



## Table of contents

Abbreviations .....	3
Introduction .....	5
Air quality .....	10
Climate .....	14
Biodiversity .....	20
Land Health .....	24
Forests .....	28
Fire .....	34
Water Resources .....	38
Water Quality .....	42
Coastal & Marine Environment .....	48
Waste & Resource Recovery .....	56
Energy .....	60
Transport .....	64

### Page

Front Cover, 2, 4, 9, 10, 19, 20, 24, 31, 32, 34, 37, 38, 42, 47, 48, 56, 60, 64, Back Cover  
14, 17, 28, 63, 66  
55

### Photo Attribution

Salahuddin Ahmad  
Parks Victoria  
Jenny Jelbart

## Abbreviations

BoM.....	Bureau of Meteorology
C&D.....	Construction and demolition
C&I.....	Commercial and Industrial
CES Act.....	Commissioner for Environmental Sustainability Act
CFA.....	Country Fire Authority
DEDJTR.....	Department of Economic Development, Jobs, Transport and Resources
DELWP.....	Department of Environment, Land, Water and Planning
EMV.....	Emergency Management Victoria
EPA.....	Environment Protection Authority
ESD.....	Ecologically Sustainable Development
EVC.....	Ecological Vegetation Classes
GDP.....	Gross Domestic Product
GHG.....	Green House Gas
GSP.....	Gross State Product
IGEM.....	Inspector General for Emergency Management
KAB.....	Keep Australia Beautiful
LULUCF.....	Land use, land-use change and forestry
MAC.....	Ministerial Advisory Committee
NLI.....	National Litter Index
NRM.....	Natural Resource Management
OCES.....	Office of the Commissioner for Environmental Sustainability
PFAS.....	Per- and poly-fluoroalkyl substances
PFOS.....	Perfluoro-octane sulfonate
PTV.....	Public Transport Victoria
RFA.....	Regional Forest Agreement
SDGs.....	Sustainable Development Goals
SEEA.....	System of Environmental-Economic Accounting
SEPP.....	State Environment Protection Policy
SFM.....	Sustainable Forest Management
SoE.....	Victorian State of the Environment report
SoF.....	Victorian State of the Forests report
SoY.....	State of the Yarra and its Parklands report
SV.....	Sustainability Victoria
SWRRIP.....	Statewide Waste and Resource Recovery Infrastructure Plan
TfV.....	Transport for Victoria
VAGO.....	Victorian Auditor General's Office
VREAS.....	Victorian Renewable Energy Auction Scheme
VRIAR.....	Victorian Recycling Industry Annual Report
WOV.....	Waters of Victoria
WMP.....	Waste Management Policies

**Note:** All online content referenced throughout this report was retrieved on 18 July 2018.





## Traditional Owners

The Office of the Commissioner for Environmental Sustainability proudly acknowledges Victoria's Aboriginal community and their rich culture and pays respect to their Elders past and present.

We acknowledge Aboriginal people as Australia's first peoples and as the Traditional Owners and custodians of the land and water on which we rely. We recognise and value the ongoing contribution of Aboriginal people and communities to Victorian life and how this enriches us.

We embrace the spirit of reconciliation, working towards the equality of outcomes and ensuring an equal voice.



# Introduction

---

This Interim Victorian State of the Environment report (SoE) provides a considered glimpse into the content, challenges and structure of the Victorian SoE 2018 to be issued in early 2019.

The approach taken is consistent with the *State and Benefit: Framework for the Victorian 2018 State of the Environment Report* which was tabled in the Victorian Parliament in December 2015 as required under the *Commissioner for Environmental Sustainability Act 2003*.<sup>1</sup>

This interim report is an important part of the process of preparing the SoE 2018. It is intended as a 'progress report' to highlight the content, inform the development and ultimately result in a higher quality SoE report.

There are no findings or recommendations in this Interim report as the scientific synthesis is not complete and at the time of writing, data acquisition is still underway. However, the Interim report does include a discussion of the management issues and the data and information challenges observed thus far.

## **The structure of the Victorian SoE 2018**

The 12 content sections included in this Interim report – from air quality through to energy – mirror the structure of the SoE currently under development and due to be completed by the end of 2018.

Each section in this Interim report includes the following information:

- background
- policy/management and data/information challenges<sup>2</sup>
- scope of indicators (inclusions, exclusions, data availability/limitations)
- current policy and management responses by State Government.

This information will be repeated in the SoE 2018 and updated, full data assessments complete with findings for each indicator included along with a Future Focus 2030 summation.

## **Future Focus 2030**

Future Focus 2030 will be a critical component of each of the content sections in SoE 2018. It will provide an analysis of knowledge gaps to address important blind spots in our evidence base to manage for environmental outcomes. Future Focus 2030 will also propose which current indicators should be retained for future reports and will identify new indicators as the Office continues delivering the journey of reform set out in the *State and Benefit Framework* – from reporting on 'what we know' to reporting on 'what we need to know' to improve environmental outcomes for all Victorians.

## **2030 is not an arbitrary time horizon**

It has been selected because it is also the year assigned to many of the 169 targets of the UN Sustainable Development Goals (SDGs). The *State and Benefit Framework* tabled in 2015 announced the Commissioner's intention to align environmental reporting in Victoria with international frameworks such as the SDGs and the System of Environmental-Economic Accounting (SEEA).

Environmental-economic accounting expertise (provided by the Victorian Department of Environment, Land, Water and Planning (DELWP)), will help inform the Commissioner's recommendations regarding future indicators. Victoria's environmental reports are transitioning towards a regime which not only detail the condition and trends in the health of the environment but also on the benefits of the ecosystem services provided: services which society relies on.

Importantly, the *Commissioner for Environmental Sustainability Act 2003* (CES Act) enables the Commissioner to make recommendations to Government to improve environmental outcomes through better data and monitoring regimes, management interventions, policy settings and tools. Each section of the SoE 2018 will conclude with these recommendations and is an approach intended by the Commissioner, to focus the effort and investments by government over the next decade.

---

1. Commissioner for Environmental Sustainability 2015, 'State and Benefit Framework for the 2018 State of the Environment Report', Melbourne, Victoria <http://www.ces.vic.gov.au/framework>.

2. Note: The challenges are not prioritised and the order they are listed in each section do not represent their respective importance.

## Cross-cutting issues that are relevant to every section

The SoE 2018 (and this Interim report) employs a matrix structure. Each section emphasises the biophysical science relevant to the environmental topic and discusses cross-cutting pressures, along with socio-economic and cultural issues, pertaining to each section.

While the SoE 2018 will consider critical threats to Victoria's natural assets, including population growth (and associated pressures on land use), climate change and biodiversity loss, in detail they are only dealt with briefly, per section, in this Interim report.

It is important to recognise that ecologically sustainable development (ESD) is defined in the CES Act (s.4 *What is ecologically sustainable development?*), as an organising principle of the SoE 2018. The principle provides a logical basis for deciding on the scope of the report – both in terms of indicators as well as UN SDG targets.

Traditional Owner engagement and contribution to SoE reporting is also important across all sections of the report. Scientists estimate humans have occupied Victoria's south east for at least the past 30,000 years<sup>3</sup> and the archaeology of sites in Victoria illustrate Traditional Owners' cultural association with the land.

In recent decades, governments and communities have acted to protect and preserve sites of significant cultural value. State and federal government legislation<sup>4</sup> helps to protect and preserve significant Aboriginal places, areas and objects (on land and in the water).

Victoria's Traditional Owners consider working on country as a cultural responsibility. Currently, they are working with scientists, archaeologists, developers and the broader community, to identify key culturally significant areas. Together, these groups are managing the effects of human development and climate change.

## Data availability

This Interim report reviews the anticipated data limitations and information challenges for the SoE 2018 for each environmental theme, as observed at the time of writing.

In addition, there are several overarching challenges (not prioritised):

- internal alignment of monitoring and data integration efforts across policy functions of Government
- integrating citizen science into conventional monitoring systems and use in policy development
- transitioning to digital reporting capabilities (and the role of Government as moderator and curator)
- determining trends over time due to methodological changes between reporting cycles
- understanding non-market values of natural assets (and the current state of those values) to inform environmental-economic accounts
- statewide assessments based on incomplete and/or localised monitoring regimes.

## Total Indicators

2008 Indicators	120 (approx.) <sup>5</sup>
2013 Indicators	90 (approx.) <sup>6</sup>
2018 Indicators	242 (approx.) <sup>7</sup>

Table 1. Total Indicators by SoE report

## Total Indicators (SoE 2018 Data)

Indicators where quantitative data is confirmed or anticipated	171
Indicators where quantitative data is not available – 2018 SoE will use qualitative data such as case studies, narrative only, etc.	71

Table 2. Anticipated data availability<sup>8</sup>

3. Canning S and Thiele F 2010, *'Indigenous Cultural Heritage and History within the Metropolitan Melbourne Investigation Area'* Australian Cultural Heritage Management, technical report, Victorian Environmental Assessment Council, Melbourne, Victoria.

4. Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Cwth), *Aboriginal Relics Preservation Act 1972 – revoked in 2006 (State)*, *Aboriginal Heritage Amendment Act 2016* (current State Act).

5. Approximate figure – indicators are not always identified clearly in previous reports (particularly SoE 2008) and data quality was not consistently assessed in SoE 2008. Comparing indicators is also problematic as methodologies and scopes change.

6. Approximate figure – indicators are not always identified clearly in previous reports. Comparing indicators is also problematic as methodologies and scopes change.

7. Note at July 2018 – total number of indicators will change as data is assessed and further research is undertaken.

8. Note at July 2018 – indicators will be recategorised, removed or added as data is acquired, verified and assessed.

SoE 2018 Section	Indicators
Introduction	22
Air Quality	10
Climate Change Impacts	23
Biodiversity	46
Land Health	15
Forests	23
Fire	4
Water Resources	16
Water Quality	13
Coastal and Marine Environment	60
Waste and Resource Recovery	6
Transport	1
Energy	3

Table 3. Indicators by report section

### **State of the Yarra and its Parklands 2018**

The CES Act was amended in 2017 for the first time since its inception in 2003 to include a “periodical report on the environmental condition of Yarra River land” to reflect the provision in the *Yarra River Protection Act (Wilip-gin Birrarung murrn)* 2017.

The State of the Yarra & its Parklands (SoY) report will be a five-yearly report issued with the SoE report and delivered consistent with the provisions of the CES Act including the environmental reporting framework. The SoY report will be told as a journey of flow from catchment to coast. It will tell the story of the Birrarung being alive as an integrated and flowing natural entity.

The SoY will include approximately 45 biophysical indicators of environmental health that will also be included in the SoE as statewide indicators. In addition, the SoY will include a second part to its story entitled ‘Communities of the Yarra’ which will include socio-economic indicators on:

- cultural landscape health and management
- stewardship and recreational health
- private protected areas.

As with the SoE 2018, case studies will be used in the SoY to supplement data and demonstrate actions.





Figure 1. Countries that have adopted the Montreal Process for reporting on forests.

Source retrieved 18 July 2018 <https://www.fs.fed.us/research/sustain/montreal-process.php>.

### State of the Forests 2018

The Montreal Process has been adopted by 12 countries (including Australia) to report on agreed criteria and indicators for sustainable forest management (Figure 1). Each jurisdiction can independently decide on a set of indicators relevant to their conditions to report against the seven themes of the Montreal Process:

- conservation of biological diversity
- productive capacity of forest ecosystems
- forest ecosystem health and vitality
- conservation and maintenance of soil and water resources
- forest contribution to global carbon cycles
- enhancement of long-term multiple socio-economic benefits to meet the needs of society
- legal, institutional, and economic frameworks for forest conservations and sustainable management.

In Victoria, 45 indicators were developed for reporting on sustainable forest management and have been assessed every five years in the State of the Forests (SoF) report since 2003. These indicators are aligned with the Federal Government's reporting on forest trends at a national level.

The SoF report is a statutory report under the *Sustainable Forests (Timber) Act 2004*. Previous reports have been developed and issued by the responsible Government department. Responsibility for the SoF transferred from DELWP to the Commissioner for Environmental Sustainability (OCES) in 2017 through Ministerial authority (i.e. there has been no legislative change).

Although the SoF 2018 will report on and assess all 45 indicators developed for the Montreal Process, 22 have been identified as the most critical indicators to Victoria through consultation with DELWP, stakeholders and scientists.

Some data limitations have been identified. These include that:

- complete data coverage is not available for all the 45 indicators<sup>9</sup>
- the majority of indicators use data and information that is less than five years old,<sup>10</sup> so it is difficult to conduct trend analysis
- climate change impact data on native forests is limited (including the impact on fragmentation)
- the number of forest-dependent species at risk from isolation (and the accompanying loss of genetic variation) is difficult to assess.

9. Mellor A, Phelan T and Haywood A 2015, 'Sustainable forest management in Victoria: improving criteria and indicator data and reporting trends.' Paper presented at the 8th ANZIF Conference – 'Beyond tenure: managing forests across the landscape', Creswick, Victoria, 13-15 April 2015.

10. Ibid.





# Air Quality





### Background

Good air quality is essential for human health and the environment. The links between air quality, population exposure and health are an increasing focus of research and policy development, with the greatest adverse health effects from air pollution experienced in densely populated areas that are exposed to emissions from motor vehicles, industrial facilities and domestic activities (e.g. wood heaters). Significant smoke impacts are also associated with bushfires and fuel reduction burns.

Victoria's air quality is considered good relative to international standards, although poor air quality is still measured near major industrial facilities and during major fire incidents such as bushfires, fuel reduction burns and large industrial fires.

As Victoria's population increases and the demographics shift to an ageing population, the health impacts could increase unless there is a decrease in air pollution. Climate change will also compound existing threats, with higher temperatures and longer periods of reduced soil moisture likely to increase the risk of more frequent and severe fires and dust storms as well as exacerbating the conditions for summer smog formation.<sup>11</sup>

During recent years, poor air quality has been recorded for multiple consecutive days in populated areas near major fires, notably the Hazelwood mine fire in 2014,<sup>12</sup> the industrial fire at a recycling facility near Coolaroo in 2017<sup>13</sup> and the peat fires near Cobden in 2018.<sup>14</sup> In association with climate change, the fire season in eastern Australia has lengthened from 1996 to 2013,<sup>15</sup> meaning fuel reduction burning needs to occur in a shorter, but potentially more intense, period during cooler months. This shorter window for fuel reduction burning increases the risk of widespread particle pollution associated with the calm weather conditions that are suitable for fuel reduction burning, but also facilitate an accumulation of air pollution.

EPA has increased the number of air monitoring stations since the Victorian SoE 2013 report. EPA now monitors air quality at 19 sites across Victoria, with 12 sites located in Melbourne, five in the Latrobe Valley and one each in Geelong and Wangaratta. Since the 2014 Hazelwood mine fire, the EPA has worked with the local Latrobe Valley community to co-design a more extensive air monitoring network in the region.<sup>16</sup>

Despite EPA's expansion of its air monitoring network, a 2018 Victorian Auditor-General's Office (VAGO) report found EPA cannot demonstrate that its current monitoring provides a representative measure of ambient air quality across the state. The VAGO report recommended an expanded air monitoring network for Victoria that better aligns coverage with pollution risks.<sup>17</sup>

Information is lacking on the impacts of air pollution on human health in Victoria. No long-term studies that document the association between mortality and air pollution exposure have been carried out in Australia. However, short-term studies suggest there are similar relationships between health and air pollution in Australia to those observed in Europe and North America.

The critical challenges facing Victoria's air quality management now and into the future include:

- reducing air pollution emissions and population exposure to air emissions
- mitigating human health impacts associated with an increasing and ageing population, particularly during pollution events and in areas with chronic poorer air quality
- managing the air quality risks from continuing economic growth
- expanding Victoria's air monitoring network to include a greater coverage across regional Victoria and some areas of Melbourne, as well as including targeted roadside air monitoring sites

11. Environment Protection Authority Victoria 2013, 'Future air quality in Victoria – Final report', Melbourne, Victoria <https://www.epa.vic.gov.au/our-work/publications/publication/2013/july/1535>.

12. Environment Protection Authority Victoria 2015, 'Summarising the air monitoring and conditions during the Hazelwood mine fire, 9 February to 31 March 2014', Melbourne, Victoria <http://www.epa.vic.gov.au/-/media/Publications/1598.pdf>.

13. Environment Protection Authority Victoria 2017, 'EPA completes air monitoring campaign in Coolaroo', Melbourne, Victoria <http://www.epa.vic.gov.au/about-us/news-centre/news-and-updates/news/2017/july/21/epa-completes-air-monitoring-campaign-in-coolaroo>.

14. Environment Protection Authority Victoria 2018, 'Last EPA air monitoring station leaving as Cobden gets the all clear', Melbourne, Victoria <http://www.epa.vic.gov.au/about-us/news-centre/news-and-updates/news/2018/may/08/last-epa-air-monitoring-station-leaving-as-cobden-gets-the-all-clear>.

15. Jolly M, Cochrane M, Freeborn P, Holden Z, Brown T, Williamson G and Bowman D 2015, 'Climate-induced variations in global wildfire danger from 1979 to 2013', Nature Communications 6: 7537 <https://www.nature.com/articles/ncomms8537>.

16. Environment Protection Authority Victoria 2017, 'Latrobe Valley air monitoring co-design', Melbourne, Victoria <http://www.epa.vic.gov.au/our-work/programs/latrobe-valley-air-monitoring/latrobe-valley-air-monitoring-codesign>.

17. Victorian Auditor-General's Office 2018, 'Improving Victoria's Air Quality', Melbourne, Victoria <https://www.audit.vic.gov.au/sites/default/files/2018-03/20180308-Improving-Air-Quality.pdf>.

- improving understanding of the sources and extent of air pollution through better monitoring and reporting and a more comprehensive emissions inventory
- improving knowledge of the link between air quality and health, particularly during short-medium pollution events (e.g. the effects of being exposed to significant amounts of smoke from bushfires or fuel reduction burns)
- ensuring suitable buffer protection measures are in place between odorous industries and residential communities
- identifying opportunities to include air quality in urban planning decisions, particularly in relation to urban green space and opportunities to reduce reliance on causes of pollution such as motor vehicles<sup>18</sup>
- mitigating the effects of climate change on the risk of pollution from bushfires, fuel reduction burns, summer smog formation and dust storms.

### **Air quality themes**

To understand trends and identify information gaps to address the above challenges, SoE 2018 will assess:

### **Air pollutants**

The common air pollutants – ozone, particles, nitrogen dioxide, carbon monoxide and sulphur dioxide – are associated with a range of health effects. This theme will report on the status and trends in levels of those main air pollutants monitored by EPA. The discussion will be limited to areas that are currently monitored by EPA, which does not include major regional population centres such as Ballarat and Bendigo.

### **Air pollutants – sources**

An understanding of the sources of air pollution is important for the development of effective air quality strategies. To determine the contribution of each major air pollution source, a prioritisation structure of air quality issues and initiatives is enabled. This theme will discuss the contributions

of the main sources of air pollution in Victoria, which are industry, wood heaters, windblown dust, bushfires, planned burning activities, and motor vehicles (especially diesel exhaust).

### **Amenity**

The impacts from odour, noise and dust are a significant issue in Victoria both in terms of human health and complaints to regulators. This theme will touch on the pollution reports received by EPA. Local councils also receive a lot of amenity reports, however there are 79 local councils in Victoria with significant variances in the way individual councils record pollution report data, meaning it is not currently feasible to access and analyse the council data alongside the EPA pollution report data.

### **Health**

The impacts of air pollution on human health is dependent on a range of factors, including exposure level, age and the background health status of individuals. If recent data on respiratory illnesses and other diseases is available, this theme will report on trends in the occurrence and numbers of health impacts attributed to air quality issues. An overview of the latest research on the links between indoor air quality and human health will also be included, with some of the key indoor air quality issues (including gas heating and cooking and smoking in residential properties).

### **Government policy response**

In May 2018, the Victorian Government released *Clean Air for All Victorians – Victoria's Air Quality Statement*. The Statement contains ideas on what could be done to protect Victoria's air quality through to 2030.

Public comments on the statement, and a subsequent Clean Air Summit and workshops, are informing the development of a Victorian Clean Air Strategy for release in 2019. The Victorian Government has allocated \$1.2 million to develop this Strategy, which will articulate policy and programs to underpin air quality management to 2030.

---

18. World Health Organisation Europe 2016, 'Urban green spaces and health: A review of evidence', Copenhagen, Denmark [http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0005/321971/Urban-green-spaces-and-health-review-evidence.pdf](http://www.euro.who.int/__data/assets/pdf_file/0005/321971/Urban-green-spaces-and-health-review-evidence.pdf).

In 2016, a Ministerial Advisory Committee (MAC) completed its inquiry into EPA. One of the MAC's recommendations was for EPA to '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'.<sup>19</sup>

- the Victorian Government is investing \$182.4 million to reform the EPA. The reform aims to transform the EPA into a modern environmental regulator focused on preventing pollution. This includes a comprehensive reform of the Environment Protection Act 1970 through two pieces of legislation. These reforms intend to provide the EPA with stronger powers and tools to prevent and manage instances of air pollution
- the first piece of legislation, the Environment Protection Act 2017 achieved royal ascent in October 2017 and established EPA as a statutory authority and legislated the role of the Board, CEO and Chief Environmental Scientist
- the *Environment Protection Amendment Bill 2018* was read in parliament on 19 June 2018 and then for a second time on 20 June 2018.

The significance of the second reading was for the Bill and its associated documents to become public. If passed by the Parliament, the second piece of legislation covering EPA powers is expected to commence in July 2020.

Furthermore, in March 2018, the VAGO report *Improving Victoria's Air Quality* made five recommendations for EPA to improve its work in the air quality sector.<sup>20</sup> The five recommendations were for EPA to:

- expand its air monitoring network
- improve its reporting on air quality
- expand and update its knowledge on Victoria's air quality
- work with all relevant councils to address air quality issues at the Brooklyn Industrial Precinct
- work with the DELWP to clarify the roles and responsibilities of relevant Victorian Government agencies with respect to air quality management.

DELWP and EPA have accepted all recommendations of the VAGO report and are commencing actions to address them.

Air Quality Theme	Air Quality Indicator	2008	2013	2018
Air Pollutant	<i>Ambient ozone levels (summer smog)</i>	✓	✓	✓
	<i>Carbon monoxide and nitrogen dioxide</i>	✓	✓	✓
	<i>Particle pollution (PM<sub>10</sub> and PM<sub>2.5</sub>)</i>	✓	✓	✓
	<i>Sulfur dioxide</i>	✓	✓	✓
	<i>Stratospheric ozone:</i>	✗	✗	✓•
	<i>a) Observed stratospheric ozone concentration</i> <i>b) Average size of the ozone hole over Antarctica</i> <i>c) Ultraviolet radiation flux at the surface</i> <i>d) Concentration of ozone depleting substances</i> <i>e) Victorian emissions of ozone depleting substances</i>			
Air Pollutant – Sources	<i>Emissions of major air pollutants by sector</i>	✓	✓	✓
Amenity	<i>Amenity – dust, noise and odour</i>	✗	✓	✓
	<i>Light pollution</i>	✗	✗	✓•
Health	<i>Health impacts of air pollution</i>	✗	✓	✓
	<i>Indoor air quality</i>	✗	✗	✓•

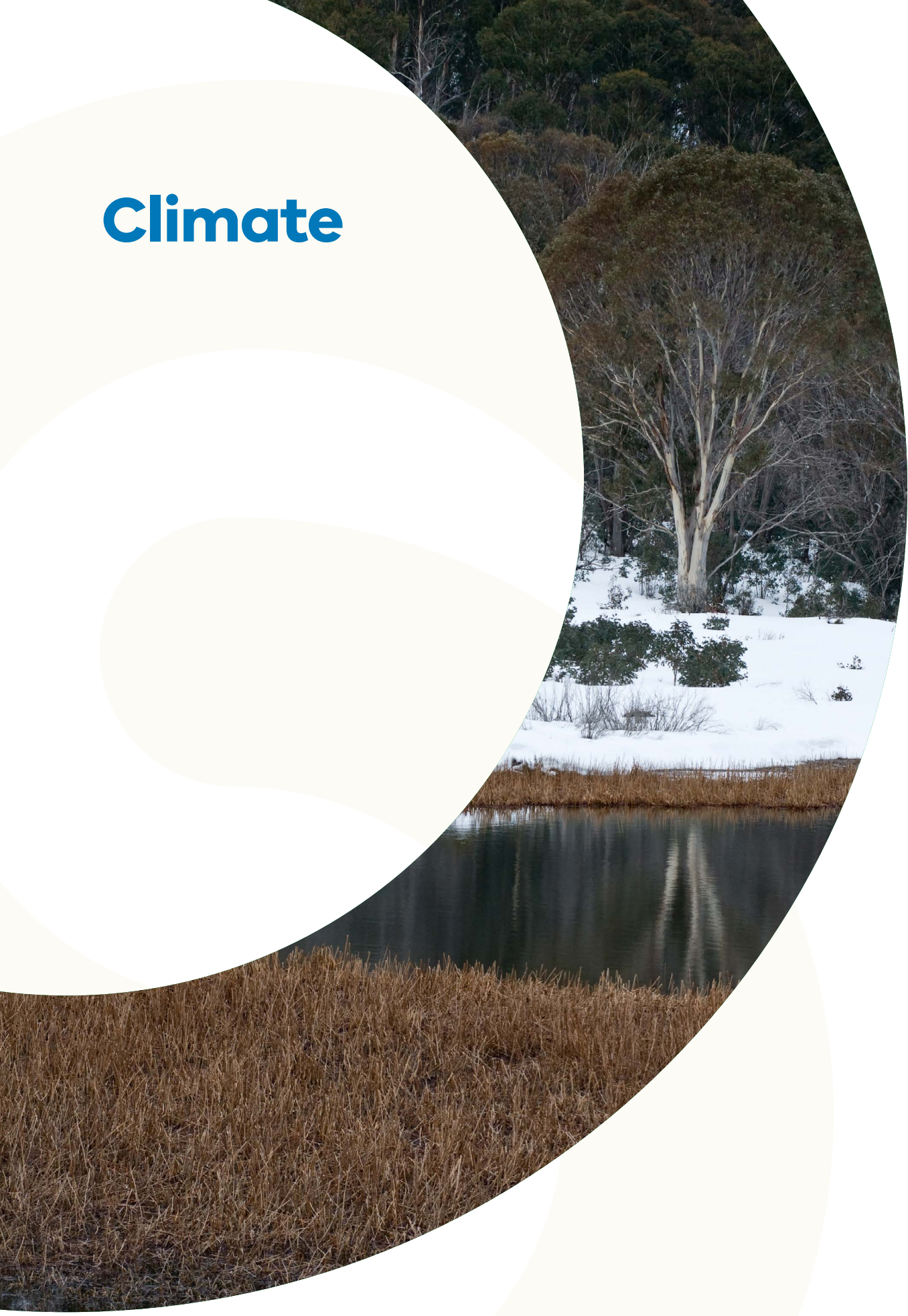
• Only as narrative

19. Ministerial Advisory Committee to the Minister for Environment, Climate Change and Water 2016, *'Independent inquiry into the Environment Protection Authority'*, Melbourne, Victoria [http://www.epa-inquiry.vic.gov.au/\\_data/assets/file/0008/336698/Inquiry-report-EPA\\_June.pdf](http://www.epa-inquiry.vic.gov.au/_data/assets/file/0008/336698/Inquiry-report-EPA_June.pdf).

20. Victorian Auditor-General's Office 2018, *'Improving Victoria's Air Quality'*, Melbourne, Victoria <https://www.audit.vic.gov.au/sites/default/files/2018-03/20180308-Improving-Air-Quality.pdf>.



# Climate



## Background

Climate research continues to show that temperatures, sea levels and sea-surface temperatures are rising in Australia.<sup>21</sup> The Bureau of Meteorology (BoM) advises that such changes will lead to significant ecosystem and biodiversity impacts and will expose Victorians to more frequent and intense droughts, fires, heatwaves, extreme rainfall events and coastal inundation.<sup>22</sup> The SoE 2018 will report on the effect climate change is having in these areas, as well as the potential future implications.

Victoria's climate is influenced by a range of factors, including atmospheric conditions (the Southern Oscillation) and changes in sea-surface temperatures (El Niño and La Niña cycles). These drivers of climate lead to large natural year-to-year variations in temperature and rainfall. However, long-term climate change and global warming caused by increasing greenhouse gas (GHG) emissions is occurring at global scales and is cumulative over many years.<sup>23</sup>

Victoria's GHG emissions are reported annually in the Australian National Greenhouse Accounts. In 2016, Victoria emitted a total of 124Mt CO<sub>2</sub>-e with land use, land-use change and forestry (LULUCF) excluded, this was a 5% reduction from 2011 when 130Mt CO<sub>2</sub>-e was emitted (excluding LULUCF). By contrast, from 2011 to 2016, Australia's GHG emissions increased by 2% (excluding LULUCF).

In 2016, the stationary energy and transport sectors were the largest emitters, accounting for 50% and 18% of the total GHG emissions in Victoria respectively.<sup>24</sup>

Critical challenges facing Victoria's management of climate change impacts now and into the future include:

- reducing GHG emissions to mitigate the speed and severity of climate change
- developing our understanding of the impacts of climate change through better, real time monitoring, trend analysis and predictive capabilities so that we can respond and protect the environment and communities, in a timely manner

- reducing the health burden associated with heatwaves and other natural disasters
- maintaining/designing vital infrastructure, such as power generation and rail transport, for reliability in the face of more frequent and intense weather events
- maintaining secure water supplies across the State as population grows and average rainfall reduces
- maintaining the viability of the agricultural sector
- protecting biodiversity from the impacts of climate change
- mitigating the effects of sea level rise and its associated adverse coastal impacts that include more frequent and severe flooding in low-lying coastal areas, dune erosion, loss of coastal ecosystems and reduced public access to coastal environments.

## Climate themes

To understand trends and identify information gaps to address the above potential impacts from climate change, the SoE 2018 report will assess:

## Climate – overview

This section will report on the observed rainfall, surface temperature and snow cover trends. For the SoE 2018, BoM will provide an update on the rainfall and temperature data that was provided in the SoE 2013, while data on snow cover will be taken from a 2016 publication that reported on current and projected snow cover at Victorian alpine resorts and was produced by the Antarctic Climate & Ecosystems Cooperative Research Centre.<sup>25</sup>

## Climate – projections

Australian climate projections are predominantly focused at a national level, but the Australian Government through [Climate Change In Australia](#) has made available a Climate Analogues tool that

21. The Bureau of Meteorology, CSIRO 2016, 'State of the Climate 2016', Melbourne, Victoria <http://www.bom.gov.au/state-of-the-climate/State-of-the-Climate-2016.pdf>.

22. Ibid.

23. Commissioner for Environmental Sustainability 2013, 'State of the Environment report 2013', Melbourne, Victoria <http://www.ces.vic.gov.au/publications/state-environment-report-2013>.

24. The Australian Government Department of the Environment and Energy 2018, 'National Greenhouse Gas Inventory – Kyoto Protocol classifications', Canberra, Australian Capital Territory <http://ageis.climatechange.gov.au/>.

25. The Antarctic Climate & Ecosystems Cooperative Research Centre 2016, 'The Potential Impacts of Climate Change on Victorian Alpine Resorts', Hobart, Tasmania [http://www.arcc.vic.gov.au/uploads/publications-and-research/The%20Potential%20Impact%20of%20Climate%20Change%20on%20Victorian%20Alpine%20Resorts%20Study\\_FINAL.pdf](http://www.arcc.vic.gov.au/uploads/publications-and-research/The%20Potential%20Impact%20of%20Climate%20Change%20on%20Victorian%20Alpine%20Resorts%20Study_FINAL.pdf).

provides information on the future climate of more than 400 towns across Australia.<sup>26</sup> Where possible, regional climate projections will be included in the SoE 2018 report for Victoria's major urban and regional population centres such as Melbourne, Geelong, Ballarat and Mildura.

### **Sea-level rise**

Sea-level rise is the result of thermal expansion of ocean water in response to global warming and increases in ocean mass from the melting of glaciers (with smaller contributions from the polar ice sheets). Similar to previous Victorian SoE reports, sea level data for the SoE 2018 will be provided by BoM and will be reported as annual means and linear trends, monitored at Victorian sites.

### **Sea level rise – projections**

Sea level projections will be a reporting addition to the broader climate change theme in the SoE 2018. The information provided in this theme will be based on projected sea level data for Williamstown and Geelong – both sites for which there is long-term records.

### **Sea temperature**

Changes in current strength and rising sea temperatures are likely to impact marine ecosystems in Victoria. Similar to the SoE 2013, data on sea-surface temperatures will be provided by the BoM and reported as trends in sea-surface temperatures in Victorian coastal waters.

### **Greenhouse gas (GHG) emissions**

This topic will report on the trend of GHG emissions in Victoria, with DELWP to provide data on annual CO<sub>2</sub> emissions by sector. A brief analysis of CO<sub>2</sub> emissions per unit of value is also planned for this theme.

### **Carbon storage**

Carbon sequestration is an important contributor to changes in Victoria's net emissions over time. Carbon storage in vegetation and soil plays an important role in the global carbon cycle and GHG balance. The indicator in this theme will assess Victorian ecosystems' capacity to store carbon as well as the trends in carbon stocks, while providing commentary on the role of land management in climate change mitigation.

### **Impacts of climate change**

This is a new theme for Victoria's SoE report and will present a number of indicators that explore climate change impacts and associated mitigation strategies. These indicators include the occurrence and impacts of extreme weather, encompassing the social and economic costs of heatwaves, storms, bushfires, flooding and drought. The impacts of climate change on biodiversity will also be covered, investigating climate change impacts on Victorian species and ecosystems.

Other indicators will consider the extent and condition of key climate-sensitive ecosystems, changes in suitable habitat for Victoria's flora and fauna in 50 years and a measure of community knowledge of risks associated with climate change. The data for this theme will be provided by BoM, DELWP and EMV. Much of the data required for the SoE 2018 will be available however, some there will be gaps as some datasets are still emerging and have been created in response to the *Protecting Victoria's Environment – Biodiversity 2037 plan*.<sup>27</sup>

### **Management**

This is another new theme for the Victorian SoE and covers the effectiveness of management actions to reduce the impacts of climate change and adapt to a changing climate. The data will be sourced from DELWP and the Department of Economic Development, Jobs, Transport and Resources (DEDJTR). The indicators will specifically focus on the number of councils in Victoria that have urban forestry plans or urban greening related strategies, and the percentage that consider climate change risks in their land-

26. Commonwealth Scientific and Industrial Research Organisation 2018, 'Climate Analogues' <https://www.climatechangeinaustralia.gov.au/en/climate-projections/climate-analogues/analogues-explorer/>.

27. The State of Victoria Department of Environment, Land, Water and Planning 2017, 'Protecting Victoria's Environment – Biodiversity 2037', Melbourne, Victoria [https://www.environment.vic.gov.au/\\_data/assets/pdf\\_file/0022/51259/Protecting-Victorias-Environment-Biodiversity-2037.pdf](https://www.environment.vic.gov.au/_data/assets/pdf_file/0022/51259/Protecting-Victorias-Environment-Biodiversity-2037.pdf).



use planning and the percentage of agricultural businesses that use long-term weather and climate change projections in farm and business planning. It is recognised that the data for some of these indicators, particularly the proportion of councils considering climate change risks, may include a level of subjectivity, where councils have different interpretations of what constitutes adaptation activity.

## **A note on climate change adaptation and resilience**

*Numerous indicators to be assessed in the SoE 2018 will incorporate social or environmental adaptation to climate change, assessing the resilience of Victorian communities and ecosystems. These indicators will be identified as 'climate change adaptation and resilience' indicators and prefigure the potential indicators that could be included in a future Victorian State of Climate Change Adaptation report.*

## **Government policy response**

The Victorian Climate Change Act 2017 came into effect on November 1, 2017. It establishes a long-term emissions reduction target of net zero by 2050, with interim emissions reduction targets to be set for five-year periods starting from 2021. The Act also requires the Government to develop a Climate Change Strategy every five years and Adaptation Action Plans from 2021 for key systems vulnerable to the impacts of climate change. Periodic reporting by DELWP is mandated in the Act, with the following measures to be reported:

- standalone reports on the science and data relevant to climate change in Victoria.
- annual greenhouse gas emissions reporting.
- assessment reports at the end of each interim target period.<sup>28</sup>

To develop the five-yearly emissions reduction targets, the Victorian Government is required to seek expert independent advice. In March 2018 the independent panel released an Issues Paper that explored the issues relevant to setting interim emissions reduction targets for Victoria for 2021-2025 and 2026-2030 and trajectories to net zero emissions by 2050.<sup>29</sup>

Climate change responses are being integrated into federal, state and local government policies and strategies across many sectors. Recent notable publications include Protecting Victoria's Environment – Biodiversity 2037<sup>30</sup> that outlines a vision for Victoria's biodiversity in a time of climate change, the 2016 water plan, Water for Victoria and the Agriculture Victoria Strategy that identified delivering research and capacity building programs that help farmers adapt to climate change as a priority action.<sup>31</sup>



28. Office of the Chief Parliamentary Counsel Victoria 2017, 'Climate Change Act 2017', Melbourne, Victoria [http://www.legislation.vic.gov.au/Domino/Web\\_Notes/LDMS/PubStatbook.nsf/f932b66241ecf1b7ca256e92000e23be/05736C89E5B8C7C0CA2580D50006FF95/\\$FILE/17-005aa%20authorised.pdf](http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubStatbook.nsf/f932b66241ecf1b7ca256e92000e23be/05736C89E5B8C7C0CA2580D50006FF95/$FILE/17-005aa%20authorised.pdf)

29. Independent Expert Panel on Interim Targets 2017, 'Independent Expert Panel: Interim Emissions Reduction Targets for Victoria (2021-2030)', Melbourne, Victoria [https://www.climatechange.vic.gov.au/\\_\\_\\_data/assets/pdf\\_file/0019/121924/Issues-Paper\\_28-03-2018.pdf](https://www.climatechange.vic.gov.au/___data/assets/pdf_file/0019/121924/Issues-Paper_28-03-2018.pdf).

30. The State of Victoria Department of Environment, Land, Water and Planning 2017, 'Protecting Victoria's Environment – Biodiversity 2037', Melbourne, Victoria [https://www.environment.vic.gov.au/\\_\\_\\_data/assets/pdf\\_file/0022/51259/Protecting-Victorias-Environment-Biodiversity-2037.pdf](https://www.environment.vic.gov.au/___data/assets/pdf_file/0022/51259/Protecting-Victorias-Environment-Biodiversity-2037.pdf).

31. The State of Victoria Economic Development, Jobs, Transport and Resources 2017, 'Agriculture Victoria Strategy', Melbourne, Victoria [http://agriculture.vic.gov.au/\\_\\_\\_data/assets/pdf\\_file/0011/385949/Agriculture-Victoria-Strategy\\_FINAL.pdf](http://agriculture.vic.gov.au/___data/assets/pdf_file/0011/385949/Agriculture-Victoria-Strategy_FINAL.pdf).

Climate Change Impacts Theme	Climate Change Impacts Indicator	2008	2013	2018
Climate	Observed average rainfall	✓	✓	✓
	Snow cover	✓	✓	✓
	Observed surface temperature	✓	✓	✓
Climate – projections	Projected changes in temperature	✓	✓	✓
	Projected changes to average rainfall	✓	✓	✓
	Regional climate projections	✓•	✓	✓
Sea level	Observed Sea level	✓	✓	✓
Sea level – projections	Projected sea level	✓	✗	✓
Sea temperature	Sea-surface temperature	✗	✓	✓
Greenhouse gas emissions	Annual greenhouse gas emissions	✓	✓	✓
	CO2 emission per unit of value added	✗	✗	✓
Carbon storage	Victorian ecosystem contribution to global greenhouse gas balance and carbon storage	✗	✓	✓
Impacts of climate change	Occurrence and impacts of extreme weather	✗	✗	✓
	Impacts of climate change on biodiversity	✗	✗	✓
	Extent and condition of key climate-sensitive ecosystems	✗	✗	✓
	Change in suitable habitat in 50 years	✗	✗	✓
	Community awareness of climate risks and associated responsibilities	✗	✗	✓
Management	Councils (or other organisations) with urban forestry plans or urban greening or cooling-related strategies	✗	✗	✓•
	Considering climate change risks in land use planning (including in the coastal zone)	✗	✗	✓•
	Percentage of agri-businesses planning using long term weather and climate change projections	✗	✗	✓•
	Evidence of an integrated policy/strategy/plan which increases ability to adapt to the adverse impacts of climate change, and foster climate resilience.	✗	✗	✓
	Integration of mitigation, adaptation, impact reduction and early warning into education curriculum.	✗	✗	✓
	Strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer actions	✗	✗	✓

• Only as narrative







# Biodiversity





## Background

Healthy land, water and biodiversity are essential for the health and wellbeing of all Victorians – providing ecosystem services, such as clean air, drinking water and improved soil health for food production. A healthy Country is fundamental to the cultural, spiritual, physical and economic wellbeing of all Aboriginal Victorians.

Victoria's natural environment attracts local and international tourists, who spend \$1.4 billion per annum visiting parks.<sup>32</sup> This generates \$1 billion gross value added to Victoria's economy, while supporting 14,000 jobs across the state.<sup>33</sup> Biodiversity is also essential for Victoria's agriculture, forestry and fisheries sectors who economically contribute approximately \$8 billion, or 2.8%, to the annual Gross State Product (GSP).

Victoria has experienced extensive biodiversity loss over the past two centuries due to land clearing, fire, pest plants and animals, land development, water pollution and, more recently, reduced resilience under climate change.<sup>34</sup> This loss and degradation impacts the supply of essential ecosystem services, posing a potential risk to sectors dependent on functioning ecosystems, and the future health, wellbeing and prosperity of all Victorian communities.

Native vegetation continues to be lost at approximately 4,000 habitat hectares per year.<sup>35</sup>

Native vegetation clearing has created fragmented and degraded habitats across Victoria. Reduced extent and quality of native vegetation increases risk, vulnerability and exposure of native animals and plants to other pressures and threats.

Victoria has the highest number of threatened species by subregion in Australia.<sup>36</sup> Since European settlement there has been a progressive rate of native animal and plant extinction with Victoria losing 18 mammal species, two birds, one snake, three freshwater fish, six invertebrates and 51 plants.<sup>37</sup> Conserving habitats and connecting fragmented native vegetation to create nature corridors that enable species movement, will reduce the vulnerability of Victoria's threatened species.

Many of Victoria's natural habitats are threatened by invasive species. These species pose a major threat to biodiversity, ecosystem health, primary production and landscape aesthetics. Victoria's invasive species originate either from outside Australia or interstate, or are Victorian natives that have become established outside their pre-European range, for example, spotted gum (*Corymbia maculata*) and coastal umbrella-bush (*Acacia cupularis*) used as ornamental plantings.<sup>38</sup>

The number of invasive plant species has increased steadily since settlement, with a five-fold increase since the early 20th century.<sup>39, 40</sup>

There are several overarching policy and management challenges facing Victoria's biodiversity now and into the future, including:

- protecting native vegetation to halt habitat loss, reduce habitat fragmentation and degradation, especially on private land
- assisting environmental adaptation to climate change pressures
- collaborating, aligning and co-investing across Victoria's environment sector for conserving and maintaining biodiversity
- increasing rigor and accessibility, to offsetting and rehabilitation schemes to achieve strategic biodiversity outcomes on private land.

The general lack of an integrated and well-designed monitoring and assessment program to answer key biodiversity, ecological and management questions is a persistent challenge for conserving Victoria's natural assets, which include:

- maintaining disparate biodiversity datasets that are not routinely updated, reducing accessibility and utility of available data
- establishing the status of threatened species due to a lack of data, specifically their abundance, population age structure and distribution

32. The State of Victoria Department of Environment, Land, Water and Planning 2017, 'Protecting Victoria's Environment – Biodiversity 2037', Melbourne, Victoria.

33. Ibid.

34. Ibid.

35. Ibid.

36. Ibid.

37. Ibid.

38. White et al. 2018, 'Advisory list of environmental weeds in Victoria'. Arthur Rylah Institute for Environmental Research Technical Report Series No. 287, Heidelberg, Victoria.

39. Carr GW 1993, 'Exotic flora of Victoria and its impacts on indigenous biota'. In Flora of Victoria Volume 1, pp 256–97. Foreman D B and Walsh N G (eds). Inkata Press, Port Melbourne, Victoria.

40. White et al. 2018, 'Advisory list of environmental weeds in Victoria'. Arthur Rylah Institute for Environmental Research Technical Report Series No. 287, Heidelberg, Victoria.

- determining biodiversity trends over time due to methodological changes. While changes can improve data quality, it is often unclear whether biodiversity changes are due to actual ecological changes or increased accuracy in the methodological approach
- establishing the distribution and abundance of naturalised plants and pest animals
- improving our poor knowledge on the status of invertebrates, lichens and fungi.

### **Biodiversity themes**

There are many data gaps which will limit the ability to report on long-term biodiversity trends in SoE 2018. These data gaps are due to: (i) the lack of recent biodiversity monitoring, and (ii) a change in a number of biodiversity indicators due to new methodologies and assessments outlined in the *Biodiversity 2037* plan released in 2017. Where possible, trends will be reported.

### **Invasive pest plants and animals**

This theme will report on trends in the types and extent of terrestrial and inland aquatic plants and pest animals. This will be defined as the number of invasive plant and animal species, and will replace the previous SoE indicator: 'threatening processes impacting on terrestrial and inland aquatic species'.

### **Native vegetation**

This theme will report on change in suitable habitat and net gain (formerly habitat condition and extent) trends. This indicator will build on the trend analysis provided in both the 2008 and 2013 SoE reports. There will be the inclusion of a new indicator for native vegetation, landscape scale change which replaces habitat extent, native vegetation extent and quality, condition and fragmentation of Victoria's native vegetation. Previous biodiversity indicators, including changes in the extent of vegetation by Ecological Vegetation Classes (EVC) categories will be reported in SoE 2018 as net gain.

### **Conservation**

This theme reports on management actions for conserving Victoria's natural ecosystems on both Crown and private land. Community attitudes and experience in nature, as part of 'Victorians Valuing Nature' in the *Biodiversity 2037* plan, will be explored as a new indicator for reporting.

### **Threatened species**

The threatened species theme will report on the number and type of management programs for these species. This will replace the previous SoE indicator 'trends in populations of selected threatened terrestrial species'. Some results on re-establishment of select threatened species in the wild will be included. Case studies on threatened species will share insights about the varying levels of management success and lessons learnt.

### **Aquatic biodiversity**

This theme will report on aquatic biodiversity trends, specifically macroinvertebrate and fish assemblages. There will be no update for Victorian river condition under the Index of Stream Condition (ISC) program, in the SoE 2018 report. This is due to the shift in the ISC program's monitoring regime from six to 12 yearly. River condition will be reported as 2010 Index of Stream Condition results. Case studies will focus on improving management of native fish populations and the connectivity between environmental watering and water quality.

### **Government policy response**

In 2017, the Victorian Government released *Protecting Victoria's Environment – Biodiversity 2037* with the aim to stop the decline of Victoria's biodiversity and achieve an overall biodiversity improvement over the next twenty years. Under the two goals of 'Victorians Valuing Nature', and Victoria's Natural Environment is *Healthy*, *Biodiversity 2037* is committed to providing an opportunity for Traditional Owners and Aboriginal Victorians to be involved in biodiversity planning, management and decision-making, self-determination, land justice and economic

advancement. Key targets under the plan include five million Victorians acting to protect the natural environment, ensuring that endangered species will persist in natural environments, and achieving a net gain in the overall extent and condition of terrestrial, marine and waterway habitats.

The *Guidelines for the removal, destruction or lopping of native vegetation* aims to prevent net loss to biodiversity as a result of the removal, destruction or lopping of native vegetation.

The guidelines provide a three-step approach:

- avoid the removal, destruction or lopping of native vegetation
- minimise impacts from the removal, destruction or lopping of native vegetation that cannot be avoided

- provide an offset to compensate for the biodiversity impact from the removal, destruction or lopping of native vegetation.

The guidelines are an incorporated document in Victoria's planning system, which requires a permit to remove native vegetation. The three-step approach is applied when assessing whether or not to grant a permit, and when determining the conditions on any permits granted.

The Victorian Government has also reviewed the *Flora and Fauna Guarantee Act 1988* with the aim to more effectively protect Victoria's biodiversity in the face of existing and emerging threats. The *Flora and Fauna Guarantee Amendment Bill* was introduced to Parliament on 23 May 2018 and amends the Act with a new framework for biodiversity protection and management, including Victoria's native species and important habitats.

Biodiversity Theme	Biodiversity Indicator	2008	2013	2018
Pests	<i>Inland aquatic and terrestrial pest plants and animals and threatening processes</i>	✓	✓	✓
	<i>Management of pests</i>	✓	✓	✓
Native Vegetation	<i>Ecosystem health: change in suitable habitat (formerly biodiversity information, area of management in priority locations and restoration of habitat)</i>	✓	✓	✓
	<i>Ecosystem health: net gain (formerly habitat condition)</i>	✓	✓	✓
	<i>Ecosystem Health: Landscape Scale Change (formerly native vegetation extent and quality, condition and fragmentation of Victoria's native vegetation)</i>	✓	✓	✓
Conservation	<i>Management: Conservation of Victorian ecosystems.</i>	✓	✓	✓
	<i>Management: Conservation on Private Land.</i>	✓...	✓	✓
	<i>Land management activities</i>	✗	✗	✓
	<i>Victorians Valuing Nature: community attitudes and experience with nature</i>	✗	✗	✓.
Threatened species	<i>Management: conservation of terrestrial and inland aquatic threatened species</i>	✓	✓	✓
Inland Aquatic and Wetland Biodiversity	<i>Inland aquatic ecosystem health: River health – index of stream condition</i>	✓	✓	✓....
	<i>Inland aquatic ecosystem health: macroinvertebrates and fish population trends</i>	✗	✗	✓
	<i>Wetland ecosystem health</i>	✓	✓	✓
	<i>Conservation</i>	✓	✓	✓

● Only as narrative

●●● Assumed

●●●● No update since 2013

# Land Health





### Background

Victoria's land is used for a variety of purposes, including residential and business use, agricultural lands for production of food and fibre and conservation areas to protect biodiversity. Maintaining the viability of the agricultural sector whilst also protecting and enhancing biodiversity is a key challenge for land managers.

The SoE 2013 reported that land development for urban and agricultural uses has resulted in declines in the condition of land, water and biodiversity. Many of the environmental challenges facing Victoria are the result of past decisions about land use and land management. Land-use change is driven by a range of social, economic and environmental pressures. Preference for living in coastal or rural areas close to Melbourne has an impact on natural ecosystems, agricultural land and is a threat to biodiversity. However, the main drivers of agricultural land-use change are climate (e.g. water availability), commodity prices, supporting infrastructure and land capability (soil type). These factors determine the type of farming that can be carried out as well as those types that will maximise returns.<sup>41</sup>

Few long-term data sets exist and those that do are often limited in extent, impairing our ability to comprehensively understand environmental condition.<sup>42</sup> This lack of land health data was a key observation of the Victorian Catchment Management Council's 2017 Catchment Condition and Management Report.<sup>43</sup>

New and emerging technology is helping to improve the data capture and understanding of Victoria's land health. Remote sensing is one such example, with satellite and aerial imagery capable of identifying areas subject to climate stress, however remote sensing only has a limited ability to identify specific land management types. Despite this limitation, remote sensing is rapidly improving with more investment in the sector (e.g. Digital Earth Australia<sup>44</sup> and the Australian National University<sup>45</sup>).

More frequent drought and fires will reduce vegetation cover and more severe storms and extreme rainfall events are likely.<sup>46</sup> These will create great potential for severe erosion and reductions in soil nutrients and carbon.<sup>47</sup>

The critical challenges facing Victoria's land health management now and into the future include:

- ensuring on-ground monitoring is undertaken to understand changing land-management practices
- enhancing the ability of technology such as remote sensing to identify land areas subject to climate stress
- mitigating the effect of climate change on soil degradation
- increasing, and then maintaining, soil carbon. Decomposing organic matter is the most useful soil carbon for farming and is very susceptible to deterioration during drought
- proactively identifying and remediating legacy land contamination
- ensuring that environmental implications are a primary consideration in land-use decision making.

### Land Health Themes

To understand trends and identify information gaps to address the above challenges, the SoE 2018 will assess:

#### Land use

An overview of broad land-use types, their extent, land tenures and changes over time will be presented.

#### Land health

The intention of this theme is to assess and provide an understanding of the links between land degradation and current land-use practice. Determining localised land degradation is difficult due to a lack of data.

41. Commissioner for Environmental Sustainability 2013, 'State of the Environment report 2013', Melbourne, Victoria <http://www.ces.vic.gov.au/publications/state-environment-report-2013>.

42. Note: Knowledge of land and soil health is hampered by a lack of statewide data and monitoring.

43. The State of Victoria, Victorian Catchment Management Council 2017, 'Catchment Condition and Management Report', Melbourne, Victoria [http://www.vcmc.vic.gov.au/pdf/CCMR\\_Report\\_2017.pdf](http://www.vcmc.vic.gov.au/pdf/CCMR_Report_2017.pdf).

44. The Australian Government, Geoscience Australia 2017, 'Digital Earth Australia', Symonston, Australian Capital Territory [http://www.ga.gov.au/\\_\\_data/assets/pdf\\_file/0008/49490/Prospectus.pdf](http://www.ga.gov.au/__data/assets/pdf_file/0008/49490/Prospectus.pdf).

45. Fenner School of Environment & Society ANU College of Medicine, Biology and Environment, 'Water and Landscape Dynamics', Canberra, Australian Capital Territory <http://www.wenfo.org/wald/projects/>.

46. Commissioner for Environmental Sustainability 2012, 'Climate Change Victoria: the science, our people and our state of play', Melbourne, Victoria <http://www.ces.vic.gov.au/sites/default/files/publication-documents/63-98.pdf>.

47. Commissioner for Environmental Sustainability 2012, 'Climate Change Victoria: the science, our people and our state of play', Melbourne, Victoria <http://www.ces.vic.gov.au/sites/default/files/publication-documents/1-62.pdf>.

### Soil health

Good soil health is vital for Victoria's agriculture and natural ecosystems. Healthy soils support essential ecosystem services such as the production of food, fibre, timber and clean water, as well as the decomposition and detoxification of wastes. The indicators in this theme focus on soil carbon content, areas affected by salinity, soil acidification, soil erosion and soil condition in production areas. For the most part, long-term data for the indicators in this section won't be available because there is currently no consolidated statewide information on soil condition and the effectiveness of its relationship to soil management. Agriculture Victoria will provide information for indicators in this topic, although this data will mostly be confined to projects providing a snapshot of soil health at a recent point in time, rather than trend data. For example, the soil salinity map is not expected to be updated from the SoE2013 report, although data from selected hydrographs is planned for inclusion to highlight key salinity issues across the state.

### Contaminated sites

The information in this theme will focus on the number of contaminated sites and their management and rehabilitation. The theme will be reporting on the number of Clean Up Notices issued per year by the EPA and the number of notifications for an Environmental Audit each year. The number of completed Environmental Audits per year will demonstrate where contaminated sites have been improved and are suitable for a more sensitive land use.

### Land management

The number and type of land management activities will be reported in this theme, as well as the trends and participation in Natural Resource Management (NRM). Trend data will be included where available, although the data is likely to be limited. Data on the number and type of management activities will also be included. However, data is unlikely to be available for the indicator 'use of best practice on agricultural lands'.

### Government policy response

In May 2016, a Ministerial Advisory Committee (MAC) completed its inquiry into EPA. One of the MAC's recommendations was for DELWP to 'develop a comprehensive database of contaminated sites'.<sup>48</sup> The Victorian Government supported this recommendation and asserted that 'a public database providing consistent and easily accessible, statewide site history information will be developed to assist with the identification of potentially contaminated sites'.<sup>49</sup>

A couple of relevant audits within the land health sector have been completed during the past decade by the Victorian Auditor General's Office (VAGO). The audit topics were Soil Health Management (October 2010<sup>50</sup>) and Enhancing Food and Fibre Productivity (August 2016<sup>51</sup>). The 2010 audit recommended the development of agreed soil health indicators and monitoring programs to assess soil health status and trends over time. The Soil Health Strategy released by the DELWP in July 2012 responded to the 2010 audit. This strategy included an action to identify key performance indicators that effectively and pragmatically measure the impact against departmental and regional priority environmental assets, using monitoring programs to collect the data required.<sup>52</sup>

The 2016 audit recommended that DEDJTR develop or utilise external performance measures to provide assurance that changes in agricultural practices and productivity are not affecting the long-term sustainability of the natural resources base. In its response to the audit, DEDJTR agreed to seek to incorporate indicators of the long-term sustainability of the state's natural base as part of the agriculture industry component of the DEDJTR-wide Outcomes Framework.

To address the challenges associated with measuring statewide changes to soil health, Agriculture Victoria is working with the Cooperative Research Centre for High Performing Soils to ascertain key soil properties that could form the basis for soil performance indicators.<sup>53</sup> To support this work, Agriculture Victoria has recently completed work to update its data systems for improved data sharing and accessibility.

48. Ministerial Advisory Committee to the Minister for Environment, Climate Change and Water 2016, 'Independent inquiry into the Environment Protection Authority', Melbourne, Victoria [http://www.epa-inquiry.vic.gov.au/\\_data/assets/file/0008/336698/Inquiry-report-EPA\\_June.pdf](http://www.epa-inquiry.vic.gov.au/_data/assets/file/0008/336698/Inquiry-report-EPA_June.pdf).

49. The State of Victoria Department of Environment, Land, Water and Planning 2017, 'Andrews Labor Government Response to the Independent Inquiry into the Environment Protection Authority', Melbourne, Victoria [https://www.environment.vic.gov.au/\\_data/assets/pdf\\_file/0025/49741/Andrews-Labor-Government-Response-to-the-Independent-Inquiry-into-the-Environment-Protection-Aut.pdf](https://www.environment.vic.gov.au/_data/assets/pdf_file/0025/49741/Andrews-Labor-Government-Response-to-the-Independent-Inquiry-into-the-Environment-Protection-Aut.pdf).

50. Victorian Auditor-General's Office 2010, 'Victoria Soil Health Management', Melbourne, Victoria <https://www.parliament.vic.gov.au/papers/govpub/VPARL2006-10No378.pdf>.

51. Victorian Auditor-General's Office 2016, 'Enhancing Food and Fibre Productivity', Melbourne, Victoria <https://www.audit.vic.gov.au/report/enhancing-food-and-fibre-productivity>.

52. The State of Victoria Department of Sustainability & Environment 2012, 'Soil Health Strategy', Melbourne, Victoria

53. Soil CRC, 'Project 2.1.01: A review of indicators of soil health and function: farmers' needs and data Management', Callaghan, New South Wales <http://www.soilcrc.com.au/programs-projects>

Agriculture Victoria also runs a Land Health Program that works with dry land farmers across Victoria to improve the long-term productivity, quality and health of their land and protect adjacent natural assets such as waterways.<sup>54</sup>

The Australian Government has invested \$1 billion in the National Landcare Program over four years from 2014-15 to 2017-18. The program is designed to address problems such as loss of vegetation, soil degradation, the introduction of pest weeds and animals, changes in water quality and flows, and changes in fire regimes. Over the coming five years, from 2018-19 to 2022-23, the Australian Government will invest more than \$1 billion in a second phase of the National Landcare Program.<sup>55</sup>

In 2017, Agriculture Victoria released the *Agriculture Victoria Strategy*. The strategy noted the agriculture sector was continuing to make a major contribution to Victoria's economic and employment growth even though the nature of farming has changed dramatically in recent decades.

Land Health Theme	Land Health Indicator	2008	2013	2018
Land use	<i>Land use types in Victoria</i>	✓	✓	✓
	<i>Changes in major land uses in Victoria</i>	✓	✓	✓
	<i>Changes in land tenure</i>	✗	✗	✓
	<i>Greenfield versus infill development</i>	✗	✗	✓
Land health	<i>Proportion of land that is degraded over total land area</i>	✗	✗	✓
Land health	<i>Soil carbon content</i>	✓•	✓	✓
	<i>Area Affected by Salinity</i>	✓	✓	✓
	<i>Soil acidification</i>	✓	✓	✓•
	<i>Soil erosion</i>	✓	✓	✓•
	<i>Soil condition in production areas</i>	✗	✗	✓•
Contaminated sites	<i>Contaminated sites</i>	✗	✗	✓
Land management	<i>Land management activities</i>	✗	✗	✓
	<i>Participation in natural resource management activities</i>	✓	✗	✓
	<i>Use of best practice on agricultural land</i>	✗	✗	✓
	<i>Proportion of agricultural area under productive and sustainable agriculture</i>	✗	✗	✓

• Only as narrative

54. State of Victorian Department of Economic Development, Jobs, Transport and Resources, Agriculture Victoria 2017, 'Land Health' <http://agriculture.vic.gov.au/agriculture/farm-management/land-health>.

55. National Landcare Program 2018, 'National Landcare Program Phase Two', Canberra, Australian Capital Territory <http://www.nrm.gov.au/national-landcare-program>.



# Forests



## Background

Forests and the services they provide are essential for the health and wellbeing of all Victorians. Forests maintain Victoria's world-class water quality, they purify our air, stabilise and nourish our soil, assist agriculture and support economies vital for regional communities and businesses. Forests have also been an essential part of history and culture for Victoria's Traditional Owners and Aboriginal Victorians.

Victoria has 8.4 million hectares of public land, of which 3.4 million hectares are State forest and 3.7 million hectares are forested parks and reserves.<sup>56</sup> Since European settlement, more than 14 million hectares (60%) have been cleared, mainly for agriculture and settlements.<sup>57</sup> Victoria's population growth and subsequent urban expansion will increase the pressure on Victorian forests. In managing these forests, a range of actions are identified to achieve the principals of sustainable forest management (SFM) which seek to protect the health and biodiversity of forests, whilst ensuring existing social, cultural and economic benefits for Victorian communities.

Victoria's forests have been identified to have several major issues that need consideration for long-term SFM:

- *climate change* – There is considerable scientific evidence predicting the adverse impacts of climate change on the vitality and health of Australia's forests.<sup>58, 59, 60, 61</sup> As forests play an important role in understanding the global carbon cycle, monitoring carbon stocks in forests is also an essential part of sustainable forest management
- *biodiversity* – In Victoria, nearly 250 fauna species are listed under a 'threatened' status in the *Victorian Flora and Fauna Guarantee Act 1988*. Of these, approximately 20% are forest-dependant species. While disturbance and regeneration are fundamental to forest maintenance, significant shifts in the frequency, scale and intensity of these processes can disrupt the health of forests<sup>62</sup>

- *fragmentation* – Forest-dwelling fauna species, including endangered species, are impacted by the fragmentation of native forests.<sup>63</sup> This eventually leads to the geographic isolation of a species' population and genetic diversity resulting from the loss of forest connectivity and has significant implications for the survival of many iconic and forest-dependent species
- *economy* – Forests provide a resource base for one of the most economically-significant industries in Victoria. Forests support over 21,000 direct and 40,000 indirect jobs which generates \$1.4 billion of net annual expenditure in Victoria.<sup>64</sup> Victoria was recorded to have the largest total area of plantations in Australian states and territories with 433,000 hectares of commercial hardwood and softwood plantations in 2013-14, up 13% from 2003-4.<sup>65</sup> The ability to successfully manage Victoria's plantation forests is of vital economic importance for Victoria
- *legal framework* – Management of Victoria's forests is delivered within a complex legal and policy framework including the *Sustainable Forests (Timber) Act 2004*, *Sustainability Charter for Victoria's state forests (2006)* and *Forests Act 1958*.<sup>66</sup>

Critical challenges for Victoria's sustainable forest management aspirations, now and into the future, include:

- monitoring the loss of species population and genetic diversity resulting from fragmentation of native forests
- understanding changes in patterns of native disturbances including fire, flood and drought and any increase in variability and intensity of these disturbances due to climate change
- understanding Victoria's forest carbon cycle and increasing the carbon storage capacity of forests

56. Haywood H et al. 2018, 'Monitoring Victoria's public forests: implementation of the Victorian Forest Monitoring Program', Southern Forests: a Journal of Forest Science, 80:2, 185-194.

57. Office of Commissioner for Environmental Sustainability Victoria 2013, 'State of Environment (2013): science policy people', Melbourne, Victoria <http://www.ces.vic.gov.au/sites/default/files/publication-documents/2013%20SoE%20report%20full.pdf>.

58. Madsen T, Ujvari B, Shine R and Olsson M 2006, 'Rain, rats and pythons: climate-driven population dynamics of predators and prey in tropical Australia', *Austral Ecology* 31(1), 30-37.

59. Donohue Rj, McVicar TR and Roderick L 2009, 'Climate-related trends in Australian vegetation cover as inferred from satellite observations, 1981-2006', *Global Change Biology* 15(4), 1025-1039.

60. Johnson BJ, Miller GH, Fogel ML, Magee JW, Gagan MK and Chivas AR 1999, '65,000 years of vegetation change in central Australia and the Australian summer monsoon', *Science* 284(5417), 1150-1152.

61. Hughes L 2003, 'Climate changes and 'Australia: trends, projections and impacts', *Austral Ecology* 28(4), 423-443.

62. Keenan R J and Nitschke C 2016, 'Forest management options for adaptation to climate change: a case study of tall, wet eucalypt forests in Victoria's Central Highlands region', *Australian Forestry*, 79:2, 96-107.

63. Riitters KH, Wickham JD, O'Neill R, Jones B and Smith E 2000, 'Global-scale patterns of forest fragmentation', *Conservation Ecology* 4(2): 3.

64. Schirmer J, Mylek M and Morison J 2013, 'Socio-economic characteristics of Victoria's forestry industries, 2009-2012'. Unpublished report.

65. Victorian Association of Forest Industries 2016 'Industry', Melbourne, Victoria <http://www.vafi.org.au/industry/>.

66. Victorian Environmental Assessment Council 2017, 'Conservation values of state forests: assessment report', Melbourne, Victoria.

- improving complex and outdated forest management legislation that cause inconsistencies, overlaps and gaps and lead to confusion for land managers and communities
- managing forests for a range of social, cultural, economic and ecological values and uses
- consistent, multi-tiered, multi-valued monitoring approach and data acquisition strategy for sustainable forest management.

### **Forests themes**

Previous Victorian State of the Forests reports will be utilised to analyse trends for the SoE 2018 and SoF 2018 and to identify information gaps to address the above challenges. The forest information in the reports will be structured consistent with the themes of the Montreal Process:

#### ***Conservation of biological diversity***

Identification of species considered to be rare and threatened will be used as an indication of forest health. Changes in the conservation status for each species can also be used as an indication of the effectiveness of sustainable biodiversity management and of individual species recovery programs. This theme will focus on forest-dwelling species, and their conservation status, to provide an assessment on the disturbance to native forest species caused by invasive species. Case studies including Victoria's faunal emblem, the Leadbeater's possum which was thought to be extinct but re-emerged, will highlight species conservation efforts.

#### ***Productive capacity of forest ecosystems***

Wood production in Victoria is a key industry in the rural economy. The forests' productive capacity is influenced by tenure (area available for harvest), silviculture, and climate (impacts of fire and the availability of water in the long-term). Timber is harvested according to sustainable harvest yield set by allocation order, under lease, from the state to VicForests. This theme will report on the available area and volume of timber to harvest, and the regeneration rate, and evaluate

the sustainability of the process. Information on native forest on private land will not be provided as there is no comprehensive data available on wood production from these areas.

#### ***Forest ecosystem health and vitality***

This theme will focus on the impact of natural and human-induced disturbances on forest health and vitality. Disturbances will include fire, climatic events, planned burning and road management.

#### ***Forest contribution to global carbon cycles***

Forests play an important role in understanding the sum of all carbon stocks in Victoria. The maintenance and increase of forest carbon stocks are key indicators for sustainable forest management. This theme will investigate the contribution of forest ecosystems to the global greenhouse gas balance and carbon distribution by various forest parameters.

#### ***Enhancement of long-term multiple socio-economic benefits to meet the needs of society***

Forests provide significant benefits to the social, cultural and economic fabric of Victoria. However, these benefits can be difficult to quantify and translating ecosystem services into economic values is challenging. One of the difficulties is in understanding the non-market values that forests provide and the current state of those values. This theme will describe the current state of ecosystem services that are derived from forests in Victoria and provide existing economic information for these services.

#### ***Legal, institutional, and economic frameworks for forest conservation and sustainable management***

This theme will describe and contextualise relevant forestry legislation, institutional capacity and economic arrangements.



## Government policy

Victoria's forests are managed in accordance with Victorian legislation including the *National Parks Act 1975*, *Forests Act 1958*, *Conservation, Forests and Land Act 1987*, *Flora and Fauna Guarantee Act 1988*, *Crown Land (Reserves) Act 1978*, *Land Act 1958*, and *Sustainable Forests (Timber) Act 2004*, together with related regulations, codes of practice, management plans and policy initiatives.<sup>67</sup> This system undertakes to balance management of the multiple values of Victoria's forests, including environmental values.

Recent policy measures that address or overlap the issues above include:

- *Protecting Victoria's Environment – Biodiversity 2037*, which sets out a twenty-year vision and goals for biodiversity in Victoria
- *Review of the Flora and Fauna Guarantee Act 1988* so that it can more effectively protect Victoria's biodiversity in the face of existing and emerging threats
- amendments to regulation of native vegetation with the aim to provide for better consideration of biodiversity elements in decision making, including habitat for rare or threatened species, large trees, endangered EVCs, sensitive wetlands and coastal areas
- In 2017, the Victorian Environmental Assessment Council recommended that within five years:
  - State forest be administered under one Act
  - the *National Parks Act* be expanded to include revised categories of national parks, conservation parks, nature reserves, marine protected areas, and other categories and overlays classified as protected areas, to become the National Parks and Conservation Reserves Act
  - a new public land Act be developed to replace the current *Land Act*, *Crown Land (Reserves) Act* and *Forests Act*.

The Government has accepted these recommendations.

Elements of Victoria's forest management framework are accredited by the Commonwealth under five Regional Forest Agreements (RFAs).<sup>68</sup> The RFAs were a key outcome of the National Forest Policy Statement (1992) through which the federal, state and territory governments committed to the sustainable management of all Australian forests.

RFAs endeavour to maintain a comprehensive, adequate and representative reserve system, to manage forests on an ecologically sustainable basis; and provide for the long-term stability of forests and forest industries. All five Victorian RFAs are due to expire in March 2020.

The Victorian Government endorsed a program to modernise Victoria's RFAs. Over the next two years, DELWP have committed to engage with Victorian communities on how they value Victoria's forests. DELWP will also complete assessments of forest values, including environmental values, indigenous heritage values, economic value, social values and principles of ecologically sustainable management.

It is anticipated that the outcomes of the engagement and assessments processes will inform the modernisation of Victoria's RFAs and the planning and regulatory frameworks they accredit.

67. Forest & Wood Products Australia 2011, '*Management of Victoria's Publicly-owned Native Forest for Wood Production*', Melbourne, Victoria [http://www.fwpa.com.au/images/resources/PRC174-0910\\_Research\\_Report\\_Native\\_forest\\_project.pdf](http://www.fwpa.com.au/images/resources/PRC174-0910_Research_Report_Native_forest_project.pdf).

68. The State of Victoria Department of Environment, Land, Water and Planning 2018, '*Modernising Victoria's regional forest agreements*', Melbourne, Victoria <https://www.forestsandreserves.vic.gov.au/forest-management/regional-forest-agreements>.



## Forests

Forests Theme	Forests Indicator	2008	2013	2018
Ecosystem Diversity	Area of forest by type and tenure	✓	✓	✓
	Area of forest type by growth stage	✓	✓	✓
	Area of forest type by growth stage distribution in protected zones	✓	✓	✓
	Fragmentation of native forest cover	✓	✓	✓
Generic Diversity	Number of in-situ and ex-situ conservation efforts for forest dependent species	✓	✓	✓
Species Diversity	The status of forest dependant species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment	✓	✓	✓
	Degree of disturbance to native forest species caused by invasive species	✓	✓	✓
Ecosystem Health	Scale and impact of agents and processes affecting forest health and vitality	✓	✓	✓
	Area and type of human-induced disturbance	✓	✓	✓
Carbon Cycles	Total forest ecosystem biomass and carbon pool by forest type, age class and successional stages	✓	✓	✓
	Contribution of forest ecosystems to the global greenhouse gas balance	✓	✓	✓
Productive Capacity	Area and percentage of forest and net area of forest available and suitable for wood production	✓	✓	✓
	Area of native forest harvested	✓	✓	✓
	Annual production of wood products from State forests compared to sustainable harvest levels	✓	✓	✓
	Proportion of timber harvest area successfully regenerated by forest type	✓	✓	✓
Legal, institutional and economic benefits	Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests	✓	✓	✓
	Extent to which the institutional framework supports the conservation and sustainable management of forests	✓	✓	✓
	Capacity to measure and monitor changes in the conservation and sustainable management of forests	✓	✓	✓
	Capacity to conduct and apply research and development aimed at improving forest management, including development of scientific understanding of forest ecosystem characteristics and functions	✓	✓	✓
Socio-economic benefits	Investment and expenditure in forest management	✓	✓	✓
	Value (\$) of forest derived ecosystem services	✓	✓	✓



# Fire



## Background

Victoria's native plant and animal species have evolved symbiotically with the patterns of fire and climate and depend on fire for survival and growth. For instance, some fire-dependent flora species only germinate seeds after stimulation by heat or smoke. Fire also initiates natural processes by breaking down organic materials into soil nutrients that provide fertile soil conditions to accelerate rejuvenation processes for plants. In addition, fire reduces competition and increases sunlight for plants to grow quickly.

Traditional owners used fire to manipulate vegetation, encourage new growth and assist hunting. They also used fire for cultural and spiritual reasons. In the absence of traditional burning practices, and in a time of climate change, fuel load accumulation has shifted fire behaviour towards less predictable but more intense fires.<sup>69</sup> Compounded by population growth and residential incursion into previously uninhabited forest areas, the risk of fire to people and property has increased. It is estimated that around \$8.5 billion or 1.15% of the Australia's GDP accounts for the total annual cost of fires in Australia.<sup>70</sup> In Victoria, \$4.4 billion was evaluated as the economic cost of the 2009 Black Saturday fire.<sup>71</sup>

Fire managers and communities must plan for more frequent and extreme bushfire events in the future.<sup>72,73</sup> It is predicted that Victoria will encounter more dangerous conditions than other states in Australia.<sup>74</sup> Current climate change predications also impact on biodiversity with some effects being noticed already – such as changes in plant growth rates, fuel loads and moisture content as a result of longer periods of weather conditions associated with high fire risk.<sup>75</sup> Although many native Australian flora and fauna species are tolerant of individual fires, an increase in fire intensity and frequency may impose a variety of negative impacts on biodiversity. Some habitats and species are more likely to be adversely influenced than others.<sup>76</sup>

Smoke from fires – planned burns and bushfires – have health implications for surrounding communities – in some cases the area of effect can expand to 50km from the source or the fire.<sup>77</sup>

Particulate matter and noxious gasses associated with smoke can reduce air quality in rural and urban areas and may affect people's health.<sup>78</sup>

The critical challenges facing Victoria's bushfire management now and into the future include:

- minimising the impact of major bushfires on human life, communities, essential and community infrastructure, industries, the economy and the environment
- maintaining or improving the resilience of natural ecosystems and their ability to deliver services such as biodiversity, water, carbon storage and forest products
- addressing data and information gaps: there is no long-term research on climate change impacts on fire behaviour and patterns
- increasing community awareness and establishing effective emergency systems, especially in peri-urban areas
- protecting human health from more frequent smoke exposure.

## Fire themes

To understand trends and identify information gaps to address the above challenges, the SoE 2018 report will assess:

### Fire occurrence

DELWP maintains more than ten years of historic data which produce trends related to planned burns and bushfires. Analysis of this data enables reporting of native vegetation burnt.

### Impacts of bushfires

This theme covers impacts of unplanned fires on biodiversity, human settlements, business, infrastructure and water resources. The indicators include assessments of biological impacts on species and ecosystems, human casualties, loss of property and economic costs of fire responses.

69. State of Victoria Department of Sustainability and Environment 2008, 'Living with Fire: Victoria's bushfire strategy', Melbourne, Victoria.

70. Ashe B, Mc Aneney KJ, Pitman AJ 2009, 'Total cost of fire in Australia.' Journal of Risk Research 12:121-136.

71. Teague B, McLeod R, Pascoe S 2010, 2009 'Victorian Bushfires Royal Commission Final Report.' Parliament of Victoria.

72. Hughes L 2003, 'Climate changes and Australia: trends, projections and impacts'

73. Downie C 2006, 'Heating up: bushfires and climate change.' The Australia Institute.

74. Dowdy JA 2018, 'Climatological variability of fire weather in Australia.' Journal of Applied Meteorology and Climatology. 57, 221-234.

75. Enright NJ, Fontaine JB, Bowman DMJS, Bradstock R, Williams RJ 2015, 'Interval squeeze: altered fire regimes and demographic responses interact to threaten woody species persistence as climate changes.' Frontiers in Ecology and the Environment. 13:265-272.

76. Williams D, Bowman D, Little J. 2014, 'Climate Change, Fire and Terrestrial Biodiversity: information sheet six', James Cook University.

77. Goodrick SL, Achtemeier GL, Larkin NK, Liu Y, Strand TM 2013, 'Modelling smoke transport from wildland fires: a review.' International Journal of Wildland Fire 22:83-94.

78. Health Victoria 2018, 'Bushfire smoke and planned burns', Melbourne, Victoria <https://www2.health.vic.gov.au/public-health/environmental-health/climate-weather-and-public-health/bushfires-and-public-health/bushfire-smoke-and-planned-burns>.

## Bushfire risk

Bushfire risk is the likelihood of a fire starting, spreading and affecting people, property and the environment. Fuel management activities (as well as bushfires) reduce fuel hazards, which help to reduce the size, speed and severity of major bushfires and lessen their impact. This theme will investigate current approaches in mitigating bushfire risks, and ways to improve residual risk estimates after planned and unplanned burns.

## Government policy response

The Victorian Government introduced *Safer Together: A new approach to reducing the risk of bushfire in Victoria* in 2015 based on recommendations from the Inspector General for Emergency Management (IGEM). *Safer Together* adopts a risk reduction target to replace the previous hectare target approach to bushfire fuel management on public land. This approach enables the Government to focus effort in strategic areas by planning and implementing risk reduction activities in areas that will derive the greatest benefit. The Government has committed to maintain residual bushfire risk at, or below 70%, signifying that fuel management

activities will reduce bushfire risk by about a third from maximum levels. In addition, DELWP, along with the Country Fire Authority (CFA) and Forest Fire Victoria, now involves local communities in prioritising fuel management activities and identifying opportunities to reduce risk across all land tenures.

Since the new approach was initiated, the IGEM published three monitoring reports that reviewed DELWP's progress in response to the recommendations. Three of four recommendations are being implemented as part of *Safer Together*. The remaining recommendation will be continuously monitored as part of ongoing assurance activities, including breaches of planned burn control lines.

Underpinning the Government's efforts to reduce risk of bushfires is the Code of Practice for Bushfire Management on Public Land. The Code was adapted from its 2006 iteration following the 2009 Victorian Bushfires Royal Commission. Risk-based planning, where human life is afforded the highest priority, is a fundamental part of the Code, however it also recognises the impacts of fire on the natural environment and thereby considers risk to human life, infrastructure and ecological assets within its approach.

Fire Theme	Fire Indicator	2008	2013	2018
Fire occurrence	<i>Area of native vegetation burnt in planned fires and bushfires</i>	✓	✓	✓
Fire impacts	<i>Impacts of bushfire</i>	✓	✓	✓
	<i>Actual fire regimes compared to optimal fire regimes</i>	✓	✓	✓
Fire risk	<i>Bushfire risk</i>	✗	✓	✓







# Water Resources



### Background

Water is used for a variety of purposes, including residential supply, primary production (particularly for irrigation), power generation and industry.

The quality of Victoria's water resources is vital for human health and wellbeing and for accommodating its anticipated population growth. Victoria's Traditional Owners and Aboriginal Victorians have managed water sustainability over thousands of generations.

The availability and quality of water is also key for economic prosperity, especially for primary production industries. Irrigated agriculture is the largest water user in the state with a net worth of \$4.4billion in 2013-14.<sup>79</sup> Food and fibre alone was worth \$12.6 billion in that same year and employs over 190,000 people.<sup>80</sup> Victoria's water consumption increased over the last century, peaking in the 1990s, but dropped in response to water restrictions caused by the long-term Millennium drought between 1996 and 2010. The severity of water shortages has been particularly marked in central and western Victoria, where some storages were more than 90% empty at the end of the drought. Rainfall reductions have continued during Victoria's cooler months since the drought and are expected to continue, leading to an overall reduction in average annual rainfall.<sup>81</sup>

The availability and quality of surface and groundwater resources is mainly determined by streamflow and rainfall, as well as impacts of land use on catchment hydrology. With a steady temperature increase since 1970, there has been an overall decrease in streamflow of approximately 50% over the past 20 years.<sup>82</sup> Streamflow in Victoria is highly variable, with most basins receiving only a fraction of their average flow in most years. The generally dry conditions are punctuated by wet years with flows well exceeding the average, replenishing storages and river systems. This was seen during 2016, where Victoria experienced its wettest year since 2011 with rainfall 19% above average. This caused flooding across western and northern Victoria.<sup>83</sup>

The effect of climate change will influence and increase the frequency of extreme weather events such as droughts and floods, creating an annual level of uncertainty for stream flow, water quality

and resource availability. However, the overall long-term projection for streamflow is to decrease by a greater proportion than rainfall due to the interaction between rainfall and catchment hydrology.<sup>84</sup>

In some rivers, up to half of the water that would have naturally flowed in them is removed each year to provide water for farms, homes and industries.<sup>85</sup> Almost all Victorian catchments, rivers and larger streams have been modified to some degree, within land waters being transformed into a complex and extensive system for harvesting, transporting and controlling the movement of water. There are 134 declared water supply catchments across Victoria and about 52 major storages, with at least one major on-stream storage constructed in 19 of Victoria's 29 river basins. In addition, there are about 450,000 farm dams in Victoria. As a result, many river systems in Victoria are now environmentally degraded because of impacts on natural flow regimes.<sup>86</sup>

As demand for water has increased in Victoria, especially during high peak periods of hot weather, the use of groundwater to complement surface water sources has increased. Groundwater is now an important resource for agriculture, industry and domestic use. Groundwater resources are used across 70 Victorian cities and towns as either a supplementary or primary water supply. In some regional areas, groundwater is the sole source of water. Groundwater is increasingly becoming a more valuable water resource as surface water becomes scarcer.

Water resources, use and consumption (including entitlements and trade) are overseen by the Victorian State Government. Decision-making and management is delegated to the water sector which is comprised of urban, regional and rural water corporations, Catchment Management Authorities and the Victorian Environmental Water Holder. This water sector provides approximately 6,000 jobs<sup>87</sup> across the state. The Victorian water sector is the largest emitter of carbon dioxide as a sector or government, with almost 1 million tonnes per annum emitted.<sup>88</sup> The largest proportion of these emissions originates from sewerage treatment – and this service will need to increase in the future due to Victoria's projected population growth.

79. The State of Victoria Department of Environment, Land, Water and Planning 2016, 'Water for Victoria Water Plan', Melbourne, Victoria.

80. Ibid.

81. Ibid.

82. Ibid.

83. Victorian Environmental Water Holder 2017, 'Reflections Water for the Environment in Victoria 2016-2017', Melbourne, Victoria.

84. The State of Victoria Department of Environment, Land, Water and Planning 2016, 'Water for Victoria Water Plan', Melbourne, Victoria.

85. Victorian Environmental Water Holder 2017, 'Reflections Water for the Environment in Victoria 2016-2017', Melbourne, Victoria.

86. The State of Victoria Department of Environment, Land, Water and Planning 2014, 'Dams in Victoria', Melbourne, Victoria.

87. The State of Victoria Department of Environment, Land, Water and Planning 2016, 'Water for Victoria Water Plan', Melbourne, Victoria.

88. Ibid.



Critical challenges facing Victoria's water resources and consumption use now and into the future includes:

- meeting water consumption needs of Victoria's growing population, projected to reach 10.1 million people by 2051.<sup>89</sup> This includes increasing pressures on assets, infrastructure, plants and wastewater services which require ongoing monitoring and maintenance
- meeting primary industry water resource needs in response to Victoria's growing population resource consumption. This includes increasing pressure on services such as irrigation, drainage and storage
- addressing water resource availability and natural flow regimes under climate change, particularly during extreme weather events such as floods and droughts
- addressing the increased dependency on ground water as a water resource during periods of drought, or less than average rainfall, that can lead to unsustainable use
- facilitating innovation in water resources and infrastructure to upgrade existing sewerage treatment facilities and develop new sewerage treatment approaches to reduce carbon dioxide emissions
- continuing to develop processes and protocols to enable transparent and accountable collaboration on infrastructure projects, across organisational boundaries to deliver sustainable, integrated water management solutions.

### **Water resources themes**

To understand trends and identify information gaps to address the above challenges, the SoE 2018 will assess:

#### **Water resources and consumption**

This theme will report on storage and water consumption trends, looking at key challenges such as water restrictions. Surface water harvested for consumptive use and the percentage

of water extraction from waterways and groundwater areas will be discussed and linked to rainfall trends.

#### **Flow regimes**

This theme will report on streamflows, described at the basin level, and how this is influenced by dams, weirs and levees. Case studies will highlight the benefits of delivering environmental water for improved waterway and ecosystem health and the communities dependent on this water.

#### **Water recycling**

This theme will describe water efficiency and conservation through water recycling practices reported as volume of wastewater recycled in Victoria and surface water harvested for consumptive use.

#### **Groundwater**

Groundwater levels are greatly affected by climate trends, with periods of flood and droughts influencing groundwater recharge and extraction. This theme will report on groundwater levels and use. Due to limited data, long-term changes in groundwater condition and quality, including contamination, cannot be demonstrated at the statewide level. There will be a trend analysis of regional groundwater levels across upper, middle and lower aquifers. Total groundwater resource allocation by consumer can be used as an indicator for sustainable use of groundwater resources.

#### **Government policy response**

In 2016, the Victorian Government released its water plan, *Water for Victoria*, which sets out the strategic directions and proposed actions to meet the water security challenges facing Victoria – principally those arising from climate change and population growth. The Government invested \$537 million to deliver *Water for Victoria* over a four-year period.

---

89. The State of Victoria Department of Environment, Land, Water and Planning 2016, 'Water for Victoria Water Plan', Melbourne, Victoria.

## Water Resources

Major areas of investment aligned to the strategic aims of *Water for Victoria* have included \$222 million to improve waterway and catchment health in regional Victoria, \$60 million to strengthen water entitlement and planning processes, \$151 million for water and irrigation infrastructure, including \$42 million in the 2018-19 Victorian Budget towards water security infrastructure in the East Grampians and Mitiamo, and \$20 million to respond to the challenges of climate change.

*Water for Victoria* recognises the value water has for Traditional Owners and Aboriginal Victorians. Funding of \$9.7 million has been provided to support economic development and an Aboriginal Water Program. The objectives of the Aboriginal Water Program are to: recognise Aboriginal values and objectives of water; include Aboriginal values and traditional ecological knowledge in water planning; support Aboriginal access to water for economic development; and build capacity to increase Aboriginal participation in water management.

Water Resources Theme	Water Indicator	2008	2013	2018
Water Resources & Consumption	<i>Water resources and storage trends.</i>	✓	✓	✓
	<i>Surface water harvested for consumptive use.</i>	✓	✗	✓
	<i>Percentage of waterways and groundwater areas, subject to water extraction, exceeding sustainable yields.</i>	✓	✗	✓
Flow Regimes	<i>Streamflow at basin level.</i>	✓	✓	✓
	<i>Delivery of Environmental Water.</i>	✓	✓	✓•
	<i>Number of dams, weirs and levees.</i>		✗	✓•
Water Recycling	<i>Measure of water efficiency and conservation through recycling practices.</i>	✓	✓	✓
Groundwater	<i>Trends in groundwater levels resulting from rainfall or extraction for consumption.</i>	✓	✓	✓
	<i>Groundwater resource allocation by consumer.</i>	✓	✗	✓

• Only as narrative

# Water Quality





### Background

Water quality is fundamental to the ecosystem services that inland waters provide, such as drinking water, cycling of nutrients, maintenance of biodiversity, and recreational and cultural opportunities. Poor water quality has serious implications for the ecological health of inland waters, biodiversity, and human and livestock health.

Water quality pollution generally arises from point-source discharges (directly from industry and treatment plants) or diffuse sources (runoff from catchments). Regulatory improvements have reduced point-source water pollution, with diffuse sources, such as urban stormwater, now the most significant contributor to pollution of Melbourne's rivers, creeks and wetlands. The projected increase in extreme rainfall events in Victoria is highly likely to amplify the effects of urban stormwater pollution unless practical solutions are implemented.

The main water quality issues for Victoria have traditionally been salinity, turbidity, nitrogen and phosphorus. At a statewide and national level, these variables are considered as the most significant river contaminants. However, there are numerous other variables that contribute to water quality, such as pH, pesticides, heavy metals and temperature, which may have particular local or regional significance. Water quality is also affected by interactions between these components. For example, salinity and temperature both affect the saturation concentration of dissolved oxygen.

When the SoE 2013<sup>90</sup> was written, DELWP had not analysed the raw monitoring data that had been collected and was unable to provide a statewide assessment of water quality in Victoria. Consequently, the SoE 2013 contained only a limited update of water quality from the SoE 2008 report.<sup>91</sup> The 2008 assessment showed that water quality was generally poor in much of Victoria, particularly in Victoria's lowlands and in the west of the state.

There has been an increased focus on the water quality sector since 2013. DELWP conducted an internal audit of its water quality monitoring programs in January 2015 prior to a VAGO audit

into Victorian water resource monitoring that was completed in May 2016. The VAGO audit made three recommendations encompassing a central finding that, although some individual programs are coordinated and governed well, oversight of the individual long-term water quality monitoring programs in the Port Phillip Bay and Western Port region is deficient. The deficiency arose from an inadequate coordination across all programs between the three relevant agencies: DELWP, Melbourne Water and EPA. This issue is less prevalent in the nine other catchments where DELWP has the clear coordination role. Specific findings from the VAGO audit included agencies not having a formal cooperative approach to monitoring, reporting and evaluating the individual monitoring programs in the region, as well as agencies not sharing and using data efficiently to meet reporting needs.<sup>92</sup> The DELWP and VAGO audits informed the Victorian Government's release of a water plan for Victoria in October 2016.<sup>93</sup>

With the importance of long-term water quality monitoring being reflected in state and departmental strategies, the SoE 2018 report is expected to provide a significant update to the water quality section that was provided in the 2013 report. This is due to the availability of trend data to be supplied by DELWP on a range of water quality indicators measured at approximately 80 sites.

Several chemicals are emerging as threats to water quality and human health; including Per- and poly-fluoroalkyl substances (PFAS) and Perfluoro-octane sulfonate (PFOS). An example of the increasing focus on these pollutants is the investigation EPA is coordinating into potential environmental contamination, including surface water quality pollution, from the historical use of PFOS in firefighting foam by the CFA.<sup>94</sup>

A warmer climate will lead to higher water temperatures, affecting the distribution of many aquatic species. Increased temperatures also have water quality implications through reduced concentrations in dissolved oxygen and potential increase in algal blooms. Increased bushfires will also impact on water quality and riparian vegetation.

90. Commissioner for Environmental Sustainability 2013, 'State of the Environment report 2013', Melbourne, Victoria <http://www.ces.vic.gov.au/publications/state-environment-report-2013>.

91. Commissioner for Environmental Sustainability 2008, 'State of the Environment report 2008', Melbourne, Victoria <http://www.ces.vic.gov.au/publications/state-environment-report-2008-0>.

92. Victorian Auditor-General's Office 2016, 'Monitoring Victoria's Water Resources', Melbourne, Victoria <https://www.audit.vic.gov.au/sites/default/files/20160525-Water-Resources.pdf>.

93. The State of Victoria Department of Environment, Land, Water and Planning 2018, 'Water for Victoria', Melbourne, Victoria <https://www.water.vic.gov.au/water-for-victoria>.

94. Environment Protection Authority Victoria 2018, 'CFA regional training centres', Melbourne, Victoria <http://www.epa.vic.gov.au/our-work/current-issues/water-quality/cfa-regional-training-centres>.

Critical challenges facing Victoria's management of water quality impacts now and into the future include:

- balancing the needs of catchment and waterway health with the needs of water consumption for towns and agriculture
- managing urban growth and its impact on urban waterway health
- ensuring long-term water quality monitoring is coordinated and shared amongst the lead agencies. This was a key recommendation of the 2016 VAGO audit
- finalising a new State Environment Protection Policy (SEPP) that combines the existing 'Waters of Victoria' and 'Groundwaters of Victoria' SEPPs. It is essential this new SEPP ensures greater accountability for lead agencies responsible for managing water quality
- maintaining long-term water quality monitoring data so that it is easily accessible and suitable for use to inform policy and strategy development
- ensuring a coordinated approach to citizen science in the water quality sector. Citizen science programs are more prevalent in water quality than for other sectors and the value of community involvement can be maximised if citizen science programs are designed and targeted with a similar level of rigour across lead agencies within the water quality sector
- identifying strategies to tackle the likely increase in stormwater pollution incidents associated with more frequent and intense rainfall events
- identifying and managing the risks, including legacy contamination, associated with emerging chemicals such as PFAS and PFOS
- adapting to, and mitigating the risks from, climate change.

### **Water quality themes**

To understand trends and identify information gaps to address the above challenges, the SoE 2018 will assess:

#### **Algal blooms**

Cyanobacteria (blue-green algae) are naturally present in Victoria's inland waters. Under certain conditions their populations can increase causing a potentially toxic bloom. Low flows caused by river regulation have been identified as a primary cause of cyanobacterial blooms, with the availability of nutrients affecting the size of the bloom. The SoE 2013 noted there is a high variability in algal bloom number and extent, and that it was not possible to determine any trends.<sup>95</sup> Algal blooms are reported through a coordinated database managed by DELWP.

#### **Water quality measures**

Around half of Victoria's native vegetation has been cleared, including riparian vegetation, increasing runoff and erosion.<sup>96</sup> This has resulted in a significant decline in water quality with increases in sedimentation and nutrient pollution, as well as toxicants from roads, agriculture and industry. Data for this theme will cover approximately 80 rivers and will be supplied by DELWP. The following topics will be reported:

- dissolved oxygen concentrations in rivers
- salinity concentrations in rivers
- total nitrogen concentrations in rivers
- total phosphorus concentrations in rivers
- turbidity levels in rivers
- pH
- proportion of bodies of water with good ambient water quality.

95. Commissioner for Environmental Sustainability 2013, 'State of the Environment report 2013', Melbourne, Victoria <http://www.ces.vic.gov.au/publications/state-environment-report-2013>.

96. Ibid.

It was hoped that data would be available on new indicators: suspended solid concentrations in rivers, water temperature and chlorophyll-a concentrations in rivers, however DELWP will be unable to supply data for these items.

### Discharges

Even though diffuse pollution is the main driver of water quality impacts for most systems, point-source discharge systems may have an impact on water quality in some areas. This is a new reporting theme in the SoE 2018. EPA will provide data on the locations and clusters of licensed sites discharging to surface waters; however, discharge volumes will not be available.

### Pollution incidents

Pollution incidents will be another new reporting theme in the water quality section of the SoE 2018. The information reported in this theme will be provided by EPA and will include a measure of the occurrence of pollution incidents categorised by catchment areas, with identification of clusters in specific waterways. Any significant incidents will be discussed in more detail to provide an understanding of impacts, responses and costs.

### Government policy response

In October 2016 the Victorian Government released *Water for Victoria* – a plan for the management of Victoria's water resources, now and into the future.<sup>97</sup>

The plan included commitments to improving Victoria's existing waterway monitoring programs, investing in community partnerships and citizen science initiatives, strengthening integrated catchment management and delivering a new SEPP to protect water quality.

*Water for Victoria* includes a commitment of \$222 million in catchment and waterway health to better balance the needs of the environment with the needs of water consumption. The investment includes water for the environment, riparian restoration and other programs.

The Government has also established a series of Integrated Water Management Forums across the state. Within the Forums, the water sector and community are working together to plan, manage and deliver water in towns and cities.

To help manage urban growth and its impact on urban waterway health, the Government has developed a range of water policies, including *Water for Victoria*, the *Yarra Action Plan*, the *Plan Melbourne Implementation Plan* and the *Port Phillip Bay Environmental Management Plan*.

Melbourne Water's responsibility is to create long-term plans that ensure the region's waterways are healthy, liveable and accessible. Melbourne Water's draft *Healthy Waterways Strategy* is intended to address future urban waterway management needs. As part of the Melbourne Urban Stormwater Institutional Arrangements Review, DELWP is reviewing the arrangements between Melbourne Water and local government authorities in a bid to clarify responsibilities for urban stormwater risk management, related assets and services in the Melbourne metropolitan area. A recommendations paper is scheduled for completion in late 2018.<sup>98</sup> The Government has established the Improving Stormwater Management Advisory Committee to provide independent advice on planning and development controls for improving stormwater management and strengthening the links between water management and urban planning.

The 2003 *State Environment Protection Policy (Waters of Victoria)*<sup>99</sup> (SEPP (WoV)) is the Government's primary water quality policy, however it does not provide clarity on the roles and responsibilities of the lead agencies involved in long-term water quality monitoring. The Government has committed to ensuring that the underpinning water quality standards and objectives reflect best available science and provide clear and relevant standards and obligations to protect and improve the health of our water environments. To do this, the Government is updating and merging the *State Environment Protection Policies (SEPPs) – Waters of Victoria and Groundwaters of Victoria*.<sup>100</sup>

97. The State of Victoria Department of Environment, Land, Water and Planning 2018, '*Water for Victoria*', Melbourne, Victoria <https://www.water.vic.gov.au/water-for-victoria>.

98. The State of Victoria Department of Environment, Land, Water and Planning 2018, '*Melbourne Urban Stormwater Institutional Arrangements Review*', Melbourne, Victoria <https://www.water.vic.gov.au/managing-floodplains/stormwater-review>.

99. Environment Protection Authority Victoria 2018, '*Water-related policies*', Melbourne, Victoria <http://www.epa.vic.gov.au/about-us/legislation/water-legislation/water-related-policies#seppwov>.

100. The State of Victoria Department of Environment, Land, Water and Planning 2018, '*Draft State Environment Protection Policy (Waters)*', Melbourne, Victoria <https://engage.vic.gov.au/seppwaters>.



## Water Quality

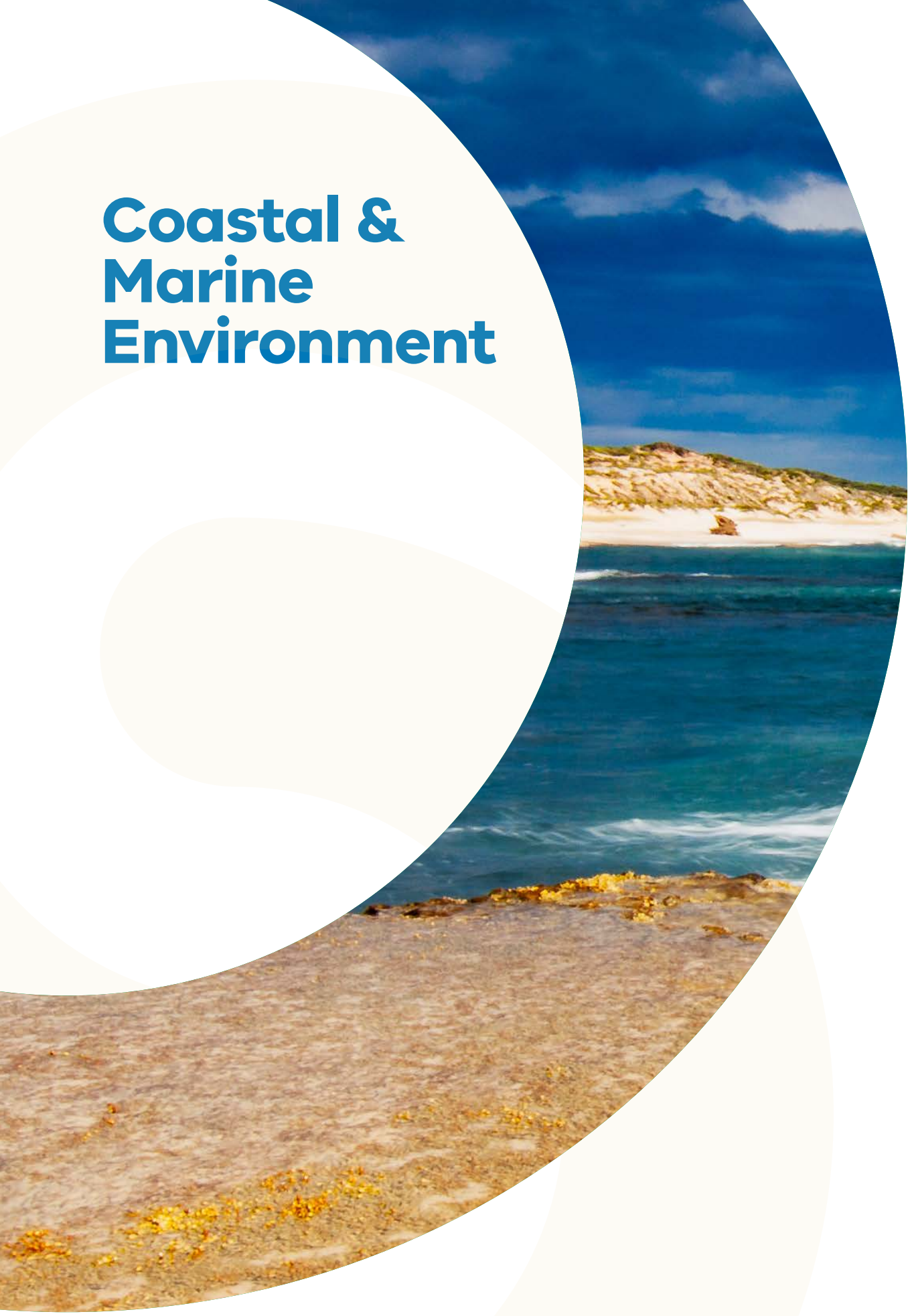
Water Quality Theme	Water Quality Indicator	2008	2013	2018
Algal blooms	<i>Occurrence of algal blooms</i>	✓	✓	✓
Water quality	<i>Dissolved oxygen concentrations in rivers</i>	✗	✗	✓
	<i>Salinity concentrations in rivers (EC)</i>	✓	✓•	✓
	<i>Suspended solid concentrations in rivers</i>	✗	✗	✓•
	<i>Total nitrogen concentrations in rivers</i>	✓	✓•	✓
	<i>Total phosphorus concentrations in rivers</i>	✓	✓•	✓
	<i>Turbidity levels in rivers</i>	✓	✓•	✓
	<i>Water temperature</i>	✗	✗	✓•
	<i>pH</i>	✗	✗	✓
	<i>Chlorophyll-a concentrations in rivers</i>	✗	✗	✓•
	<i>Proportion of bodies of water with good ambient water quality</i>	✗	✗	✓
Discharges	<i>Volume of sewage discharge to surface waters</i>	✗	✗	✓
Pollution incidents	<i>Reported inland water pollution incidents</i>	✗	✗	✓

• Only as narrative





# Coastal & Marine Environment





### Background

The Victorian state and local governments have worked to improve marine and coastal planning, protection and management through legislation, regulation, institutional and policy settings, strategic and statutory planning and the creation of conservation reserves (approximately 70% of the coast and 12% of marine waters are managed by Parks Victoria in national and coastal parks, marine national parks and sanctuaries, and other parks). But the pressures on the coastal and marine environments have continued to build, largely driven by the resource-intensive demands of population growth.

From 2011 to 2016, the Barwon Heads-Ocean Grove population grew by more than 28%, Torquay-Jan Juc by 27%, the Surf Coast and Bellarine Peninsula by 18% and the Bass Coast by 11%.<sup>101</sup> Urbanisation along the Victorian coast increased by 15% (41 kms<sup>102</sup>) between 1980 and 2004, while today Victoria's rural and peri-urban land within 30 km of the coast is being urbanised at a rate faster than any other state.<sup>103</sup> More recently climate change has accentuated the pressures from population growth and urbanisation.

Victoria's marine and coastal environments are highly valued by Victorians. Polling has found that they are proud of their coast, and a natural environment contributes more to their enjoyment than coastal infrastructure.<sup>104</sup> Most Victorians visit the coast regularly (on average 23.4 daytrips each in 2012<sup>105</sup>) or live along or near it (more than 80% live within 50 km<sup>106</sup>). In 2013, Parks Victoria estimated that there were 3.8 million visits to marine national parks and sanctuaries and 32 million visits on Port Phillip and Western Port bays.<sup>107</sup>

Ecosystem services from marine and coastal environments drive commercial and recreational fishing, recreation and tourism. Wild catch fisheries harvested 4,832 tonnes in 2016-17, with the abalone and rock lobster catches together worth more than \$42 million,<sup>108</sup> by far Victoria's most important. The economic value of recreational fishing to Victoria has been estimated at \$7 billion.<sup>109</sup> Domestic and international visitors to the Geelong and Bellarine region totalled 5.1 million in 2017 and generated a gross regional product of \$542 million.<sup>110</sup>

In a 2012 Ipsos poll for the Victorian Coastal Council, the top four marine and coastal issues for Victorians were overfishing/illegal fishing, pollution, development and stormwater pollution. Fewer believed the coast was well-managed compared with earlier polls, and two-thirds felt that sea level was rising due to climate change and causing erosion and flooding.<sup>111</sup>

Coastal and catchment development over the past two centuries has led to significant losses of coastal vegetation types, with some now endangered or vulnerable. Coastal alkaline scrub has been reduced to 22% of its original cover on the Victorian Volcanic Plain,<sup>112</sup> and to 31% on the Otway Plain and 56% on the Gippsland Plain. The Otway Plain has now only 26% of its pre-1750s cover of coastal saltmarsh, while Port Phillip Bay has only 50%.<sup>113</sup> Although threatened coastal plants and animal species are well documented, there is limited research on those in marine waters.

Coastal urbanisation increases runoff, with Port Phillip Bay each year receiving 540 billion litres of stormwater from more than 300 outfalls.<sup>114</sup> The Yarra River annually discharges into the bay 14,000 tonnes of sediment along with 650 tonnes of nutrients in fertiliser, litter, heavy metals and bacteria.<sup>115</sup> However, water quality in Port Phillip Bay is generally good due to the efficiency of denitrification processes.<sup>116</sup>

101. Australian Bureau of Statistics 2016, 'Quick Stats', Canberra, Australian Capital Territory <http://www.abs.gov.au/websitedbs/censushome.nsf/home/quickstats?opendocument&navpos=220/>.

102. Commissioner for Environmental Sustainability 2008, 'State of the environment report 2008', Melbourne, Victoria.

103. Clark G, Johnston, E 2017, 'Australia state of the environment 2016: coasts, independent report to the Australian Government Minister for Environment and Energy', Australian Government Department of the Environment and Energy, Canberra, Australian Capital Territory.

104. Ipsos Consultants 2012, 'Coastal and marine environment community attitudes and behaviour: Wave Four report', prepared for Victorian Coastal Council, Melbourne, Victoria.

105. Ibid.

106. Australian Bureau of Statistics 2001, 'How many people live in Australia's coastal areas?', Canberra, Australian Capital Territory <http://www.abs.gov.au/ausstats/abs@.nsf/Previousproducts/1301.0Feature%20Article32004>.

107. Parks Victoria 2013, 'Park visits and visitor services', Melbourne, Victoria [http://parkweb.vic.gov.au/\\_data/assets/pdf\\_file/0004/672106/5.1-Park-visits-and-visitor-services-provided.pdf](http://parkweb.vic.gov.au/_data/assets/pdf_file/0004/672106/5.1-Park-visits-and-visitor-services-provided.pdf).

108. Victorian Fisheries Authority 2018, 'Commercial Fish Production Information Bulletin 2017', Queenscliff, Victoria.

109. White, A 2015, 'Recreational fishing boosts Victoria's economy by \$7.1 billion, report finds', Herald Sun, 9 November 2015.

110. Tourism, Events and Visitor Economy (TEVE) Research Unit 2018, 'Geelong and the Bellarine Regional Tourism Summary Year ending December 2017', Department of Economic Development, Jobs, Transport and Resources.

111. Ipsos Consultants 2012, 'Coastal and marine environment community attitudes and behaviour: Wave Four report', prepared for Victorian Coastal Council, Melbourne, Victoria.

112. Victorian Environment Assessment Council 2017, 'State-wide assessment of public land: state-wideEVCsBCS', Victorian Environment Assessment Council, Melbourne, Victoria.

113. Sinclair S and Boon P 2012, 'Changes in the area of coastal marsh in Victoria since the mid 19th century', Cunniamia12 (2): 153-176.

114. Environment Protection Authority 2015, 'Yarra and Bay: Stormwater', Melbourne, Victoria <https://www.yarraandbay.vic.gov.au/issues/stormwater>.

115. Ibid.

116. Commissioner for Environmental Sustainability 2016, 'State of the Bays', Melbourne, Victoria.

Since the early 1980s the commercial catches of many key Victorian fish stocks<sup>117</sup> have been in slow decline.<sup>118</sup> Port Phillip Bay, Western Port and some of the smaller East Gippsland estuaries are now mostly closed to commercial fishing. Port operations and shipping activity can also impact marine and coastal environments by leading to habitat damage and loss, increased turbidity (from dredging) and an increased risk of spills.

Most of the 160 introduced marine species now resident in Port Phillip Bay have arrived on the hulls and in the ballast water of visiting ships. Few impact local marine habitats and species. Those of greatest concern are the northern Pacific seastar, wakame (*Undaria*), Pacific oyster, green shore crab, European fan worm and the New Zealand screw shell, which prey on, or outcompete, native species for space, food and light.

The south-eastern waters of Australia are one of ten global hotspots for rising sea surface temperatures; the rate is almost four times faster than the global average.<sup>119</sup> This has energised ocean currents that now transport warm waters and subtropical species such as mahi mahi and cobia to Victoria.

Victoria's sea level has been rising on average of 3 mm per year since 1993,<sup>120</sup> with projected sea level and temperature rises of up to 82 cm and 3°C respectively this century.<sup>121</sup> Along with the potential loss of coastal infrastructure, rising sea levels could also flood low-lying intertidal platforms and beaches, erode sand dunes and reduce available coastal public open space at a time when population growth is placing more demands upon it. Although 96% of the coast is publicly owned, the coastal crown land reserve, and some coastal national parks, can be very narrow, wedged between land development and the water's edge. Climate change will also impact food security, human health, culture and livelihoods.<sup>122</sup>

In March 2018, the VAGO released its *Protecting Victoria's coastal assets* report.<sup>123</sup> It identified 63 entities involved in coastal management and concluded that the framework was complex and that governance and oversight by the Department of Environment, Land, Water and Planning (DELWP) was very poor. The VAGO report also

identified the lack of well-targeted funding and inefficient funding processes for resourcing coastal management.

Key policy and management challenges for the marine and coastal environment of Victoria include:

- ensuring effective community engagement in the sustainable management of coastal and nearshore environments
- implementing an effective, ecosystem-based marine spatial planning framework to ensure equitable access to resources, including ensuring the needs of the natural environment
- improving and simplifying coastal management governance and oversight
- adapting to climate change and the impacts of population growth.

Data and monitoring challenges include:

- expanding monitoring programs beyond localised areas within Port Phillip Bay, Western Port and the Gippsland Lakes
- broadening monitoring from species to ecosystems
- publicly releasing fisheries data on the impacts of commercial and recreational fishing on bycatch, habitats, threatened species and trophic structures
- adapting monitoring programs to cover the loss of fisheries data from the closure of bays and estuaries to commercial fishing
- aligning the research priorities of agencies, academic institutions and citizen scientists with the needs of coastal and marine management.

### **Coastal and Marine Environment Themes**

SoE 2018 coastal and marine environment chapter will include all the indicators from the State of the Bays 2016 report. Where new data is available, the status of these indicators will be updated, while several others will have their geographical scope extended to beyond the bays. There will also be several new indicators. The chapter will be structured around the following eight themes:

117. Note: Key species are southern rock lobster, giant crab, snapper, blacklip and greenlip abalone, King George whiting, southern sand flathead, black bream, southern garfish, pipi, yellow-eye mullet, rock flathead, southern calamari, blue throat and purple wrasse, gummy shark, sliver trevally, southern blue spot flathead, sand crab, Australian salmon and tailor.

118. Victorian Fisheries Authority 2017, 'Review of key Victorian fish stocks — 2017', Victorian Fisheries Authority Science Report Series No. 1.

119. Burrows MT et al. 2011, 'The pace of shifting climate in marine and terrestrial ecosystems', *Science* 2011 Nov 4;334(6056):652-5. doi: 10.1126/science.1210288.

120. SouthWest Climate Change Portal 2018, 'Sea Level Rise Projections for South West Victoria', <http://www.swclimatechange.com.au/SeaLevelRise>.

121. Klemke, J and Arundel H 2013, 'Implications of future climate for Victoria's marine environment'. Glenelg Hopkins Catchment Management Authority, Hamilton, Victoria.

122. Pecl G et al. 2014, 'Rapid assessment of fisheries species sensitivity to climate change', *Climatic Change*, DOI 10.1007/s10584-014-1284-z.

123. Victorian Auditor-General's Office 2018, 'Protecting Victoria's coastal assets', Melbourne, Victoria.

### **Coastal wetlands**

These indicators will assess wetland-dependent species that are threatened, including any changes in the status of these species, the extent and condition of coastal wetlands, the ecological character of coastal Ramsar wetlands (there are six in Victoria) and the level of protection given to coastal wetlands. Threatened species advisory lists will be used to identify threatened marine and coastal species but these are limited when it comes to estuarine fish, invertebrates and plants, and for the smaller estuaries where little data has been gathered.

### **Conservation**

The area and type of marine and coastal ecosystems with formal protection, along with the conservation status of marine species within those conservation areas (and trends over time), are the focus of this theme. There have been no new marine or coastal conservation areas established since the 2008 and 2013 SoE reports and with the exception of cetaceans, seabirds and other charismatic fauna, there has been limited monitoring of threatened species within existing areas. Parks Victoria's intertidal and subtidal monitoring of marine national parks between 2003 and 2011 will be a key data source.

### **Biodiversity**

These indicators cover threatening processes, the status of five groups of bird species and three species of fish, intertidal and subtidal reefs, and seagrass-dependent fish. Most of the indicators are from the State of the Bays report. For fish and birds, the data quality is generally good, whereas for subtidal and intertidal reefs, data quality ranges from poor to good. However, the monitoring points are highly localised. The Birdlife Australia and Parks Victoria monitoring programs, along with the citizen science program, Reef Watch, will be critical sources of data to help build a picture beyond just the two bays and the Gippsland Lakes, especially for species of the open coast. This theme will also identify key species groups, such as beach-nesting birds and open-coast fish species, which may be missing from the assessment process.

### **Fisheries**

Annual commercial and aquaculture fisheries production and their impacts will be assessed in this theme. Data for annual production volumes and values is very good, although at times it is limited for confidentiality reasons (less than five fishers reporting). There is limited publicly available data on the impacts of fisheries in terms of habitats, bycatch, trophic structures and interactions with threatened species due to a research focus on the effect of fishing on targeted stocks. Research on recreational fishing catches and their impacts is also limited.

### **Ecosystem health**

Macroalgae on intertidal reefs and urchins on subtidal reefs, as well as saltmarsh, mangrove and seagrass extent and condition are the focus of these indicators, most of which are from the State of the Bays report and where data quality ranged from poor to good. Monitoring by Parks Victoria will be a key source of data and will enable assessment along the open coast.

### **Water quality**

These indicators are important measures of environmental stressors, aquatic health and the functioning of critical ecosystem services. They cover water chemistry, denitrification processes, contaminants, algal blooms, marine pollution and the impacts of catchment discharges, with many of them already assessed in the State of the Bays report. New indicators assess catchment and point source discharges to marine waters, marine water pollution incidents, eutrophication and plastic debris. Water quality data is generally good but limited to the two main bays, the Gippsland Lakes and the mixing zones of 17 ocean outfalls.

### **Management**

Habitat restoration, the area of management in priority locations, the information needs for effective management, and the re-establishment of species in the wild in response to climate change are covered by the indicators in this theme.



### **Estuarine health**

This indicator assesses the condition of estuaries, of which there are more than 100 along the Victorian coast. Data being compiled for the Index of Estuarine Condition, and from the citizen science program – Estuary Watch – will help the assessment for this indicator.

### **Policy and management responses**

Victoria's new Marine and Coastal Act has passed through Parliament and is expected to commence on 1 August 2018. The Act has been established to provide improved governance and oversight of the marine and coastal environment and aims to:

- establish an integrated and co-ordinated whole-of-government approach to protect and manage Victoria's marine and coastal environment
- provide for integrated and co-ordinated policy, planning, management, decision-making and reporting across catchment, coastal and marine areas.

It endeavours to establish clear objectives and guiding principles for planning, management and decision-making. Recognising the need to plan for and manage the impacts of climate change is a significant addition to coastal management in Victoria – as is the acknowledgement of traditional owner groups' knowledge, rights and aspirations for land and sea country.

The number of advisory bodies has been simplified, by phasing out the regional coastal boards and Victorian Coastal Council and the establishing the statewide advisory Marine and Coastal Council. Membership of the Council will address a greater focus on the marine environment. The Council will be responsible for providing advice on the implementation of the Act by agencies including DELWP and will be enabled to establish sub committees – for example a science panel.

The Act establishes statutory documents for planning and management of the marine and coastal environment at the statewide, regional and local levels. This includes a Marine and Coastal Policy and a Marine and Coastal Strategy to be prepared every five years. These both require agreement across relevant portfolios and

intend to help deal with key challenges such as the impacts of climate change and population growth. The policy will include Victoria's first ever marine spatial planning framework to help achieve integrated and co-ordinated planning and management of the marine environment.

The new legislation requires a State of the Marine and Coastal Environment Report be prepared every five years. The legislation enables the Commissioner for Environmental Sustainability to prepare this report, with the first due in 2021. This report will monitor trends in a variety of indicators to help measure the condition of the marine and coastal environment and any changes over time. This information will be used to better inform ecologically sustainable policy, planning and decision making.

The Act introduces a new partnership approach for planning for significant regional issues impacting the marine and coastal environment. A regional and strategic partnership will produce tools to address a regional issue, such as, coastal hazard assessments, adaptation plans or other regional plans. Importantly, these partnerships can formally include community and non-government members to boost public involvement.

Environmental management plans will consider a broad range of threats to the health of the marine environment and aim to identify actions to fix them. Catchment Management Authorities are also now required to better plan for impacts on the marine and coastal environment through Regional Catchment Strategies.

Local level planning will provide opportunities for the community's voice to be heard and the Government anticipates a more streamlined process for consents to use, develop or undertake works on public land.

The new Act also helps address a key technical gap by enabling advice to be provided on matters relating to coastal erosion by those organisations advising on coastal flooding, coastal Catchment Management Authorities and Melbourne Water.

In 2017, the Victorian Government also established the Victorian Fisheries Authority to support the development of recreational and commercial fishing and aquaculture in Victoria, regulate fisheries and provide advice to government on a range of fisheries management opportunities.

## Coastal & Marine Environment

Coastal and Marine Theme	Coastal and Marine Indicator	2008	2013	2018
Coastal Modification	Amount of coastline urbanised	✓	×	✓•
	Amount of coast in protected area system	✓	✓	✓ <sup>124</sup>
	Condition of coastal vegetation communities	✓	✓	✓•
	Estuarine condition	✓	✓	✓
	Coastal population growth	✓	×	✓•
	Coastal recreation and tourism	✓	×	✓•
	Coastal subdivision	✓	×	✓•
	Occurrence of acid sulfate soils	✓	×	✓•
	Townships with settlement plans and boundaries	✓	×	✓•
Conservation	Conservation of coastal ecosystems	✓	✓	✓
	Conservation of marine ecosystems	✓	✓	✓
Water quality	Denitrification efficiency	✓	✓•	✓
	Concentration of chlorophyll- <i>a</i>	✓	✓	✓
	Lead concentration	✓	✓ <sup>125</sup>	✓ <sup>126</sup>
	Secchi depth	✓	✓••••	✓••••
	Enterococci concentration	✓	✓	✓
	Commercial shipping	✓	×	✓•
	Dredging in Port Phillip Bay and Western Port	✓	✓••	✓•
	Reported marine pollution	✓	✓•	✓•
	Point source discharges	✓	✓	✓
	Catchment inputs into coastal waters	✓•	✓	✓
	Harmful algae blooms	✓•••	✓••	✓
	Algae	✓•••	✓••	✓
	pH	✓ <sup>127</sup>	×	✓•
	Salinity	✓••	✓	✓
	Dissolved oxygen	✓•••	×	✓
	Nutrients	✓ <sup>128</sup>	✓	✓
	Temperature	✓ <sup>129</sup>	×	✓
	Sediment contamination	✓ <sup>130</sup>	×	✓
	Ratio of nitrogen fixation to denitrification	✓ <sup>131</sup>	×	✓

• Only as narrative

•• As case study

••• Eutrophication

•••• Water clarity

124. Conservation indicator.  
 125. Toxic pollutants in narrative.  
 126. Metals.  
 127. Acid sulphates soils.  
 128. Across several indicators.  
 129. Climate change.  
 130. Disturbance.  
 131. Assumed.

## Coastal & Marine Environment

Coastal and Marine Theme	Coastal and Marine Indicator	2008	2013	2018
Biodiversity	Conversion of subtidal reef communities to simplified states	✓	×	✓•
	Changes in the distribution and extent of seagrass habitats	✓	×	✓
	Trends in abundance of marine mammals that were previously hunted in Victoria	✓	×	✓
	Marine communities and species listed as threatened	✓	✓	✓
	Number of introduced species in Victorian marine environments	✓	✓	✓
	Number of introduced species that have the potential to cause large impacts	✓	✓	✓
	Threatening processes impacting on marine species	✓•	✓•	✓
	Birds (Status of: foraging shore birds; Little penguins; Fish-eating birds; Roosting shorebirds; Waterbirds)	×	×	✓
	Fish (King George whiting; sand flathead; snapper)	×	×	✓
	Intertidal reef (Mobile invertebrates; Sessile invertebrates)	×	×	✓
	Seagrass (dependent fish)	×	×	✓
	Subtidal reef (Fish; Mobile megafaunal invertebrates)	×	×	✓
Fisheries	Annual fisheries production	✓•	✓	✓
	Impacts of fisheries production	✓•	✓	✓
	Impacts of aquaculture production	✓•	×	✓•
Ecosystem health	Intertidal reef (Macroalgae)	✓•	✓•	✓
	Intertidal vegetation (Saltmarsh and mangrove extent; Saltmarsh condition)	×	✓•	✓
	Seagrass (Seagrass condition; Seagrass extent)	✓	✓•	✓
	Subtidal reef (Macroalgae dominated beds; Sea urchins)	×	✓•	✓
Management	Management of threatened species	×	×	✓
	Options available for re-establishment of species in the wild where feasible under climate change	×	×	✓
	Area of management in priority locations	✓•	×	✓
	Restoration of habitat	×	×	✓

• Only as narrative





# Waste & Resource Recovery



### Background

Waste is produced at all stages in the manufacture of products and services, as well as at the end of a product's lifecycle. Within this linear model of economy, the 'take-make-waste' results in a range of consequences including promotion of consumption over conservation, depletion of natural resources, environmental pollution and a compounding of the impacts of population growth and climate change.

When waste is not reused, recycled or used efficiently, there is an opportunity lost, as the material can no longer be used to contribute to the economy. Victoria produces approximately 12.8 million tonnes of solid waste per annum<sup>132</sup> and about 1.3 million tonnes of hazardous waste.<sup>133</sup>

Depending on how it's managed the impact of waste on the environment includes:

- greenhouse gas emissions
- amenity impacts and pollution of groundwater from landfill
- impacts on amenity, ecosystems and human health from hazardous wastes

- increased energy use through utilisation of virgin materials rather than recycled products
- impacts of unmanaged outputs such as litter and dumped wastes.

Recycling waste not only makes such materials available to the economy, it also reduces the demand for resource extraction and conserves energy and water compared to manufacturing products from virgin materials. In 2016-17, of the 12.8 million tonnes of solid waste produced, approximately 67% or 8.6 million tonnes was recovered for reprocessing. This leaves 4.2 million tonnes still going to landfill. Figure 2 shows the total waste trends since 2005/06.

The concepts of waste minimisation and recycling of materials are central to the development of a circular economy, where material is not lost to the system through becoming waste but once no longer needed, becomes a resource for another use. Circular thinking is aligned with aspirations around climate change mitigation and underpins the concepts behind many of the Sustainable Development Goals.

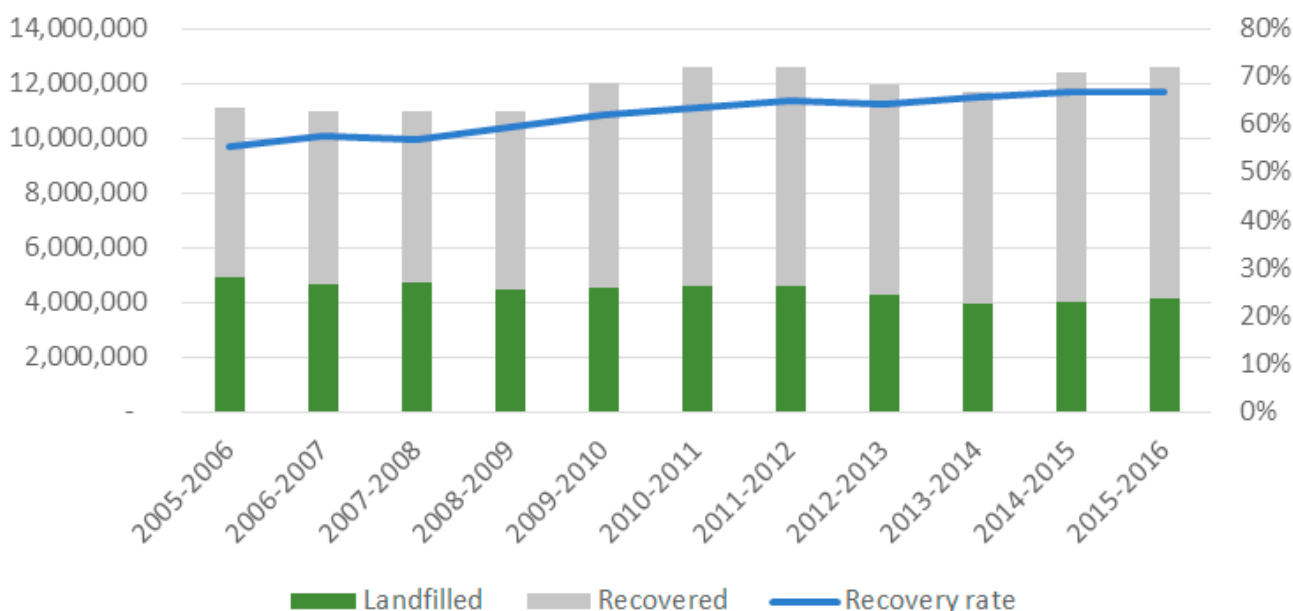


Figure 2. Total Waste generated, landfilled and recovered 2005/06 to 2015/16<sup>134</sup> (excludes hazardous waste)

132. Sustainability Victoria 2016, 'Victorian Recycling Industry Annual Survey Report 2015-16', Melbourne, Victoria <http://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Victorian-Recycling-Industry-Annual-Report>.

133. The Australian Government Department of the Environment and Energy 2017, 'Hazardous Waste in Australia 2017', Canberra, Australian Capital Territory <http://www.environment.gov.au/protection/publications/hazardous-waste-australia-2017>.

134. Sustainability Victoria 2016, 'Victorian Recycling Industry Annual Survey Report 2015-16', Melbourne, Victoria <http://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Victorian-Recycling-Industry-Annual-Report>.



Challenges facing the waste and resource recovery sector in Victoria include:

- increasing volumes of material entering the waste and resource recovery sector. As Victoria's population grows, so too does the amount of material discarded and by 2046, it is projected to reach 20 million tonnes – an increase of 57%
- new waste materials, created in the design of new products can be problematic for the existing waste treatment system to handle (e.g. composite plastics or emerging battery technologies (lithium-ion)) and legacy wastes in high volumes such as 7.5 million tonnes of dewatered contaminated biosolids at Melbourne's Western Treatment Plant and other waste stockpiles
- reprocessing and recovery systems of waste materials being affected by global commodity market disruptions such as the reliance on sending sorted and baled plastic, paper and cardboard to export markets (China) instead of reprocessing in Victoria. The closure of the Chinese market through the "Blue Sky" initiative in 2018 significantly disrupted the markets for these materials and highlighted the need to develop local markets for recovered materials
- increasing diffuse sources of pollution (litter and illegal dumping) presenting management and monitoring issues for waste that does not enter the formal collection system. Whilst there has been a long-term trend of reduction in litter in Victoria as measured by the annual National Litter Index, problematic materials such as plastics remain in the environment for many years
- addressing food waste which is a significant concern in Victoria estimated to be at least 20% of all food produced, and it is associated with undue pressure on finite natural resources, the environment and climate change. It also has important financial costs.

### **Waste and Resource Recovery Themes**

To understand trends and identify information gaps to address the above challenges, the SoE 2018 will assess:

### **Waste Generation**

Waste generation information is essentially the waste managed by Victoria's waste system. It is derived from a voluntary annual survey of all Victorian reprocessors that receive material from different source sectors such as Municipal (household and council activity), construction & demolition (C&D) and commercial & industrial (C&I). The Victorian Recycling Industry Annual Report (VRIAR) outlines the amount of waste managed, landfilled and recovered in Victoria as well as the composition of material, sources of recyclables, material exports and product markets. SV has collated this information through surveying Victorian waste reprocessors since 1999 about the amount of material diverted from landfill as well as using landfill data provided by the EPA.

### **Reprocessing and Recovery**

The reprocessors' survey captures information about the amount of material recovered for reprocessing in Victoria by material type. SV then estimates the amount of material deposited in Victorian landfills from using both the EPA landfill levy data which provides a total figure for municipal waste and industrial waste (C&I and C&D waste) and then using SV landfill audits conducted in 2009 to determine the proportion of material that would theoretically be present in the landfill by source sector. The recovery rate of each major material category by source sector is then calculated. The recovery rate is shown in the Projection Model which is available on the SV website.<sup>135</sup>

### **Litter and Illegal Dumping**

The NLI is an independent survey undertaken annually by KAB national and financed by the Australian state jurisdictions. There are limitations with the survey, in particular the sample size is small, and measurement of litter is only within a 50km radius from capital cities. Nonetheless, it provides a uniform and consistent methodology to compare the littering rate between states for different material types. The survey provides counts of material observed in areas and estimates the volume and weight of the observed litter.

135. Sustainability Victoria 2018, 'Waste projection model', Melbourne, Victoria <http://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Interactive-waste-data-mapping/Waste-projection-model#>.

### A note on the circular economy

Although these three themes provide a sensible structure for reporting on existing data sets, the scope of the waste and resource recovery chapter in the SoE 2018 will also include discussion on the benefits of a future reporting regime framed by the circular economy model.

### Government Response

Materials and wastes can be harmful to human health, damage the natural environment, and/or impact on amenity. Therefore, the system, which is regulated by the EPA, must operate to minimise these risks. Under the *Environment Protection Act 1970*, the EPA can develop waste management policies (WMPs) to improve management of waste and material streams. WMPs provide enforceable statewide objectives and directions. Currently, a series of WMPs address movement of controlled waste, landfills, used packaging materials and other waste-related operations.

Sustainability Victoria has a legislated responsibility for the long-term planning for waste and recycling infrastructure and released the first Statewide Waste and Resource Recovery Infrastructure Plan (SWRRIP) in 2015, with an update in April 2018 to reflect the priorities identified in the seven regional implementation plans. The SWRRIP is premised on a circular economy model; sets goals and strategic directions to ensure that the system continues to not only provide an efficient and well-operated service, but to maximise the recovery of materials and reduce reliance on landfill. It draws on data and information from a range of sources and

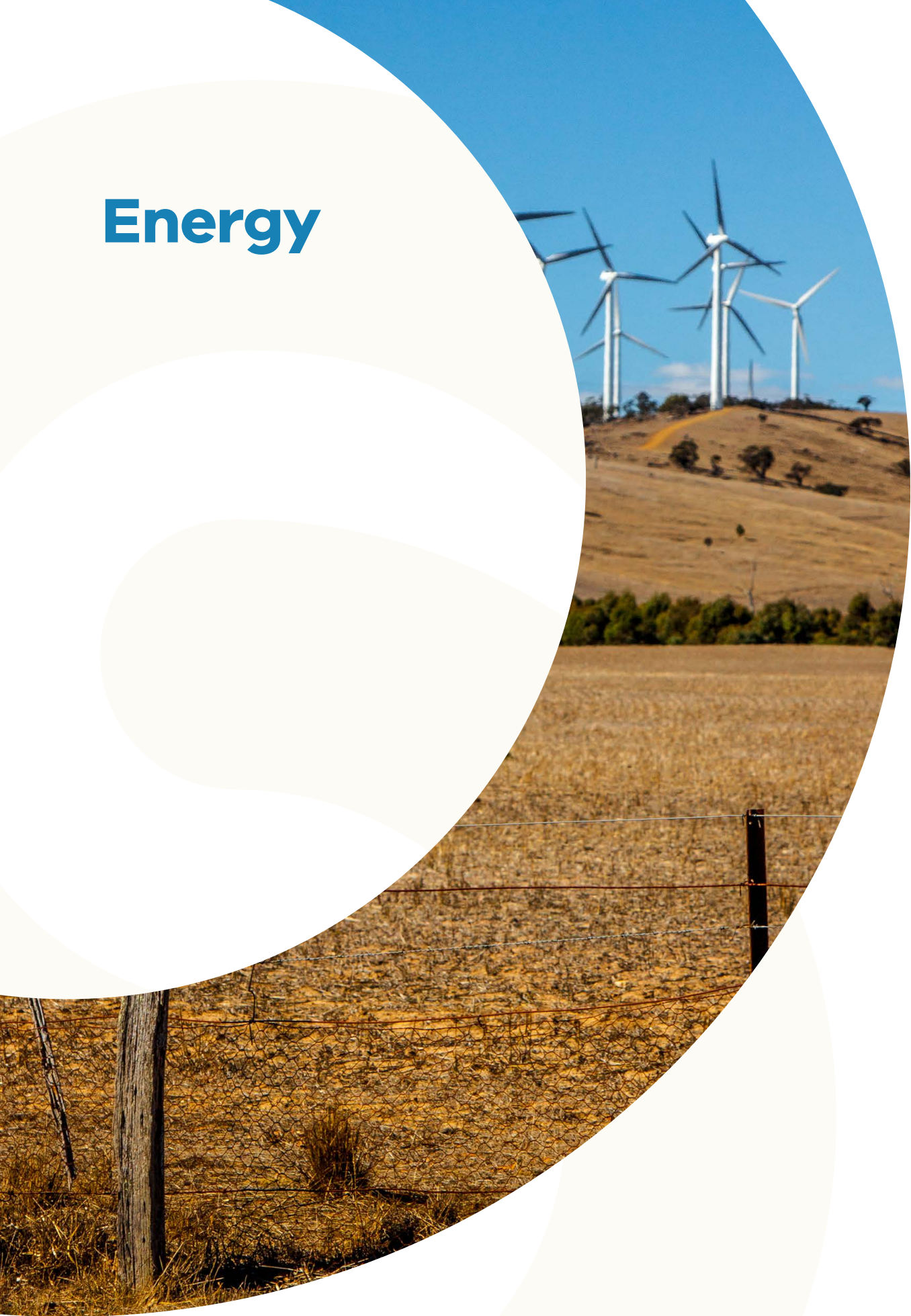
identifies opportunities – both local and statewide – to increase recovery of the materials and the infrastructure needed to do so. The strategic directions underpin government interventions, but also play a critical role in informing industry investment and government decisions, such as strategic land use planning and approvals. It critically notes the importance of viable markets for recycled materials. Since its initial introduction, a focus on the recovery of organic materials, particularly food waste, is building momentum for a significant increase in recovery. Monitoring and evaluation will measure progress and inform future iterations and action. The SWRRIP will also be broadened to consider hazardous waste.

While the primary role of the SWRRIP is to plan for the infrastructure needed to manage the waste and materials entering the waste and resource recovery system, the Victorian Government's supporting initiatives also aim to educate and assist Victorians to avoid generating waste in the first place and support the development of markets for products from recovered materials.

The Victorian Government has also released a funded Recycling Industry Strategic Plan, with a focus on the kerbside recycling system, in response to global changes in markets for recycled materials. Key interventions, which will ultimately support a circular economy, focus on stabilising the recycling sector and increasing the quality of recycled materials, driving demand for products using recycled materials, including government procurement, collaboration to better design products for sustainability, and the development of a whole-of-government circular economy policy and action plan in 2020.

Waste Theme	Indicator	2008	2013	2018
Waste generation	<i>Total waste generation</i>	✓	✓	✓
	<i>Total hazardous waste managed, per capita</i>	✗	✗	✓
	<i>Generation of municipal waste per capita, generation of waste per unit of GSP</i>	✗	✗	✓
	<i>Total Food Waste generated</i>	✗	✗	✓
	<i>Diversion rate (total recovery/total waste)</i>	✗	✗	✓
Reprocessing and Recovery	<i>Recovery rates for major material categories</i>	✓	✓	✓
Litter and Illegal Dumping	<i>NLI Litter Index results</i>	✗	✗	✓

# Energy





## Background

Meeting goals of the Paris Agreement<sup>136</sup> will require an unprecedented “energy transition” because the energy sector – spanning primary energy extraction and transformation through energy carriers to end-use in industry, buildings or transport – is responsible for about two-thirds of global greenhouse gas emissions. Without major transformation in this sector, the goals of the Paris Agreement cannot be met. In Victoria, the energy sector generates almost nine-tenths of the state’s direct greenhouse gas emissions.<sup>137</sup> Therefore, energy sector transformation is the principal challenge to meet Victoria’s climate goals. Alongside energy efficiency and the decarbonization of the electric power sector, increasing electrification of end-use energy sectors including industry, transport (particularly road transport) and buildings is a key priority for reducing energy sector emissions.<sup>138</sup> Integration of these end-use sectors into the electricity system will play an important role in increasing the proportion of intermittent renewable energy sources because it allows for substantial increases in system flexibility, primarily by increasing demand-side flexibility.<sup>139</sup> The aggregation, integration and coordination of new loads, storage and sources of supply through digital technologies is likely to accelerate this transition but represents a major challenge.<sup>140</sup>

The Victorian Government has committed to renewable energy targets of 25% of electricity generated in Victoria by renewables by 2020 and 40% by 2025.<sup>141</sup> For comparison, in 2014-2015 around 11% of the state’s electricity generation came from renewable sources. Alongside Victoria’s renewable energy targets, the state has committed to a major energy efficiency and productivity strategy, which has an aspirational aim of improving energy productivity by 50% on 2015 levels by 2030.<sup>142</sup>

Challenges for the energy sector in Victoria include:

- **transforming the electric power system** from today’s centralised, carbon-intensive electric power system to a more distributed, smarter, primarily renewable, zero-carbon future power system
- **substituting electricity for carbon-intensive fuels** in transportation, buildings and industry in parallel with the decarbonisation of the electric power sector is critical to reducing overall energy sector emissions
- **undertaking substantial improvements in energy efficiency** are required across all end-use sectors to meet the Paris Agreement goals cost-effectively. Energy efficiency initiatives include new technologies, energy-efficient building and urban design, new or altered construction materials, improved manufacturing processes (particularly the capture and reuse of waste heat).

136. Note: The Paris Agreement central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change.

137. The Australian Government Department of the Environment and Energy 2018, ‘Australian Greenhouse Emissions Information System (AGEIS)’, Canberra, Australian Capital Territory <http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/ageis>.

138. International Energy Agency 2017, ‘Energy Technology Perspectives 2017’, Paris, France <http://www.iea.org/etp/>.

139. Ibid.

140. Ibid.

141. Renewable Energy (Jobs and Investment) Act 2017 (Vic), section 7.

142. The State of Victoria Department of Environment, Land, Water and Planning 2018, ‘Energy Efficiency and Productivity Strategy’, Melbourne, Victoria <https://www.energy.vic.gov.au/energy-efficiency/energy-efficiency-and-productivity-strategy>.

## Victorian Government Policy response

The Victoria Government has had an active period responding to energy sector transition, including the following legislation, policies and programs:

- *Climate Change Act 2017* provides for a net zero emissions target by 2050 and five-yearly interim targets to be set from 2021. Given 90% of Victoria's GHG emissions come from the energy sector, energy sector transformation is the primary challenge for meeting Victoria's climate change targets
- *Renewable Energy (Jobs and Investment) Act 2017* legislates Victorian Renewable Energy Targets to bring forward investment in new renewable energy projects in Victoria. The targets are 25% of electricity generated in Victoria to be renewable by 2020 and 40% by 2025
- Victorian Renewable Energy Auction Scheme (VREAS) supports the *Renewable Energy (Jobs and Investment) Act 2017*
- The New Energy Jobs Fund a \$20M fund supports Victorian-based projects "create long-term sustainable jobs, increase the uptake of renewable energy generation, reduce greenhouse gas emissions and drive innovation in new energy technologies"
- Renewable Energy Action Plan, \$146M in supporting renewable energy growth, empowering communities and modernising Victoria's energy system
- Government Renewable Energy Purchasing: "an initiative to source renewable energy certificates from new projects in Victoria, bringing forward around \$200 million of new investment in around 100 megawatts of renewable energy projects"
- Solar Trams TAKE2 pledge to source 100% of the electricity load of Melbourne's tram network from new solar projects
- Energy Efficiency and Productivity Strategy, which sets an aspirational target of 50% improvement in energy productivity from 2015 to 2030.

Theme	Description	Indicator	2008	2013	2018
Energy Consumption	<i>Trends in energy consumption and generation. Reported as primary and final energy consumption by source, fuel type, user (e.g. manufacturing, residential), and by end use (e.g. heating). This will also include energy use per capita and per unit of GSP.</i>	<i>Total net energy consumption by sector</i>	✓	✓	✓
		<i>Total energy consumption by fuel</i>	✓	✓	✓
		<i>Total electricity consumption</i>		✓	✓
		<i>Energy use per capita</i>	✗	✓	✓
Renewable Energy	<i>Trends in renewable energy consumption and generation. Reported as Victoria's renewable energy use and generation – % Victoria's electricity consumption from renewable energy sources, consumption of renewable energy, % of total energy.</i>	<i>Electricity generation by fuel type</i>	✓	✓	✓





# Transport



## Background

An integrated transport network across all modes of travel is essential for a sustainable, liveable and prosperous state, with the mode and the efficiency of our travel having a significant effect on Victoria's local economy and environment. Pollution from motor vehicles, aircraft, trains and boats increases Victoria's greenhouse gas emissions, worsens Victoria's ambient air quality and the associated noise impacts can affect human health and well-being.

The transport sector is the second biggest contributor to greenhouse gas emissions in Victoria, contributing 18% of the total greenhouse gas emissions for Victoria in 2016. Within the transport sector, passenger cars are the biggest greenhouse gas emitter, accounting for 50% of the transport emissions in 2016. Trucks and light commercial vehicles are the next biggest greenhouse gas emitters within the transport sector, contributing 20% and 17% of the transport emissions during 2016 respectively.<sup>143</sup>

Victoria's population has increased from 4.8 million in 2001 to 5.9 million in 2016.<sup>144, 145</sup> This population expansion has been reflected in increased motor vehicle use, with the total kilometres travelled by motor vehicles registered in Victoria increasing by 15% from 2007 to 2016.<sup>146</sup> The population is projected to nearly double in the next three decades, with the forecast population reaching 10.1 million in 2051, which would place a significant strain on Melbourne's motor vehicle and public transport networks that are already experiencing congestion and overcrowding.<sup>147, 148, 149</sup> Traffic congestion increases vehicle emissions and population exposure to degraded ambient air quality.

The critical environmental challenges facing Victoria's transport management now and into the future include:

- reducing the greenhouse gas emissions and other major pollutants in the transport sector
- reducing congestion on our roads
- limiting noise impacts associated with transport travel and construction.

## Transport Themes

To understand trends and identify information gaps to address the above challenges for transport, the SoE 2018 will assess:

### Travel demand

This transport indicator will look at travel demand, with a focus on trends in the type of transport used to travel to work. The indicator will include data on vehicle kilometres travelled (total and per person) and public transport use (overall trips).

### Transport emissions

The Climate Change Impacts section will include a discussion and analysis of greenhouse gas emissions, which will include commentary on greenhouse gas emissions in the transport sector. Transport emissions will also be considered in the air quality section, which will include an indicator reporting the emissions of major air pollutants by sector.

143. The Australian Government Department of the Environment and Energy 2018, 'National Greenhouse Gas Inventory – Kyoto Protocol classifications', Canberra, Australian Capital Territory <http://ageis.climatechange.gov.au/>.

144. Australian Bureau of Statistics 2006, 'Population by Age and Sex, Victoria, Jun 2002', Canberra, Australian Capital Territory <http://www.abs.gov.au/ausstats/abs@.nsf/ProductsbyReleaseDate/428E8A4528CB1F2DCA256EC2007BE025?OpenDocument>.

145. Australian Bureau of Statistics 2016, '2016 Census Quick Stats', Canberra, Australian Capital Territory [http://www.censusdata.abs.gov.au/census\\_services/getproduct/census/2016/quickstat/2?opendocument](http://www.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/2?opendocument).

146. Australian Bureau of Statistics 2016, 'Survey of Motor Vehicle Use, Australia, 12 months ended 30 June 2016', Canberra, Australian Capital Territory <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/9208.012%20months%20ended%2030%20June%202016?OpenDocument>.

147. The State of Victoria Department of Environment, Land, Water and Planning 2016, 'Victoria in Future 2016: Population and household projections to 2051', Melbourne, Victoria [https://www.planning.vic.gov.au/\\_data/assets/pdf\\_file/0014/14036/Victoria-in-Future-2016-FINAL-web.pdf](https://www.planning.vic.gov.au/_data/assets/pdf_file/0014/14036/Victoria-in-Future-2016-FINAL-web.pdf).

148. Infrastructure Victoria 2016, 'The Road Ahead: How an efficient, fair and sustainable pricing regime can help tackle congestion', Melbourne, Victoria <http://www.infrastructurevictoria.com.au/sites/default/files/images/The%20road%20ahead%20final%20web.pdf>.

149. Transport for Victoria 2017, 'Metropolitan Train Load Standards Survey Report', Melbourne Victoria <https://transport.vic.gov.au/content/docs/MI-Metropolitan-Train-Load-Standards-May-2017.pdf>.



### Government Policy Response

Transport for Victoria (TfV), part of the Department of Economic Development, Jobs, Transport and Resources (DEDJTR), was established in April 2017. Its function is to plan, coordinate and manage the State's transport system. TfV provides leadership to Victoria's transport agencies, including VicRoads, Public Transport Victoria (PTV) and V/Line, and is the customer of major project construction authorities, such as the Level Crossings Removal Authority and Rail Projects Victoria (formerly Melbourne Metro Rail Authority). TfV also works closely with VicTrack.

The objectives of Victoria's transport system are defined in the Transport Integration Act 2010. Section 10 of the Act states that: *The Transport system should actively contribute to environmental sustainability.*

Theme	Transport Indicator	2008	2013	2018
Introduction	<i>Travel demand</i>	×	×	✓
Transport energy	<i>Greenhouse gas emissions from transport</i>	✓	✓	✓
Transport energy	<i>Air pollution from transport</i>	✓	×	✓







©The State of Victoria, Commissioner for Environmental Sustainability 2018. This publication is copyright.

No part may be reproduced by any process except in accordance with the provisions of the Copyright Act 1968.

For further information contact the Office of the Commissioner for Environmental Sustainability, phone +61 3 9948 2846 or visit [www.ces.vic.gov.au](http://www.ces.vic.gov.au)

ISBN:978-0-646-99198-6



Commissioner  
for Environmental  
Sustainability  
Victoria

