Natural Environment Climate Change Adaptation Action Plan 2022–2026

VICTORIA
State Government

This Natural Environment Climate Change Adaptation Action Plan 2022–2026 was produced after rigorous public and targeted consultation.

Acknowledgement of Aboriginal Victorians

The Department of Environment, Land, Water and Planning (DELWP) proudly acknowledges Victoria's Aboriginal communities and their rich culture. We honour Elders, past, present and emerging whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it.

We are committed to genuinely partner, and meaningfully engage with Victoria's Traditional Owners and Aboriginal communities to support the protection of and connection to Country, the maintenance of spiritual and cultural practices and their goals in the 21st century and beyond.

* The term 'Aboriginal' is used to refer to all people of Aboriginal and/or Torres Strait Islander descent who are living in Victoria.

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Minister's foreword

Victoria's precious natural environment is home to unique plant and animal life, and irreplaceable Aboriginal cultural heritage. It is fundamental to our health and wellbeing, providing clean air and water, pollination, flood mitigation and carbon sequestration.

Climate change represents a profound challenge to this natural environment. We have already started seeing the devastating effects of climate change, particularly with more bushfire danger days, drought, reduced snowfall and increasing marine temperatures.

The Black Summer Bushfires in Victoria of 2019/2020 burned more than 1.5 million hectares of land, significantly impacting biodiversity, particularly in East Gippsland and north-east Victoria. Several warming scenarios will see the weather experienced in the summer 2019-20 as the 'average summer' by 2050.

The natural environment has some capacity to adapt to increased fire intensity, warmer temperatures or reduced rainfall. However, this varies across ecosystems and species. To give our precious biodiversity the best chance of success, we need to adapt the way we manage the natural environment.

The Natural Environment Adaptation Action Plan aims to embed climate change adaptation into natural environment management.

The actions in this plan focus on providing decision makers with tools to support flexible, adaptive and robust decision making in conditions of high uncertainty.

Victoria is taking strong action to reduce emissions by halving our emissions by 2030 as we work towards net zero by 2050, but we still need to plan for our future in a changing climate.

As the first 5-year adaptation action plan for the natural environment system, it lays the foundation for good practice adaptation.

The Hon. Lily D'Ambrosio MP

Minister for Energy, Environment and Climate Change

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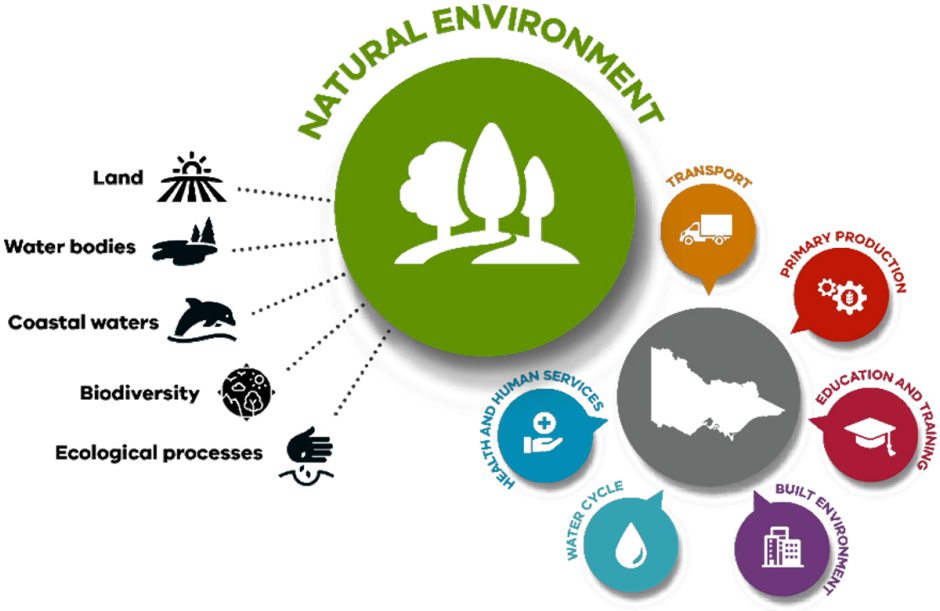
About this Plan

Victoria's natural environments are already experiencing early impacts of a changing climate and these impacts are expected to increase through this century. There is a need to act now to respond to these challenges to help minimise consequences to the environment, as well as our society and the economy.

In Victoria, action on climate change is underpinned by the *Climate Change Act 2017*. Victoria's Climate Change Strategy sets out the Victorian Government's current action on climate change and guides our next steps. Ministers for seven different systems, including the Natural Environment, are preparing 5-yearly climate change Adaptation Action Plans. This is the Natural Environment AAP (this Plan). Adaptation Action Plans are also being prepared for Transport, Primary Production, Education and Training, Built Environment, Water Cycle and Health and Human Services.



This Plan aims to establish **practices**, **systems**, and **knowledge** to enable Victoria's natural systems to adapt to climate impacts. It will embed climate change adaptation into natural environment management by guiding planning in regional and place-based plans that manage specific areas, species and ecosystems.

The natural environment system

What is the natural environment?

The natural environment consists of land-based ecosystems such as grasslands and forests, aquatic ecosystems such as rivers and wetlands, and coastal and marine ecosystems such as mangroves and sea-grass meadows.



Source: DELWP

Ecosystems include animals and plants and the interactions they have with each other and their physical environment. Climatic conditions, particularly rainfall patterns and fire regimes, strongly affect the type and extent of an ecosystem and the animals and plants that are present.

The natural environment system spans public and private land. There are not clear boundaries between where the natural environment system ends, and other systems begin. There are strong connections between the natural environment system and the primary production system, built environment and water cycle systems. These are described later in this Plan.

Source: DELWP

Why is the natural environment important?

Victoria's natural environment has an intrinsic right to exist and flourish.

The state's diverse and unique mix of plants, animals, soils, seas and waterways function together as ecosystems, which produce some of our most basic needs – clean water, productive soil, natural pest control, pollination, flood mitigation and carbon sequestration.

Victoria's natural environment is fundamental to human wellbeing and the quality of human life. The natural environment contributes to our economy through the provision of goods and services and to our mental and physical health and spiritual and cultural wellbeing.

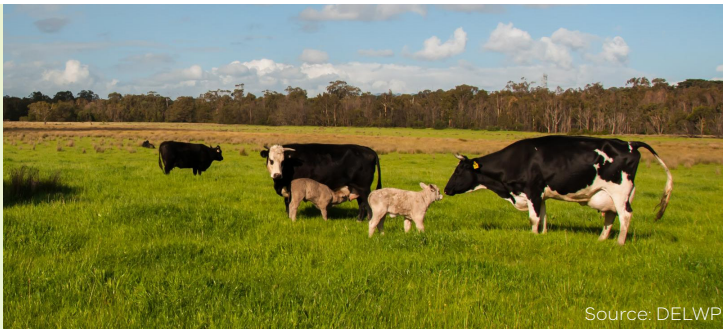
The value of biodiverse ecosystems to humans is immeasurable. Replacing the services they provide would be extremely challenging and costly, if not impossible.

The natural environment provides a wealth of benefits and offers the potential for more to be discovered. Maintaining our natural environment for future generations is important insurance in the face of ongoing change.

Victoria's forests provide more than $3 billion worth of carbon sequestration per year.


Source: DELWP

Victoria's agriculture, forestry and fisheries sectors rely on the natural environment, and contribute about $8 billion, or 2.8 per cent, to annual Gross State Product.


Source: DELWP

Victoria's parks and forests generate at least $1.9 billion in tourism per year.


Source: DELWP

Victoria's parks and forests provide at least $1 billion worth of water supply each year.


Source: Parks Victoria

Aboriginal Victorians and connection to Country

Country that provides a healthy ecosystem in which the living world thrives is central to Traditional Owner wellbeing. Connection to Country is how Aboriginal Victorians define their identity and spirituality.

From a western perspective, the natural environment is often considered as being separate to human actions.

For Aboriginal Victorians, these two concepts are not separate, but rather intertwined, and this relationship has created the cultural landscapes and processes we see today.

The Charter of Human Rights recognises the rights of Aboriginal Victorians to practise their culture, and to enjoy the economic benefits that flow from healthy ecosystems.

Source: DELWP

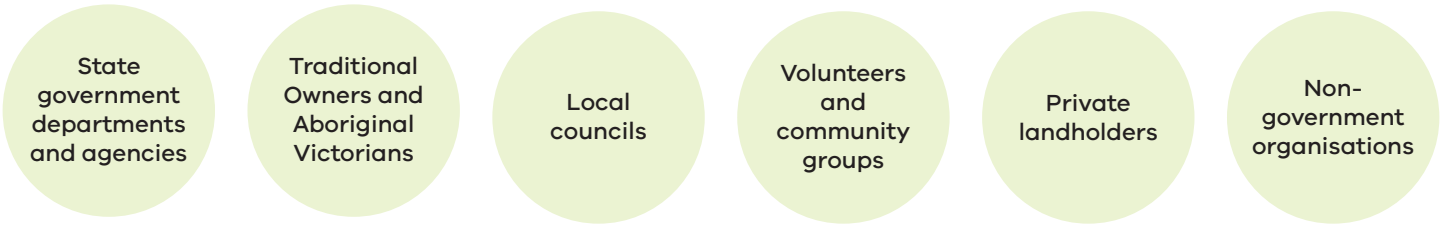
Who manages the natural environment?

A diverse range of people contribute to managing the natural environment. As a group they can be referred to as the 'natural environment sector'.

State government departments and agencies and local councils – in partnership with Traditional Owners and Aboriginal Victorians – develop policy, make plans and undertake on-ground actions.

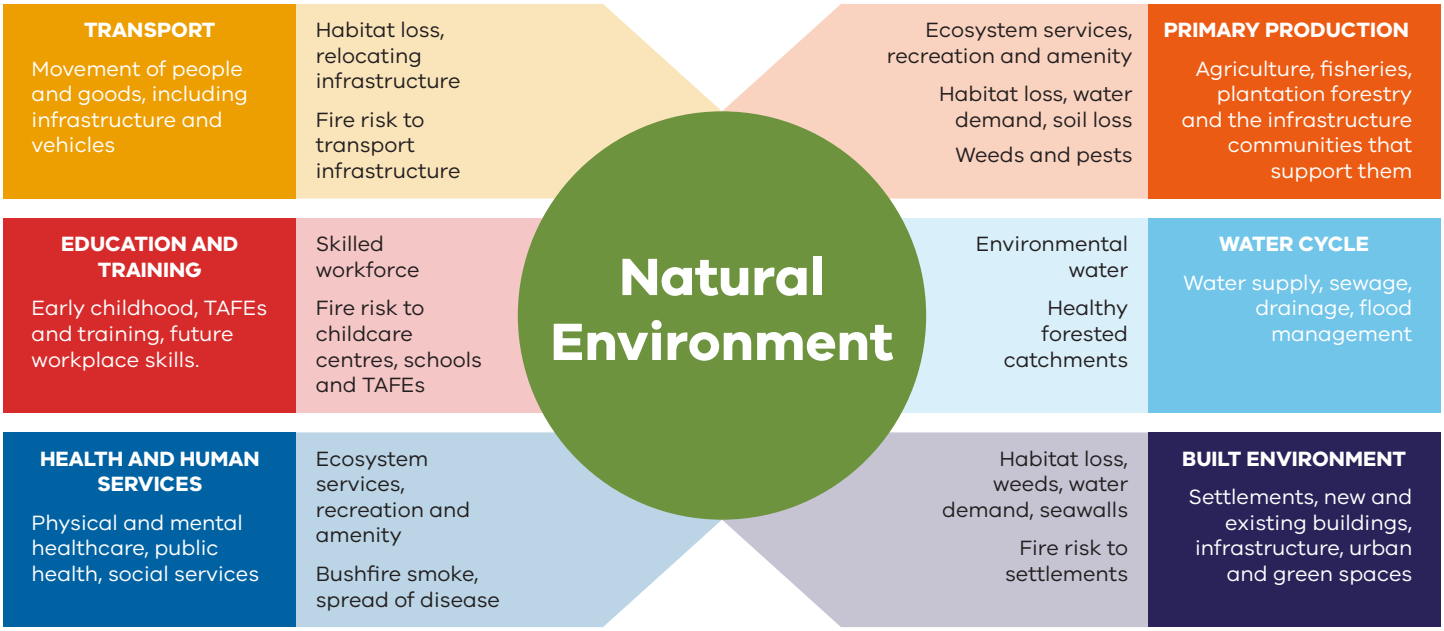
Volunteers, community groups and private landholders play an important role in managing parks, reserves and private properties.

Various non-government organisations also undertake on-ground actions and advocacy.



Links with the other systems

The six other systems developing adaption action plans under the Climate Change Act 2017 are: Primary Production, Water Cycle, Built Environment, Health and Human Services, Education and Training and Transport.



These systems do not operate in isolation. Each one relies on, and may impact other systems, both positively and negatively. The natural environment system has many connections with the six other systems. Some of these are beneficial to the natural environment and some may be detrimental.

What is climate change adaptation?

Responding to climate change requires both mitigation and adaptation. Mitigation is about limiting the amount of climate change by reducing greenhouse gas emissions (for example, from burning fossil fuels) or enhancing the 'sinks' that accumulate and store greenhouse gases (such as increasing carbon sequestration in forests, mangroves and soil). Adaptation is about adjusting to life in a changing climate or preparing for future changes.

Mitigation is critical to avoiding catastrophic climate change. However, even with the deepest cuts to carbon emissions some climate change is unavoidable. Adaptation is key to responding to these unavoidable changes. Some example mitigation and adaptation actions are provided in the figure below.

There are some actions that contribute to both reducing greenhouse gas emissions (mitigation) and to helping reduce the impact climate change has on society, the economy or the environment (adaptation). These are shown in the centre of the diagram.

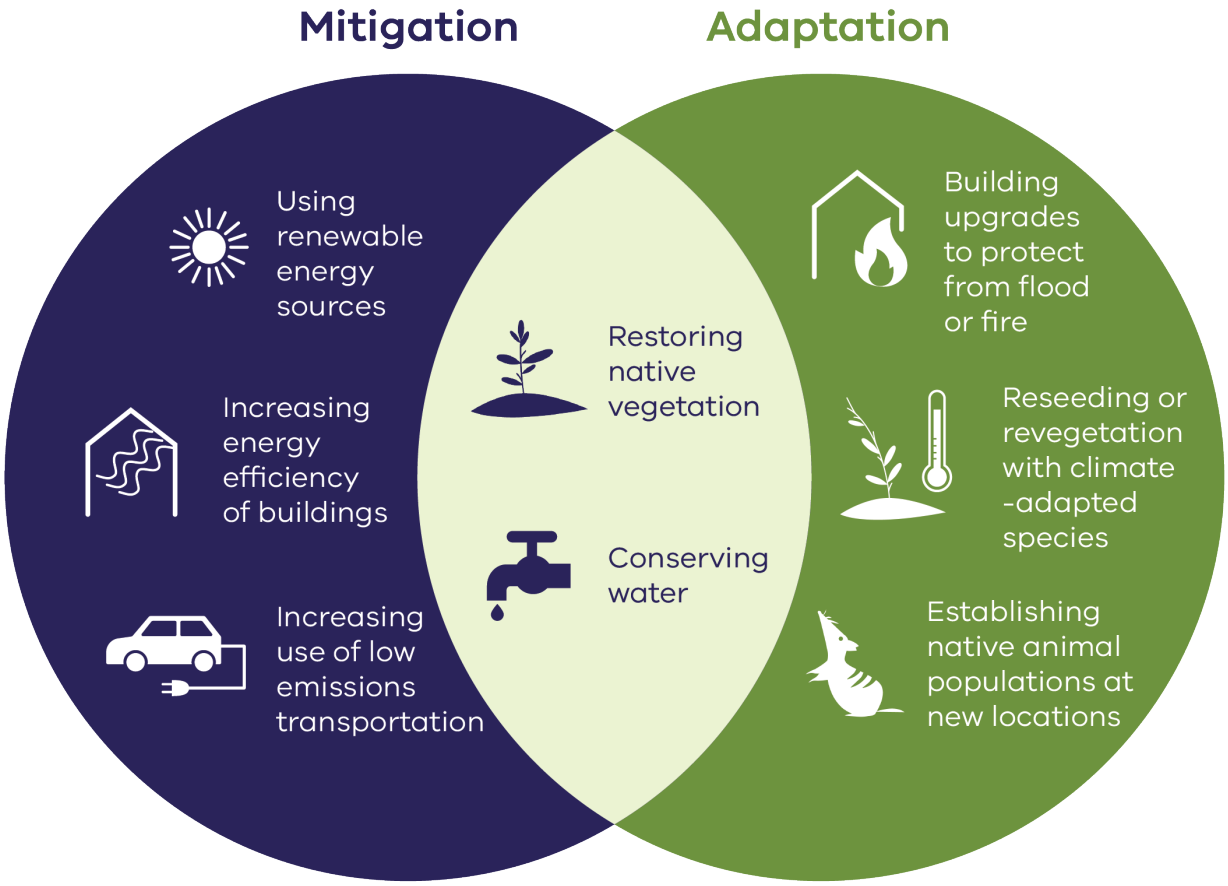


Figure adapted from Warren, F. and Lulham, N., editors (2021). Canada in a Changing Climate: National Issues Report Government of Canada, Ottawa, ON.

Mitigation has clearly defined targets where the relative contributions of different actions to achieving these targets can be measured. In contrast, adaptation does not have an end-point – it is a continuous process of change that all parts of government need to consider in the design and implementation of policy.

Undertaking adaptation in how we manage the natural environment is essential to understanding how Victoria's landscapes will change, where and how we can intervene to improve resilience, and ensuring naturally occurring adaptation is beneficial to ecosystems and communities.

What is the purpose of this Plan?

Adaptation Action Plans are one of the key mechanisms through which the Victorian Government will deliver on its five-year adaptation priorities. Adaptation Action Plans will build Victoria's climate resilience by ensuring that the Victorian Government considers climate change risks in its own policies and operations, as well as creating the enabling environment for communities, industries, non-government organisations and local governments to adapt to climate change. The Adaptation Action Plans do not address mitigation. The roadmap to net-zero emissions is set out in the Victoria's Climate Change Strategy.

Adaptation is a dynamic, continuous process involving learning and experimentation. As the climate changes and we have a better understanding of impacts, it will be necessary to adjust our management approaches or to try new approaches. It will not work to simply do an adaptation project once and then move on. Adaptation is also highly context specific. This means that problems and solutions will vary between places. The effectiveness of an adaptation approach will depend on not just the condition of the natural assets and how they are likely to be impacted by climate change, but also the values and interests of the community, their view of risk and preferences for different actions. The ongoing and context-specific nature of adaptation means that it must be part of the work of anyone who manages the natural environment.

This plan aims to embed climate change adaptation into natural environment management. As the first 5-year adaptation action plan for the natural environment system, it lays the foundation for how adaptation should be done. The actions in this plan focus on providing decision makers with tools to support flexible, adaptive and robust decision making in conditions of high uncertainty, rather than actions for specific locations, ecosystems or species.

This plan is intended to inform sector-specific plans and strategies, such as the Victorian Government's Whole of Sector Bushfire Strategy and Victorian Waterway Management Strategy. It will complement the place-based Regional Adaptation Strategies and help guide other plans that implement on-ground adaptation actions.

This plan expands on, and reinforces directions identified in Protecting Victoria's Environment – Biodiversity 2037, particularly the need to view conservation decisions through a climate change lens and the importance of taking an adaptive approach to management decisions that responds to the dynamic nature of climate change and other uncertainties.

Objectives

This Plan includes short, medium and long term adaptation objectives for the Victorian Government.

Short-term objectives (to 2026)

By 2026 the natural environment sector has:

- improved its understanding of climate change risks and vulnerabilities
- created a framework to support climate-adapted decision making

This will result in the sector being better able to:

- prioritise adaptation actions and focus efforts.
- make decisions in the context of a changing climate and increased uncertainty
- integrate climate change adaptation into existing and future policies and programs
- support Traditional Owner outcomes and objectives related to climate adaptation.

Medium-term objectives (to 2031)

By 2031, the sector has a strong capacity to support the natural environment system's ability to continue to adapt to the changing climate. This is so:

- the natural environment system is better managed to enhance its resilience to current and future climate impacts so that Victoria's natural environment is healthy and biodiverse.
- Traditional Owners are able to enact their right to self-determination so that they can heal Country with an understanding of future climate impacts.
- the community is engaged in finding ways to manage risks to the natural environment system arising from climate change so that they can navigate trade-offs and make informed decisions in relation to the natural environment system. This will enable people to understand the future predictions of climate change and make decisions about what their business, tourism industry, local community and the environment may look like in the future.

Long-term objectives (to 2050)

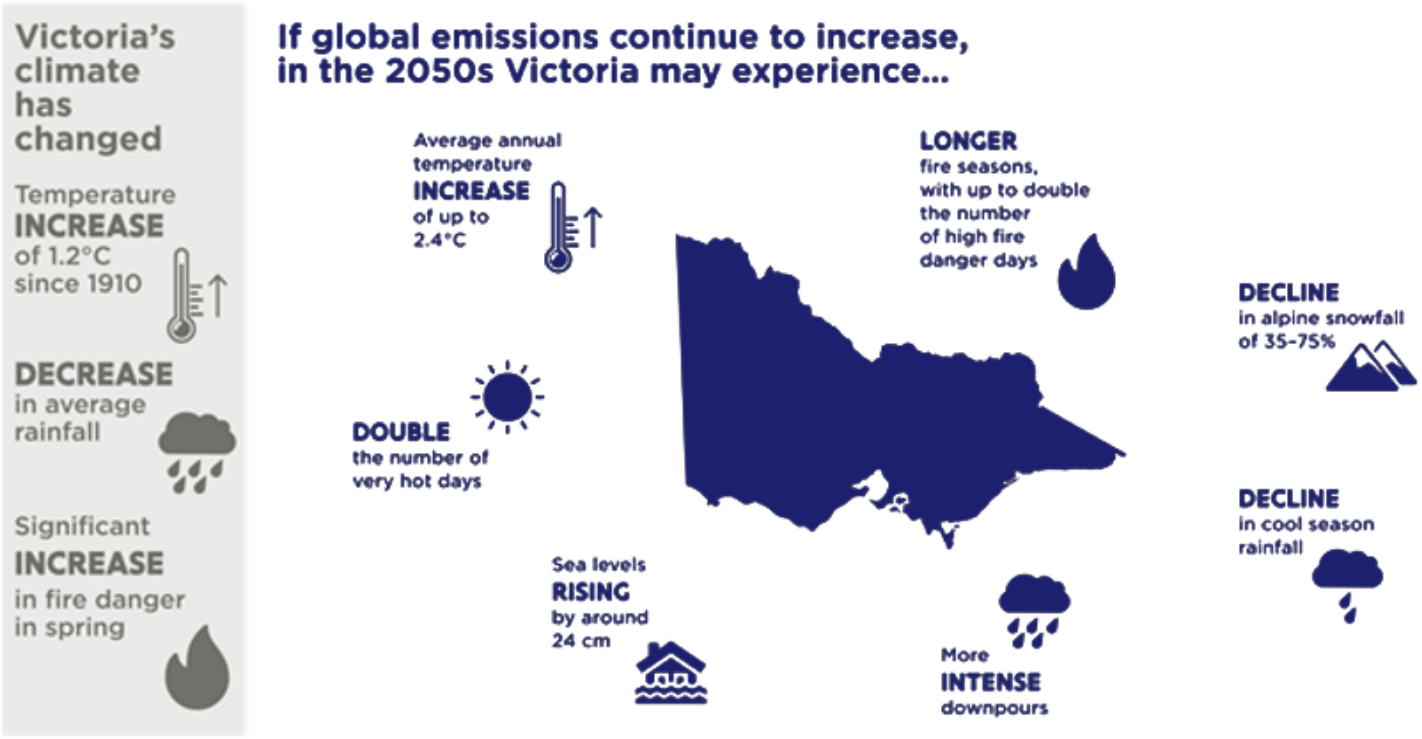
By 2050, the sector is continually adjusting to support the natural environment to adapt to the changing climate, so:

- the natural environment is able to respond to the disruptions of climatic and other events. Changes to ecosystem services are anticipated and managed.
- Aboriginal Victorians are able to heal Country and culture through the application of their knowledge and practice in the contemporary expression of living bio-cultural landscapes.
- the natural environment continues to provide benefits to the Victorian community into the future.

Climate change impacts

How is Victoria's climate changing?

Victoria's climate has changed in recent decades, becoming warmer and drier. These changes are expected to continue in the future. The image below shows current and projected climate change impacts for Victoria under a high emissions scenario.



Under high emissions, compared to 1986-2005. Updated from Victoria's Climate Science Report 2019
Source: Department of Environment, Land, Water and Planning 2021, Victoria's Climate Change Strategy.

How will the natural environment be affected?

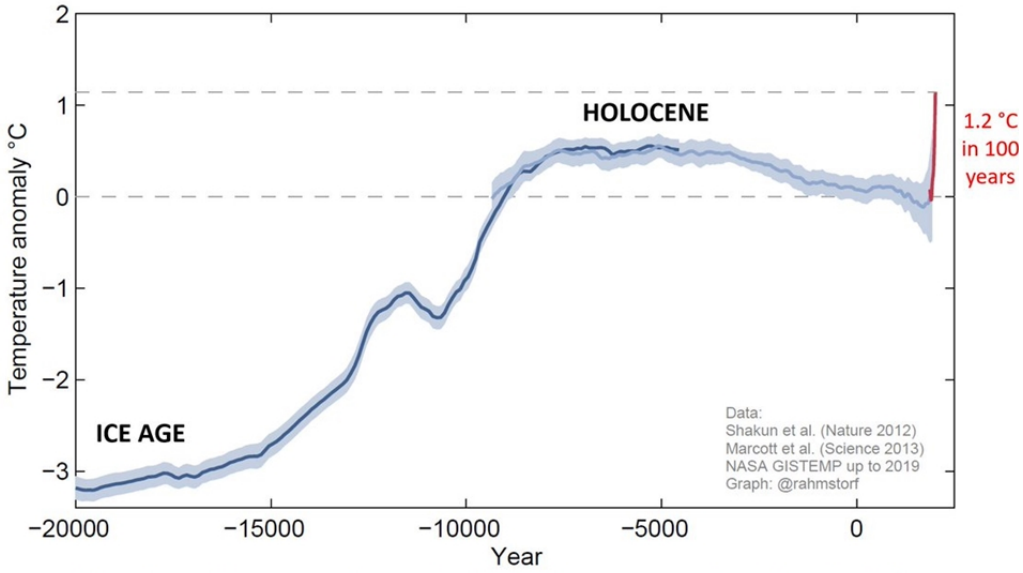
Australian plants and animals are adapted to a high degree of environmental variability. This includes cycles of hot and dry years followed by cool and wet years, and periodic fires and floods.

The fossil record shows that species can shift in response to climatic changes. However, there are limits to how much change plants and animals can adapt. Even the fastest rates of movement in the past are likely to be at least five times slower than the rate of projected climate change.

The planet has gone through alternating warm and cold periods (ice ages) over the last 2.6 million years.

The transition from the end of the last 'cold period' to the start of the 'warm period' took 9,000 years and involved global warming of 5°C.

Even if global warming is limited to 1.5°C, the rate of change will be 25 times faster.



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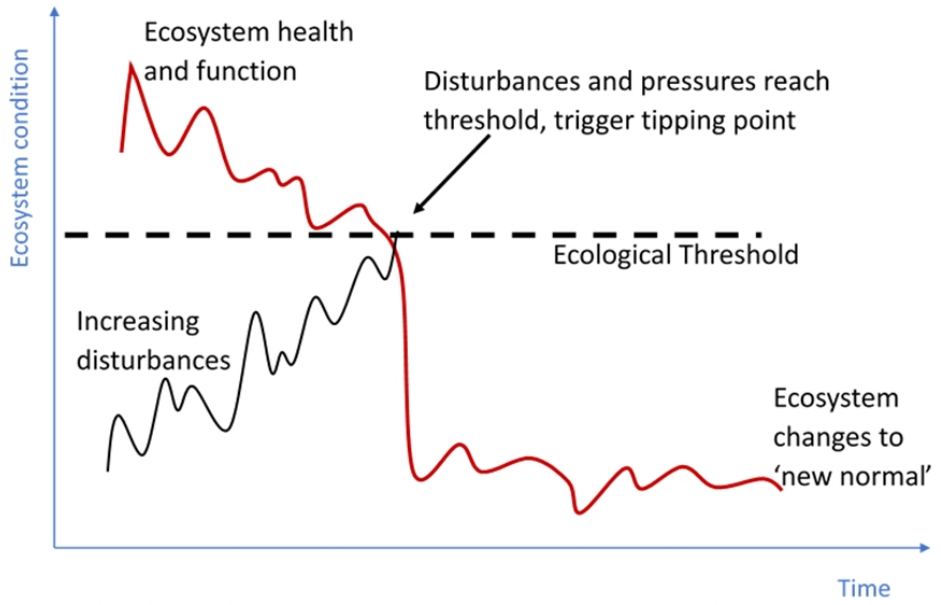
Source: Professor Stefan Rahmstorf, Potsdam Institute for Climate Impact Research

Some changes to the natural environment will occur slowly while others will be more sudden.

Over time, we will see some species disappear from certain places and be replaced by others (including weeds and pests) so that a new type of landscape emerges. Other changes will occur quickly within a matter of weeks or months.

Gradual changes and sudden events can each trigger tipping points, leading to permanent irreversible changes to ecosystems.

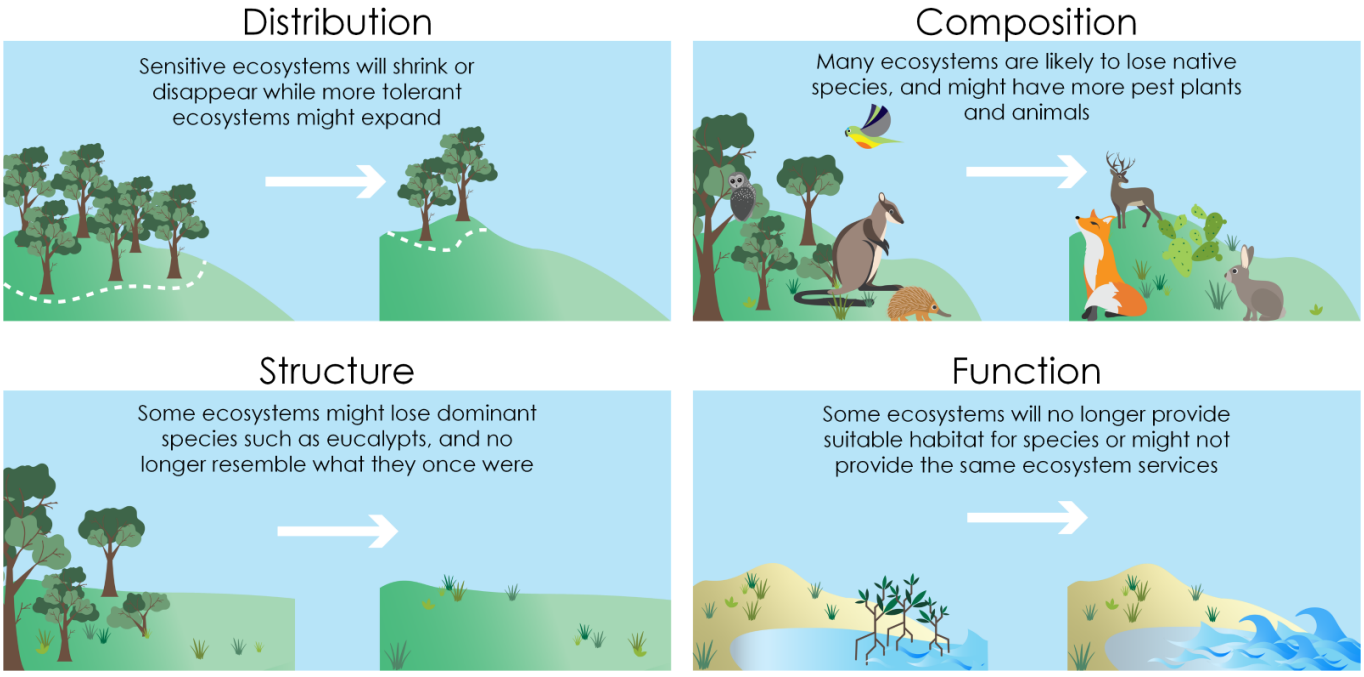


This figure shows changes in ecosystem condition over time. Ecosystem health and function is shown to decrease dramatically once disturbances (the black line) reach the ecological threshold. After this point ecosystem condition stays low, indicating a 'new normal'.

Adapted from Dana M et al (2011) Global Change Biology 27(9): 1692-1703

We know that climate change is likely to result in changes to the distribution, composition, structure and function of ecosystems.

Knowing which ecosystems will be affected, when and how is more difficult.



Why are impacts uncertain?

Firstly, there is a lot we don't know (and might never know) about plants and animals. For instance, our understanding of the physiology, demography and genetics of many species is limited.

Physiology is the study of how plants and animals function. Physiological characteristics (such as temperature tolerance) affect survival, growth, development, movement and reproduction. Species with a narrow environmental tolerance could be particularly vulnerable to climate change.

Demography is the study of populations and how they change due to birth, death and migration. Demographic variables, such as whether a plant survives to reproductive age, affect population numbers. Species whose young need special conditions to survive and grow could be particularly vulnerable to climate change.

Genetics is the study of genes and how traits might be passed along generations. Genes can determine whether an individual tolerates future climatic conditions. Species without high genetic diversity could be particularly vulnerable to climate change.

A lack of key biological information makes it difficult to predict if or how a species will be able to adapt to changing environmental conditions.

Secondly, species are connected through complex relationships.

We have a relatively good understanding of food webs ('what eats what' in an ecosystem) and how differences in fire frequency or average rainfall have affected the distribution of plants and animals today.

We have a more limited understanding of other relationships, such as competition and pollination, and how they will be affected by climate change.

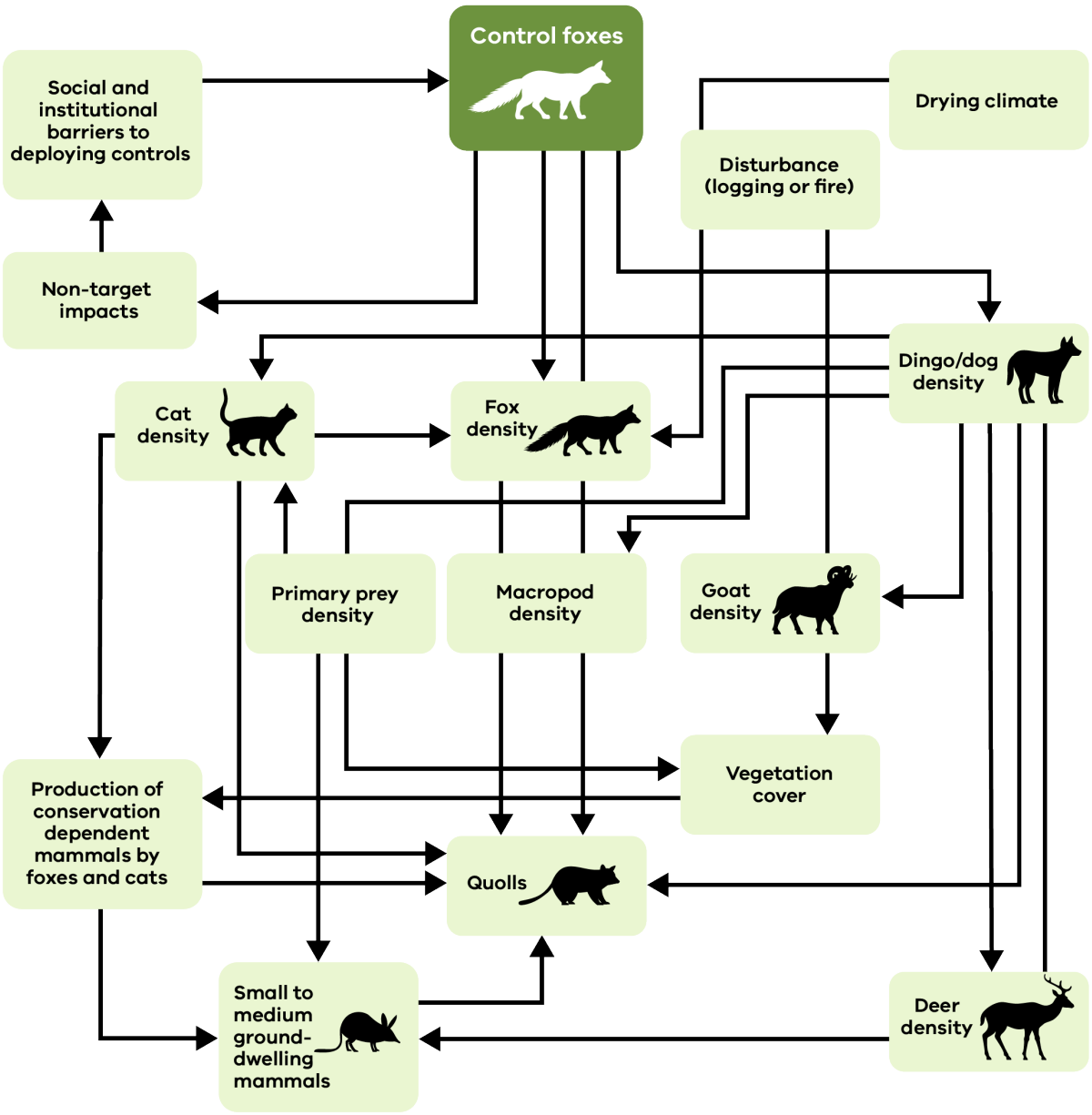


Image mapping the complex relationships and considerations relevant to fox control.
Adapted from DELWP 2020 Biodiversity Knowledge Framework Version 1


Source: DELWP

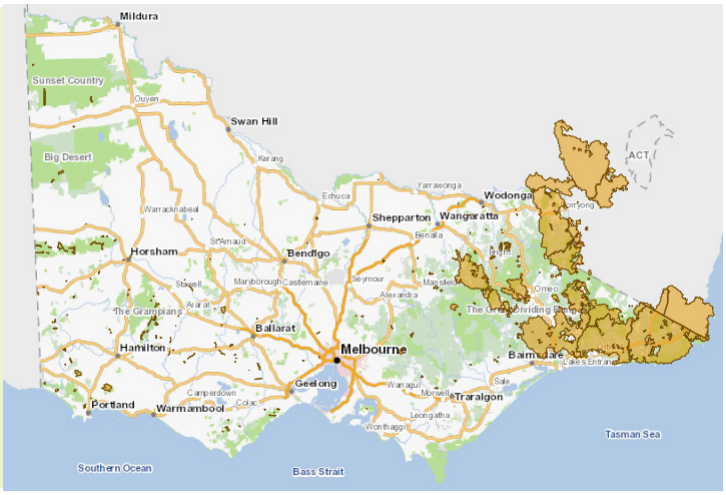
Thirdly, the degree to which ecosystems are exposed to climate change will vary across Victoria. This means we can't assume the same type of ecosystem will be affected in exactly the same way across the state.

Some forests along the Great Dividing Range were severely burnt in 2019–20.

Other forests along the same range were not burnt.

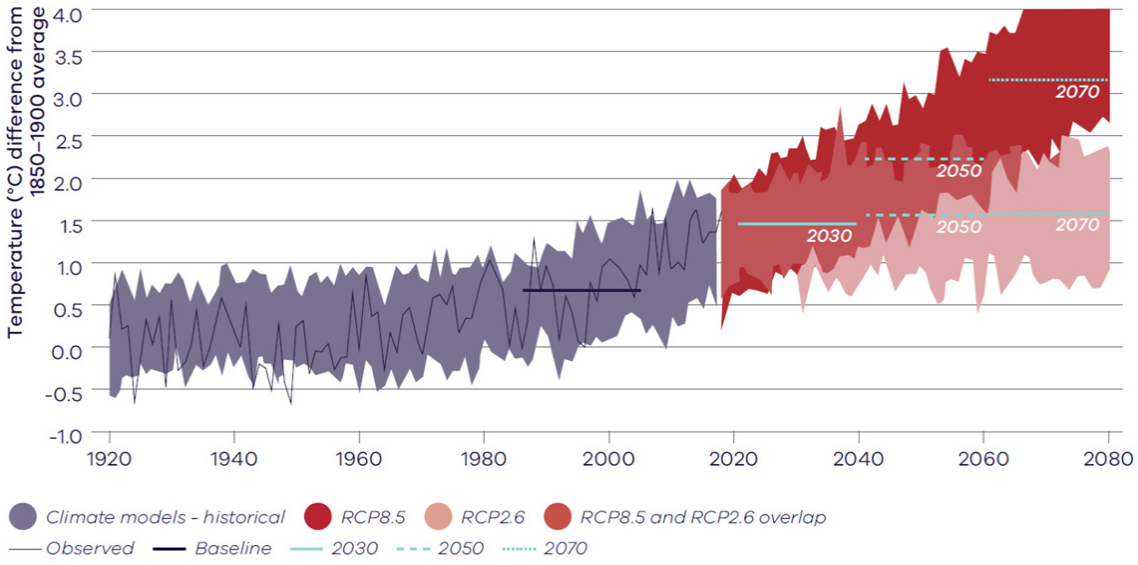
Ecosystems have already been affected by stressors – such as habitat loss, invasive species and resource use – and will continue to be. The degree of impact will differ, even within the same ecosystem type. Climate change will compound the impacts but this will also vary across the state.

This map shows the extent of the 2019-2020 bushfires in Victoria and southern New South Wales.



Finally, the impact of climate change on the natural environment cannot be considered in isolation. Big societal changes, such as population shifts and technological advancements, are likely to affect the natural environment. The exact nature and timing of these impacts is unknown.

Perhaps most significantly, we don't know how effectively worldwide greenhouse gas emissions will be reduced over the next 20, 50 or 100 years. The level of greenhouse gases in the atmosphere and when they peak will determine the degree of warming.



Average annual temperatures of Victoria in observations and models relative to the pre-industrial era, showing the highest (RCP 8.5) and lowest (RCP 2.6) emissions pathways. The thicker lines show the 20-year average temperature from the average of all models for each time period. (Source: CSIRO, 2019, Victorian Climate Projections 2019)

Warming of 1-1.5°C is likely to result in species vulnerable to climate hazards becoming extinct.

A rise of more than 2°C is likely to accelerate extinctions and result in significant ecosystem changes.

What is likely to occur?

While the natural environment is complex, and the impacts of climate change are uncertain, there is a lot we do know. We have already started seeing the effects of climate change particularly on fire, drought, reduced snowfall and increasing marine temperatures. These are likely to worsen over time.

Alpine areas that depend on regular snowfall will be affected by reduced snowfall and increased snow melt.

Source: Parks Victoria

Source: DELWP

Coastal woodlands on established dune systems will be affected by increased storm surge.

Forests that require long periods between fires to regenerate will be affected by more frequent fires.

Source: Parks Victoria

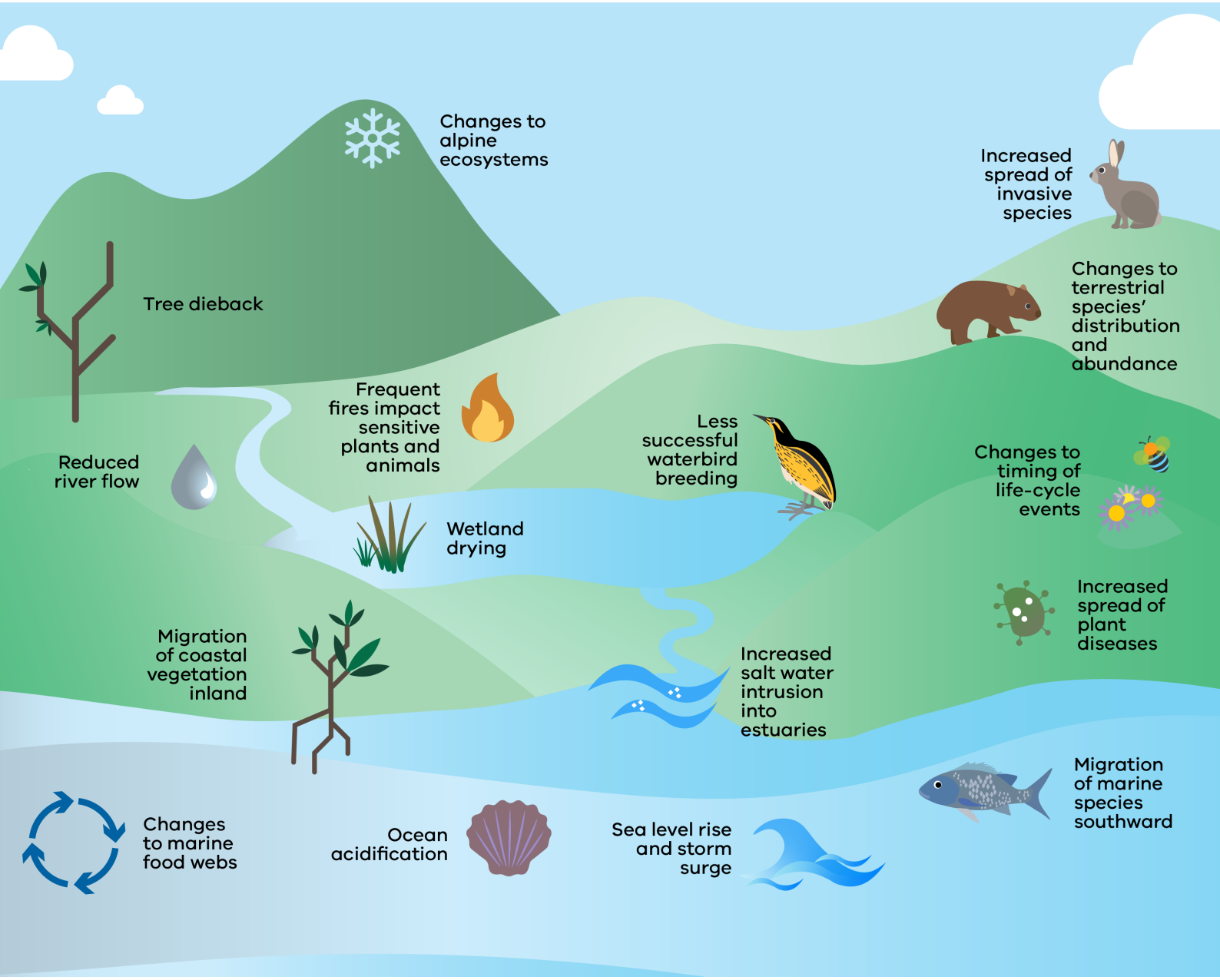
Source: Parks Victoria

Waterways dependent on seasonal flooding will be affected by reduced winter rainfall.

For some ecosystems and species, we don't need to gather a lot more information to know how they are likely to be impacted by climate change.

Climate change will affect Aboriginal culture and practices including through loss of land and hunting ground, changing fire regimes, and changes in the distribution of native species.

The following image highlights some of the impacts of climate change on different ecosystems and species.



Changes to alpine ecosystems

In the Victorian Alps, snow cover has already diminished by about 50 per cent since the 1960s. Modelled future climate changes indicate that snow cover and volume are likely to decline significantly into the future. Snow-dependent species and communities will become progressively vulnerable, including threatened species such as the Mountain Pygmy Possum. It is also likely that rare alpine wetlands will disappear in some locations.

Reduced river flow

Projected declines in cool-season rainfall and higher potential evapotranspiration are expected to reduce runoff to Victorian waterways. What may seem like small changes in rainfall can have a big impact on streamflow – generally, a 10 per cent reduction in rainfall might lead to a 20 –30 per cent reduction in streamflow. Impacts are unlikely to be equal – reductions in streamflow since the beginning of the Millenium Drought (1997) were greatest in the central west of the State. As the amount of water in river and wetlands decreases, water temperatures rise and dissolved oxygen levels decrease. Under these conditions, the risk of toxic algal blooms and fish death increases.

Wetlands drying

Many Victorian wetlands are adapted to dry periods but do require regular flows of water and flooding. Without regular flows and floods, wetlands can be lost and replaced by dryland vegetation. The most vulnerable inland wetlands are likely to be those along floodplains in western Victoria and parts of the Goulburn River catchment, wetlands in northern and western Victoria that rely on rain to fill them, and wetlands in the high Alps.

Tree dieback

Large scale canopy dieback in native forests has been increasing and is likely to continue as the climate warms. This is likely to result in landscapes with fewer trees and permanent shifts to species more tolerant of hot and dry conditions. In recent years snow gums have been found to be dying at unprecedented rates due to infestations of Longicorn beetles, a native woodboring insect. These insects are not normally a threat to snow gums, but warmer, drier conditions are helping the beetles to breed and grow quickly. Eucalypts have incredible abilities to recover and regrow following fire and drought but there are limits. Repeated drought and fire in many areas of snow gums in Victoria has left them without the energy reserves to fight off relatively minor infestations of fungus or insects.

Frequent fires impact sensitive plants and animals

Climate change is likely to increase fire frequency. Some plant species are adapted to regular bushfires, but others may not be able to regenerate if there is not enough time between fires. Alpine Ash is an 'obligate-seeder', a plant that regenerates from seed after fire. Alpine Ash trees are not mature enough to produce seed until they area 20 years old and so they cannot regenerate when fires are too frequent. Since 2002, most of the Alpine Ash in Victoria have been burned by several large fires and many of the mature trees have been lost. This means that there are few stands with trees old enough to set seed. Repeat burning of Alpine Ash before it reaches maturity means that it will not be able to regenerate naturally.

Fire and weather are strong drivers of small mammal abundance. Some small mammal species, such as Southern Brown Bandicoots, require habitat that hasn't been burnt for decades. As fires become more frequent due to climate change, these mammal species are likely to decline in abundance.

Less successful waterbird breeding

Climate change is expected to decrease flood frequency in major wetlands within the Murray-Darling Basin which will increase risks to colonial waterbird species such as egrets, herons and cormorants. Colonial waterbird species living in forested wetlands in the Murray-Darling Basin usually require large flood events raise young. Wetlands must be inundated for enough time for young to grow old enough to leave the nest. If water levels drop before young are mature their parents may abandon them and they die.

Increased spread of plant diseases

Increased heat and decreased water availability have altered the composition of forests and the spread and impact of pathogens, disease and pests. These conditions are likely to continue to worsen, promoting increased spread of plant diseases. For example, it is expected that wetter summers and warmer winters will enable the plant disease Phytophthora to spread further in Victoria potentially leading to significant biodiversity loss.

Changes to terrestrial species distribution and abundance

Climate change will impact the distribution and abundance of species. This can be hard to predict, but species with limited dispersal abilities, small geographic ranges, or confined to specialised habitats are likely to be particularly vulnerable. In mountainous areas it is expected that species will move to higher elevations. However, there is limited opportunity for most Victoria species to do this because the land is relatively flat. Species already at high elevations may have 'nowhere else to go'. The Gang-gang Cockatoo and Flame Robin which breed at higher elevations are already showing signs of decline as warmer temperatures are shrinking the area suitable for breeding.

Changes to timing of lifecycle events

Many species rely on the timing of life-cycle stages to ensure optimal environmental conditions for growth and breeding, such as abundant food for raising young or flowering to coincide with pollinator emergence. Changes to the timing of life-cycle events within one species can has flow-on effects to the other species that depend on it.

Warmer temperatures have been shown to alter timing of flowering in alpine species on the Bogong High Plains but responses vary between species. Some species are flowering earlier, and some showing changes in when seeds reach maturity.

Evidence suggests that since the 1960s some migratory birds visiting or breeding in south-eastern Australia are arriving earlier. There is substantial evidence that arrival dates in general are related to local temperatures.

Increased spread of invasive species

Overall, warmer drier conditions are expected to benefit weeds and pests when compared with native species. The characteristics that make many weeds and pests invasive, for instance that they can tolerate a broad range of environmental conditions and can breed quickly, will help them exploit new opportunities. Introduced plants species that are currently not considered to be weeds could become problems in the future as the environment changes.

Inland migration of coastal vegetation

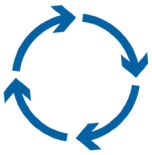
As sea levels rise, marine and coastal habitats like mangroves and saltmarsh must migrate landwards to survive. Where there are built structures (like roads, concrete paths and levee banks) adjacent to coastal vegetation it will be unable to move further inland. The coastal wetlands around Port Phillip and Western Port Bays are vulnerable because of this. Coastal wetlands south of the Otways and along the far east coasts may be vulnerable due to natural barriers created by the shape of the land and coastline. Loss of mangroves and saltmarsh has significant flow-on effects because they filter water and improve its quality, prevent erosion, are important nursery habitats for fish and crustaceans, and provide roosting habitats for shorebirds (including the rare orange-bellied parrot). They also sequester carbon out of the atmosphere at a much faster rate than the planet's forests and can continue to do so for millions of years.

Increased saltwater intrusion into estuaries

Saltwater intrusion is where saltwater extends further upriver into freshwater rivers as well as into groundwater. Climate change is likely to increase saltwater intrusion due to decreased rainfall and streamflow and rising sea levels. This may result in estuary entrances being open more to the sea. This will impact the plants and animals that live in them.

Ocean acidification

Globally, surface waters are now 30 percent more acidic than they were at the start of the industrial era. Ocean acidification is now happening at a faster rate than at any point in the last 66 million years. When seawater absorbs carbon dioxide, chemical reactions occur, resulting in a greater concentration of hydrogen ions. This causes the seawater to become more acidic and for carbonate ions to be relatively less abundant. Carbonate ions are the building blocks for many marine animals such as bryozoans, oysters, molluscs, crustaceans and echinoderms, helping them to produce shells and skeletons. Plankton, which form the basis of many marine food chains, also require carbonate to build shells and skeletons. These types of marine animals species may decline as a result of ocean acidification.



Changes to marine food webs

Increasing ocean temperatures and ocean acidification are likely to reduce the productivity of phytoplankton that form the basis of marine food webs. Phytoplankton are consumed by zooplankton (tiny animals), which in turn provide food for small fish, all the way up the food chain to top predators like dolphins and sharks. Plankton influence the pace and extent of climate change. They produce chemicals that assist in the formation of clouds, plus through photosynthesis transport carbon to the deep ocean.

Southward migration of marine species

Climate change is likely to result in increased ocean temperatures and more frequent marine heatwaves. As the ocean warms, it is expected that many marine species will migrate southward to cooler waters. In Victoria, some changes are already being observed including the southern migration of seaweed to cooler waters and a southward extension in range of 15 per cent of coastal fishes in temperate south-eastern Australia. The southern migration of sea urchins from New South Wales has led to a loss of kelp forests, destroying vital habitat for fish and abalone.

Sea level rise and storm surge

Climate change projections show that sea levels will continue to rise, and storms will be more frequent and intense. Sea level rise will alter mangrove and saltmarsh habitats and lead to a loss of coastal habitats for biodiversity such as roosting or nesting sites for shorebirds. The increased intensity of storms along the coast will result in greater inundation of low-lying coastal environments. The most vulnerable areas are beach fronts, low-lying wetlands and coastal reserves. Changes to the direction of waves will affect the pattern of sediment movement and erosion along Victoria's coastline which could impact plant and animal species that currently live there.

Key issues

This section highlights some key issues for the natural environment system. These issues have been selected because they are likely to have significant impacts on the natural environment system and involve other systems. These are examples of 'cross-system risks'.

Managing cross-system risks requires collaboration across systems. For more information on other cross-system risks that impact on the natural environment system please see the supporting documents.

Bushfires

Climate change will increase the risk of more severe and frequent bushfires. This is likely to mean that a larger area is burnt in a single fire season and fires occur in places that didn't historically burn. This will have direct and indirect effects on the natural environment as well as human systems.

The natural environment, such as forests and grasslands, increases the bushfire risk to nearby infrastructure and settlements. Managing this risk through prescribed burning and other fuel reduction activities affects the natural environment both positively and negatively. These activities will need to intensify to keep pace with increasing bushfire risk. Why communities are vulnerable and what else could be done to reduce this risk might need to be considered. Transformational approaches might be required.

The 2019-20 fires were reported as 'without precedent'. Several warming scenarios will see the weather experienced in the summer 2019-20 as the 'average summer' by 2050.

Source: DELWP

Other afftected systems

TRANSPORT | PRIMARY PRODUCTION | EDUCATION AND TRAINING | WATER CYCLE | HEALTH AND HUMAN SERVICES | BUILT ENVIRONMENT

Disease

The impact of climate change on the spread of disease is uncertain. Like other living things, organisms that spread disease have ideal conditions for growing, reproducing and spreading. Warmer temperatures will enable some of these organisms to grow and reproduce faster, while others might not survive.

Climate change is also likely to affect the health of disease hosts, including humans, notably through heatwaves and heat stress. This could make hosts more susceptible to infection or harm from disease and parasites.

Wetter and warmer winters are expected to enable the plant disease Phytophthora cinnamomi to spread further in Victoria.

Many experts think climate change will increase the risk of diseases spread by mosquitos, such as Ross River virus, dengue Fever and Malaria.

Source: Flikr

Other afftected systems

PRIMARY PRODUCTION

HEALTH AND HUMAN SERVICES

BUILT ENVIRONMENT

Weeds and pests

Changing temperature, wind and rainfall patterns along with more extreme weather events will likely affect how weeds and pests spread and how abundant they are. As for native species, it can be difficult to predict which weed and pest species will benefit from a changing climate.

Overall, warmer drier conditions are expected to benefit weeds and pests when compared with native species. This is because:

- climate change will make many ecosystems more vulnerable to invasion.
- the characteristics that make many weeds and pests invasive (e.g. able to breed quickly and tolerate a broad range of environmental conditions) will help them exploit new opportunities.

As the climate changes, it will be important to detect new threats as early as possible to provide the best chance of successful intervention. This includes the arrival of new weeds and pests into Victoria, and existing species expanding their range or impact.

In the Australian Alps, foxes have become more common at higher altitudes as the climate has warmed. As snow cover declines, native animals are becoming easier for foxes to find.

Source: DELWP

Other afftected systems

TRANSPORT

PRIMARY PRODUCTION

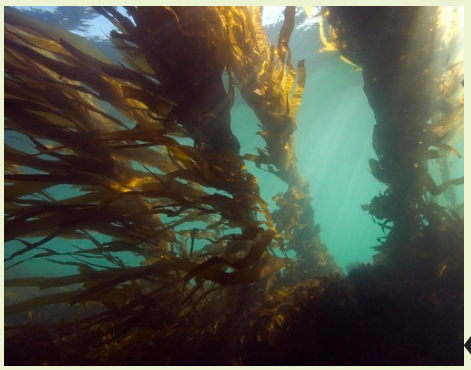
BUILT ENVIRONMENT

Marine ecosystem change

Climate change is likely to increase ocean temperatures and acidity and cause more marine heatwaves. This will significantly affect Victoria's marine ecosystems.

Many species are migrating southwards in response to increased temperatures. However, some might be limited by the lack of suitable habitat south of the Australian mainland.

Increased ocean acidity will affect which species can survive. Changes to the composition and abundance of marine species, particularly plankton, might disrupt fundamental processes such as nitrogen cycling and reduce the ocean's ability to store carbon. This has significant implications for the natural environment and human systems.



Climate change has enabled the southern migration of Black-spined Sea Urchins, which have devastated many kelp forests.

❮Before

After❯

Source: Museums Victoria

Other afftected systems

PRIMARY PRODUCTION

What is ocean acidification?

Scan the QR code to watch a video about Coastal acidification - Rate Impacts and Management (carim.nz)

Will the environment adapt on its own?

The natural environment has some capacity to adapt to climate change on its own, but its ability to do so varies across ecosystems and species. For instance, some ecosystems will:

- be **resistant** – they will be able to withstand climate-related impacts and remain essentially unchanged.
- be **resilient** – they will be impacted but have the ability to recover.
- **transition** – they will be impacted and will not recover to their previous state. For instance, they could change structure or composition and, in some cases, even become a 'novel' ecosystem.

To give species and ecosystems the best chance we need to reduce the other pressures on them, such as invasive species and habitat loss. However, we also need to consider what options are available for species and ecosystems that may be significantly impacted by climate change. In some instances, we may have to facilitate or accept a transition to something new.

We need to act now to identify potential tipping points and minimise their consequences on our economy, society and the environment. If we wait until changes are obvious, it might be too late to intervene and the consequences could be severe.

Fossil evidence shows that plant species have migrated in response to past climatic changes. However, to keep pace with human-induced climate change, plant species would have to move five to 50 times faster than they would have in the past.

Source: Museums Victoria

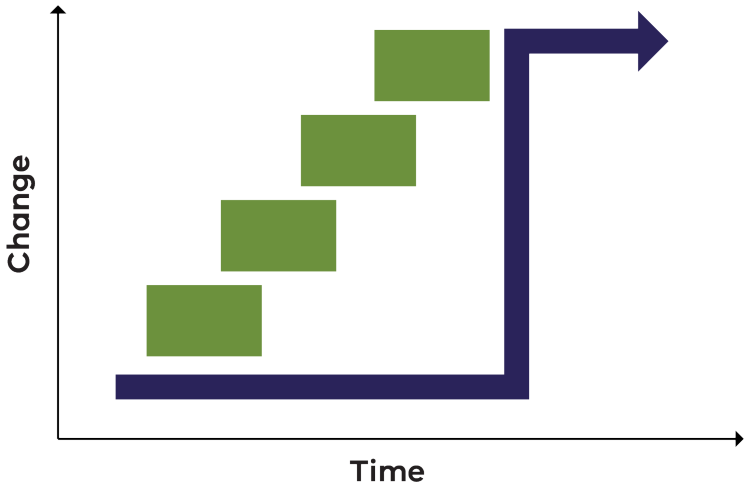
Adaptation means doing things differently

The ongoing and context-specific nature of adaptation means that it must be part of the work of anyone who manages the natural environment.

Across the world, adaptation efforts are mainly focused on incremental adaptation, which is about maintaining the essence of existing systems while making small adjustments in response to climate change. This approach is best suited to gradual changes.

In contrast to incremental adaptation, transformational adaptation changes the fundamental attributes of a system in response to climate change and its cascading impacts. Transformational adaptation is likely to be needed in systems where tipping points may be reached.

To be effective, transformational adaptation must consider the social and economic factors that affect ecosystem management. Changing how we affect or manage the environment could delay a tipping point, giving communities and human systems time to adapt to expected new conditions.



Triggers for transformational adaptation

Transformational adaptation should be investigated if any of the following conditions are met.

Significant changes have already occurred	If climate change has driven significant changes to social or ecological systems, it indicates transformational adaptation is necessary. This is not only to adjust the system to accommodate the changes but also to anticipate further impacts. *For instance, if the wave patterns have changed so that the sand at a beach has washed away and any replacement sand cannot be retained.*
There are signs of high vulnerability	If climate change impacts are expected to test the existing systems' resilience (especially if tipping points might be reached), this is an indication that transformational adaptation is likely to be needed. *For instance, if an alpine area is projected to have significant declines in snowfall.*
Current approaches are failing	If current approaches are no longer effective at achieving their goals, it might indicate that transformational adaptation is necessary. *For instance, if the historical approach to managing weeds in a location is no longer effective due to higher levels of disturbance due to climate hazards.*
Decisions have long-term consequences	If a decision has a long-term consequence (30+ years) and/or requires a long lead-time to implement, the need for transformational adaptation should be considered. *For instance, if an island or coastal location is identified as a potential site for the reintroduction of captive-bred animals but it is going to be affected by sea-level rise.*

Whether adaptation is incremental or transformational, there is a need to navigate the significant uncertainty associated with climate change impacts on the natural environment.

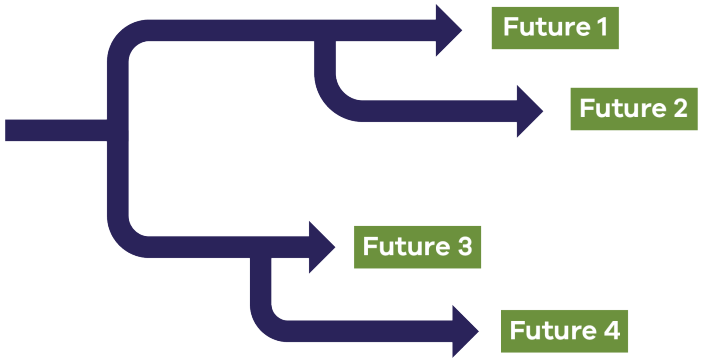
Dealing with uncertainty

Climate change adaptation occurs within a context of high uncertainty, which creates an enormous challenge. Decision making needs to be adaptive and flexible to navigate this and allow us to accommodate changes in our understanding.

It can be helpful to identify 'possible futures' for an environmental value or location.

Some of these futures will be preferable to others, and we will want to make decisions to keep us on the 'preferred path'. However, over time it could become clear that the preferred future is unattainable, and we will have to reconsider what is possible.

Considering multiple futures and acknowledging uncertainty are two parts of the Climate Adaptation Lens.



Source: Adapted from a 1997 article in the Harvard Business Review titled 'Strategy under uncertainty'. Authored by Hugh Courtney, Jane Kirkland and Patrick Viguerie.

The Climate Adaptation Lens

Climate change is likely to affect all Victorian ecosystems to some extent. To prepare and respond effectively, a climate adaptation lens should be applied to natural environment management decisions at the appropriate scale.

To apply a climate adaptation lens, decision makers should do the following.

Consider the issue within context	• Consider climate change impacts within context of other pressures on the environment and other socio-economic drivers, and tailor solutions accordingly. *For instance, how adaptation actions proposed by other systems may have consequences for the natural environment.*
Account for the 'lifetime' of the decision	• Determine how far into the future a decision will be effective (e.g. are the consequences of this decision short-, medium- or long-term) and factor this into decision making. *For instance, if a decision will have long-term consequences (20+ years) it is important to consider projected climate change over this time and whether transformational change may be necessary.*
Acknowledge uncertainty	• Acknowledge inherent variability and uncertainty in future predictions and identify the futures and variables on which a decision could hinge. • Be transparent about dealing with uncertainty and document assumptions behind a decision. *For instance, be clear about what assumptions have been made in making a management decision. Monitor whether those assumptions hold over time. If the context changes, have a clear path for reviewing the initial decision.*
Take a futures approach	• Explore multiple possible futures and identify tipping points. • Test the robustness of actions against multiple future scenarios. *For instance, use the adaptation pathways approach. Identify what may occur in the future and determine how these 'possible futures' would affect management actions. Prioritise actions that are worth doing under multiple future scenarios ('no regrets' options).*
Anticipate transformational change	• Identify early on whether transformational adaptation should be explored now. If not, continually monitor and assess whether incremental adaptation is sufficient or whether transformational adaptation may be required. *For instance, determine whether one of the four triggers for transformational adaptation are met. Use a futures approach to consider under what circumstances transformational change would occur or be beneficial. Consider impacts of transformational change on environmental and socio-economic values. Use this analysis to inform adaptation planning.*
Be transparent about trade-offs	• Identify potential negative consequences of an action, including equity and social vulnerability, and work to avoid them. *For instance, consider whether a management decision has negative consequences for other systems or vulnerable people. Consider these consequences in decision making. Clearly document trade-offs that have been made.*

It is very important that the sector apply all parts of the Climate Adaptation Lens to projects where:

- decisions are 'locked-in'
- investment is significant
- there is a long lead time to plan and implement the project
- it takes a long time to see whether the approach is effective or not
- the risks and/or benefits extend beyond the boundaries of the project.

The climate adaptation lens can also help with emergency prevention, preparedness, response and recovery. Climate projections suggest extreme events are likely to become more frequent and/or severe in the future. They are also likely to become more unpredictable as they diverge from our past experience. This means climate change will play an increasingly important role in emergency management decisions.

Transformational adaptation is part of preventing disasters because it moves beyond resilience to think about why the natural environment or communities are vulnerable, and what can be done to reduce this.

Futures approaches, such as scenario planning, can help emergency management teams consider what might happen in the future, including events outside their experience.

This thinking can be used to determine how to reduce risk and identify any gaps in response capability. 'If… then…' statements can help with planning.

It helps to work with the community before an extreme event and discuss what will be prioritised and why. This **transparency about trade-offs** enables different voices to be heard and communities to support decisions.

Protecting Victoria's Environment – Biodiversity 2037 states that 'the impacts of climate change, and the uncertainty it brings, will be considered in all conservation decisions'. To give our biodiversity programs best chance of success they must consider the climate adaptation lens. This could look like:

- ensuring that locations identified for long-term protection of species (i.e. those that are fenced and intensively managed) are not highly vulnerable to climate impacts
- identifying species most at risk and designing appropriate interventions (e.g. insurance populations)
- undertaking scenario planning for emergency events specifically focussed on biodiversity impacts.

Victoria's Climate Change Strategy

The Victorian Government is taking strong and lasting action to reduce Victoria's emissions to net zero by 2050 and build resilient communities prepared to deal with the impacts of climate change. Victoria was one of the first jurisdictions in the world to legislate a net-zero emissions target with the Climate Change Act 2017 and set a strong foundation for future climate resilience with action under Victoria's Climate Change Adaptation Plan 2017–20.

Victoria's Climate Change Strategy sets out the Victorian Government's current action on climate change and our next steps. Reducing our emissions will help lessen the impact of climate change, but it will not prevent it – some degree of climate change is already locked in. Adapting to the impacts of climate change will reduce risks, build social and economic resilience, and ensure Victoria is best placed to take advantage of opportunities.

The Climate Change Strategy sets our adaptation objectives for the next decade and priorities for the next 5 years consisting of priority focus areas to:

- address current climate change impacts
- reduce barriers to adaptation
- lay the foundations for transformational adaptation

It also outlines the enablers that will support action:

- capacity building and partnerships
- governance and strategic planning
- sustainable adaptation finance
- leadership and innovation

Contributing to the Climate Change Strategy

Analysis was undertaken to determine how current government initiatives in the natural environment system were contributing to Victoria's Climate Change Strategy priorities. The findings are summarised below. Further detail about existing government initiatives in the natural environment system and how they contribute to the Climate Change Strategy priorities are provided in the supporting documents.

Focus area 1: Address current impacts

Several government initiatives have been designed and undertaken to address current climate impacts on the natural environment system, many in direct response to disaster events. The 2019–20 bushfires demanded and received a swift recovery response. They also provided impetus to look beyond a single fire event and consider long-term strategies for maximising ecosystem resilience throughout Victoria.

There are many other projects across the natural environment system aimed at enhancing resilience. It is important for these projects to apply the climate adaptation lens to decision making.

Victoria's Catchment Management Authorities have been leaders in trialling new approaches to climate adaptation, including using pathways to deal with uncertainty and integrate local knowledge into planning. Adaptation pathways are also being used as part of Victoria's Resilient Coast Project.

Innovative place-based approaches to decision making, such as adaptation pathways, could be adopted more broadly across the natural environment system.

Identified needs

- Help build capacity to deal with uncertainty by providing guidance to decision-makers.
- Collect and analyse more and better data to monitor and assess emerging threats.
- Move beyond recovery from disaster events and strategically build ecological resilience.
- Provide leadership and support for adaptation pathways to be adopted more broadly.

Focus area 2: Reduce barriers to adaptation

Capacity building programs are underway to reduce barriers to action arising from lack of knowledge. A significant amount of research is being undertaken to improve our understanding of how climate change will affect the natural environment. Tools and guidance are also being developed to help apply this research to real-world problems.

Given the natural environment's size and complexity, and the diversity of organisations and people involved in its management, there is no consistent coordinated approach to climate change adaptation across the system.

Targeted approaches can promote innovation to solve specific issues, however their ability to meet adaptation objectives and resolve trade-offs is limited. Therefore, strategic prioritisation is needed – supported by a state-wide view of relative vulnerabilities – to inform where place-based approaches will be most beneficial. There are tools available to support this, such as the DELWP's Strategic Management Prospects tool. It is important for these tools to apply the climate adaptation lens.

Identified needs

- Provide a statewide view of the natural environment's vulnerability to climate change to identify strategic priorities and inform adaptation planning.
- Examine current projects and tools to determine if and how they apply a climate adaptation lens.

Focus area 3: Lay foundations for transformational adaptation

A variety of projects across Victoria are anticipating climate change impacts over the long-term and preparing for them. Some actions are more novel than standard approaches and involve more modification of the natural environment. Whether an action is appropriate will depend on many factors.

The lessons from experiments and trials of new approaches should be shared widely to build on successes and reduce risks.

Transformational change is not easy and generally has a long lead time. The Royal Society of Victoria's Future Thinking Forum 2020 – Addressing resilience in Victoria's Water, Agriculture and Biodiversity reported that it is essential to begin the hard and slow work of transformational adaptation now.

Decisive action to adapt now will reduce current and future risks, build environmental and social resilience, and ensure the consequences of climate change are minimised.

Identified needs

- Support innovative trials and provide guidance on how to manage risks arising from new approaches.
- Embed a learning approach into monitoring and evaluation frameworks.
- Undertake first steps for transformational adaptation in the natural environment system by identifying locations in Victorian where it should be further explored and gathering information on past transformational projects.

Actions

The actions are designed to respond to the identified needs (above) and meet this Plan's short-term objectives. They are complementary and together lay the foundation for how adaptation should be approached across the sector.

The lead responsibility to implement these actions sits primarily with DELWP. In developing guidance and tools, DELWP will collaborate with Traditional Owners, other government agencies, non-government organisations and the community to ensure that they are effective and fit-for-purpose.

Improve our understanding of climate risks and vulnerabilities

Four actions will be undertaken to improve our understanding of climate change risks and vulnerabilities.

Climate vulnerability assessments related to natural environment assets will be updated with the latest climate model data (Action 1.1). This will allow land managers and policy makers to better identify areas of the landscape that will be most impacted by climate change. Updated datasets are also a useful tool in communicating the impacts of climate change with stakeholders, including the community.

DELWP will identify areas where natural assets could migrate under climate change (Action 1.2). For instance, coastal vegetation is likely to migrate inland in response to rising sea levels and there is evidence that some bird species are migrating to higher altitudes.

DELWP will identify how a changing climate will impact on our fire regimes (Action 1.3).

Work will also be taken to identify key research gaps for which additional information would enhance climate-adapted decision making (Action 1.4). This will help environmental managers to determine research priorities to pursue through research collaborations.

Objective	Action	Timing
1. Improve our understanding of risks and vulnerabilities	1.1 Explore opportunities to update climate vulnerability assessments related to natural environment assets with latest climate model data	June 2022 – June 2024
	1.2 Identify areas where natural assets could migrate to under climate change	June 2025 – June 2026
	1.3 Incorporate future weather scenarios in bushfire and forest modelling and planning	May 2022 – June 2024

Objective	Action	Timing
1. Improve our understanding of risks and vulnerabilities	1.4 Identify key research gaps and undertake value of information analysis to determine research priorities to pursue through research collaborations	Jan 2023 – June 2026

Help to prioritise adaptation actions and focus efforts

Four actions will be implemented to help prioritise adaptation actions and focus efforts to improve their effectiveness.

A framework for monitoring and assessing emerging threats will be developed (Action 2.1). As the climate changes and the natural environment responds, it will be important to detect new threats as early as possible to provide the best chance of successfully intervening. The framework will outline what should be monitored, when and how.

A toolbox will be developed that describes what tools are suitable for managing uncertainty in the natural environment system and how they can be applied (Action 2.2).

A strategy will be developed to help determine areas that are likely to be impacted by climate change and to identify the actions that would be most effective at enhancing ecological resilience (Action 2.3).

A policy will be developed to help guide novel environmental management actions such as ecological engineering and genetic interventions (Action 2.4). The policy will define novel environmental management actions, describe where they should be applied and how risks should be managed.

Objective	Action	Timing
2. Help to prioritise adaptation actions and focus efforts	2.1 Develop a framework for monitoring and assessing emerging threats	June 2023 – Oct 2026
	2.2 Build a toolbox for decision making under uncertainty	June 2022 – June 2024
	2.3 Develop a strategy to maximise ecosystem resilience	July 2022 – Aug 2024
	2.4 Prepare a policy for novel environmental management actions	April 2024 – June 2025

Create a framework to support climate-adapted decision making

Three actions will be implemented to create a framework to support climate-adapted decision making.

Guidance will be prepared on applying adaptation pathways in the natural environment context (Action 3.1). This will build on work undertaken by the Southern Slopes Climate Change Adaptation Research Partnership between Victoria's Catchment Management Authorities and universities. It will describe what the adaptation pathways approach is, when it is useful to be applied and how to do it. Cross-sector collaboration will be an essential part of developing the guidance.

The adaptation pathways guidance will be trialled (Action 3.2). The trial will be developed and undertaken in partnership with Traditional Owners and in close collaboration with affected stakeholders such as the local community, local Councils, Catchment Management Authorities, Landcare and other local environment groups and portfolio agencies.

A foundational guide to transformational adaptation will be developed (Action 3.3). The guide will describe the conditions under which transformational adaptation should be explored, identify the contexts in Victoria which meet these conditions and identify learnings from previous transformational change experiences.

Objective	Action	Timing
3. Create a framework to support climate-adapted decision making	3.1 Develop guidance on applying adaptation pathways in the natural environment context	June 2023 – Oct 2026
	3.2 Trial the adaptation pathways guidance by applying it to specific locations highly vulnerable to climate change	June 2022 – June 2024
	3.3 Prepare a foundational guide to transformational adaptation in the natural environment	July 2022 – Aug 2024

Support and enable practitioners to better approach decision making in the context of a changing climate and increased uncertainty

A set of eight actions will be implemented to support practitioners to better approach decision making in the context of a changing climate and increasing uncertainty.

The climate adaptation lens is an important tool to frame adaptation decision making. Actions will be taken to ensure the climate adaptation lens is:

- integrated into decision support tools (Action 4.1)
- considered in the development of the Whole of Sector Bushfire Strategy and the renewal of the Victorian Waterway Management Strategy (Action 4.2)
- incorporated into current methodologies and projects where possible (Action 4.3)
- integrated into bushfire preparedness, response and recovery (Action 4.4)
- incorporated into behaviour change initiatives (Action 4.5)
- promoted and further developed through pilot projects (action 4.6)

Opportunities will be identified to work across DELWP and with partner agencies to integrate adaptation consideration into existing Monitoring Evaluation Research and Improvement frameworks (MERI) (Action 4.7). Adaptation depends on learning and responding effectively to lessons learned, as well as experience, changing circumstance and new knowledge. It will also be deliberately trialling new approaches and being prepared to fail. Enhancing learning in MERI will be a key focus of this action.

To facilitate learning more broadly, communities of practice will be supported and promoted. These communities of practice will facilitate knowledge sharing and application of best-practice climate adaptation within the natural environment system (Action 4.8).

Objective	Action	Timing
4. Support and enable practitioners to better approach decision making in the context of a changing climate and increased uncertainty	4.1 Integrate the climate adaptation lens into decision support tools	June 2023 - Dec 2025
	4.2 Consider the climate adaptation lens in developing the Whole of Sector Bushfire Strategy and in renewal of the Victorian Waterway Management Strategy	Jan 2022 - Aug 2023
	4.3 Review methodologies and projects to see how they're using the climate adaptation lens	Jan 2022 - Sept 2023
	4.4 Integrate the climate adaptation lens into bushfire preparedness, response and recovery	Jan 2022 - Oct 2024

Objective	Action	Timing
4. Support and enable practitioners to better approach decision making in the context of a changing climate and increased uncertainty	4.5 Explore opportunities to incorporate the climate adaptation lens into behavioural change initiatives and build community understanding of adaptation	Jan 2022 – Sept 2025
	4.6 Support and promote pilot projects applying the climate adaptation lens	June 2022 – June 2026
	4.7 Embed a learning approach into monitoring, evaluation, reporting and improvement frameworks	Aug 2022 - Ongoing
	4.8 Support and promote climate change adaptation communities of practice	June 2022 – July 2023

Support Traditional Owner outcomes and objectives

Traditional Owners will be supported to explore climate impacts on their cultural values (Action 5.1). The type of support will depend on the needs identified by Traditional Owner groups. This could include providing access to data and information about climate projections or assisting with research into climate risks to specific cultural assets.

Objective	Action	Timing
5. Support Traditional Owner outcomes and objectives	5.1 Provide opportunities for Traditional Owner self-determination	Ongoing

Monitoring, evaluation, reporting and improvement

DELWP is committed to building a strong evidence-based and learning culture. This is critical to supporting adaptation, as well as strategic decision making, public sector accountability, efficient and effective management and continuous improvement.

A fit-for-purpose monitoring, evaluation and learning framework will be developed within year one to guide the implementation of this Plan. The framework will include an outcome logic model or theory of change, key evaluation questions, data collection methods (both quantitative and qualitative) and a strategy for improvement and learning.