/m^3	none

In addition, the advisory reporting standard for $PM_{2.5}$ sets a daily (25µg/m^3) and annual (8µg/m^3) objective. EPA is monitoring $PM_{2.5}$ to collect data that will enable a review of the NEPM to commence in 2005.

Trends in air quality over a number of years can indicate whether the situation is improving or not. Comparisons are difficult because different stations operated from year to year, and weather patterns can vary dramatically. In this report, regional trends have been reported in three ways:

- the maximum number of days per year that any individual station in a region does not meet an air quality objective (for example, Figure 4(a)). This may occur at different stations each year
- annual maximums, defined as the average of the maximum pollutant concentrations recorded at all stations in a region (for example, Figure 4(b)). These maximums can be compared to the objective level shown as a red line in the relevant figures
- annual averages, defined as the average of the average pollutant concentrations recorded at all stations in a region (for example, Figure 4(b)).

Where EPA monitors

In 2004, EPA Victoria's air monitoring program recorded representative air quality measurements (see Table 2) from 23 sites (both permanent and short-term), with:

- 16 in metropolitan Melbourne (stations are assigned to regions in the City, East and West – see Figure 3)
- two in Geelong
- two in the Latrobe Valley
- three other sites in country Victoria (Bendigo, Mildura and Shepparton).

In addition, three sites close to roads or industry were monitored (Brooklyn, Corio, Nunawading).

The locations of all monitoring stations are shown in Figure 3.

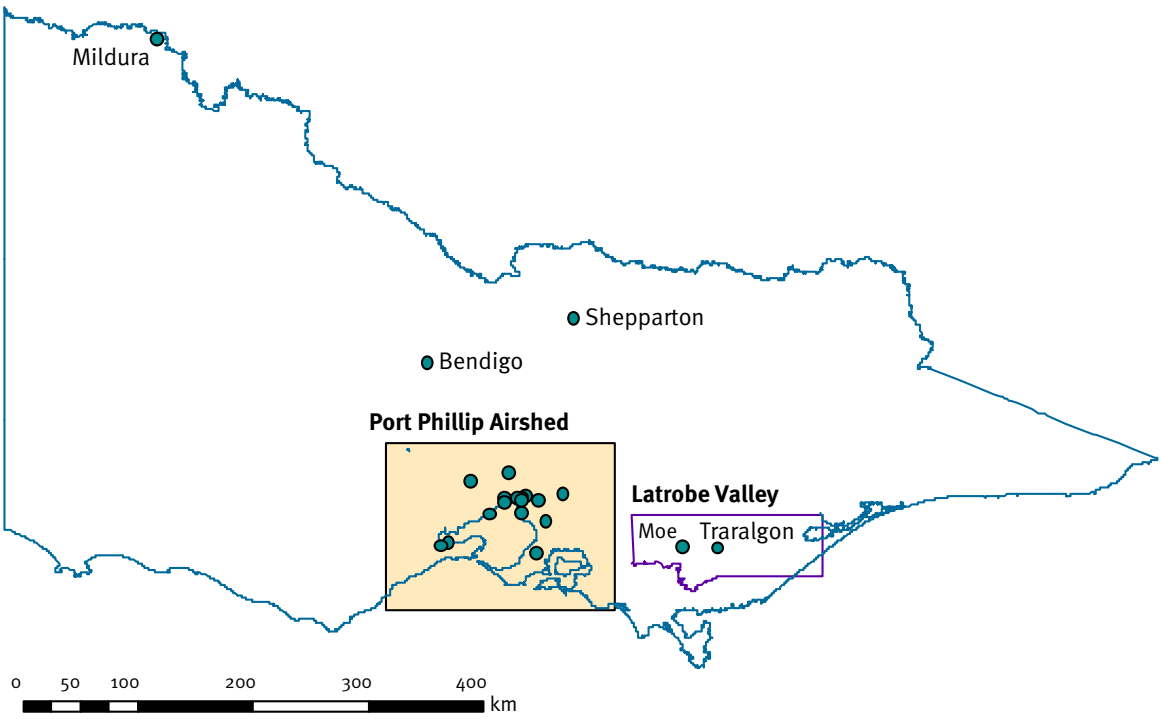
EPA continued to update the air monitoring network during 2004, with:

- a mobile air monitoring station located at Bendigo for 12 months commencing May 2004
- monitoring for ozone at a site in Moorooduc for a period of 12 months from December 2004
- monitoring for ozone at Craigieburn for a period of eight months to June 2004
- monitoring for PM_{10} commencing at Mildura in December 2004 for a period of 12 months
- monitoring for PM_{10} concluding at Shepparton in December 2004, after a period of 12 months
- monitoring for motor vehicle derived pollutants at Brooklyn from March to November 2004
- monitoring for industry and motor vehicle related pollutants at Corio over 2004
- monitoring for motor vehicle derived pollutants at Nunawading for five months concluding February 2004.

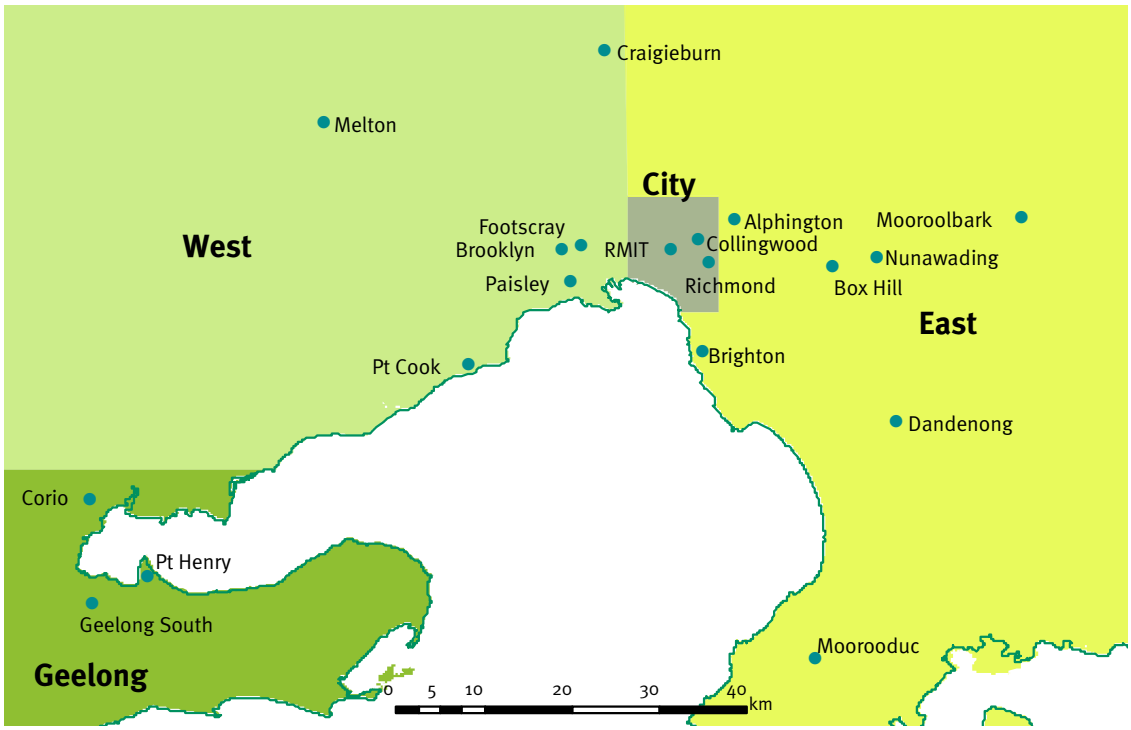
AIR QUALITY IN 2004

A summary of Victoria's performance against the air quality objectives and goals in the SEPP is shown in Table 2. Details of monitored pollution levels can be found on EPA's website at www.epa.vic.gov.au/air/air_monitoring_report_2004, along with a report assessing Victoria's performance against the requirements of the Ambient Air Quality NEPM.

Results from EPA's air monitoring network are presented below for Melbourne, Geelong, the Latrobe Valley and other rural regions.



a) Air monitoring stations across Victoria



b) Air monitoring stations in the Port Phillip airshed

Figure 3: EPA air monitoring stations in 2004

Table 2: Assessment of Victoria's air quality on a station-by-station basis

The numbers in the table indicate the number of days where the objectives were not met.

Region		Station	API	PM_{10}	Ozone		NO_2	CO	SO_2	Pb
					1h	4h				
MELBOURNE	City	Collingwood		1*						0
		Richmond		0			0*	0		0
		RMIT	2*	2	0	0	0	0	0	
	East	Alphington	10	1	0	0	0	0	0	
		Box Hill	2*	7	0	0	0	0	0	
		Brighton	6	0	1	1	0			
		Dandenong	4	1	0	0	0			
		Mooroolbark		1	0	0	0	0		
		Moorooduc			0*	0*				
	West	Craigieburn			0*	0*				
		Footscray	4	3	1	1	0	0	0*	
		Melton			0					
		Paisley	5	0*	0	1	0		0	
		Pt. Cook	4		0	1	0			
Geelong		Geelong South	1	11	0	1	0	0	0	
		Pt. Henry			0	1			0	
Latrobe Valley		Moe	8	1*	0	0	0		0	
		Traralgon	15	0	0	0	0		0	
Other Rural		Bendigo	0*	1*	0*	0*	0*	0*		
		Mildura		2*						
		Shepparton		1*						

Key:

0	Objectives and Goal met on all days.		Exceeded the objective but met the Goal		Goal not met		Insufficient data to assess likely performance

* 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 an assessment was made, if possible on the basis of available data, of whether it was likely that the objective would have been met.

Air Quality in Melbourne

Summary

Air quality in Melbourne was generally good in 2004, although visibility and particles remain an issue needing attention. Performance against the air quality objectives is summarised below.

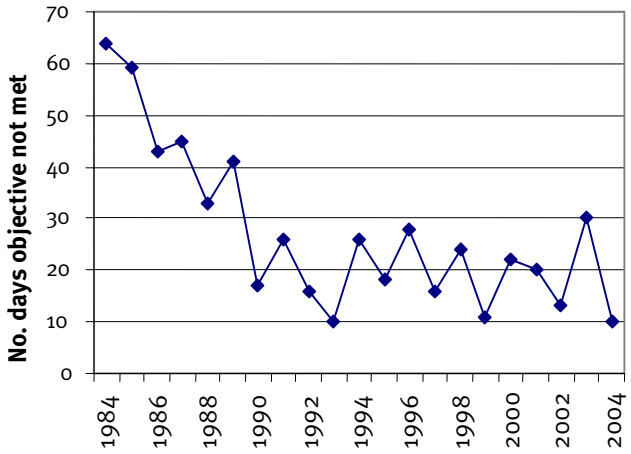
- *Visibility* – there were days at all stations when the objective was not met.
- *Particles as PM_{10}* – most stations reported days when the objective was not met.
- *Particles as $PM_{2.5}$* – the daily reporting standard was not met on one day at Alphington. Both of Melbourne's stations met the annual reporting standard.
- *Ozone* – some stations reported a single day in which the ozone objectives were not met.
- *Carbon monoxide, nitrogen dioxide, sulfur dioxide* – these continue to meet the objectives.
- *Lead* – the objective was met, and levels have dropped to such a low level that EPA will cease monitoring lead in 2005 (see Figure 2).

Visibility

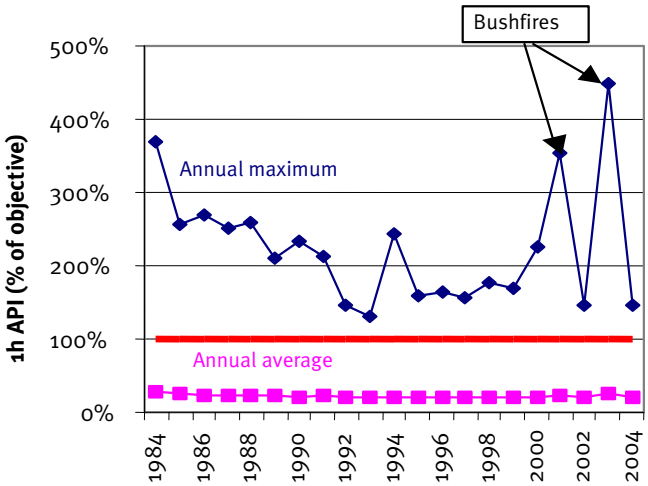
Visibility remains an issue in Melbourne, although conditions in 2004 were significantly better than in 2003, where drought related impacts (dust storms and bushfires) during the summer contributed to a marked increase in the number of poor visibility days. In 2004, visibility was worst in autumn and winter, when controlled burning and domestic heating (old wood heaters and open fires) contributed significantly to elevated particle levels.

The number of days not meeting the visibility objective at each station is shown in Table 2. In 2004 the objective was not met on up to 10 days (compared to 30 in 2003). There has not been a significant change during the last 10 years, following a significant improvement in the previous decade (see Figure 4(a)). EPA is undertaking investigations into the causes of the visibility issues with the aim of identifying opportunities to further improve Melbourne's air quality.

On most days (at least 90 per cent) Melbourne stations experienced Good to Very Good visibility (as defined by EPA's air quality index – see www.vic.gov.au/air/bulletins/abindex.asp). The maximum and average visibility levels are shown in Figure 4(b). The peaks in recent years have been attributed to bushfires.



(a) Maximum number of days an individual station does not meet the objective

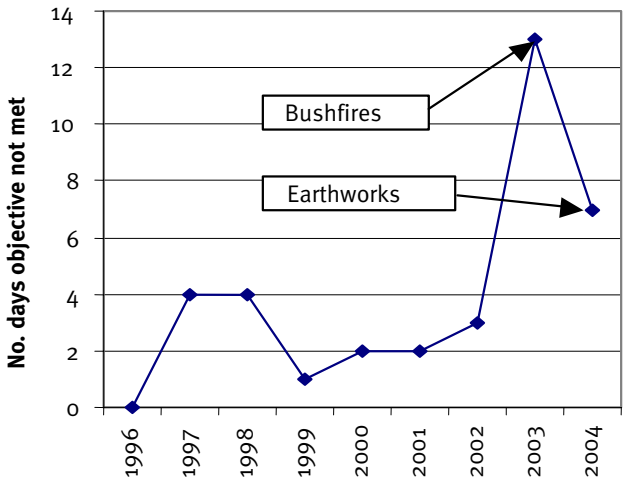


(b) Average of all stations' maximum and average concentrations

Figure 4: Visibility trend in Melbourne

Particles as PM_{10}

In comparison to 2003, when bushfires and dust storms routinely affected Melbourne's air quality, 2004 was a relatively good year in terms of particles pollution (as PM_{10}). In 2004, whilst conditions were improved, there were still days where the PM10 objective was not met (see Table 2). Most of these days were due to windblown dust, which affected large areas of Melbourne.



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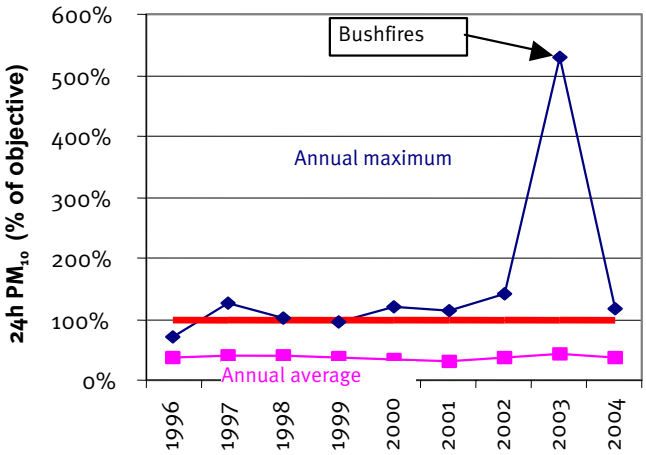


(b) Average of all stations' maximum and average concentrations

Figure 5: PM_{10} trend in Melbourne
Only stations with at least five years data are shown.

Construction work adjacent to the Box Hill station led to seven days not meeting the PM_{10} objective over a short period of time (monitoring commenced in September). Due to these construction activities the station is not considered as providing a good indication of regional PM_{10} levels. EPA has issued a notice requiring dust control measures on the construction site.

Whilst Melbourne does experience PM_{10} issues, on most days (at least 93 per cent, except for Box Hill) Melbourne stations experienced Good to Very Good particles levels.

Excluding the effect of bushfires in 2003 and the Box Hill construction work in 2004, over the last eight years there has been little change in PM_{10} concentrations and the number of days where the objective is not met (see Figure 5).

Particles as $PM_{2.5}$

EPA also monitored particles as $PM_{2.5}$ in Melbourne (at Alphington and Footscray). The daily $PM_{2.5}$ advisory reporting standard was exceeded on one day at Alphington. The annual reporting standard was met at both sites. Results are shown in Table 3.

Table 3: $PM_{2.5}$ levels in Melbourne

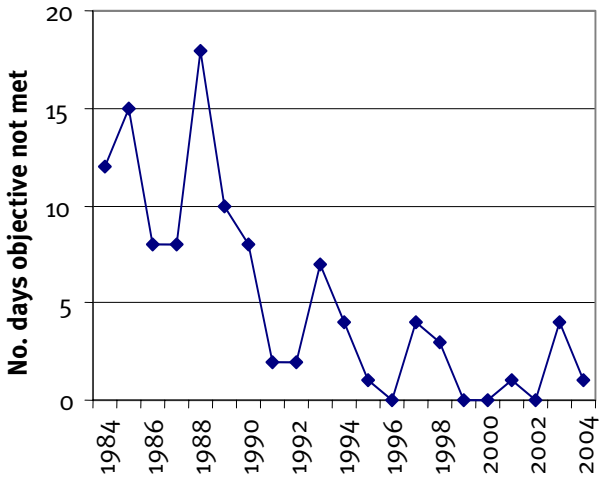
	24-hour Maximum ($\mu g/m^3$)	Annual Mean ($\mu g/m^3$)
Reporting standard	25	8
Alphington	27	7
Footscray	22	6

Ozone

Melbourne remains a city that will at times experience ozone episodes. During the hotter months, ozone building up over Port Phillip Bay can be transported across Melbourne by sea breezes. 2004 was no exception, with the ozone objectives exceeded on one day at the near-coastal stations of Brighton, Footscray, Paisley and Point Cook (see Table 2).

Days with ozone levels higher than the objective are now much less prevalent than they were in the 1980s (see Figure 6(a)). There is no significant trend in average ozone levels over the last ten years but

maximum concentrations are tending to decline (Figure 6(b)). Figure 6 presents comparisons against the four-hour average objective, which normally is more difficult to achieve than the one-hour objective.



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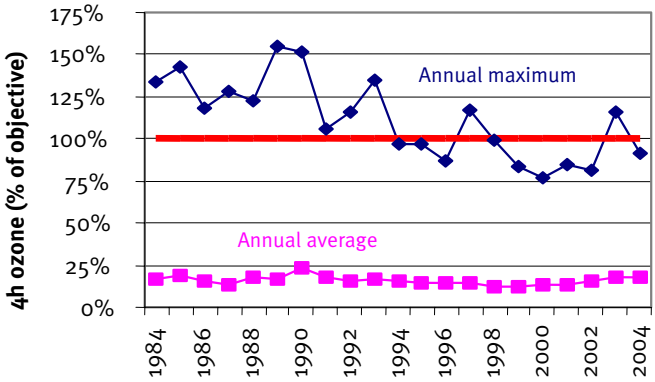


(b) Average of all stations' maximum and average concentrations

Figure 6: Four-hour ozone trend in Melbourne

Other gaseous pollutants

Motor vehicles remain a large source of pollutants, accounting for approximately three quarters of Melbourne's emissions of oxides of nitrogen and carbon monoxide. Despite motor vehicle usage increasing on a year-to-year basis, improvements in fuel standards and vehicle performance have resulted in an overall improvement in air quality.

Figure 7, for example, shows that levels of NO_2 and CO in Melbourne remain low and have not increased over the last twenty years in spite of increasing vehicle usage (as measured by VKT – Vehicle Kilometres Travelled).

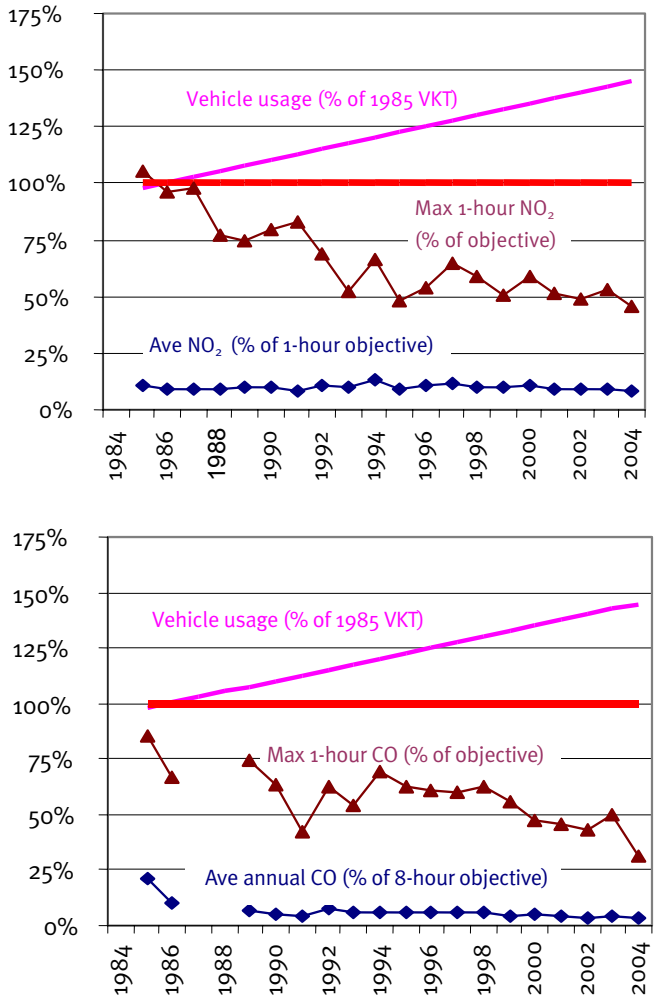


Figure 7: NO_2 and CO have not increased with road traffic

SO_2 in Melbourne is very low, except where influenced by specific industrial sources, and has not increased over the years.

Roadside monitoring

In addition to EPA's fixed air monitoring network, EPA studied air quality near some major metropolitan roads:

- The intersection of Springvale and Whitehorse Roads in Nunawading was chosen as a worst-case scenario of a congested intersection.
- The Millers Road onramp adjacent to the Westgate Freeway, Brooklyn was chosen to assess the levels of pollutants alongside a major freeway.

Toxic hydrocarbons were included in the pollutants monitored. The results showed that concentrations of air pollutants met state and national objectives and were similar to those measured at EPA air monitoring stations in Footscray and Alphington, except for fine particle levels, which were slightly higher. These studies supported findings of other studies that show that within a short distance from the road air quality objectives are generally met.

Air quality in Geelong

Summary

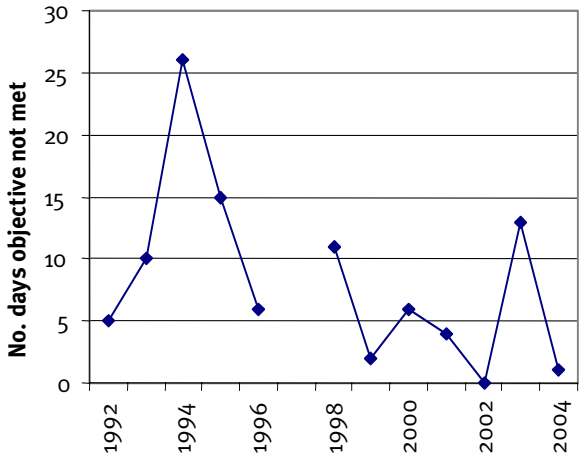
Air quality in Geelong was generally good in 2004. Performance against the air quality objectives was:

- *visibility* – one day did not meet the visibility objective
- *particles as PM_{10}* – the objective was not met on 11 days, mostly due to windblown dust
- *ozone* – both stations had a single day where the objectives were not met
- *carbon monoxide, nitrogen dioxide, sulfur dioxide* – continued to meet the objectives.

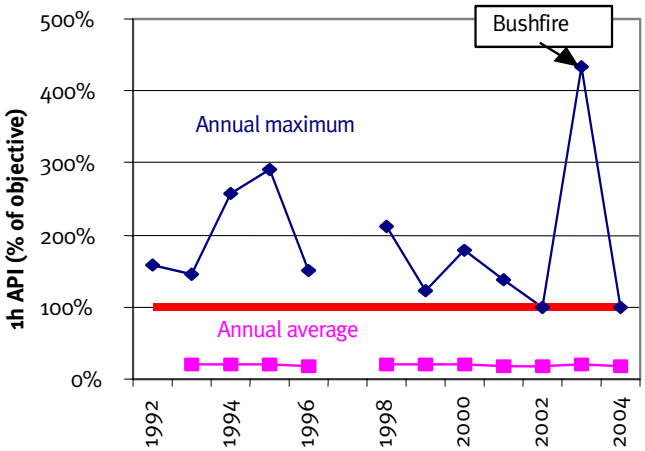
Visibility

In 2004, visibility levels were significantly better in Geelong in comparison to the drought/bushfire year of 2003. In 2004, one day exceeded the visibility objective, compared to 13 days in 2003. Readings were Good to Very Good on most days (97 per cent of days).

Visibility levels are, in general, similar to Melbourne, but Geelong traditionally experiences fewer days where the visibility objective is not met (compare Figure 8(a) to Figure 4(a)). There is little evidence of a change in visibility levels in Geelong over the last ten years (see Figure 8(b)).



(a) Number of days Geelong does not meet the objective



(b) Geelong's annual maximum and average concentrations

Figure 8: Visibility trend in Geelong

(Visibility was not monitored at Geelong in 1997)

Particles as PM_{10}

In 2004, the Geelong South station recorded 11 days on which the PM_{10} objective was not met. Ten of these days were due to windblown dust. Earthworks near the station contributed to the levels found. On other days monitoring was impacted as part of larger scale dust events. In 2003, the first full year of continuous monitoring for PM_{10} at Geelong, the objective was exceeded 10 times (due to bushfire/wind blown dust impacts).

PM_{10} levels in Geelong were mostly Good to Very Good (88 per cent of days). In 2004, the annual average of daily PM_{10} at Geelong was similar to Melbourne.

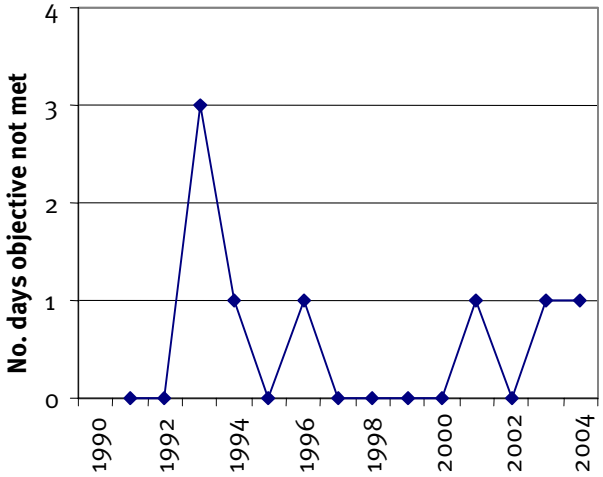
Ozone

There was a single day at both the Geelong South and Point Henry stations when the 4-hour ozone objective was not met (in common with the bayside Melbourne stations). The ozone objectives have been exceeded less frequently than in Melbourne (Figure 9(a) – compare with Figure 6). Average levels in Geelong are similar to Melbourne stations. No clear trend is evident (Figure 9(b)).

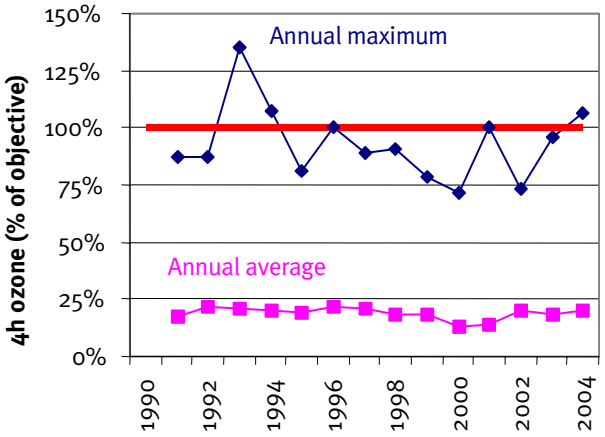
Other monitoring

Annual average CO and NO_2 levels in Geelong were about half of the Melbourne averages, reflecting lower motor vehicle traffic densities.

Air quality close to an industrial area in Corio was also monitored to provide real-time feedback about pollution levels, including hydrocarbons. Studies to be completed in 2005 indicated that average levels of benzene in Corio are similar to levels in Melbourne and lower than those found beside busy roads.



(a) Maximum number of days an individual station does not meet the objective



(b) Average of all stations' maximum and average concentrations

Figure 9: Four-hour ozone trend in Geelong

Air quality in the Latrobe Valley

Summary

Air quality in the Latrobe Valley was generally good in 2004. Performance against the air quality objectives is summarised below.

- *Visibility* – there were days when the objective was not met.
- *Particles as PM_{10}* – the objective was not met on one day.
- *Ozone*, *nitrogen dioxide and sulfur dioxide* – these continue to meet the objectives.

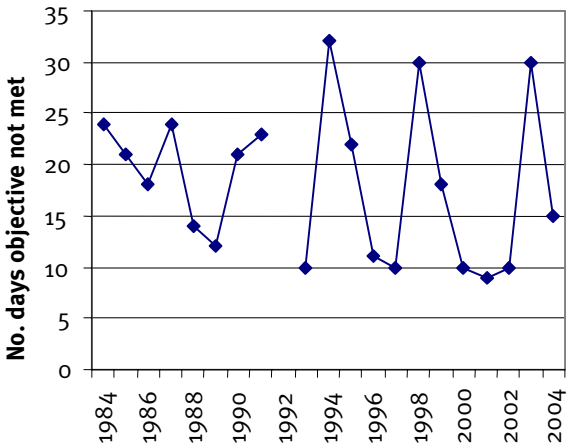
Visibility

Particles pollution is the main issue in the Latrobe Valley. The visibility objective was not met on 8 and 15 days respectively at Moe and Traralgon. These numbers are typical of recent years (Figure 10(a)), and higher than Melbourne in 2004. Fuel reduction burning in April and May was the main cause of the visibility problems.

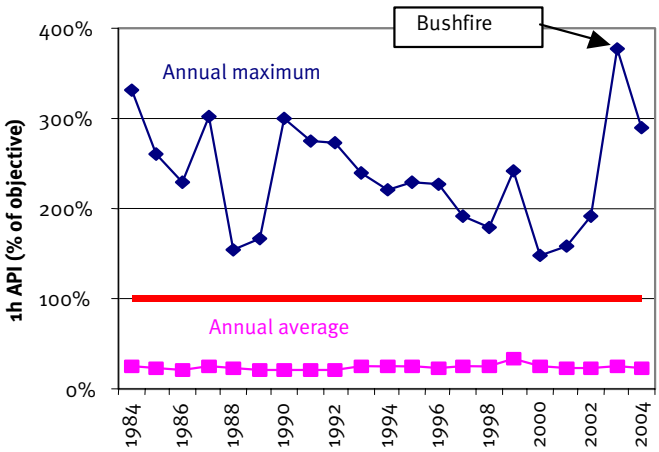
Visibility was Good to Very Good on most days (about 88 per cent of days). The annual average API in the Latrobe Valley (Figure 10(b)) is similar to Melbourne.

Particles as PM_{10}

Fuel reduction burning also led to the single day when the Latrobe Valley (Moe) did not meet the PM_{10} objective.



(a) Maximum number of days an individual station does not meet the objective



(b) Average of both stations' maximum and average concentrations

Figure 10: Visibility trend in the Latrobe Valley

Other Monitoring

Ozone, NO_2 and SO_2 met the objective levels in the Latrobe Valley. Average ozone levels were similar to Melbourne, NO_2 levels were lower and, as in Melbourne, SO_2 levels were very low.

Air quality in other rural regions

Bendigo

The Bendigo station monitored visibility, PM_{10}, CO, O_3 and NO_2 since May 2004. All pollutant levels met the objectives, except for PM_{10} on one day (due to wood smoke). Results from Bendigo will be reported after the full year's monitoring.

Shepparton

In 2004 EPA monitored PM_{10} on a one-day-in-six basis at Shepparton. The objective was not met on one day, due to wind blown dust. PM_{10} levels in Shepparton are, on average, similar to levels recorded in Melbourne.

Mildura

PM_{10} monitoring at Mildura commenced in December 2004. On two days the objective was not met, due to dust storms. Results will be reported when more monitoring data becomes available.

IMPROVING VICTORIA'S AIR QUALITY

While Victoria's air quality is considered good in an international context, the 2004 monitoring results highlight the impact of particles in the major metropolitan areas and in the smaller rural towns.

Days when the particles objectives were not met (both visibility and PM_{10}) have been attributed mainly to:

- *dust*, whether that be due to construction activities in localised areas close to the monitoring stations or more widespread dust storms due to the transport of dust from drought affected rural areas
- *prescribed burning,* that forms an integral part of Victoria's bushfire management practices.

In addition, particle pollution results from activities associated with our urbanised lifestyle, including motor vehicle usage, industrial/commercial activities and the widespread usage of household wood heaters in many areas of Victoria.

EPA continues to work to address issues with the generation of dust from local construction sources. EPA is also contributing to the review of the 'Code of Practice for Fire Management on Public Land' that the Department of Sustainability and Environment is currently conducting.

Some other programs being undertaken by EPA to reduce emissions include:

- progressive introduction of new national fuel standards that by 2008 will reduce diesel particle emissions
- continued promotion of the benefits of proper motor vehicle maintenance and of smooth driving techniques
- continuing the smoky vehicle program, with more than 16,000 reports made in 2004 by the Victorian community
- the introduction in 2004 of a new regulatory requirement that means all new wood heaters made and sold in Victoria must comply with the Australian Standard. These compliant heaters will produce significantly less emissions. A media campaign was also undertaken to raise awareness of the importance of good wood heater operating techniques
- ongoing activities to work with industry to promote best practice in the management of air

emissions. Action plans were developed by major industries in 2004.

The impact of particles pollution on human health is an area that is generating significant research both locally and overseas. EPA will be undertaking further studies that will enable a better understanding of particle pollution in Victoria and be used to guide further improvement strategies.

RELATED PUBLICATIONS

The following publications are accessible through the EPA website www.epa.vic.gov.au, by clicking on 'Publications & Legislation' at the homepage.

Air Monitoring Report 2004: Compliance with the National Environment Protection (Ambient Air Quality) Measure, EPA Publication 1001, 2005. Includes more data tables and statistics.

State Environment Protection Policy (Ambient Air Quality), *Victoria Government Gazette* No. S19, 09/02/1999 (amended in Dec 2001). Sets air quality objectives and broad monitoring protocol.

Ambient Air Quality NEPM Monitoring Plan Victoria, EPA Publication 763, 2001. Details Victoria's commitments for monitoring under the National Environment Protection Measure.

Air Monitoring at Nunawading – September 2003 to February 2004, EPA Publication 948, 2004.

Airborne particle monitoring at Shepparton, December 2003 to December 2004, EPA Publication 992, 2005.

Benzene air monitoring in Corio 2003–2005, EPA Publication 999, 2005.

The following additional information on air quality is available from www.epa.vic.gov.au/air:

Tables of air quality data for 2004.

Annual monitoring reports and data tables from past years.

The EPA air quality index. Definition and method calculation of the index.

Wood Heaters, Open Fires and Air Quality. Tips for reducing pollution.