



Standard for Smoke, Air Quality and Community Health –

Significant fires with fine particles as the primary smoke
component of health concern

November 2019

VERSION 2.0

Working in conjunction
with Communities,
Government, Agencies
and Business.

The *Standard for Smoke, Air Quality and Community Health – Significant fires with fine particles as the primary smoke component of health concern* is authorised and endorsed by the following:

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Contents

| | |
|--|----|
| Section 1 - Background..... | 5 |
| Overview | 5 |
| Purpose..... | 5 |
| Strategic Intent..... | 6 |
| Governance and Authorising Framework | 7 |
| Latest review (October 2019) | 8 |
| Section 2 – Fine particles in smoke and community health | 10 |
| Fine particles, smoke exposure and health..... | 10 |
| Section 3 – Ambient (outdoor) air quality monitoring for fine particles | 11 |
| Air quality standards..... | 11 |
| EPA AirWatch and ambient air quality | 11 |
| Section 4 – Community Air quality guideline values and air monitoring during extended smoke events..... | 12 |
| Air quality and smoke action levels for cautionary advice and actions | 12 |
| Smoke advice and action levels for PM _{2.5} (rolling 24-hour) and recommended cautionary health protection advice and actions | 13 |
| Section 5 - Key considerations - risk management decisions to protect public health..... | 14 |
| Section 6 - Community information about Smoke and Health..... | 15 |
| Information about smoke and health for the community | 15 |
| Community actions to protect health during smoky conditions | 15 |
| Appendix 1 – USEPA and Victorian approach for smoke fine particles..... | 17 |
| Appendix 2 – EPA AirWatch and general health messages | 18 |
| Appendix 3 – Air Quality Categories for PM _{2.5} (rolling 24-hr) and cautionary Health Protection advice and actions | 21 |
| Appendix 4-Air quality self-assessment guide | 23 |
| Appendix 5 – Victorian approach for significant smoke events and managing public health impacts | 25 |
| Appendix 6 – Superseded versions of this Standard | 26 |
| Appendix 7 - References and contextual information to this Standard..... | 27 |

Section 1 - Background

Overview

This *Standard for Smoke, Air Quality and Community Health – Significant¹ fires with fine particles as the primary smoke component of health concern* (the Standard) outlines a graduated system for responding to the impacts of significant smoke events on air quality and risk management options for protecting community health.

The Victorian approach is informed by the US experience and approach for managing the public health impacts of smoke from wildfires, applied since 2007.² Significant smoke events with the potential for community health impacts include fires in vegetation (bushfires), brown coal and peat bogs.

Smoke contains particles of differing size ranging from visible debris (large particles) to very small, invisible particles small enough to be breathed deeply into the lungs (fine particles). The amount and size of smoke particles is unique to each fire and depends on what is burning, at what temperature and for how long, and other factors. The exposure of communities to smoke is typically influenced by the meteorological conditions, for example, wind speed and direction and their variability.

The air quality measure for assessing the potential health risks of community exposure to smoke is PM_{2.5} fine particles – which have an aerodynamic diameter of less than 2.5 µm (one 30th the size of a human hair). The monitoring and estimation of PM_{2.5} fine particle concentrations in air informs the recommended level of cautionary advice and actions for people to follow to protect their health until air quality improves.

Purpose

The objectives of this Standard are to:

- Describe the air quality categories of the Victorian Environment Protection Authority (EPA) Air Quality Index, the 24-hour thresholds for smoke (as PM_{2.5}) and air quality³, and the corresponding cautionary advice and actions for protecting community health during smoke events.
- Ensure communities receive the best available information on what to do to minimise smoke exposure to protect their health during significant smoke events.

¹ Significant fires – are fires that are complex, or large-scale, or prolonged, or produce large amounts of smoke or emissions, or a combination of any of these factors, and that may affect community health. In this Standard, ‘prolonged’ means *medium term* (days to a few weeks) to *long term* (greater than a few weeks). In comparison, *short term* is one hour to 24 hours up to a few days.

² *Appendix 4* - Victorian approach for managing public health impacts of smoke during extended smoke events

³ *Appendix 3* – Air quality categories for PM_{2.5} (rolling 24-hr) in smoke and cautionary health protection advice and actions. This also refers to 1-hour EPA AirWatch levels.

- Protect the community from potential health impacts of smoke exposure, especially sensitive groups. Sensitive groups include those over 65 years, children 14 years and younger, pregnant women and people with heart or lung conditions, including asthma.
- Prevent sensitive groups being exposed to PM_{2.5} fine particle concentrations greater than 250 µg/m³ (24-hour rolling average) for three or more consecutive days. Prior to reaching this level, the Chief Health Officer will consider the need to issue an advisory strongly recommending sensitive groups consider temporarily relocating away from the smoke until air quality improves, and for others to also consider this advice.
- Support decision-making of agencies, Incident Controllers and Agency Commanders in responding to smoke events, minimising as much as possible the impacts of smoke exposure on community health.

The Standard is:

- Not a step-by-step guide, however the content is operationalised in separate cross-government joint standard operating procedures, including SOP J03.18 and SOP J03.19.
- Not designed for workplace-related exposures to extended smoke events for firefighters and other emergency personnel.

Most hazardous material fires have additional smoke components or emissions of health concern other than fine particles and are therefore complex fires with unique risks to responder and community health and safety. The Protective Action Guide for Hazardous Outdoor Atmospheres⁴, and the hierarchy for selecting community air values applies to hazardous outdoor emergencies where shelter indoors is a first line option for protecting community health and safety during short term (ie one hour to 24 hours up to a few days) hazardous materials fires.

This Standard contains important provisions for community health that will only be fully effective with the cooperation of all responders and agencies and the willingness of the community to follow cautionary advice and actions, and warnings issued by the Incident Controller.

Strategic Intent

Under Victoria's emergency management arrangements, the Control agency for fire response is one of the Country Fire Authority (CFA), Metropolitan Fire Brigade (MFB) or the Department of Environment, Land Water and Planning (DELWP)⁵.

The Emergency Management Commissioner has an overarching management role during major emergencies to ensure that response is systematic and coordinated for both Class 1 (major fire) and Class 2 (all other except major fire and terrorism or hijack-related) emergencies.

State Emergency Management Priorities guide all decisions made during emergencies. The following priorities are relevant to fires resulting in extended smoke events:

⁴ For further information go to: www.mfb.vic.gov.au/News/Publications/Fact-sheets.html

⁵ From July 2020 onwards, Fire Services Victoria will encompass CFA and MFB.

- the protection and preservation of life is paramount. This includes the safety of emergency services personnel and safety of community members, including vulnerable community members and visitors/tourists located within the incident area.
- issuing community information and community warnings detailing incident information that is timely, relevant and tailored to assist community members make informed decisions about their safety.

The EPA is a technical support agency in Victoria's emergency management arrangements. Technical advice is provided before, during and after emergencies to the Control agency, government, industry and the community through scientific, engineering and regulatory expertise on the environmental and public health impacts of pollution and waste.

During emergencies, EPA response activities include:

- The provision of advice to the Control agency on risks to the environment and human health, and the practical measures to reduce environmental and public health impacts of pollution and waste from the emergency and response activities
- In cooperation with the Control agency, provision of advice to the community on the harmful effects of pollution and waste and recommended actions to protect human health.
- Supporting the Chief Health Officer with expert advice on the risks of pollution and waste on human health as required.

During emergencies involving significant pollution consequences, the Chief Environmental Scientist supports the Emergency Management Commissioner, State Controller and Chief Health Officer with expert advice on the risks to the environment and human health, and practical measures to protect the environment and public health from impacts of pollution and waste⁶. For significant smoke events this can be at any stage, particularly when air quality is in the Very Poor or Hazardous range (refer *Appendix 3*).

When air quality is heavily impacted, the Chief Health Officer can recommend additional health protection advice or cautionary actions for the community (as required). Advice is provided to the Incident Controller (and Regional/State Controllers) on the need for, and timing of, a strong recommendation for sensitive groups to consider temporary relocation until air quality improves. Relief and recovery arrangements are available to support people in sensitive groups who decide to temporarily relocate, if required.

Governance and Authorising Framework

The Standard is authorised in accordance with the statutory responsibilities of the:

- Emergency Management Commissioner and Emergency Management Victoria (EMV) with respect to responder and community safety under the *Emergency Management Act 2013*
- Heads of Victorian fire agencies in relation to Control responsibilities in fire response

⁶ Environment Protection Authority Victoria Role Statement (EMMV Part 7)

- Chief Executive Officer, EPA with respect to the statutory objective of the *Environment Protection Act 2017* to protect human health and the environment by reducing the harmful effects of pollution and waste
- Chief Health Officer with respect to the protection of public health in accordance with the *Public Health and Wellbeing Act 2008*.

The following legislation, other arrangements and documents inform this Standard:

- *Emergency Management Act 1986; Emergency Management Act 2013*
- Emergency Management Manual Victoria and role statements for: Emergency Management Commissioner and EMV (November 2016); DHHS (November 2016) and EPA and fire agencies
- State Emergency Response Plan (2016); State Health Emergency Response Plan (2017)
- State Smoke Framework 2016
- US EPA Wildfire Smoke (A Guide for Public Health Officials) Revised 2019
- JSOP3.18 - Incident air monitoring for community health (July 2017)
- JSOP3.19 - Managing significant community exposure to fine particles and carbon monoxide in smoke from fires (October 2019)
- JSOP J04.01 Public Information and Warnings (October 2017)

Latest review (October 2019)

This Standard supersedes the *Community Smoke, Air quality and Health Standard – Air quality assessment, forecasting and health protection messaging for particulate matter* Version 1, December 2015 (DHHS, EPA and EMV) and earlier versions.

The Standard has been amended in line with:

- The *Environment Protection Act 2017* and the objective to ‘protect human health and the environment by reducing the harmful effects of pollution and waste’ and other changes, including transfer of the Victorian Smoke Communications Strategy and “tools” from DHHS to EPA in 2017.
- EPA Victoria as a technical support agency to Incident Controllers during emergencies for air quality monitoring, interpretation of data and forecasting, assessment of potential risks to human health, communication of health protection messages to the community and other practical measures to reduce environmental and public health impacts of pollution and waste from the emergency and response activities.
- A rapid review of published literature (2016 to 2018) in relation to population exposure to fine particles from vegetation fires and health undertaken by DHHS⁷ and a contemporary

⁷ Useful further reading includes: WE Casio (2018), *Wildland fire smoke and human health*, *Science of the Total Environment* 624: 586-595; JR Balmes (2018), *Where there's Wildfire, There's Smoke*, *The New England Journal of Medicine* 378 (1): 881-883; and Adetona O et al (2016), *Review of the health effects of wildland fire smoke on wildland firefighters and the public*, *Inhalation Toxicology*, 28(3): 95-139.

summary of health effects of wildfire smoke in the US EPA Wildfire Smoke – A Guide for Public Health Officials (August 2019)⁸.

Superseded documents are listed in *Appendix 4*.

⁸ The US Wildfire Smoke Guide is an inter-agency collaboration that includes: the California Air Resources Board; California Office of Environmental Health Hazard Assessment; US Centers for Disease Control and Prevention; US Forest Service and the US Environmental Protection Agency.

Section 2 – Fine particles in smoke and community health

Fine particles, smoke exposure and health

Smoke from fires is a mixture of particles, also known as particulate matter, water vapour and gases, including carbon monoxide, carbon dioxide, hydrocarbons and other organic chemicals, nitrogen oxides, and other compounds depending on the type of fire.

Particulate matter (PM) in smoke can range in size from large, visible debris down to very small, invisible particles. It is the size of PM that determines how deep the particle can travel into the lungs when inhaled.

PM bigger than 10 micrometres in diameter generally only go as far as the nose and throat before being removed by the body. This particle size irritates the eyes, nose and throat and irritant effects usually resolve once smoke exposure ceases.

PM smaller than 10 micrometres in diameter or PM₁₀ inhalable particles may settle in the bronchi and lungs when breathed in. PM less than 2.5 micrometres in diameter or PM_{2.5} respirable fine particles can penetrate deep into the lungs (ie into the gas exchange regions – alveolus).

The likelihood of health effects occurring from exposure to PM₁₀ particles, or PM_{2.5} fine particles depends on: the concentration in air and duration of exposure; the person's age; the level of activity (rest, running, heavy exertion); whether a person has existing medical conditions (particularly cardiorespiratory disease or asthma); and other individual susceptibilities.

The following groups are most sensitive to being exposed to particles and particularly exposure to PM_{2.5} fine particles during smoke events:

- unborn babies up to children of 14 years of age
- people over 65 years of age
- people with pre-existing heart or lung conditions, including asthma
- smokers
- pregnant women.

A contemporary summary of the evidence of health effects of smoke from vegetation fires (wildfires/bushfires) and impacts on population health is available in the USEPA publication, *Wildfire Smoke – A Guide for Public Health Officials* (2019).

Although PM₁₀⁹ particles and PM_{2.5} fine particles can be inhaled and affect health to different degrees, PM_{2.5} is the preferred air quality indicator for air monitoring and assessment of the potential health impacts of community exposure to smoke.

⁹ The US EPA recommends that when PM₁₀ measurements are only available during smoky conditions, it can be assumed that the PM₁₀ is composed primarily of fine particles (PM_{2.5}), and therefore the AQI and associated cautionary statements and advisories for PM_{2.5} may be used

Section 3 – Ambient (outdoor) air quality monitoring for fine particles

Air quality standards

The National Environment Protection Measure (Ambient Air Quality) (NEPM AAQ 2016) outlines national reporting standards for the management of ambient air quality in each state or jurisdiction. Standards are set to be protective of population health from day to day (ie common) air pollutants including particulate matter (PM_{2.5}, PM₁₀) carbon monoxide, sulfur dioxide and nitrogen dioxide.

These standards are adopted in the Victorian State Environment Protection Policy (Ambient Air Quality) (to 30 June 2020) and the future Environmental Reference Standard (from 1 July 2020).

These air quality standards are applied to air measurements collected at permanent, fixed-location air monitoring stations in locations across the state.

For PM_{2.5}¹⁰ fine particles the daily and annual Victorian air quality standards are:

- 25 µg/m³ averaged over 24 hours
- 8 µg/m³ averaged over one year.

Ambient air monitoring trends for PM are influenced by many sources including, but not limited to roads, vehicle emissions, industries, dust and smoke from personal wood heater use as well as vegetation fires (burn-offs, planned fuel reduction burns or bushfires).

EPA AirWatch and ambient air quality

The EPA AirWatch webpage provides real-time (ie continuous) hourly reporting of common air pollutants including PM₁₀ and PM_{2.5}.

The Air Quality Index (or AQI) at each EPA monitoring station is based on the highest hourly measurement for a common air pollutant. Hourly values inform general health messaging for air quality over the five Air Quality Categories: which are Good, Moderate, Poor, Very Poor and Hazardous. The messages are contained in *Appendix 2*.

For PM_{2.5}, the EPA AirWatch webpage reports 24-hour averages in addition to 1-hour values.

¹⁰ For PM₁₀ the air quality standards applied in Victoria are 50 µg/m³ averaged over 24 hours and 20µg/m³ averaged over one year.

Section 4 – Community Air quality guideline values and air monitoring during extended smoke events

Air quality and smoke action levels for cautionary advice and actions

Fine particles are ‘non-threshold’ pollutants, which means no threshold has been identified below which no damage to health is observed¹¹ The higher the level of population exposure, the greater likelihood of sensitive groups experiencing health effects. When exposure levels are very high, health effects may occur in everyone.

Smoke events can affect outdoor air quality and sometimes this can be at levels higher than day-to-day measurements.

This Standard is informed by an internationally recognised graduated smoke advisory system developed in the US¹², which links monitored PM_{2.5} levels to corresponding cautionary health protection advice and recommended actions for the community to follow until air quality improves. At each increasing AQI category, recommended health protection messages and actions change to reflect an increase (or decrease) in potential public health risk during an extended smoke event.

In Victoria, the starting point is a 24-hour standard for PM_{2.5} of 25 µg/m³, the EPA uses an AQI approach (with adjustments to the US categories) and these are referred to as Air Quality Categories. For PM_{2.5}, 24-hour averages and hourly real-time (ie continuous) measurements¹³ are available on EPA AirWatch.

The USEPA approach to fine particles and smoke and the Victorian AQI (Air quality category) system (ie smoke advice and action levels) is summarised in *Appendix 1*.

¹¹ [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health) (accessed 19 November 2019)

¹² This is described in the US Wildfire Smoke: A Guide for Public Health Officials (revised 2019) and informed by the Technical Assistance Document for the Reporting of Daily Air Quality – the Air Quality Index (AQI) (USEPA, September 2018).

¹³ The hourly real-time measurements of fine particles on EPA AirWatch are based on the 24-hour Air Quality Categories of Good, Moderate, Poor, Very Poor and Hazardous with adjustment of values using Haber’s law.

Smoke advice and action levels for PM_{2.5} (rolling 24-hour) and recommended cautionary health protection advice and actions

In addition to hourly air monitoring on EPA AirWatch from the standard monitoring sites, an Incident Controller (or Agency Commander) may request¹⁴ that EPA deploy Incident Air Monitoring equipment to assess the impacts of smoke on air quality to understand the level of potential community health effects.

Air monitoring requires interpretation and scientific advice to determine the impacts on current air quality and to also forecast air quality over the next day or days. Trends and predictions in atmospheric fine particle concentrations over time are also important for decision making.

The concentration of fine particles in smoke fluctuates continuously with frequent spikes depending on local conditions such as wind speed and direction. This occurs during vegetation fires such as planned fuel reduction burns (ie short-term smoke events) or bushfires (ie short-term to long-term events).

Information issued to the community is based on both measured air quality data and forecast weather and fire data, which includes:

- measured results, some adjusted to 24-hourly averages from monitoring
- forecast models
- fire behaviour – both actual and forecast
- the predicted duration of prevailing conditions and elevated PM_{2.5} levels
- the size of the affected community
- the proximity of the community to the fire.

Average values (rolling 24-hour averages) are considered against the Air Quality Categories (Good, Moderate, Poor, Very Poor, Hazardous) with an understanding of the likely duration of the fire, the fire suppression strategy and predictions of weather conditions.

Air monitoring (from standard EPA monitoring sites and EPA incident monitoring) informs the air quality category and corresponding level of cautionary health protection advice and actions for people to follow to minimise impacts on their health – refer to *Appendix 3*. The latter is issued by the Incident Controllers and other agencies.

¹⁴ JSOP3.18 - Incident air monitoring for community health (July 2017)

Section 5 - Key considerations - risk management decisions to protect public health

Tactical decisions during fires require sufficient time to communicate and implement on a whole-of-population basis.

During fires that threaten life, property and community safety such as bushfires, the Incident Controller also makes informed, balanced judgements in tactical decision-making about smoke.

Tactical options for protecting community health from fine particles during smoke events include:

- Informing the community of the level of impact on air quality and the potential health risks associated with exposure to fine particles
- Ongoing provision of advice and cautionary actions people can take to protect their health and the health of those in their care (eg advice to reduce activity and minimise exposure)
- Steps to protect all sensitive groups such as closing some or all schools or early childhood centres and rescheduling outdoor events in smoke-affected areas
- Balancing the need for sensitive groups to temporarily relocate against the potential risks associated with moving highly vulnerable people out into smoky conditions (eg high-level aged care residents).

For Incident Controllers (or Agency Commanders) and other agencies, the most important reference point in this Standard is *Appendix 3* (ie Air quality categories for PM_{2.5} (rolling 24-hr) and cautionary health protection advice/actions).

Concept of operations

In Victoria, the following Joint Standard Operating Procedures operationalise the intent of this Standard:

- *SOP J03.18 - Incident Air Monitoring for Community Health* (July 2017)
- *SOP J03.19 - Managing Significant Community Exposures to Fine Particles and Carbon Monoxide in Smoke from Fires* (October 2019)

Joint Standard Operating Procedures apply to any event that generates significant or prolonged smoke where PM_{2.5} fine particles are the primary health hazard and detail the arrangements between relevant agencies for providing air-quality monitoring and the process for communicating health protection messages to smoke impacted communities.

Section 6 - Community information about Smoke and Health

Information about smoke and health for the community

Before a major smoke event occurs, the following information is available to help people plan:

- EPA provides air quality information and general health protection advice about smoke and health at: www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke
- The EPA AirWatch webpage provides real-time (continuous) air monitoring and health messages at: www.epa.vic.gov.au/for-community/airwatch
- Better Health Channel also provides community information on smoke and health: www.betterhealth.vic.gov.au/

People with heart or lung conditions, including asthma should maintain the treatment plan advised by their doctor. For example, making sure asthma is well-managed before a smoke event is something that can reduce the impacts of smoke exposure on individuals' health.

Community actions to protect health during smoky conditions

Members of the community must remain vigilant during any emergency to receive and act on emergency warnings and information in a timely way.

During a major smoke event people can get information from:

- VicEmergency website at: www.emergency.vic.gov.au/respond/ for cautionary advice and recommendation actions to protect health during any emergency.
- The EPA AirWatch webpage provides real-time (continuous) air monitoring and health messages at: www.epa.vic.gov.au/for-community/airwatch
- EPA provides air quality information and general health protection advice about smoke and health at: www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke
- Better Health Channel also provides community information on smoke and health: www.betterhealth.vic.gov.au/

Advice for people with pre-existing health conditions should include:

- Anyone with a heart or lung condition should follow the treatment plan advised by their doctor and keep at least a five-day supply of medication available.
- Anyone with asthma should ensure their personal asthma plan is up to date and followed.
- Anyone who needs to leave their home due to a fire or very smoky conditions should take prescriptions and medication with them.

Advice to help people prepare for and avoid smoky conditions should include:

- whenever possible, stay out of the smoke
- stay indoors when practical and safe to do so (ie if smoke is due to bushfire)
- close all doors and windows

- keep cool in hot weather – use a fan or air conditioner (split system) and keep hydrated
- seal gaps under doors or around windows and wall vents with towels, blankets or plastic
- avoid other sources of indoor air pollution (such as smoking, burning candles, using woodstoves, or stirring up fine dust by sweeping or vacuuming)
- consider bringing pets inside away from the smoke or heat
- take the opportunity during breaks in smoky conditions to air out homes to improve indoor air quality
- when safe to do so, take air-conditioned breaks at a local community library, shopping centre or respite centre under circumstances where homes become too smoky or hot to be comfortable.

When air quality is impacted by smoke everyone should consider the following:

| Advice and cautionary actions for community exposure to smoke |
|---|
| <p>Everyone should minimise the time spent in smoky conditions whenever practical to do so.</p> <p>People over 65 years, children 14 years and younger, pregnant women and those with existing heart or lung conditions, should reduce prolonged or heavy physical activity. Where possible (and not under direct threat from bushfires), also limit the time spent outdoors.</p> <p>Anyone with a heart or lung condition should take their medication as prescribed. Asthmatics should follow their personal asthma action plan, continue to take preventer medication as prescribed and keep reliever medication on hand.</p> <p>If you or anyone in your care is experiencing symptoms that may be due to smoke exposure, call NURSE-ON-CALL on 1300 60 60 24 or seek medical advice.</p> <p>Anyone experiencing difficulty breathing or tightness in the chest should seek urgent medical assistance – call 000.</p> <p>For regular updates on what you should do, listen to your local emergency radio station or visit www.emergency.vic.gov.au</p> |

During smoky conditions, and if air quality monitoring data is not available nearby, an approximate self-assessment of air quality based on visibility (ie how far you can see clearly) can be done to inform health protection actions. Refer to *Appendix 4* for the air quality self-assessment guide.

Appendix 1 – USEPA and Victorian approach for smoke fine particles

The US EPA AQI for air quality is on a normalised scale from 0 to 500, where an AQI of 100 is equivalent to the US national 24-hour PM_{2.5} standard of 35 µg/m³.

AQI categories reflect the degree of deviation (i.e. increasing PM_{2.5} levels) from the 24-hour ambient air quality standard. At each increasing AQI category, recommended health protection messages and actions change to reflect an increase (or decrease) in potential public health risk during an extended smoke event.

Table 1: Compares the US and Victorian equivalent action levels for fine particles in outdoor air during extended smoke events

| US Environmental Protection Agency (US EPA) | | US EPA action level 24-hr average PM _{2.5} (µg/m ³) | Percentage of US EPA national 24-hr ambient air quality standard PM _{2.5} | EPA Victoria Air Quality Categories 24-hr average PM _{2.5} (µg/m ³) ¹ Smoke advice and action levels | |
|---|-------------------------|--|---|---|-------------|
| Health-based category | Air Quality Index Value | | | | |
| Good | 0- 50 | At or below ≤ 35 | ≤ 100 | Good (0-50) | <9 |
| Moderate | 51 - 100 | US air quality standard | | Moderate (51-100) | 9 to 25 |
| Unhealthy for Sensitive Groups | 101 - 150 | 35.5– 55.4 | 100 to 156 | Poor (101-150) | 25 to 40 |
| Unhealthy | 151 - 200 | 56–150 | 156- to 424 | Very Poor (151-300) | >40 to 177 |
| Very Unhealthy | 201 - 300 | 151–250 | 424 to 705 | | |
| Hazardous | 301 - 500 | 251–500 | 706 to 1408 | Hazardous (301- 425) | >177 to 250 |
| | | | | Hazardous (426- 500) Chief Health Officer involved | >250 |

¹ Calculated as a percentage of the NEPM AAQ 24-hour air quality standard for PM_{2.5} of 25 µg/m³.

Appendix 2 – EPA AirWatch and general health messages (1 hour averages)

| Air Quality Category | |
|----------------------|---|
| Good | <p>Air quality at this station is good</p> <p>What this means:</p> <ul style="list-style-type: none"> • It's a good day to be outside <p>The air quality where you are might not be the same as the air quality at this site.</p> <p>If you see or smell smoke near you follow these steps (goes to Smoke webpage at: www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke)</p> |
| Moderate | <p>Air quality at this station is moderate</p> <p>What this means:</p> <ul style="list-style-type: none"> • The air is probably a bit smoky or dusty here • Air quality is okay now but it could change soon <p>What you can do:</p> <ul style="list-style-type: none"> • It's okay to be outside but watch for changes in air quality around you • If you are sensitive to air pollution (www.epa.vic.gov.au/for-community/monitoring-your-environment/about-epa-airwatch/air-pollution-sensitivity) follow your treatment plan <p>The air quality where you are might not be the same as the air quality at this site.</p> <p>If you see or smell smoke near you follow these steps (goes to Smoke webpage at: www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke).</p> |
| Poor | <p>Air quality at this station is poor</p> <p>What this means:</p> <ul style="list-style-type: none"> • The air is probably smoky or dusty here • People who are sensitive to air pollution (www.epa.vic.gov.au/for-community/monitoring-your-environment/about-epa-airwatch/air-pollution-sensitivity) could have symptoms like coughing or shortness of breath <p>What you can do:</p> <ul style="list-style-type: none"> • If you are coughing or have shortness of breath, avoid being outside in the smoke or dust • If you are sensitive to air pollution (www.epa.vic.gov.au/for-community/monitoring-your-environment/about-epa-airwatch/air-pollution-sensitivity), spend less time outside in the smoke or dust and follow your treatment plan • Close your windows and doors to keep smoke and dust out of your home • If you are worried about your symptoms, see your doctor or call Nurse on Call on 1300 606 024 • Seek urgent medical help if anyone has trouble breathing or tightness in the chest. Call 000 for an ambulance |

| | |
|------------------|---|
| | <p>The air quality where you are might not be the same as the air quality at this site. If you see or smell smoke near you follow these steps (goes to Smoke webpage at: www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke).</p> |
| <p>Very Poor</p> | <p>Air quality at this station is very poor</p> <p>What this means:</p> <ul style="list-style-type: none"> • The air is probably very smoky or dusty here • Many people might have symptoms like coughing or shortness of breath <p>What you can do:</p> <ul style="list-style-type: none"> • Listen to your local emergency radio station or visit Emergency Vic for advice • Avoid being outside in the smoke or dust • Close your windows and doors to keep smoke and dust out of your home • If you think the air in your home is uncomfortable, consider going to an air-conditioned building like a library or shopping centre for a break if it's safe to do so • If you are sensitive to air pollution (www.epa.vic.gov.au/for-community/monitoring-your-environment/about-epa-airwatch/air-pollution-sensitivity), follow your treatment plan • If you are worried about your symptoms, see your doctor or call Nurse on Call on 1300 606 024 • Seek urgent medical help if anyone has trouble breathing or tightness in the chest. Call 000 for an ambulance <p>The air quality where you are might not be the same as the air quality at this site. If you see or smell smoke near you follow these steps (goes to Smoke webpage at: www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke).</p> |
| <p>Hazardous</p> | <p>Air quality at this station is hazardous</p> <p>What this means:</p> <ul style="list-style-type: none"> • The air is smoky or dusty here • Everyone might have symptoms like coughing or shortness of breath <p>What you can do:</p> <ul style="list-style-type: none"> • Listen to your local emergency radio station or visit Emergency Vic for advice • Stay indoors away from smoke and dust • Close your windows and doors to keep smoke and dust out of your home • If you think the air in your home is uncomfortable, consider going to an air-conditioned building like a library or shopping centre for a break if it's safe to do so. • If you have asthma you should follow your asthma action plan • If you have a heart or lung condition, follow your treatment plan • If you are worried about your symptoms, see your doctor or call Nurse on Call on 1300 606 024 |

- Seek urgent medical help if anyone has trouble breathing or tightness in the chest. Call 000 for an ambulance

The air quality where you are might not be the same as the air quality at this site.

If you see or smell smoke near you follow these steps (goes to Smoke webpage at: www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke).

Appendix 3 – Air Quality Categories for PM_{2.5}¹⁵ (rolling 24-hr) and cautionary Health Protection advice and actions

| Air Quality Categories | PM _{2.5} (24 hour) µg/m ³ (rolling) | PM _{2.5} (1 hour) µg/m ³ AirWatch | Visibility (by eye) | Potential health effects without following advice or actions | Cautionary health protection advice/actions based on 24-hr rolling PM _{2.5} for prolonged smoke events |
|-------------------------------|---|---|---------------------|--|---|
| Good ¹⁶ | < 9 | <27 | > 20km | | None |
| Moderate ¹⁷ | 9-25 | 27-62 | >10k m-20km | | None |
| | | | | | Smoke impacts on air quality |
| Poor | >25-40 | >62-97 | >5-10km | Increasing likelihood of health effects in sensitive groups: People over 65, children 14 years and younger, pregnant women and those with existing heart or lung conditions. Health effects may occur in some people not in sensitive groups | People in sensitive groups should minimise or avoid prolonged or heavy physical activity and where possible, limit the amount of time spent outdoors. Those with a health condition, follow the treatment plan as prescribed. Everyone else should reduce prolonged or heavy physical outdoor activity if they develop health effects. |
| Very Poor | >40-177 | >97-370 | >1.5-5km | Significant aggravation of health effects in sensitive groups. Significant increase in respiratory and other effects in everyone else | People in sensitive groups should avoid outdoor physical activity (exercise) and where possible, stay indoors. Those with a health condition, follow the treatment plan as prescribed and seek medical advice if symptoms worsen. Everyone else should minimise or avoid prolonged or heavy physical outdoor activity and where possible spend more time indoors. Consider closing some or all schools or early childhood centres and rescheduling outdoor events (such as concerts and competitive sports) until air quality improves. |

¹⁵ General precautionary health protection advice for 1-hourly PM_{2.5} is available at EPA AirWatch website.

¹⁶ Less than 50% of the 24-hr air quality standard. EPA AirWatch message - it is a good day to be outside

¹⁷ At or below the 24-hr air quality standard. EPA AirWatch message - it is okay to be outside but watch for changes in air quality

| Air Quality Categories | PM _{2.5} (24 hour) µg/m ³ (rolling) | PM _{2.5} (1 hour) µg/m ³ AirWatch | Visibility (by eye) | Potential health effects without following advice or actions | Cautionary health protection advice/actions based on 24-hr rolling PM _{2.5} for prolonged smoke events |
|---|---|---|---------------------|--|---|
| Hazardous | >177 | >370 | 1-1.5km | <p>Serious aggravation of health effects in sensitive groups.</p> <p>Serious risk of respiratory effects in everyone else.</p> | <p>Sensitive groups consider temporarily relocating to stay with a friend or relative living outside the smoke-affected area. If this is not possible and there is no direct threat from bushfires, stay indoors and keep activity levels as low as possible</p> <p>Everyone should avoid outdoor physical activity as much as possible and where possible, stay indoors (if not under threat from bushfires).</p> <p>Anyone with symptoms should seek medical advice and take regular breaks out of smoky conditions.</p> <p>Consider closing some or all schools or early childhood centres and reschedule outdoor events (such as concerts and competitive sports) until air quality improves.</p> |
| Hazardous (Chief Health Officer) | >250 | Not applicable | 0.5-1km | As for Hazardous (above) | <p>Cautionary health advice/actions are for above (Hazardous) and</p> <p>if PM_{2.5} levels (ie rolling 24-hour average) are predicted to be or they are at or above 250µg/m³ for two consecutive days and are predicted to continue at or above this level, sensitive groups are strongly recommended to temporarily relocate away from smoky conditions until there is a sustained improvement in air quality.</p> <p>Everyone else should consider this advice.</p> |

Column 1 EPA Air Quality Categories: Good, Moderate, Poor, Very Poor and Hazardous. Hazardous category has a threshold point for extended smoke events and consideration of additional health protection advice and actions by the Chief Health Officer.

Column 2 PM_{2.5} 24-hour rolling average¹⁸ values equivalent to each Air Quality Category and these values inform column five and column six.

Column 3 Hourly values for EPA AirWatch, based on 24-hour values for each Air Quality Category adjusted using Haber's law. This shows how EPA AirWatch links to this system.

Column 4 Visibility range (ie to the human eye) with guidance available in *Appendix 4*.

¹⁸ A rolling 24-hour average is an average of the previous 24 one-hour readings of PM_{2.5} levels updated every hour.

Appendix 4-Air quality self-assessment guide

Visual assessments are based on the USEPA visual range and actions to take to reduce smoke exposure during smoky conditions. They may be useful in deciding what to do when local air is smoky and air quality monitoring information is not available.

This procedure provides good estimates of visibility only when:

- It is daylight hours (avoid sunset and sunrise)
- The relative humidity is less than 65% because moisture in the air (fog or rain) reduces visibility
- Focusing on dark objects (black is better than green).

Follow this procedure:

1. When there is no smoke (or fire) in the landscape, identify landmarks that are visible from home. Look for dark landmarks (such as buildings, sheds or large trees) that are at distances of 1.5, 2, 5, 10 kilometres.
2. Each of these distances corresponds to an Air Quality Category in the following table.
3. Use the landmarks as a guide to estimate air quality in the area when smoke is present.
4. When the landmark can no longer be clearly seen, air quality has deteriorated. Visibility is the distance to the nearest landmark that is just obscured (hard to see clearly) due to smoky conditions.

| Air Quality Category | Landmark visible from home | Cautionary health advice/actions |
|-------------------------------------|----------------------------|--|
| Good | >20km | None - it is a good day to be outside |
| Moderate | >10 km and <20 km | None - it is okay to be outside but watch for changes in air quality |
| Smoke impacts on air quality | | |
| Poor | >5 km and <10 km | <ul style="list-style-type: none"> • People who are sensitive to air pollution (www.epa.vic.gov.au/for-community/monitoring-your-environment/about-epa-airwatch/air-pollution-sensitivity) could have symptoms like coughing or shortness of breath <p>What you can do:</p> <ul style="list-style-type: none"> • If you are coughing or have shortness of breath, avoid being outside in the smoke or dust • If you are sensitive to air pollution (www.epa.vic.gov.au/for-community/monitoring-your-environment/about-epa-airwatch/air-pollution-sensitivity), spend less time outside in the smoke or dust and follow your treatment plan • Close your windows and doors to keep smoke and dust out of your home • If you are worried about your symptoms, see your doctor or call Nurse on Call on 1300 606 024 • Seek urgent medical help if anyone has trouble breathing or tightness in the chest. Call 000 for an ambulance <p>www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke</p> |

| Air Quality Category | Landmark visible from home | Cautionary health advice/actions |
|----------------------|----------------------------|---|
| | | |
| Very Poor | >1.5 km and < 5 km | <ul style="list-style-type: none"> • Many people might have symptoms like coughing or shortness of breath <p>What you can do:</p> <ul style="list-style-type: none"> • Listen to your local emergency radio station or visit Emergency Vic for advice • Avoid being outside in the smoke or dust • Close your windows and doors to keep smoke and dust out of your home • If you think the air in your home is uncomfortable, consider going to an air-conditioned building like a library or shopping centre for a break if it's safe to do so • If you are sensitive to air pollution (www.epa.vic.gov.au/for-community/monitoring-your-environment/about-epa-airwatch/air-pollution-sensitivity), follow your treatment plan • If you are worried about your symptoms, see your doctor or call Nurse on Call on 1300 606 024 • Seek urgent medical help if anyone has trouble breathing or tightness in the chest. Call 000 for an ambulance <p>www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke</p> |
| Hazardous | 1.5km or less | <ul style="list-style-type: none"> • Everyone might have symptoms like coughing or shortness of breath <p>What you can do:</p> <ul style="list-style-type: none"> • Listen to your local emergency radio station or visit Emergency Vic for advice • Stay indoors away from smoke and dust • Close your windows and doors to keep smoke and dust out of your home • If you think the air in your home is uncomfortable, consider going to an air-conditioned building like a library or shopping centre for a break if it's safe to do so. • If you have asthma you should follow your asthma action plan • If you have a heart or lung condition, follow your treatment plan • If you are worried about your symptoms, see your doctor or call Nurse on Call on 1300 606 024 • Seek urgent medical help if anyone has trouble breathing or tightness in the chest. Call 000 for an ambulance <p>The air quality where you are might not be the same as the air quality at this site.</p> <p>www.epa.vic.gov.au/for-community/environmental-information/air-quality/smoke</p> |

Appendix 5 – Victorian approach for significant smoke events and managing public health impacts

The integrated smoke, air quality and public health protection messaging approach in this Standard was originally developed by the Chief Health Officer (DHHS) and EPA Victoria during the 2006/2007 summer bushfires - informed by California's¹⁹ experience in managing the public health impacts of wildfire smoke.

During the 2006/2007 summer, approximately 1.2 million hectares were burnt by extended, large area bushfires in the North East and Gippsland (Bairnsdale). Local air quality and Melbourne metropolitan areas were affected by smoke. Smoke from large fires in Tasmania and King Island also impacted Victoria's air quality²⁰.

Further information in relation to the 2006/07 summer bushfires includes:

- EPA publication 1187 (December 2007) *Air Quality During the 2006-07 Victorian bushfires*
- EPA Information Bulletin 1200 (January 2008) *Bushfires and Air Quality*
- Dennekamp et al (2015) *Forest fire smoke and out-of-hospital cardiac arrests in Melbourne, Australia: a case crossover study*. *Environmental Health Perspectives*, 123 (10) 959 – 964
- Haikerwal et al (2016) *PM_{2.5} exposure during a prolonged wildfire period and emergency department visits for asthma*. *Respirology* 21 85-94.

Until 2014, Victoria's experience of large-area fires with extended smoke events were major bushfires with PM₁₀ fine particles as the smoke component of health concern.

In 2014, a bushfire travelled into an open cut brown coal field at the Hazelwood Mine in Morwell. This fire and the learnings and recommendations from this extended smoke event informed many changes including creation of the State Smoke Framework for Victoria, this Standard and joint (all agency) standard operating procedures to ensure the community receives the best available information in the best possible way to help to protect their health. The approach and science behind this Standard (Version 1 – December 2015) underwent Independent expert review in 2015.

EPA and the Chief Environmental Scientist work in collaboration with the Chief Health Officer, Emergency Management Commissioner and Control agencies involved in responding to fire events.

¹⁹ Victoria, Australia and California have a shared history of major bushfire events

²⁰ *Bushfire smoke, air quality and health protocol* (Department of Health and EPA Victoria 2014).

Appendix 6 – Superseded versions of this Standard

This Standard supersedes the following documents:

- *Community smoke, air quality and health standard – Air quality assessment, forecasting and health protection messaging for particulate matter* Version 1, December 2015 (DHHS, EPA, EMV)
- *Community smoke, air quality and health protocol* July 2015 (DHHS, EPA, EMV)
- *Rapid deployment of air quality monitoring for community health guideline* 2015 (EPA, DHHS, EMV)
- *Hazelwood coal mine fire PM_{2.5} health protection protocol* 2014 (Department of Health/EPA)
- *Bushfire smoke, air quality and health protocol* 2014 (Department of Health/EPA 2014)

Appendix 7 - References and contextual information to this Standard

International:

Adetona O et al (2016), *Review of the health effects of wildland fire smoke on wildland firefighters and the public*, *Inhalation Toxicology*, 28(3): 95-139.

JR Balmes (2018), *Where there's Wildfire, There's Smoke*, *The New England Journal of Medicine* 378 (1): 881-883

WE Casio (2018), *Wildland fire smoke and human health*, *Science of the Total Environment* 624: 586-595

Royal Society of Chemistry UK (2016) *Toxicology, Survival and Health Hazards of Combustion Products (Issues in Toxicology)*, ed. D Purser, R Maynard and J Wakefield.

US Environment Protection Agency (August 2019, EPA-452/R-19-901) - *Wildfire smoke: A guide for public health officials (Revised 2019)*. US Environmental Protection Agency, U.S Forest Service, U.S. Centers for Disease Control and Prevention, California Air Resources Board,

Australian:

National Environment Protection (Ambient Air Quality) Measure, Australian Department of the Environment and Energy, 25 February 2016

Victorian:

VicEmergency website at: www.emergency.vic.gov.au/respond/

EPA Victoria Air Watch website: www.epa.vic.gov.au/for-community/airwatch

State Environment Protection Policy (Ambient Air Quality), EPA Victoria (July 2016) until 1 July 2020, followed by the Victorian Environmental Reference Standard (*in progress*)

State Smoke Framework, Version 3.0, EMV (November 2016)

JSOP J03.18 - *Incident Air Monitoring for Community Health*, EMV (July 2017)

JSOP J03.19 - *Managing Significant Community Exposures to Fine Particles and Carbon Monoxide in Smoke from Fires*, EMV (October 2019)

JSOP J04.01 *Public Information and Warnings* (October 2017)

EPA Publication 1187 (December 2007) *Air Quality During the 2006-07 Victorian bushfires* at www.epa.vic.gov.au

EPA Information Bulletin 1200 (January 2008) *Bushfires and Air Quality* at www.epa.vic.gov.au

Dennekamp et al (2015) *Forest fire smoke and out-of-hospital cardiac arrests in Melbourne, Australia: a case crossover study*. *Environmental Health Perspectives*, 123 (10) 959 – 964

Haikerwal et al (2016) *PM_{2.5} exposure during a prolonged wildfire period and emergency department visits for asthma*. *Respirology* 21 85-94.