ENVIRONMENT PROTECTION AUTHORITY

South Australia's air quality 2006

EPA
South Australia

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EPA Air and Noise Branch

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CONTENTS

List of figures

List of tables

ABBREVIATIONS

Air NEPM	National Environment Protection (Ambient Air Quality) Measure
AQI	Air Quality Index
DOAS	Differential optical absorption spectrometry
EPA	South Australian Environment Protection Authority
HVS	High volume sampler, an instrument used for collecting samples of airborne particulate matter.
NEPC	National Environment Protection Council, operating under the umbrella of the Environment Protection and Heritage Council
NEPM	National Environment Protection Measure
$PM_{2.5}$	Particulate matter with an equivalent aerodynamic diameter of 2.5 μm or less
PM_{10}	Particulate matter with an equivalent aerodynamic diameter of 10 μm or less
ppm	Parts per million (by volume)
TEOM	Tapered element oscillating microbalance, an instrument used to continuously monitor airborne particulate matter
TSP	Total suspended particles
VOC	Volatile organic compounds, organic (carbon-based) chemicals that evaporate at room temperatures. They react with nitrogen oxides in the presence of sunlight to form the air pollutant ozone.
$\mu g/m^3$	Micrograms per cubic metre, the unit used for determining concentrations of particulate matter in air
μm	Micrometre, one millionth of a metre

SUMMARY

This report describes the South Australian Environment Protection Authority (EPA) air quality monitoring activities conducted by the Air and Noise Branch in 2006. The report includes a compilation of the ambient air quality monitoring data obtained in 2006.

In 2006, the EPA operated seven monitoring sites in Adelaide, one site in Port Augusta, five sites in Port Pirie, four sites in Whyalla and one site in Woodside. The air pollutants monitored at these sites were carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead (in Port Pirie only), and particulate matter as PM_{10}, $PM_{2.5}$, and total suspended particles (TSP).

In Adelaide, the air quality, as indicated by the Air Quality Index, was generally very good to good, with poor or very poor air quality only 3% of the time. High levels of fine particulate matter (PM_{10}) were recorded at the Adelaide monitoring sites on 12 days. Several of these days were caused by bushfire smoke or windblown dust. The Air NEPM goal is that the standard should not be exceeded for more than five days per year.

A high ozone level was recorded on one day at the Netley monitoring site.

In Port Pirie, the annual average lead concentrations recorded at monitoring sites in located in the suburbs of Port Pirie South, Port Pirie West and Risdon Park were all below the Air NEPM standard. The monitoring site in the suburb of Port Pirie, located close to the lead smelter to monitor industry performance, consistently recorded high lead levels.

High sulfur dioxide concentrations were recorded in Port Pirie on 33 days in 2006. The Air NEPM goal is that the standard should not be exceeded for more than one day per year.

The EPA has two monitoring sites in Port Pirie where particulate matter levels are continuously monitored. These sites recorded a total of 15 days when there were high levels of fine particulate matter (PM_{10}) in the air. Several of these days were caused by bushfire smoke or windblown dust. The Air NEPM goal is that the standard should not be exceeded for more than five days per year.

In Whyalla, EPA monitoring demonstrated that particulate pollution from the OneSteel steelworks continues to be a problem in the eastern end of the city. High levels of fine particulate matter (PM_{10}) were recorded on 29 days. The Air NEPM goal is that the standard may not be exceeded on more than five days per year.

In Port Augusta there was one day on which a high level of fine particulate matter (PM_{10}) was recorded.

In Woodside in the Adelaide Hills, the EPA conducted an air quality monitoring program in conjunction with the SmokeWatch community education program. During the 15-week monitoring period, the levels of carbon monoxide, nitrogen dioxide and fine particulate matter (PM_{10}) were at all times less than the standards set by the Air NEPM.

WHY DOES THE EPA MONITOR AIR QUALITY IN SOUTH AUSTRALIA?

The En*vironment Protection Act 1993*, under which the South Australian Environment Protection Authority (EPA) was created, has as one of its objectives:

(vii) to provide for monitoring and reporting on environmental quality on a regular basis to ensure compliance with statutory requirements and the maintenance of a record of trends in environmental quality

The EPA's *Strategic Plan 2005-2008* (2005a) identifies 'clean and healthy air' as one of the five environmental goals for the EPA. The plan states that while South Australia currently enjoys good air quality, there are a number of areas where we need to improve. Emissions from motor vehicles make a significant contribution to air pollution in urban areas. Several regional problems require continuing management, including lead in Port Pirie, iron ore dust in Whyalla and wood heater smoke in the Adelaide Hills and Mount Gambier. The Strategic Plan states that poor air quality directly affects:

- human health—through, for example, the exacerbation of asthma and respiratory disease (particularly in the young and elderly), and the effects of lead on young children
- the environment—through damage to vegetation, animal health and the marine environment
- the state's economy—due to increased medical costs because of pollution–induced illness, reduced workforce productivity, damage to infrastructure and adverse effects on tourism.

The Air and Noise Branch of the Science and Sustainability Division of the EPA implements the EPA's air monitoring plan. This outlines the EPA's strategies to comply with its obligation to monitor this aspect of environmental quality, to help to achieve the goals of its Strategic Plan, and to meet its obligations to report on air quality to the National Environment Protection Council (NEPC). The ambient air quality monitoring plan is available on the EPA website (EPA 2001).

South Australia has enacted the national air quality standard, the *National Environmental Protection (Ambient Air Quality) Measure* or Air NEPM (NEPC 2003), as the required standard for seven common air pollutants. The Air NEPM sets standards and goals for carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead and particles of equivalent aerodynamic diameter 10 micrometres (μm) or less (PM_{10}), and has an advisory reporting standard for particles of equivalent aerodynamic diameter 2.5 micrometres (μm) or less ($PM_{2.5}$). Tables 2 and 3 in Appendix 1 show the Air NEPM standards and goals for these pollutants.

Carbon monoxide [CO]

Carbon monoxide is a toxic gas created by the incomplete burning of fuels that contain carbon. It is a component of the exhaust gases of motor vehicles. Exposure to carbon monoxide is a health risk, especially for people with existing heart or circulation problems as it replaces oxygen in the blood.

Nitrogen dioxide [NO_2]

Nitrogen dioxide (NO_2) and nitric oxide (NO) are two of the oxides of nitrogen (collectively called NO_x). Nitric oxide is created in combustion processes and its most common source is the exhaust gases of motor vehicles. In the atmosphere, nitric oxide is oxidised to nitrogen dioxide by reaction with ozone, or in cold winter-time conditions by reaction with oxygen.

Nitrogen dioxide irritates the eyes, nose, throat and respiratory system and aggravates existing respiratory problems.

Ozone [O_3]

Ozone is a highly reactive gas, created in the atmosphere by the reaction of nitrogen dioxide with volatile organic compounds (VOCs) under the influence of sunlight.

Ozone irritates the respiratory system and aggravates existing respiratory problems.

Sulfur dioxide [SO_2]

Sulfur dioxide is an acid gas created by the combustion of fuels that contain sulfur. In Port Pirie, it originates from the processing of lead sulfide ores.

Sulfur dioxide irritates the eyes, nose, throat and respiratory system and aggravates existing respiratory problems.

Lead [Pb]

Lead is a heavy metal pollutant originating from industrial sources, particularly in Port Pirie where the world's largest primary lead smelter is located. Leaded petrol for motor vehicles was once the principal source of lead in Adelaide and the other urban centres. It has not been sold in Australia since late 2000 after which airborne concentrations rapidly decreased to negligible levels, so the EPA no longer monitors for lead pollution in Adelaide (EPA, 2003).

Lead is a toxic metal that particularly affects intellectual development and the central nervous system. Infants and toddlers are particularly susceptible because their central nervous systems are developing rapidly. This risk is compounded because they have a higher risk of exposure and an increased ability to absorb lead.

Particulate matter

Particulate matter is measured as total suspended particles (TSP), PM_{10} and $PM_{2.5}$.

Particulate matter pollution originates from a wide range of sources, including vehicle exhausts, residential wood heaters, and industrial processes such as furnaces and boilers. Natural sources contribute mineral dusts, sea salt and pollen as components of particulate matter. Unlike the other air pollutants described here, particles are a broad mix of chemically and physically diverse substances.

The effects of particulate matter depend on the chemical nature of the particles, their size, how they are carried through the respiratory system and how the body responds to the particles. Medical studies have linked the levels of particulate matter in the air with the daily death rate and the rates of hospital admissions for respiratory ailments or heart problems in major cities.

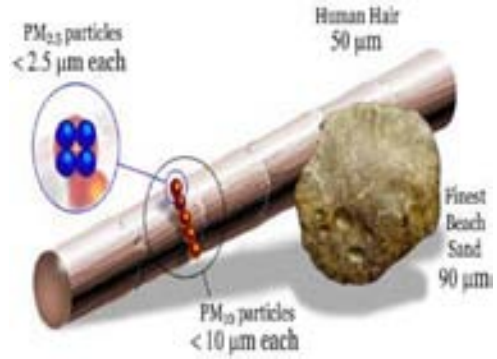

Figure 1 Comparison of PM_{10} particles to the finest beach sand, human hair and $PM_{2.5}$ particles

A comparison of the size of PM_{10} particles with a human hair and a grain of beach sand is illustrated in Figure 1. The image was obtained from the Auckland Regional Council—Air Pollution in Auckland website <http://www.arc.govt.nz> and is available at <www.arc.govt.nz/arc/index.cfm?7AB56726-21F1-4D53-A079-BFC1CE8CDF25>.

Air Quality Index

The Air Quality Index (AQI) is a simplified general indicator of air quality in a region. The AQI is calculated in three steps:

- an hourly index is calculated for each pollutant at each monitoring site in the region. This index is the measured value expressed as a percentage of the standard set by the Air NEPM.
- the highest index calculated for any of the pollutants monitored at the monitoring site is taken as the AQI value for the monitoring site. The index is the 'worst case' value for the site.
- the AQI for the region is the highest index of all the monitoring sites in the region. It is the 'worst case' value recorded for all the sites.

Table 1 defines the categories of 'very good', 'good', fair', 'poor' and 'very poor' for AQIs.

Table 1 Definition of categories used in the air quality index

AQI Category	Definition
Very good	The highest individual air quality parameter in the region is less than 33% of the Air NEPM standard.
Good	The highest individual air quality parameter is between 33% and 66% of the Air NEPM standard.
Fair	The highest individual air quality parameter is between 66% and 99% of the Air NEPM standard.
Poor	An air quality parameter exceeds the Air NEPM standard.
Very poor	The highest individual air quality parameter is at least 50% greater than the Air NEPM standard.

AIR QUALITY IN ADELAIDE

In 2006 the air quality in Adelaide, as indicated by the AQI, was very good 38% of the time, good 53% of the time, fair 6% of the time and poor to very poor just 3% of the time (Figure 2). These AQI figures are very similar to 2005, when the AQI was very good 37% of the time, good 50% of the time, fair 10% of the time and poor to very poor just 3% of the time.

Figure 2 Air quality indices for Adelaide 2002–06

The levels of airborne fine particles were usually the problem when the air quality was indexed as worse than 'very good'. The ozone levels were often a factor when the air quality was indexed as good, occasionally a factor when the air quality was fair, and on just one occasion contributed to a poor air quality index.

Two days in 2006 had particularly poor air quality. On 25 and 26 January, Adelaide was blanketed by smoke from major bushfires on Kangaroo Island and in the Grampians district of Victoria. All the EPA monitoring sites in Adelaide and the EPA monitoring sites in Port Pirie and Whyalla recorded high levels of airborne fine particles on both of those days. On 25 January, the EPA monitoring site at Netley recorded an ozone level that was above the Air NEPM standard.

Figure 3 Smoke from bushfires in the Grampians, Victoria, drifts west across South Australia

Figure 3 is an image from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the TERRA satellite operated by the United States National Aeronautics and Space Administration (NASA). It was taken on 25 January 2006 and shows smoke from a massive bushfire in the Grampians National Park in western Victoria drifting west across South Australia. On this day, the bushfire covered 122,770 hectares of bushland. The image was obtained from the NASA MODIS Rapid Response website <rapidfire.sci.gsfc.nasa.gov> and is available at <rapidfire.sci.gsfc.nasa.gov/fas/?SEAustralia1/2006025/FAS_SEAustralia1.2006025.terra>.

Other recent EPA reports on air quality in Adelaide are listed in this report under *Recent EPA Air Quality Publications*.

Fine particles in the air

The EPA monitored fine particles (PM_{10}) in the air at five monitoring sites in Adelaide. The sites located in the suburbs of Birkenhead, Elizabeth Downs, Kensington Gardens and Netley operated for the full calendar year. A fifth site at Christie Downs commenced operation in March 2006.

There were 12 days in 2006 when high levels of fine particles were recorded in the air at these monitoring sites. Most of these occasions (11 days) were recorded at the Netley site, with six days at Birkenhead, four days at Elizabeth Downs, two days at Kensington Gardens and two days at the new Christie Downs site. Of these 12 days, six were due to smoke haze from bushfires in Victoria, Kangaroo Island or the Murraylands, and two were due to strong winds and windblown dust.

At the Netley laboratory particulate matter as $PM_{2.5}$ is being monitored, a smaller component of the airborne particulate matter, as part of a national research study. For $PM_{2.5}$ the Air NEPM has advisory reporting standards of 8 $\mu g/m^3$ for the annual average and 25 $\mu g/m^3$ for the daily average. The annual average recorded at Netley equalled the advisory reporting standard of 8 $\mu g/m^3$. The advisory reporting standard was exceeded on 25 January and 26 January, the two days when Adelaide was blanketed by smoke from bushfires on Kangaroo Island and in Victoria.

Ozone

The EPA monitored ozone levels at five monitoring sites in Adelaide. Four of these sites were located in the suburbs of Elizabeth Downs, Kensington Gardens, Netley and Northfield. A fifth site, located at Christie Downs, commenced operation in March 2006.

On 25 January the ozone level recorded at the Netley site exceeded the Air NEPM standard. On this day, Adelaide was blanketed by smoke from major bushfires burning on Kangaroo Island and in the Grampians area of Victoria.

Apart from this single event, the ozone levels in Adelaide were within the Air NEPM standard. They are moderately high, however, and, as this occurrence at Netley demonstrates, under some climatic conditions, ozone levels could become a problem in Adelaide.

Carbon monoxide

The EPA monitored carbon monoxide at two monitoring sites. The monitoring site at Elizabeth Downs has been operating since 2002 and consistently records very low levels of carbon monoxide. A new monitoring site was established in Grenfell Street, Adelaide, in September 2006 and this has so far recorded moderate levels of carbon monoxide in a busy street in the central city area.

Nitrogen dioxide

The EPA monitored nitrogen dioxide at five monitoring sites located across the city, including the new monitoring site established at Christie Downs in March 2006. The levels of nitrogen dioxide were generally very low and well within the Air NEPM standard.

Sulfur dioxide

The EPA monitored sulfur dioxide at a single monitoring site at Northfield. The levels of sulfur dioxide were very low and well within the requirement of the air NEPM standard.

A report on the results of the sulfur dioxide monitoring in metropolitan Adelaide has been published previously (EPA, 2004b).

AIR QUALITY IN THE SPENCER GULF REGION

Port Pirie

The major industry in Port Pirie is the Zinifex lead smelter. The smelter processes lead sulfide ores, causing lead, sulfur dioxide and fine particulate pollution in the city.

The EPA and the Department of Health have measured lead levels and particulate matter levels in Port Pirie for many years. Currently, the EPA monitors lead and particulate matter by high volume sampling (HVS) at four monitoring sites located at Port Pirie South, Port Pirie West, Risdon Park and Port Pirie. The Port Pirie monitoring site is an industrial monitoring site located in Ellen Street near the boundary of the lead smelter.

The EPA also monitors the levels of sulfur dioxide in the air at the Port Pirie South monitoring site. Fine particulate matter (PM_{10}) is monitored continuously with TEOM (Tapered element oscillating microbalance) units both at the Port Pirie South monitoring site and at a site in Port Pirie West, operated since August 2005 on behalf of the Department of Health.

In July and August 2006, major parts of the Zinifex smelter were shut down for 46 days to undertake significant maintenance and capital works. During this period, the levels of sulfur dioxide recorded at the EPA monitoring site in Port Pirie South dropped significantly, particularly during the period when the acid plant was closed to allow replacement of the heat exchanger. The lead levels were also lower during this period than during previous years. The monitoring site in Ellen Street recorded an average lead level of 3.02 $\mu g/m^3$ during the shutdown, compared to an average of 7.53 $\mu g/m^3$ for the same period in the three preceding years.

The EPA has published a report on an air quality monitoring study that it conducted in Port Pirie from 2002 to 2005 (EPA, 2006c).

Lead

In 2006, the annual average lead concentration was 0.49 $\mu g/m^3$ at the monitoring site at Port Pirie South, 0.38 $\mu g/m^3$ in Port Pirie West, and 0.16 $\mu g/m^3$ in Risdon Park. All three sites had annual average lead concentrations below the Air NEPM standard of 0.50 $\mu g/m^3$. In 2005, the annual lead concentrations at Port Pirie South and Port Pirie West exceeded the Air NEPM standard.

At the monitoring site in Ellen Street, Port Pirie, the annual average lead concentration was 2.13 $\mu g/m^3$. This site is located in an industrial area close to the lead smelter to monitor industry performance, so the data should not be compared to the Air NEPM standard.

Sulfur dioxide

The EPA monitors sulfur dioxide at the Port Pirie South monitoring site. In 2006, the Air NEPM standard (0.20 ppm for the one-hourly average) was exceeded on 33 days during the year. However, the one-day average sulfur dioxide concentrations and the yearly average sulfur dioxide concentrations complied with the Air NEPM standards.

Fine particles in the air

There were 15 days in 2006 when high levels of fine particulate matter were recorded at the EPA monitoring sites. The Port Pirie South site recorded 13 days with high levels and the Port Pirie West site recorded 10 days. Six of these days were due to smoke haze from bushfires in Victoria, Kangaroo Island or the Murraylands, and three days were due to strong winds and windblown dust.

Whyalla

The major industry in Whyalla is the OneSteel steelworks. OneSteel's iron ore pelletising plant and the ore loading facilities at the port are close to the eastern end of Whyalla. The EPA currently has a monitoring site at the eastern end of Whyalla to monitor this industrial activity and a site in Whyalla Norrie to the west that monitors background levels.

The EPA has completed a study of the levels of ozone, nitrogen dioxide and sulfur dioxide in the suburb of Whyalla Norrie and a report has been prepared, titled *Ambient air quality at Whyalla, South Australia: Monitoring campaign 2004–06*. It is available on the EPA website <www.epa.sa.gov.au>.

Fine particles in the air

In 2006, particulate matter, as PM_{10}, was monitored at three sites in Whyalla. At Walls Street, Whyalla, particulate matter is continuously monitored using a TEOM unit. At the EPA site in Civic Park, Searle Street, Whyalla Norrie, particulate matter is monitored one day in three by HVS. A site using HVS at Hummock Hill (Gay Street, Whyalla) operated one day in three until its closure in September 2006.

At the Walls Street monitoring site, high levels of fine particulate matter were recorded on 29 (8%) of the 353 days when a one-day average was recorded. At the Hummock Hill site, high levels of fine particulate matter were recorded for 15 (17%) of the 89 one-day samples obtained by HVS before the site was closed in September. As with other EPA monitoring sites, several of these days were associated with smoke haze from bushfires in Victoria, Kangaroo Island or the Murraylands, or with strong winds and windblown dust.

The monitoring site at Civic Park, Whyalla Norrie, is used to monitor background levels of particulate matter in the City of Whyalla. High levels of fine particulate matter were recorded on two days in 2006. One of these days was on 26 January, when the state was affected by smoke from bushfires in Kangaroo Island and Victoria.

Port Augusta

In Port Augusta, the EPA monitors particulate matter, as PM_{10}, by HVS (one day in six) at a monitoring site located at the hospital. There was just one particularly high value recorded on 8 October. This may have been a localised occurrence as none of the other EPA monitoring sites recorded a high level on this day and there were no identified air quality events on this day.

THE SMOKEWATCH PROGRAM IN THE ADELAIDE HILLS

The incorrect use of wood heaters can seriously affect air quality and reduce the efficiency of wood heaters. To address this issue, the EPA, in partnership with the Adelaide Hills Council, has developed the community education and behavioural change program, SmokeWatch.

SmokeWatch aims to reduce local wood smoke by encouraging householders to use their wood heaters efficiently. The program includes a SmokeWatch Challenge (where people commit to the SmokeWatch guidelines for proper operation of their wood heater), competitions, school activities and partnerships with local businesses.

In 2006 the Adelaide Hills Council conducted a pilot study of the developed SmokeWatch program. During the pilot study, the EPA operated a short monitoring study at the Woodside Primary School to investigate the air quality in Woodside in winter. Carbon monoxide, nitrogen oxides and PM_{10} particulate matter were monitored from 14 June to 2 October 2006. Benzene and formaldehyde were also monitored by differential optical absorption spectrometry (DOAS).

During the short period of monitoring, the levels of carbon monoxide, nitrogen dioxide and fine particulate matter were at all times less than the standards set by the Air NEPM.

The EPA proposes to continue to investigate the wood smoke problem in the Adelaide Hills.

HOW CAN WE IMPROVE THE AIR QUALITY IN SOUTH AUSTRALIA?

What are the air quality issues in South Australia?

The current air pollution issues in South Australia include:

- in Port Pirie, emissions of lead and sulfur dioxide from the lead smelter
- in Whyalla, fugitive iron ore dust from the transportation, storage, shipment and pelletising operations at the OneSteel steelworks
- emissions of fine particles, nitrogen oxides and carbon monoxide from motor vehicles in urban areas
- particulate emissions and odours from industrial facilities in Adelaide and other urban centres
- smoke emissions from wood heaters in residential properties, which is a seasonal problem particularly in the Adelaide Hills and Mount Gambier
- air pollution of climatic and environmental origin, such as windblown dust and smoke from bushfires.

The emerging issues include:

- pollution issues, primarily particulate emissions and odours, arising from the establishment of new industries and expansion of existing industries adjacent to residential areas or the encroachment of residential developments into industrial areas
- possible pollution, both particulate and heavy metals, from new mineral exploitation activities in South Australia.

What is the EPA doing to improve air quality?

Lead

Reducing the lead exposure of the public, particularly children, in Port Pirie is a key environmental health initiative for South Australia. The EPA is working with Zinifex (the operator of the lead smelter), the Department of Health and the Port Pirie Regional Council in the Ten by 10 program, which targets the reduction of blood lead levels in Port Pirie children to 10 micrograms per decilitre by 2010.

Lead is not a problem in the other metropolitan centres because leaded petrol has not been sold in Australia since late 2000.

Wood heaters

According to studies for the National Pollutant Inventory, domestic solid fuel heaters are responsible for about 10% of the fine particulate pollution in the Adelaide region. The EPA is working with local government to resolve complaints relating to the use of these heaters. The SmokeWatch program aims to reduce local wood smoke problems by encouraging householders to use their wood heaters efficiently. In 2006 the Adelaide Hills Council conducted a pilot study for the SmokeWatch program and, as part of this study, air quality monitoring was conducted in Woodside in the winter months.

Industry

The EPA uses its powers under the Environment Protection Act to encourage licensed industries to undertake Environmental Improvement Programs to reduce emissions that contribute to air pollution. The EPA also supports industry by developing industry manuals for monitoring and undertaking industry compliance audits.

Motor vehicles

Emissions from motor vehicles are managed under the Australian Design Rules (ADR 79 & ADR 80), with a supporting role played by the Environment Protection (Motor Vehicle Fuels Quality) Policy 2002. The Australian Design Rules (ADRs) set out design standards for vehicle safety and emissions. They are developed through a consultative process involving government, industry, employee and consumer representatives. Australian emission standards are now harmonised with European ones and include the progressive introduction of increasingly stringent standards each year to reduce the pollution from new vehicles.

What is industry doing to improve air quality?

Even small businesses can contribute to improved air quality by establishing good environmental management procedures and using the best available technology to minimise emissions from their facilities.

Two of South Australia's largest industries currently have major projects that will improve the air quality in the cities in which they operate.

In Port Pirie, Zinifex has instituted the Ten by 10 project with the goal of having at least 95% of children 0 to 4 years of age with blood lead levels below the national standard of 10 micrograms per decilitre by the year 2010. A major component of the Ten by 10 project is reducing fugitive emissions from the smelter site, both direct emissions from the processes on the site and windborne emissions from the site. Zinifex recognises that the success of this project depends on full engagement with the local community and state and local government agencies and has adopted a partnership approach with key stakeholders.

In Whyalla, OneSteel has commenced work on Project Magnet, a project to use magnetite ore slurry instead of dry, fine haematite ore as the feedstock for their steelworks. Changes in their processes and new facilities to be constructed at the OneSteel plant and their ship-loading facilities in the Port of Whyalla will minimise the environmental impact of fugitive dust escaping from the plant. The facilities to be installed include an enclosed train unloading facility, fully enclosed conveyors with dust extraction systems to transport iron ore, a fully enclosed shed with a capacity of 250,000 tonnes, to store iron ore, and upgraded ship-loading equipment with water misting sprays.

What can the public do to improve air quality?

Motor vehicles are a major contributor to air pollution in the urban areas of South Australia. The public can assist by ensuring that vehicles are properly maintained, using their vehicles less, making more use of public transport, and cycling or walking instead of driving.

Following the SmokeWatch guidelines for proper operation of wood heaters will help reduce particulate air pollution from wood heaters, which is a seasonal problem particularly in the Adelaide Hills and Mount Gambier.

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APPENDIX 1 EPA AIR QUALITY MONITORING OPERATIONS IN 2006

EPA monitoring sites in South Australia

In 2006, the EPA carried out ambient air quality monitoring at seven monitoring sites in greater Adelaide, five sites in Port Pirie, four sites in Whyalla, one site in Port Augusta and at a temporary site in the township of Woodside in the Adelaide Hills.

The air pollutants measured at these sites were:

- carbon monoxide
- nitrogen oxides, including nitrogen dioxide
- ozone
- sulfur dioxide
- lead, at monitoring sites in Port Pirie only
- particulate matter, as particles of equivalent aerodynamic diameter 10 micrometres or less (PM_{10})
- particulate matter, as particles of equivalent aerodynamic diameter 2.5 micrometres or less ($PM_{2.5}$)
- particulate matter, as total suspended particles (TSP).

Particulate matter, as PM_{10}, is measured by two instruments: the tapered element oscillating microbalance (TEOM), a continuously monitoring unit; or the high volume sampler (HVS) which is used to collect a 24-hour sample one day in six, or, in Whyalla, one day in three.

The following descriptions of monitoring sites indicate their purpose.

Performance monitoring station (PMS)

A monitoring site used to measure air quality against the goals set by the National Environment Protection (Ambient Air Quality) Measure (Air NEPM). It should operate in the same location for at least five years.

Trend site

A performance monitoring station, operating for an extended period of at least 10 years to see if there are long-term changes in pollutant levels.

Campaign site

A site used for a short-term screening study to determine if a performance monitoring station should be established.

NEPM Study site

A site for monitoring particulate matter, as $PM_{2.5,}$ to provide data for an Air NEPM research study.

Industrial site

A site that monitors the environmental impact of industrial facilities on adjacent residential areas.

'Hot spot' site

A site that is operated for a short time to investigate air pollution levels in a particular location.

EPA monitoring sites in the Adelaide Region, 2006

ADL01 Adelaide (Grenfell Street)

This site was located in the Tandanya Building, 253 Grenfell Street, Adelaide, and monitored 'upper bound' carbon monoxide levels in the central city (Figure 4). It replaced a performance monitoring site in Hindley Street, Adelaide. The site commenced operation on 25 September 2006 and was closed on 28 March 2007 after the basement in which the equipment was located was flooded.

BIR02 Birkenhead (Hughes Street)

This monitoring site is located in the grounds of Le Fevre Peninsula Primary School in a suburb adjacent to a major industrial area (Figure 4). Monitoring for PM_{10} particulate matter by TEOM began at this site on 21 June 2005.

CHD01 Christie Downs (Sabina Crescent)

This new site is located in the grounds of Christies Beach High School and is a campaign site established to determine if there is a continuing need for air quality monitoring in the southern suburbs of Adelaide (Figure 4). Monitoring for nitrogen oxides, ozone and PM_{10} particulate matter commenced on 24 March 2006. Nitric oxide, nitrogen dioxide, sulfur dioxide, benzene, toluene, and formaldehyde are also monitored by differential optical absorption spectrometry (DOAS).

ELI01 Elizabeth Downs (Heard Street)

This is a performance monitoring site for carbon monoxide, nitrogen oxides and ozone. Monitoring commenced at this site in mid-January 2002 (Figure 4). Monitoring for PM_{10} particulate matter began on 31 May 2004. Sulfur dioxide was monitored from 12 May 2002 to 31 March 2004.

GEP01 Gepps Cross (Grand Junction Rd)

This 'hot spot' site was located in the grounds of the Gepps Cross Girls High School (Figure 4). It was operated for a short period as part of a study into industrial air pollution in the suburbs of Kilburn and Gepps Cross. Carbon monoxide was monitored from 23 November 2005 to 8 May 2006. PM_{10} particulate matter was monitored by TEOM from 22 November 2005 to 7 May 2006. TSP particulate matter was monitored by HVS from 5 January to 7 May 2006. Ozone, nitrogen dioxide, sulfur dioxide, benzene, toluene, and formaldehyde were also monitored by DOAS.

Reports on this air quality study are available on the EPA website (EPA 2006e; 2006f; 2006g).

KEN01 Kensington Gardens (East Terrace)

This site has been used for trend and performance monitoring for nitrogen oxides and ozone since 21 September 2001 and for particulate matter as PM_{10} since 6 June 2002 (Figure 4). $PM_{2.5}$ particulate matter was monitored for the NEPM Study from June 2002 to 12 March 2004. Sulfur dioxide was monitored from 13 August 2002 to 7 January 2005.

NET01 Netley (Transport Avenue)

This monitoring site is located at the EPA Air Quality Laboratory in a western industrial suburb (Figure 4). It has been used for trend and performance monitoring for nitrogen oxides and ozone since 1988. PM_{10} particulate matter has been monitored by TEOM since 21 September 2001 and by HVS from 8 February 2003 to 4 June 2006. Monitoring for $PM_{2.5}$ particulate matter for the NEPM study began on 4 September 2001 and is ongoing.

NOR01 Northfield (Hampstead Road)

This monitoring site, located in the grounds of the Hampstead Centre, has been used since 1979 for trend and performance monitoring for nitrogen oxides and ozone (Figure 4). Sulfur dioxide has been monitored since 15 October 2002. TSP was monitored by HVS from June 1995 to 13 September 2005, and PM_{10} was monitored by HVS from 8 February 2003 to 13 September 2005

WSD01 Woodside (Elizabeth Street)

This monitoring site at the Woodside Primary School was operated for a brief winter campaign in conjunction with the EPA SmokeWatch program. Carbon monoxide, nitrogen oxides and PM_{10} particulate matter were monitored from 14 June to 2 October 2006. Benzene and formaldehyde were also monitored by DOAS.

Recent monitoring sites in Adelaide

ADL04 Adelaide (Hindley Street)

This was a trend and performance monitoring site in the inner city for 'upper bound' carbon monoxide levels and operated from 18 March 1988 to 30 June 2005.

BIR01 Birkenhead (Jenkins Street)

This was the site for a 'hot spot' air quality study conducted between 6 December 2003 and 3 January 2005. PM_{10} particulate matter was monitored by TEOM. Carbon monoxide was monitored by NDIR. Nitric oxide, nitrogen dioxide, ozone, sulfur dioxide, benzene, toluene, formaldehyde and naphthalene were monitored by DOAS.

A report on this air quality study is available on the EPA website (EPA, 2006h).

GAE01 Gawler (Popham Avenue)

This was a campaign monitoring site where nitrogen oxides and ozone were monitored from January 2002 to 19 October 2004, and PM_{10} particulate matter was monitored by TEOM from June 2002 to 22 October 2004.

A report on this air quality campaign is available on the EPA website (EPA, 2006d).

KIL01 Kilburn (Cromwell Road)

This site was located in the grounds of the Canine Association of South Australia, adjacent to Kilburn Primary School. It was operated for a short period as part of a study into industrial air pollution in the suburbs of Kilburn and Gepps Cross. Carbon monoxide, sulfur dioxide and nitrogen oxides were monitored from 16 July 4 to 31 October 2005. PM_{10} particulate matter was monitored by TEOM from 1 January 4 to 27 December 2005. TSP particulate matter was monitored by HVS from 17 December 2004 to 18 November 2005. Ozone, benzene, toluene, and formaldehyde were also monitored by DOAS.

Reports on this air quality study are available on the EPA website (EPA 2006e; 2006f; 2006g).

OSB02 Osborne (Mersey Road)

This monitoring site was located on the boundary of a mineral processing plant to determine the air pollution impact on the surrounding residential area. PM_{10} and TSP data was collected by HVS from 2 July 1988 to 13 September 2005.

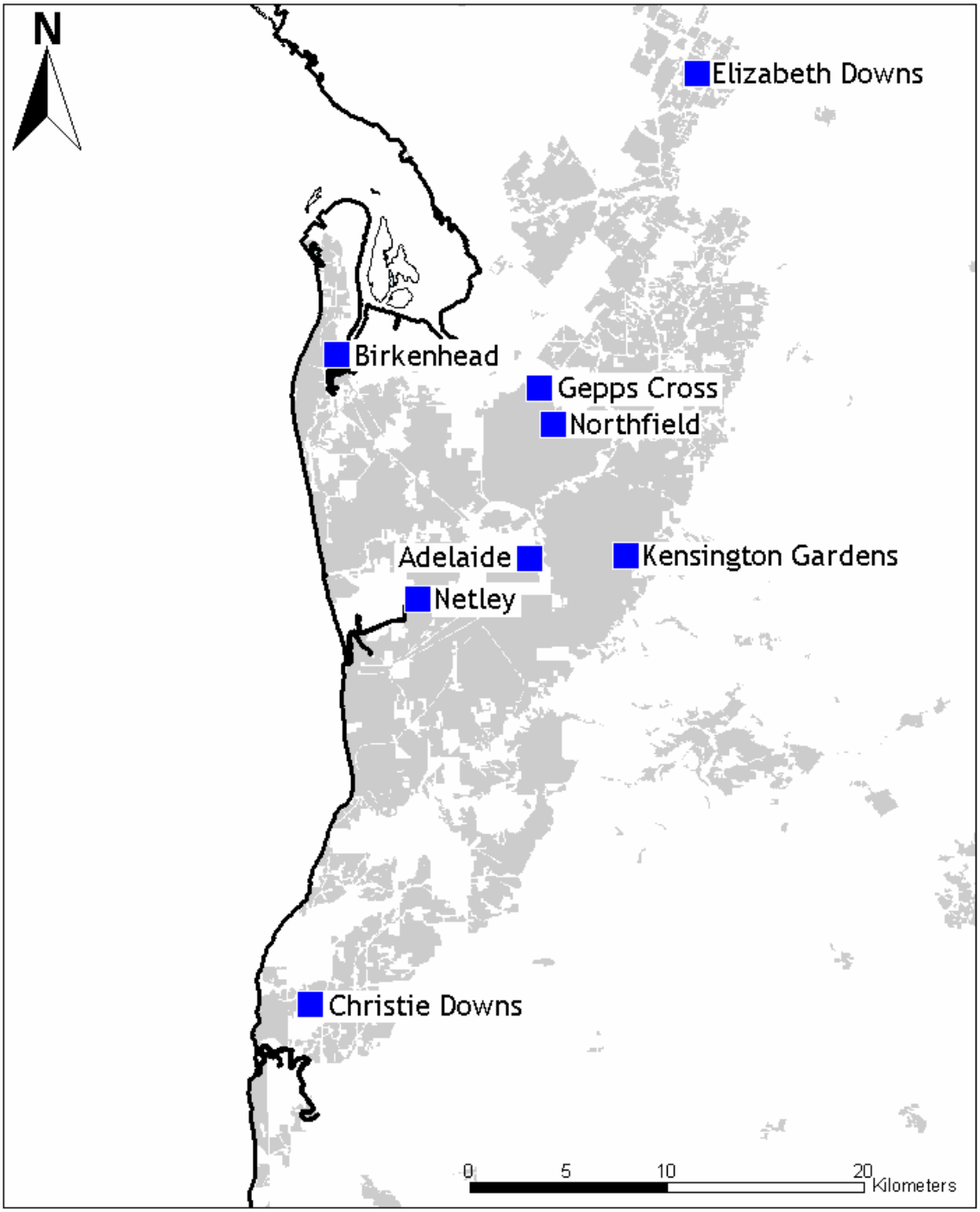


Figure 4 Air quality monitoring sites in Adelaide

EPA monitoring sites in the Spencer Gulf Region

PTA02 Port Augusta (Elizabeth Terrace)

This monitoring site is located in the grounds of the local hospital (Figure 5). PM_{10} particulate matter has been monitored by HVS since 1 August 1996. In 2006, data was recorded up to 13 November 2006. A replacement HVS unit was installed at this site in December 2006.

PTP04 Port Pirie (Ellen Street)

This is an industrial monitoring site located near the boundary of the lead smelter, so the Air NEPM standard for lead is not applicable (Figure 5). Monitoring for TSP and lead by HVS began in June 1984, paused in August 1998, and resumed in July 2001.

PTP01 Port Pirie South (Oliver Street)

PM_{10} particulate matter and TSP, with lead determinations, were monitored by HVS at this site from May 1984 to August 1988, and resumed on 8 October 1998 (Figure 5). PM_{10} particulate matter has been monitored by TEOM since 27 June 2003. Sulfur dioxide has been monitored since 26 June 2002. A monitoring campaign for nitrogen oxides and ozone took place from mid-May 2002 to 31 July 2005. A report on the air quality in Port Pirie is available on the EPA website (EPA, 2006c).

PTPO3 Port Pirie West (214 The Terrace)

This site is located at the Port Pirie West Primary School (Figure 5). TSP and lead have been monitored by HVS at this site since May 1984.

PTP02 Port Pirie West (58 The Terrace)

PM_{10} particulate matter has been monitored by TEOM at this residential site since 24 August 2005 (Figure 5). The EPA operates this site on behalf of the Department of Health.

PTP05 Risdon Park (Senate Road)

Risdon Park is a southern suburb of the city of Port Pirie (Figure 5). The monitoring site is located in Frank Green Park, near the intersection of Senate Road and Halliday Street. TSP and lead have been monitored by HVS at this site since March 1999.

WHY06 Whyalla (Gay Street)

This was an industrial monitoring site located on Hummock Hill close to the boundary of the steel works (Figure 5). Site WHY01 was established in 1989 to study the concentrations of dust near the pelletising plant. In May 2000, the monitoring site was relocated a short distance and redesignated WHY06. In May 2002 the sampling frequency was increased from one day in six to one day in three. TSP was monitored by HVS from 1989 to 30 March 2006. PM_{10} particulate matter was monitored by HVS from 1990 to 26 September 2006.

WHY04 Whyalla (Walls Street)

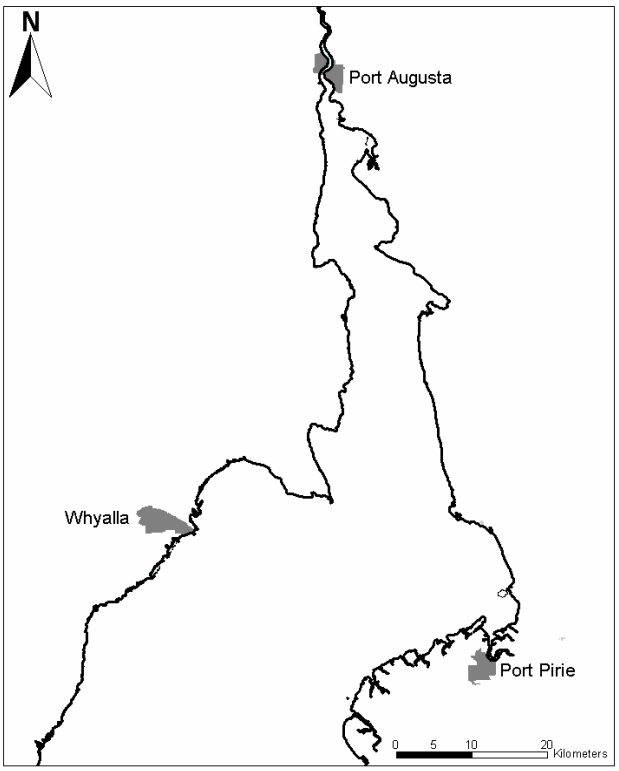
This is an industrial monitoring site (Figure 5). Site WHY03 was established in July 2003 to monitor for PM_{10} particulate matter with a TEOM unit. The monitoring unit was relocated approximately six metres due north on 29 June 2004 and redesignated WHY04.

WHY02 Whyalla Norrie (Nicolson Avenue)

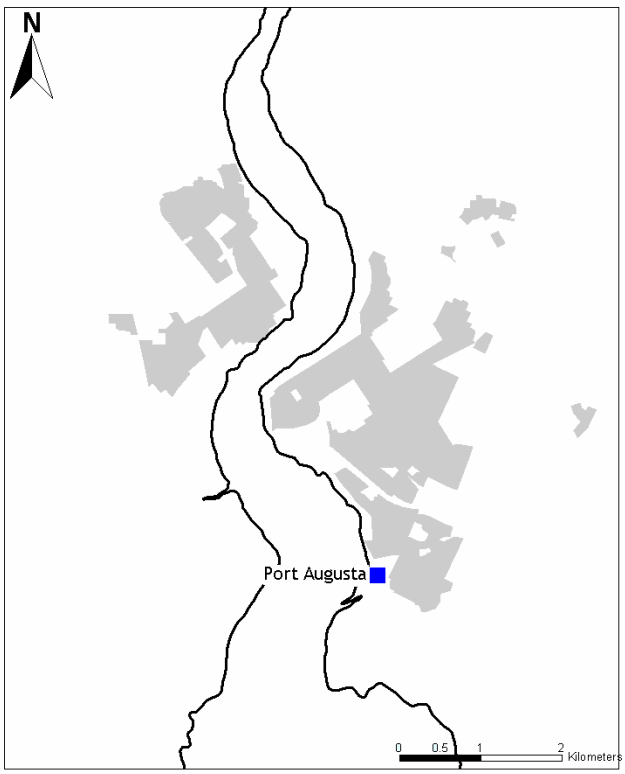
This was a campaign monitoring site in the west of the City of Whyalla (Figure 5). Ozone and nitrogen dioxide were monitored from 8 January 2004 to 6 June 2006. Sulfur dioxide was monitored from 30 March 2004 to 6 June 2006. A report has been prepared.

WHY05 Whyalla Norrie (Searle Street)

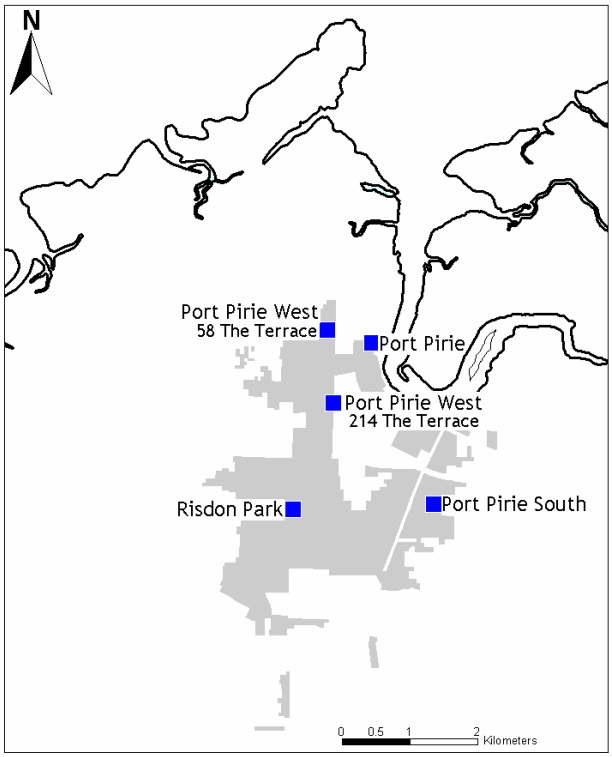
This monitoring site is located in Civic Park in the west of the city of Whyalla to monitor background levels of particulate matter (Figure 5). PM_{10} particulate matter has been monitored by HVS since October 2001. TSP was monitored by HVS from 1989 to 30 March 2006. The sampling frequency was increased from one day in six to one day in three in May 2002. This site has been closed earlier this year and the EPA monitoring facilities have been relocated to a more suitable site in Schulz Park, adjoining Civic Park.



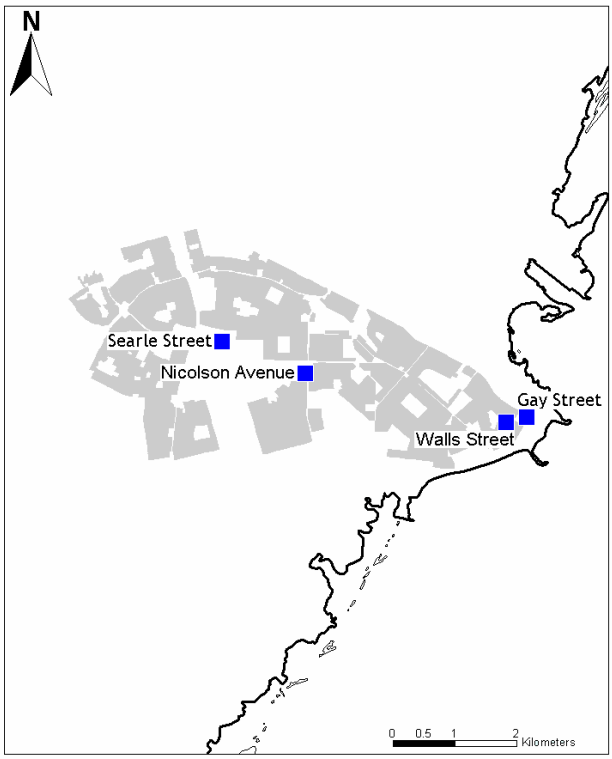
Cities in the Spencer Gulf region



Monitoring site in Port Augusta



Monitoring sites in Port Pirie



Monitoring sites in Whyalla

Figure 5 Air quality monitoring sites in the Spencer Gulf region

South Australian standards for ambient air quality

South Australia has enacted the national air quality standard as the required standard for seven common air pollutants. The Air NEPM sets standards and goals for carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead and particles of equivalent aerodynamic diameter 10 μm or less (PM_{10}). The Air NEPM was modified in 2004 to include an advisory reporting standard for particles of equivalent aerodynamic diameter 2.5μm or less ($PM_{2.5}$). Tables 2 and 3 show the Air NEPM standards and goals for these pollutants.

Table 2 Air NEPM standards and goals for pollutants other than particles as $PM_{2.5}$

Pollutant	Averaging period	Maximum concentration	10 years goal: maximum allowable exceedances
Carbon monoxide	8 hours	9 ppm	1 day a year
Nitrogen dioxide	1 hour	0.12 ppm	1 day a year
	1 year	0.03 ppm	None
Photochemical oxidants (as ozone)	1 hour	0.10 ppm	1 day a year
	4 hours	0.08 ppm	1 day a year
Sulfur dioxide	1 hour	0.20 ppm	1 day a year
	1 day	0.08 ppm	1 day a year
	1 year	0.02 ppm	None
Lead	1 year	0.50 μg/m^3	None
Particulate matter, as PM_{10}	1 day	50 μg/m^3	5 days a year

In addition to these goals, the Air NEPM has advisory reporting standards for particulate matter, as $PM_{2.5}$ (Table 2). The EPA uses the tapered element oscillating microbalance (TEOM) method to monitor particulate matter as $PM_{2.5}$. Values obtained by this method cannot be used for comparison with the advisory reporting standards until the equivalence of this method has been established and formally included in the Air NEPM.

Table 3 Air NEPM advisory reporting standards for particles as $PM_{2.5}$

Pollutant	Averaging period	Maximum concentration
Particulate matter, as $PM_{2.5}$	1 day	25 μg/m^3
	1 year	8 μg/m^3

Methods for monitoring ambient air quality

The EPA monitoring sites are placed in locations where the collected data will contribute to an understanding of air quality in South Australia. It is EPA policy to install the sites as required by *Australian Standard AS2922–1987 Ambient air—guide for the siting of sampling units*.

Most of the air quality parameters are continuously monitored by scientific instrumentation. The data generated by the instrumentation at each monitoring site is recorded onsite by a data logger and relayed by telephone to the EPA's central data system where the data is checked and validated. Where possible, the instrumentation at the sites is programmed to run response checks which are evaluated by EPA to ensure that the quality of data is maintained. The technical staff of the EPA Air Quality Laboratory at Netley provide regular maintenance and calibration services for the instrumentation.

While the monitoring instrumentation runs continuously, there are occasions when the monitoring is interrupted and data is not recorded. Data obtained during calibration and maintenance procedures are examples of this. Instrument, electrical or communication problems and vandalism of the site may also lead to the loss of data. While the Air NEPM requires a minimum data recovery rate of 75% for each quarter of the year, the data recovery rates in 2006 exceeded 85% and were generally in the mid to high 90% range.

The National Association of Testing Authorities (NATA) has accredited the EPA laboratory for the relevant chemical testing procedures. The laboratory was the third Australian EPA laboratory to achieve accreditation.

Measuring carbon monoxide

Carbon monoxide is measured by passing a beam of infrared light through a sample of air. The carbon monoxide concentration is calculated by measuring how much of the light is absorbed by the sample.

Measuring the oxides of nitrogen

Two oxides of nitrogen are measured: nitric oxide (NO) and nitrogen dioxide (NO_2). Two separate measurements are made to determine these oxides in air samples.

When the air sample is mixed with ozone, the nitric oxide molecules in the air sample react with the ozone to produce nitrogen dioxide molecules. The newly created nitrogen dioxide molecules are in a high energy state and emit light by a process called chemiluminescence. The amount of nitric oxide is calculated by measuring how much light is emitted.

The total amount of nitrogen oxides in the air sample is measured by first converting all the nitrogen dioxide molecules to nitric oxide molecules. The air sample then undergoes the same measurement process as for nitric oxide to give the total nitrogen oxide (NO_x) concentration.

The nitrogen dioxide content of the air sample is then calculated by subtracting the quantity of nitric oxide from the quantity of nitrogen oxides.

Measuring ozone

Ozone is measured by passing a beam of ultraviolet light through a sample of air. The ozone concentration is calculated by measuring how much of the light is absorbed by the sample.

Measuring sulfur dioxide

Sulfur dioxide is measured by passing a beam of ultraviolet light through a sample of air. The ultraviolet light causes the sulfur dioxide molecules in the sample to emit light by a process called fluorescence. The amount of sulfur dioxide is calculated by measuring how much light is emitted.

Measuring particulate matter by TEOM

Particulate matter concentrations (PM_{10} and $PM_{2.5}$) are measured continuously using a tapered element oscillating microbalance (TEOM). The TEOM draws air at a constant flow rate and at constant temperature through a filter attached to an oscillating element. As particulate matter accumulates on the filter, the frequency of oscillation changes. The amount of material that has accumulated is then calculated from the change in frequency.

The TEOM instrument uses a special sample collection head to collect particles in the size range of concern, either PM_{10} or $PM_{2.5}$. The '10' and the '2.5' refer to the sizes of the particles, measured as their equivalent aerodynamic diameter.

Measuring particulate matter by high-volume sampling (HVS)

High-volume samplers are used to collect 24-hour samples of particulate matter, either as PM_{10} or as total suspended particles (TSP). The sampler draws air through a filter paper at a known constant airflow for 24 hours. An operator installs a filter paper on which the sample is collected and then removes the filter paper after the sample has been taken. The filter paper is conditioned and weighed before and after sampling. The concentration of airborne particulate matter (as micrograms per cubic metre) is then calculated by dividing the increase in weight of the filter by the total airflow for the 24-hour sampling period.

HVS samples are usually collected every six days, but at the Whyalla monitoring sites the EPA takes samples every three days. In Port Pirie, the samples collected by HVS are analysed for their lead content.

Measuring airborne lead

The EPA measures the lead content of all the samples collected by high-volume sampling at the monitoring sites in Port Pirie. The material collected on the HVS filter paper is dissolved in nitric acid and analysed for lead by inductively coupled plasma atomic emission spectroscopy (ICP/AES).

Differential optical absorption spectrometry (DOAS)

The EPA uses DOAS in its campaign and 'hot spot' studies to monitor gaseous air pollutants and VOCs. In the DOAS method, a beam of light is passed through air for a distance of 200 metres to one kilometre from light source to receiver. If a pollutant of interest is present in the light beam, it will absorb small amounts of light at a specific wavelength. The concentration of the pollutant is measured by comparing the light transmitted at this specific wavelength to the light transmitted at a wavelength where no light is absorbed by the pollutant.

APPENDIX 2 AIR QUALITY MONITORING DATA TABLES

Explanation of terms used in data tables

Data recovery	For hourly data, the data recovery rate is the number of hours when valid data was collected expressed as a percentage of the total number of hours when monitoring was conducted. When the data is a rolling average covering a longer averaging period (4 hours, 8 hours), the data recovery rate is the number of valid data points expressed as a percentage of the total number of hours when monitoring was conducted.
No of valid samples	The number of valid samples is quoted for particulate matter, where the averaging period is one day.
• TEOM method	A valid one-day sample is one where the daily average is calculated from 18 or more valid hourly values (75%).
• HVS method	A valid one-day sample is one that has been obtained as required by the test method. Samples are taken one day in six, or, in Whyalla, one day in three.
Average	The sum of all the values in a set of data, divided by the number of values in the set. The average is also known as the arithmetic mean.
Highest values	
• Maximum	The largest value in a set of data.
• 2nd highest	The second largest value in a set of data. The second largest value is a significant parameter if the Air NEPM goal permits the standard to be exceeded on one day per year, as it indicates that the goal may not have been met.
• 6th highest	The sixth largest value in a set of data. The sixth largest value is a significant parameter if the Air NEPM goal permits the standard to be exceeded on five days per year, as it indicates that the goal may not have been met.
Percentile	A statistical parameter that represents the distribution characteristics of a set of data. The percentile is a value on a scale of 100 that indicates the percentage of the data points that are equal or lesser in value. For example, 90% of the data points are equal to, or less than, the 90th percentile.
Median	The middle value in a set of data that has been place in order from smallest to largest. If the set of data has an even number of values, the median is the average of the two middle values.

1 Carbon monoxide

Air NEPM Standard (8-hour average): 9.0 ppm

Maximum allowable exceedances: One day a year

Site Code	Monitoring site	Data recovery (%)	No. days NEPM Std exceeded	Annual average (ppm)	Maximum (ppm)	Percentiles of daily peak 8-hour average (ppm) 99th	95th	90th
ADL01	Adelaide[1]	90	0	0.5	2.5	2.4	2.0	1.6
ELI01	Elizabeth Downs	87	0	0.0	0.7	0.5	0.3	0.2
GEP01	Gepps Cross[2, 4]	91	See note 4	0.1	1.8	1.2	0.8	0.6
WSD01	Woodside[3, 4]	61	See note 4	0.1	1.7	1.6	1.3	1.0

1 Incomplete data for 2006. Monitoring at the Adelaide site (in the Tandanya Building, Grenfell Street) commenced on 25 September 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

2 Incomplete data for 2006. The 'hot spot' monitoring site at Gepps Cross operated from 23 November 2005 to 8 May 2006. The data shown is for this entire period.

3 Incomplete data for 2006. The 'hot spot' monitoring site at Woodside operated from 14 June to 2 October 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

4 This site is not designated as a performance monitoring site for the Air NEPM, so the data is not compared to the Air NEPM Standard.

2 Nitrogen dioxide (annual average and 1-hour average)

Air NEPM Standard (annual average):	0.03 ppm	Maximum allowable exceedances:	None
Air NEPM Standard (1-hour average):	0.12 ppm	Maximum allowable exceedances:	One day a year

Site Code	Monitoring site	Data recovery (% hours)	No. days NEPM Std exceeded	Annual average (ppm)	1-hr maximum (ppm)	Percentiles of daily peak 1-hour average (ppm) 99th	95th	90th
ELI01	Elizabeth Downs	91	0	0.00	0.04	0.03	0.03	0.02
KEN01	Kensington Gdns	96	0	0.00	0.04	0.03	0.02	0.02
NET01	Netley	95	0	0.01	0.05	0.04	0.03	0.03
NOR01	Northfield	93	0	0.01	0.03	0.03	0.03	0.03
CHD01	Christie Downs[1, 4]	89	See note 4	0.01	0.03	0.03	0.03	0.03
WHY02	Whyalla Norrie[2, 4] (Nicolson Avenue)	97	See note 4	0.00	0.02	0.02	0.02	0.02
WSD01	Woodside[3, 4]	67	See note 4	0.00	0.02	0.02	0.02	0.02

1 Incomplete data for 2006. The Christie Downs campaign site commenced on 24 March 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

2 Incomplete data for 2006. The Whyalla Norrie (Nicolson Avenue) campaign site was closed on 4 June 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

3 Incomplete data for 2006. The 'hot spot' monitoring site at Woodside operated from 15 June to 2 October 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

4 This site is not designated as a performance monitoring site for the Air NEPM, so the data is not compared to the Air NEPM Standard.

3 Ozone [photochemical oxidants] (1-hour average)

Air NEPM Standard (1-hour average): 0.10 ppm

Maximum allowable exceedances: One day a year

Site Code	Monitoring site	Data recovery (% hours)	No. days NEPM Std exceeded	Annual average (ppm)	Maximum (ppm)	Percentiles of daily peak 1-hour average (ppm)		
						99th	95th	90th
ELI01	Elizabeth Downs	91	0	0.02	0.07	0.06	0.05	0.04
KEN01	Kensington Gdns	96	0	0.02	0.09	0.06	0.05	0.04
NET01	Netley[1]	95	1	0.02	0.11	0.06	0.04	0.04
NOR01	Northfield	95	0	0.02	0.07	0.05	0.04	0.04
CHD01	Christie Downs[2, 4]	85	See note 4	0.02	0.06	0.05	0.04	0.04
WHY02	Whyalla Norrie[3, 4] (Nicolson Avenue)	98	See note 4	0.02	0.05	0.05	0.04	0.04

1 The Air NEPM Standard was exceeded at the Netley site on 25 January 2006. On this day, Adelaide was blanketed by smoke from major fires burning in the Grampians area of Victoria. The volatile organic components of the smoke were responsible for the high ozone level.

2 Incomplete data for 2006. The Christie Downs campaign site commenced on 24 March 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

3 Incomplete data for 2006. The Whyalla Norrie (Nicolson Avenue) campaign site was closed on 4 June 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

4 This site is not designated as a performance monitoring site for the Air NEPM, so the data is not compared to the Air NEPM Standard.

4 Ozone [photochemical oxidants] (4-hour average)

Air NEPM Standard (4-hour average): 0.08 ppm

Maximum allowable exceedances: One day a year

Site Code	Monitoring site	Data recovery (%)	No. days NEPM Std exceeded	Annual average (ppm)	Maximum (ppm)	Percentiles of daily peak 4-hour average (ppm) 99th	95th	90th
ELI01	Elizabeth Downs	93	0	0.02	0.06	0.05	0.05	0.04
KEN01	Kensington Gdns	99	0	0.02	0.07	0.05	0.04	0.04
NET01	Netley[1]	97	1	0.02	0.09	0.05	0.04	0.04
NOR01	Northfield	95	0	0.02	0.06	0.05	0.04	0.04
CHD01	Christie Downs[2, 4]	85	See note 4	0.02	0.05	0.05	0.04	0.04
WHY02	Whyalla Norrie[3, 4] (Nicolson Avenue)	100	See note 4	0.02	0.04	0.04	0.04	0.03

1 The Air NEPM Standard was exceeded at the Netley site on 25 January 2006. On this day, Adelaide was blanketed by smoke from major fires burning in the Grampians area of Victoria. The volatile organic components of the smoke were responsible for the high ozone level.

2 Incomplete data for 2006. The Christie Downs campaign site commenced on 24 March 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

3 Incomplete data for 2006. The Whyalla Norrie (Nicolson Avenue) campaign site was closed on 4 June 2006. The data recovery rate is calculated for the period of operation, not the full calendar year.

4 This site is not designated as a performance monitoring site for the Air NEPM, so the data is not compared to the Air NEPM Standard.

5 Sulfur dioxide (annual average and 1-hour average)

Air NEPM Standard (annual average):	0.02 ppm	Maximum allowable exceedances:	None
Air NEPM Standard (1-hour average):	0.20 ppm	Maximum allowable exceedances:	One day a year

Site Code	Monitoring site	Data recovery (% hours)	No. days NEPM Std exceeded	Annual average (ppm)	Maximum (ppm)	Percentiles of daily peak 1-hour average (ppm) 99th	95th	90th
NOR01	Northfield	94	0	0.00	0.02	0.01	0.00	0.00
PTP01	Port Pirie South	96	33	0.01	0.49	0.36	0.24	0.19
WHY02	Whyalla Norrie[1, 2] (Nicolson Avenue)	97	See note 2	0.00	0.03	0.02	0.01	0.01

1 Incomplete data for 2006. The Whyalla Norrie (Nicolson Avenue) campaign site was closed on 4 June 2006.

2 This site is not designated as a performance monitoring site for the Air NEPM, so the data is not compared to the Air NEPM Standard. The data recovery rate is calculated for the period of operation, not the full calendar year.

6 Sulfur dioxide (annual average and 1-day average)

Air NEPM Standard (annual average):	0.02 ppm	Maximum allowable exceedances:	None
Air NEPM Standard (1-day average):	0.08 ppm	Maximum allowable exceedances:	One day a year

Site Code	Monitoring site	Data recovery (% hours)	No. days NEPM Std exceeded	Annual average (ppm)	Maximum (ppm)	Percentiles of daily peak 1-hour average (ppm) 99th	95th	90th
NOR01	Northfield	96	0	0.00	0.00	0.00	0.00	0.00
PTP01	Port Pirie South	98	0	0.01	0.05	0.04	0.03	0.02
WHY02	Whyalla Norrie[1, 2] (Nicolson Avenue)	97	See note 2	0.00	0.00	0.00	0.00	0.00

1 Incomplete data for 2006. The Whyalla Norrie (Nicolson Avenue) campaign site was closed on 4 June 2006.

2 This site is not designated as a performance monitoring site for the Air NEPM, so the data is not compared to the Air NEPM Standard. The data recovery rate is calculated for the period of operation, not the full calendar year.

7 Airborne lead (annual average)

Airborne lead levels are monitored at four sites in Port Pirie:

- Oliver Street, **Port Pirie South**
- Port Pirie West Primary School, 214 The Terrace, **Port Pirie West**
- Frank Green Park, Senate Road, **Risdon Park**
- Ellen Street, **Port Pirie** (an industrial monitoring site near the boundary of the lead smelter).

The lead determinations are made on TSP samples collected by HVS, one day in six.

Air NEPM Standard (1-year average): 0.50 $\mu g/m^3$ Maximum allowable exceedances: None

Site Code	Monitoring site	No. of valid samples	Annual average ($\mu g/m^3$)	Maximum daily value ($\mu g/m^3$)	2nd highest daily value ($\mu g/m^3$)	90th percentile value ($\mu g/m^3$)	Median daily value ($\mu g/m^3$)
PTP01	Port Pirie South	61	0.49	3.87	3.64	1.05	0.15
PTP03	Port Pirie West (214 The Terrace)	61	0.38	2.08	1.92	0.84	0.20
PTP05	Risdon Park	61	0.16	1.38	1.12	0.49	0.05
PTP04	Port Pirie	59	2.13	13.53	10.55	4.56	1.03

8 Particulate matter, PM_{10} (1-day average) by TEOM method

Air NEPM Standard (1-day average): 50 $\mu g/m^3$ Maximum allowable exceedances: Five days per year

Site Code	Monitoring site	No. of valid days	No. days NEPM Std exceeded	Average ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	2nd highest ($\mu g/m^3$)	6th highest ($\mu g/m^3$)	90th percentile ($\mu g/m^3$)	Median value ($\mu g/m^3$)
BIR02	Birkenhead	353	6	22	94	79	51	34	20
ELI01	Elizabeth Downs	335	4	15	90	60	46	23	13
KEN01	Kensington Gardens	348	2	14	73	68	38	22	12
NET01	Netley	332	11	21	101	100	83	34	18
PTP01	Port Pirie South	351	13	21	182	90	66	35	17
CHD01	Christie Downs[1, 5]	268	See note 5	16	52	52	42	26	14
GEP01	Gepps Cross[2, 5]	151	See note 5	23	79	70	48	34	21
PTP02	Port Pirie West[3, 5] (58 The Terrace)	319	See note 5	20	205	112	61	34	15
WHY04	Whyalla[5] (Walls Street)	353	See note 5	23	153	124	94	44	17
WSD01	Woodside[4, 5]	109	See note 5	14	30	27	25	22	12

1 Incomplete data for 2006. The Christie Downs campaign site commenced on 24 March 2006.

2 Incomplete data for 2006. The 'hot spot' monitoring site at Gepps Cross operated from 22 November 2005 to 7 May 2006. The data shown covers this entire period.

3 This monitoring site at 58 The Terrace, Port Pirie West, is operated by EPA on behalf of the South Australian Department of Health.

4 Incomplete data for 2006. The 'hot spot' monitoring site at Woodside operated from 14 June to 2 October 2006.

5 This site is not designated as a performance monitoring site for the Air NEPM, so the data is not compared to the Air NEPM Standard.

9 Particulate matter, PM_{10} (1-day sample) by HVS method

Air NEPM Standard (1-day average): 50 μg/m^3 Maximum allowable exceedances: Five days per year

Site Code	Monitoring site	No. of valid days	No. days NEPM Std exceeded[4]	Average (μg/m^3)	Maximum (μg/m^3)	2nd highest (μg/m^3)	6th highest (μg/m^3)	90th percentile (μg/m^3)	Median value (μg/m^3)
NET01	Netley[1, 2]	25	1	24	86	40	27	34	20
PTA02	Port Augusta[1, 3]	46	1	25	96	38	35	36	22
PTP01	Port Pirie South[1]	60	0	20	38	37	33	32	19
WHY05	Whyalla Norrie[1] (Searle Street)	121	2	17	54	52	35	29	15
WHY06	Whyalla[1, 4] (Gay Street)	89	See note 4	28	142	105	84	73	16

1 Monitoring by HVS, one day in six. HVS, one day in three or one day in six, does not meet the Air NEPM requirement for 75% data recovery.

2 Incomplete data for 2006. The Netley site was closed on 4 June 2006.

3 Incomplete data for 2006. Data was recorded at the Port Augusta site to 13 November 2006. A replacement HVS unit was installed at this site on 20 December 2006.

4 Incomplete data for 2006. The Whyalla, Gay Street (Hummock Hill) site was closed on 26 September 2006. This site is not designated as a performance monitoring site for the Air NEPM, so the data is not compared to the Air NEPM Standard.

10 Particulate matter, $PM_{2.5}$ (1-day average) by TEOM method

Air NEPM Advisory Reporting Standard (1-day average): 25 $\mu g/m^3$

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

Site Code	Monitoring site	No. of valid days	Average ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	2nd highest ($\mu g/m^3$)	6th highest ($\mu g/m^3$)	90th percentile ($\mu g/m^3$)	Median value ($\mu g/m^3$)
NET01	Netley	351	8	61	37	20	12	7

All TEOM units operated by EPA are configured to make an empirical adjustment to the mass concentration to achieve results comparable to the US EPA reference methods for PM_{10}. This adjustment is expressed as the equation $y = 3.0 + 1.03x$, where x is the TEOM output data and y is the adjusted value. This adjustment is not directly applicable to $PM_{2.5}$ measurements, but EPA applies the adjustment so that all TEOM units operate consistently and so that $PM_{2.5}$ data is reported in the same manner as other reporting agencies.

11 Total suspended particles (TSP) (1-day sample) by HVS method

There are currently no standards for TSP. The *World Health Organization Guidelines for Air Quality* (1999) set a standard of 120 μg/m^3, but WHO *Guidelines for Air Quality* (2000) do not specify a standard for TSP. In Port Pirie, the TSP samples are collected to analyse their lead content.

Site Code	Monitoring site	No. of valid days	Average (μg/m^3)	Maximum (μg/m^3)	2nd highest (μg/m^3)	6th highest (μg/m^3)	90th percentile (μg/m^3)	Median value (μg/m^3)
PTP01	Port Pirie South[1]	61	44	95	91	65	65	45
PTP03	Port Pirie West[1] (214 The Terrace)	61	80	800	539	91	90	51
PTP05	Risdon Park[1]	61	45	145	99	73	73	44
PTP04	Port Pirie[1]	59	54	123	109	84	82	52
GEP01	Gepps Cross[2]	21	48	84	81	52	76	43
WHY05	Whyalla Norrie[3] (Searle Street)	28	45	112	102	67	84	36
WHY06	Whyalla[3] (Gay Street)	30	86	480	413	97	218	40

1 Monitoring by HVS, one day in six.

2 Incomplete data for 2006. The Gepps Cross 'hot spot' site operated from 5 January to 5 May 2006.

3 Incomplete data for 2006. Monitoring for TSP at these sites in Whyalla was concluded on 30 March 2006. Monitoring was by HVS, one day in three.