Acronyms and abbreviations

APS	Annual performance statement
AS/NZS 3580.1.1	Australian/New Zealand Standard 3580.1.1:2007 *Methods for sampling and analysis of ambient air—Part 1.1: Guide to siting air monitoring equipment*
BAM	Beta attenuation monitoring
DDO11	Schedule 11 of the Design and Development Overlay
DELWP	Department of Environment, Land, Water and Planning
EPA	Environment Protection Authority
IARC	International Agency for Research on Cancer
ICT	Information and communications technology
Monitoring Plan	*Ambient Air Quality NEPM Monitoring Plan Victoria*
NEPC	National Environment Protection Council
NEPM AAQ	National Environment Protection (Ambient Air Quality) Measure
NEPM NPI	National Environment Protection (National Pollutant Inventory) Measure
OPLE	Officers for the Protection of the Local Environment
PM	Particulate matter
ppm	Parts per million
SEPP AAQ	State Environment Protection Policy (Ambient Air Quality)
VAGO	Victorian Auditor-General's Office
WHO	World Health Organization

Audit overview

Clean air is important for health and wellbeing, and is an issue of community concern. The World Health Organization (WHO) reports that statistically significant evidence supports the correlation between poor air quality and negative health impacts.

The air we breathe primarily contains nitrogen, oxygen, carbon dioxide, water vapour and various inert gases. It also contains pollutant components, such as ozone and particulate matter (PM), which arise from human and natural processes and can affect human health.

In Victoria, the Environment Protection Authority (EPA) is the agency primarily responsible for monitoring, regulating and reporting on the state's air quality. EPA is subject to a range of legislation including the *Environment Protection Act 1970* (the Act) and state environment protection policies that incorporate national standards on ambient air quality.

EPA undertakes three types of air monitoring:

- ambient air (external air environment) quality monitoring that provides EPA with information on general air quality and regional pollution at designated monitoring stations
- campaign (local condition or investigation) monitoring that provides information on local air quality and pollution issues
- emergency (incident) monitoring, as part of the Victorian emergency management system, to respond to major pollution events.

The Act provides EPA with a number of tools to regulate the activities of commercial and industrial operators, including licensing and approvals, compliance monitoring and enforcement instruments.

This audit assessed whether Victoria's air quality meets ozone and PM standards. We examined EPA's monitoring of, reporting on and regulation of air quality during the audit, including an analysis of EPA's air quality monitoring data from 2010 to 2016.

Conclusion

EPA's annual air quality monitoring reports state that ambient air quality is generally good and within national standards. However, while this is true for the parts of the Port Phillip and Latrobe Valley regions that it monitors, EPA's limited air monitoring coverage does not provide it with information on air quality for most of the state, including many parts of metropolitan Melbourne. This relates to both ambient air quality and localised air quality conditions.

The utility of EPA's air quality reports is considerably diminished because EPA has not been able to demonstrate that the air quality data it collects and reports on is also representative of those areas it does not monitor.

Contrary to the intent of its 2001 *Ambient Air Quality NEPM Monitoring Plan Victoria* (Monitoring Plan), EPA has failed to provide a better understanding of air quality outside the Port Phillip and Latrobe Valley regions. It has not updated nor adjusted the plan over the last 17 years to reflect the changing risk profiles that accompany both considerable population growth and changes in industrial activities across the state.

In addition, while infrequent, we found some inaccurate assessments against PM air quality standards—all of which overstated air quality, and so serve to undermine confidence in publicly reported data.

The roles and responsibilities of agencies that contribute to air quality management in the state also remain unclear and not well understood. Consequently, attempts to address air quality issues have not always been well coordinated and implemented. Nor has EPA kept itself fully informed of and updated on air pollution sources. As a result, EPA risks not focusing its resources on those air discharges that adversely impact air quality and potentially human health.

More positively, EPA regulation of air pollution sources has begun to improve. It has achieved this through better embedding its risk-based approach into its licensing requirements and developing programs to enhance its compliance efforts—for example, with its major industry assessments and annual performance statement (APS) audits.

Findings

Monitoring air quality

Ambient air quality monitoring

EPA cannot demonstrate that its current monitoring provides a representative measure of ambient air quality across the state.

Victoria's State Environment Protection Policy (Ambient Air Quality) (SEPP AAQ) and EPA's Monitoring Plan require EPA to put in place a monitoring network that provides a representative measure of the quality of air that Victorians are likely to experience.

However, EPA does not collect information on the quality of ambient air for most parts of the state, including many parts of metropolitan Melbourne. Its network of ambient air quality monitors is limited to parts of the Port Phillip and Latrobe Valley regions.

The Monitoring Plan requires EPA to monitor ambient air quality at all urban centres with a population of at least 25 000. In 2001, using 1996 Australian Bureau of Statistics data, EPA identified eight regions in the state where ambient air monitors should be located. This has not occurred.

PM10 are inhalable particles, 10 µm in diameter or smaller. Examples include a combination of coal and fly ash, calcium carbonate, sodium chloride, mould and spores.

PM2.5 are fine inhalable particles, 2.5 µm in diameter or smaller. Examples include sulfates, nitrates, ammonium, organic compounds, elemental carbon, metals and trace elements.

EPA does not measure ambient air quality in six of the eight regions it identified. EPA explained that, based on previous assessments of these regions, it expects pollution levels to be well below the standards outlined in the National Environment Protection (Ambient Air Quality) Measure (NEPM AAQ). However:

- EPA's assessments were done at least 10 years ago and do not necessarily reflect current conditions
- not all indicator pollutants were monitored, with Mildura and Shepparton monitored for only one pollutant (PM10)
- all stations recorded exceedance levels for at least one of the indicator pollutants
- EPA has not monitored PM2.5 levels in any of these regions to date—the NEPM AAQ required assessment against PM2.5 standards from 2016.

EPA has previously acknowledged the need for more extensive monitoring in these regions but this has not occurred to date. Its 2006 air quality monitoring report indicated that regional campaign monitoring continues to record elevated concentrations of PM10 and, therefore, future monitoring of this pollutant should be considered.

Further, using 2016 Australian Bureau of Statistics data we identified some 40 urban centres with populations of at least 25 000 that are not covered by EPA's ambient air monitoring network.

Campaign and emergency monitoring

Many of EPA's campaign monitoring stations have been in operation for several years, such as the ones at Wangaratta and the Brooklyn Industrial Precinct. In comparison, emergency monitoring stations operate for shorter durations as required by the particular emergency incident.

Results from these other monitoring stations do not form part of EPA's annual air quality monitoring reports, as the data they record reflects conditions specific to local issues and emergency events. EPA does, however, publish reports on air quality results from time to time for some of these monitoring stations. EPA also provides some air monitoring results on its EPA AirWatch website.

However, publicly reported data is not quality reviewed for accuracy and reliability, nor are any limitations clearly identified and explained. The AirWatch website does not always clearly indicate units of measurement, and we found some inconsistencies between the validated raw data provided to us by EPA and the website data.

Routine public reporting of all the air quality information collected would improve transparency and provide the community with additional insights about the air pollution risks to which they are exposed.

Recommendation 6.3 of the 2016 EPA inquiry report

In 2016, a Ministerial Advisory Committee appointed by the then Minister for Environment, Climate Change and Water completed its inquiry into EPA. The committee's report recommended that EPA 'assess the adequacy of its air and water monitoring networks, particularly in relation to air quality' and 'consider options to improve data sharing and accessibility, and community communication'.

In early 2017, the Victorian Government supported these recommendations, and EPA is currently working on them through its Reform Project Plan: Environmental Monitoring Capability Review. EPA advised that the project plan aims to deliver a draft business case for proposed enhancements to its monitoring capability.

Reporting on Victoria's ambient air quality

EPA's annual air quality monitoring reports publish EPA's assessment of collected air data against NEPM AAQ standards. Air quality meets or complies with NEPM AAQ when:

- the relevant standard was exceeded no more than the allowed number of times
- data was available for at least 75 per cent of each quarter of the year.

Air quality monitoring reports indicate that for the period 2010 to 2016, in the parts of the Port Phillip and Latrobe Valley regions that EPA monitors, air quality met ozone and PM NEPM AAQ standards for all seven years, except in 2015 for PM10. Assessment against the NEPM AAQ standards for PM2.5 was not required until 2016.

EPA's 2015 air quality monitoring report states that possible causes for the PM10 exceedances include localised or regional dust storms, smoke from bushfires, planned or agricultural burning, motor vehicles or domestic wood heaters.

Inaccurate assessments

Our analysis of EPA's annual air quality monitoring reports against the actual underpinning data shows that EPA's assessments do not always accurately reflect whether Victorian air quality complies with NEPM AAQ standards. For example, in 2013, EPA assessed PM10 levels in Geelong South as meeting the standard even though there were eight days when levels exceeded the standard and EPA had sufficient data to report this.

We found three further instances of inaccurate assessments by EPA over the seven-year period we reviewed, where EPA should have reported a finding of 'not met' but instead reported a rating of 'met' or 'not demonstrated'. In a fifth instance, contrary to the requirement of the NEPM AAQ, no assessment was made for PM2.5 in 2016. A 'not met' assessment should have been given in this instance.

During the audit, EPA acknowledged that all five instances we raised should have been assessed as 'not met'.

These findings reflect weaknesses in EPA's processes for assuring the accuracy of its assessment and reporting.

Negative values included when assessing air quality

In computing average pollutant concentrations, EPA includes recorded values that are below zero. EPA advised that this is consistent with NEPM AAQ procedures.

Logically, however, the lowest possible value for air pollutant concentrations is zero. Either it is present, even if in very small amounts, or it is not. Negative values are an artefact of the measurement and recording process.

Leaving negative values in the data introduces a negative bias, which potentially under represents actual concentrations of pollutants. We noted a considerable number of negative values recorded. For example, in 2016, negative values comprised 5.3 per cent of recorded hourly PM2.5 values, and 1.3 per cent of hourly PM10 values. When we excluded negative values from the calculation of one-day averages, there were five more exceedance days for PM2.5 and one more for PM10 during 2016.

Quality of EPA's raw data

We found that EPA's air quality data is not as reliable as would be expected. Basic sample checking showed inconsistencies between EPA's raw data and what was published in its AirWatch historical data. EPA acknowledges weaknesses in this historical data and advised that it intends to eventually remove it from its website.

Moreover, when we highlighted a significantly high PM2.5 hourly value recorded in 2015, EPA informed us that this was an error due to an instrument fault, and that it should have removed this value from its air quality dataset. EPA further advised that this was true for three other PM2.5 hourly values recorded on the same day from the same monitoring station.

However, despite EPA identifying the instrument fault in 2015 on the same day on which the data was recorded, the data was not tagged as inaccurate. Instead, the data remained in EPA's air quality dataset until it was provided to us for the audit nearly two years later in mid-2017.

EPA advised that it subsequently removed the invalid data from its system but is unable to specify exactly when it made this correction. This is contrary to EPA's data validation procedure, which requires details of changes to air quality data to be recorded.

EPA is also unable to provide advice on the number of air quality data changes made on a yearly basis, or the reasons for any changes made.

Monitoring equipment, and information and communications technology infrastructure

Ambient air quality monitors are designed to be located a certain distance from direct pollution sources. While EPA's ambient air quality monitoring stations and equipment generally comply with NEPM AAQ standards, most monitors are located closer to roads than is required by the standard. EPA advised that, as the Victorian population lives and works close to roads, most of their stations are in population centres next to roads. This potentially means that the air data collected is impacted by pollutants from motor vehicles to a greater extent than is envisaged by the standard.

The information and communications technology (ICT) infrastructure underpinning EPA's air quality monitors is ageing, no longer supported by vendors and subject to security vulnerabilities. This is increasingly affecting the reliability of the data collected and computed. EPA is aware of these weaknesses and reports that it has started to address the issues.

Regulating air quality

Guided by previous Victorian Ombudsman and VAGO reports, and following an EPA-initiated Compliance and Enforcement Review in 2010 and an Approvals Review in 2013, EPA has been better embedding its risk-based approach into its licensing requirements. It has also developed programs to enhance its compliance efforts—for example, through its investigations of major industries and APS audits.

EPA could achieve further improvements by ensuring it monitors all high-risk sources of ozone and PM pollutants and by reviewing its oversight of and effectiveness in addressing unlawful air discharges.

Roles and responsibilities

The responsibility for regulating Victoria's air quality rests primarily with EPA. However, a number of other government agencies undertake functions that impact air quality, including the Department of Environment, Land, Water and Planning (DELWP), local government, the Commissioner for Environmental Sustainability, VicRoads, WorkSafe Victoria, the Victorian Planning Authority, emergency services, and a host of other agencies including the Commonwealth Government.

Across the many relevant legislative and policy instruments that relate to air quality regulation, there is a lack of clarity regarding roles and responsibilities, what triggers the commencement of a particular responsibility, and when a responsibility transfers to another agency.

In July 2013, the Statutory Policy Review prepared by the then Department of Sustainability and Environment (now DELWP) and EPA acknowledged weaknesses in this regard, noting that 'a lack of coordinated and accountable implementation' of policies 'has limited their effectiveness and exposed EPA and other Victorian government agencies to legitimate criticism'. DELWP advised that it is currently considering how to progress actions to implement the recommendations from the Statutory Policy Review, to ensure that they align with the recommendations of the 2016 EPA inquiry report.

Identifying sources of air pollution—air emissions inventory

EPA last conducted an air emissions inventory in 2006. An air emissions inventory is a comprehensive evaluation that aims to understand the extent of state pollutant emissions and their sources. Relying on a 12-year-old emissions inventory is inconsistent with EPA's approach of using science to inform its activities. While EPA has other means to identify air pollution sources, the completion of an up-to-date air emission inventory is critical for EPA's understanding of statewide point and diffuse air pollution sources that require its attention.

Another consequence of EPA's 12-year-old air emissions inventory is that Victoria's aggregated air emissions data on the Commonwealth Government's National Pollutant Inventory website remains unchanged since 2006.

Identifying sources of air pollution—unlawful discharges

EPA primarily relies on the community and industrial operators to report inappropriate or noncompliant air discharges. EPA's inspections look into these reports to confirm whether any noncompliance has occurred.

Self-reporting assumes that operators have appropriate processes to reliably monitor air discharges and will voluntarily report any breaches of their licences. However, many of the operators audited by EPA between 2014 and 2016 either did not have monitoring plans, had weak monitoring processes, or under-reported breaches. Further, EPA advised that obtaining sufficient and reliable evidence to show operators' noncompliance with air discharge conditions is a major challenge for its enforcement efforts.

Improved processes

EPA has begun to embed a risk-based approach into its regulatory activities to better manage air pollutants. EPA has developed:

- a framework to review and revise all licences to ensure the currency of licence conditions and provide consistency in emission limits
- the Licensed Operator Risk Assessment model to help prioritise compliance inspections
- new guidelines to assist operators to better understand their licence conditions and how to comply with them
- new and revised internal documentation to assist staff to apply compliance and enforcement tools
- a more rigorous approach to monitoring major industry facilities, based on the scale of discharges, the quantity of materials stored or the complexity of facilities' industrial processes.

Focus on licensed operators

EPA undertook a project to reform its licensing process in 2009. One of the intentions of this reform project was to review licence discharge limits and conditions, and to continue reviewing them annually to ensure their currency and to detect any emerging issues. An EPA internal briefing shows that this did not take place due to changed organisational priorities. There are several outstanding licensing issues:

- Current licence conditions are generic, so assessing and enforcing compliance is difficult.
- Discharge indicators are not consistent for specific industry sectors.
- Current discharge limits on many of the licences are based on limitations of existing pollution treatment systems rather than what is acceptable for release to the environment.
- Numerous limit types have been used in licences without proper assessment of their relevance.
- Operators require industry-specific guidance on how to design a monitoring program to demonstrate compliance.
- The perpetual nature of EPA licences does not encourage operators to adopt the latest technology and does not reflect community expectations.

To address these issues, EPA launched a five-year periodic licence review program in 2015–16. The program aims to ensure the currency and efficacy of licences and licence conditions, and to provide consistency in emission limits and condition requirements. Following the 2016 EPA inquiry report, the Victorian Government also committed to further improve EPA's licensing activities to minimise environmental impacts from potentially polluting industrial activities.

EPA largely targets its efforts at licensed operators—those that need to obtain EPA approval to operate and commence work. In October 2017, there were 658 licensed operators in Victoria—but there are many more unlicensed operators than licensed ones, over which EPA exercises limited oversight. EPA focuses on licensed operators because it wants to direct its limited resources to the biggest sources of potential harm to the environment.

However, some of the unlicensed operators are major contributors to air pollution in Victoria. Unlicensed operators include several thousand smaller operators that discharge air pollutants in their day-to-day operations. EPA's recent investigations that involved air discharge emissions included two unlicensed premises, and we understand that EPA intends to gradually cover more unlicensed premises in its regulatory efforts as resources allow.

Case study: Brooklyn Industrial Precinct

Poor air quality arising from the Brooklyn Industrial Precinct presents a good example of the complex issues involved in air quality management. It demonstrates how EPA needs to continue developing a close working relationship with councils and other government agencies to address harmful air emissions.

Notwithstanding some improvements, the precinct continues to experience poor air quality with considerable exceedance days for PM10.

EPA and Brimbank City Council advise that up to 10 operators within the precinct continue to be sources of inappropriate air emissions and noxious odours. In response, EPA has commenced more rigorous enforcement actions, including prosecution.

Recommendations

We recommend that the Environment Protection Authority:

1. expand its air monitoring network by:
    - reviewing and updating its current Monitoring Plan to reflect its risk-based approach to environmental regulation (see Sections 2.2 and 2.3)
    - in addition to its ambient air quality monitoring for purposes of the NEPM AAQ, designing and implementing an air monitoring program that better aligns coverage with air pollution risks that Victorian communities are exposed to (see Sections 2.2 and 2.3)
2. improve its reporting on air quality by:
    - introducing a rigorous quality review process to ensure the accuracy and reliability of the state's air quality data and assessments against NEPM AAQ standards as presented across its various reporting, including on its AirWatch website (see Sections 3.2, 3.3 and 3.4)
    - developing readable and easily accessible annual reports on the results collected from all air monitoring across the state, highlighting assessments against standards and recorded exceedances (see Sections 3.3 and 3.4)

3. expand and update its knowledge of Victoria's air quality by:
    - completing a comprehensive Victorian air emissions inventory to identify current major point and diffuse sources of air pollution (see Section 4.3)
    - determining and preparing an action plan on how best to (1) oversight the air quality monitoring conducted by high-risk operators to ensure that monitoring plans are in place, and that these plans are appropriately implemented; and (2) understand and effectively respond to air emissions from lower risk sites (see Section 4.4)
4. work with all relevant councils to address air quality issues at the Brooklyn Industrial Precinct by:
    - reducing exceedance days and achieving NEPM AAQ standards for PM10, and considering the need to monitor other pollutants (see Section 4.5)
    - agreeing on the installation and location of additional air monitoring stations to measure the impact of air discharges on nearby residential communities (see Section 4.5).

We recommend that the Environment Protection Authority and the Department of Environment, Land, Water and Planning:

5. clarify the roles and responsibilities of relevant Victorian Government agencies with respect to air quality management, and develop protocols to ensure accountabilities are understood and coordination is achieved (see Section 4.2).

Responses to recommendations

We have consulted with EPA, DELWP, City of Ballarat and Brimbank City Council, and we considered their views when reaching our audit conclusions. As required by section 16(3) of the *Audit Act 1994*, we gave a draft copy of this report, or parts thereof, to those agencies and asked for their submissions or comments. We also provided a copy of the report to the Department of Premier and Cabinet.

The following is a summary of those responses. The full responses are included in Appendix A.

All four agencies welcomed the report's findings and recommendations to further improve Victoria' air quality monitoring and management.

EPA accepted all five recommendations and provided an action plan on how it will implement them.

DELWP accepted the recommendation addressed to it, noting that it will also support EPA in its acquittal of the remaining recommendations.

There were no recommendations directed toward the Ballarat and Brimbank city councils. Even so, noting that some of the recommendations have implications for councils, the Brimbank City Council advised that it will continue to work with the EPA to facilitate the implementation of these recommendations.