Chapter 2

Climate and Natural Environment

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Ninety mile beach

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OVERVIEW

This chapter contains information about Victoria's natural environment and climate. It includes contributions from Parks Victoria, the Bureau of Meteorology and the Environment Protection Authority.

Physical features

Although Victoria is the second most populous State or Territory in the country, it is ranked sixth in terms of geographic size and accounts for only 3% of Australia's total area.

2.1 AREA OF STATES AND TERRITORIES

State or Territory	Area in square kilometres	Length of coastline in kilometres	Percentage of total area	Percentage of total population (as at 1995)
Western Australia	2 525 500	12 500	32.88	9.6
Queensland	1 727 200	7 400	22.48	18.8
Northern Territory	1 346 200	6 200	17.52	1.1
South Australia	984 000	3 700	12.81	8.0
New South Wales	801 600	1 900	10.44	33.8
Victoria	**227 600**	**1 800**	**2.96**	**24.4**
Tasmania	67 800	3 200	0.88	2.6
Australian Capital Territory	2 400	(a) 35	0.03	1.7
Australia	**7 682 300**	**36 735**	**100.00**	**100.0**

(a) Jervis Bay Territory.

Source: Bureau of Meteorology; ABS unpublished data.

Location

Wilson's Promontory, latitude 39° 08' S, longitude 146° 22' 30" E, is the southernmost point of the mainland of Victoria and similarly of the mainland of Australia; the northernmost point is where the western boundary of the State meets the Murray River, latitude 33° 59' S, longitude 140° 58' E; the point furthest east is Cape Howe, situated in latitude 37° 31' S, longitude 149° 58' E. The westerly boundary lies upon the meridian 140°58' E and extends from latitude 33° 59' S to latitude 38° 04' S, a distance of 451 kilometres.

Coastline

The Victorian coastline comprises many types of environments. Broad sandy beaches and impressive cliffs contrast with mangrove-fringed mudflats. Cliffs and beaches occur mostly in areas that receive the main impact from waves generated by the dominant winds from the south-west: for example the ocean coast and north-eastern coast of Port Phillip Bay. In the large embayments – Port Phillip Bay, Western Port Bay and Corner Inlet – and in some estuaries, waters are more protected from the wind and the ocean swells; here, tidal flats of sand or mud, traversed by sinuous channels, may be colonised by salt-tolerant plant communities such as mangroves.

Physiographic divisions

Jenkin and Rowan have classified Victoria's landforms into six main regions.

1. Central Victorian Uplands
2. South Victorian Uplands
3. The Murray Basin Plains
4. West Victorian Volcanic Plains
5. South Victorian Coast
6. South Victorian Riverine Plains

A more detailed description of these regions can be found on page 23 of the 1997 issue of the *Victorian Year Book*.

Other features

Victoria's highest mountain is Mt Bogong, located in the West Victorian Uplands. The longest river is the Goulburn, which runs from Lake Eildon to the Murray east of Echuca. The Goulburn is also the river with the greatest annual flow of water. (The Murray river flows in NSW, as the State boundary is the south bank of the river.) Other important physical features are shown in Table 2.2.

2.2 SELECTED PHYSICAL FEATURES, VICTORIA

Mountain	Height metres	River	Length km
Bogong	1 986	Goulburn	566
Feathertop	1 922	Glenelg	457
Nelse North	1 883	Loddon	381
Fainter South	1 877	Mitta Mitta	286
Loch	1 874	Hopkins	281

Climate

The major topographical determinant of Victoria's climate is the Great Dividing Range, running east-west across the State, and rising to approximately 2,000 metres in the eastern half. This acts as a barrier to the moist south-east and south-west winds and together with its proximity to the coast, causes the south of the State to receive more rain than the north.

To the south of Victoria, except for Tasmania and its islands, there is no land for 3,000 kilometres. This vast area of ocean has a moderating influence on Victoria's climate in winter. Snow, which is a common winter occurrence at similar latitudes on the eastern seaboard of the great land masses of the northern hemisphere, is rare in Victoria below elevations of 600 metres. To the north of Victoria, the land mass of Australia becomes very hot in the summer, and on several days at this time of year the temperature over the State may rise to between 35°C and 40°C, often with a strong northerly wind.

Across Victoria, the average number of days of rain (0.2mm or more in 24 hours) in a year varies considerably. In the Otway Ranges there are over 200 days of rain, compared with an average of 100 wet days a year experienced in regions approximately 160 kilometres inland from the coast. Average rainfall ranges from 250mm for the driest parts of the Mallee to 2,600mm at Falls Creek in the Alps. The distribution of rainfall in Victoria by districts is shown in Table 2.3.

2.3 RAINFALL IN DISTRICTS, VICTORIA

	Year						
District	1991 mm	1992 mm	1993 mm	1994 mm	1995 mm	1996 mm	Average (a) mm
North Mallee	300	475	364	178	348	293	309
South Mallee	319	564	412	184	373	388	355
North Wimmera	408	567	440	222	431	433	412
South Wimmera	562	763	558	355	510	581	507
Lower North	401	625	531	268	427	361	434
Upper North	500	704	648	306	570	552	517
Lower Northeast	794	1 129	1 092	610	1 065	1 042	785
Upper Northeast	1 334	1 117	1 514	940	1 245	1 442	1 111
East Gippsland	782	1 049	681	724	890	779	780
West Gippsland	1 033	972	1 055	864	952	908	917
East Central	1 061	1 171	1 111	764	969	1 093	895
West Central	634	811	718	454	752	683	615
North Central	803	1 030	910	496	750	851	731
Western Plains	642	866	707	493	642	635	632
West Coast	955	1 043	797	742	830	877	780
Melbourne Suburban	833	909	900	537	870	809	n.a.

(a) Average for 83 years 1913 to 1995.

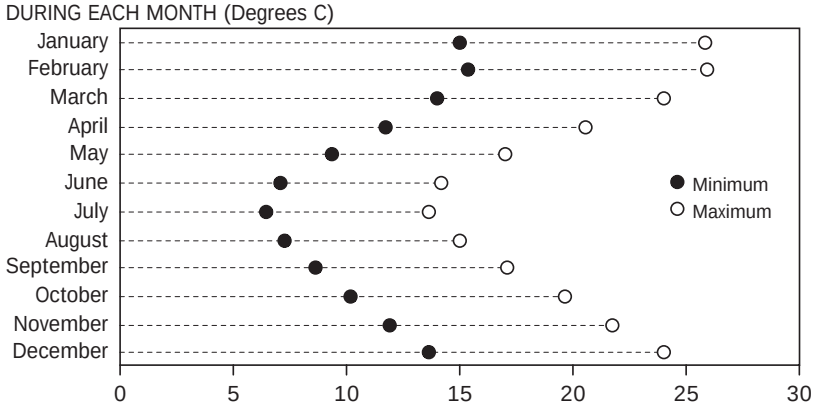
Source: Bureau of Meteorology.

Melbourne's weather

Melbourne's climate is temperate and variable, and moderate rainfall is received in most months. In summer, daytime temperatures average in the mid to high 20s. In autumn and spring, daytime temperatures average near 20ºC, while in winter, temperatures average in the low to mid teens.

Situated about 60 kilometres from the open ocean, the city has a climate midway between maritime and continental, although the extensive landlocked Port Phillip Bay has a moderating effect on temperatures in bayside areas. To illustrate, the bayside suburb of Black Rock has an average summer maximum temperature of 24.3ºC. By contrast, the outer northeastern suburb of Watsonia has an average summer maximum of 26.1ºC.

AVERAGE MONTHLY MINIMUM AND MAXIMUM TEMPERATURE IN MELBOURNE DURING EACH MONTH (Degrees C)



Source: Bureau of Meteorology

2.4 TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (ºC) Mean max.	Mean min.	Mean	Extreme air temperature (ºC) Highest max.	Date(c)	Lowest min.	Date(c)	Extreme temperature (ºC) Lowest terrestrial min.	Date(c)	Mean daily hours sunshine
Number of years of record	30	30	30	142	—	142	—	137	—	(a)85
January	25.9	15.1	20.5	45.6	13/39	5.6	*28/85	–1.0	*28/85	8.1
February	26.0	15.5	20.7	43.2	8/83	4.6	24/24	–0.6	*6/91	7.5
March	24.1	14.1	19.1	41.7	11/40	2.8	*17/84	–1.7	(b)	6.2
April	20.6	11.8	16.2	34.9	5/38	1.6	*24/88	–3.9	*23/97	4.9
May	17.1	9.5	13.3	28.7	7/05	–1.2	29/16	–6.1	26/16	3.8
June	14.3	7.2	10.7	22.4	2/57	–2.2	*11/66	–6.7	30/29	3.1
July	13.7	6.5	10.1	23.1	30/75	–2.8	*21/69	–6.4	12/03	3.5
August	15.1	7.4	11.3	26.5	29/82	–2.1	*11/63	–5.9	14/02	4.4
September	17.2	8.7	12.9	31.4	28/28	–0.6	3/40	–5.1	8/18	5.2
October	19.7	10.3	15.0	36.9	24/14	0.1	*3/71	–4.0	22/18	5.9
November	21.8	12.0	16.9	40.9	*27/94	2.4	*2/96	–4.1	*2/96	6.7
December	24.1	13.7	18.9	43.7	15/76	4.4	*4/70	0.7	1/04	7.4
Year										
Averages	20.0	11.0	15.5	. .	. .	. .	. .	. .	. .	5.6
Extremes	. .	. .	. .	45.6	13/1/39	–6.7	30/6/29	–6.7	30/6/29	. .

(a) Discontinued 1967. (b) 17/1884 and 20/1897. (c) Figures such as 13/39 indicate, in respect of the month of reference, the day and year of occurrence. Dates marked with an * indicate the nineteenth century.

Source: Bureau of Meteorology, Melbourne.

The hottest months in Melbourne are normally January and February, when the average maximum temperature is 26ºC. The hottest day on record in Melbourne was 13 January 1939, when the temperature reached 45.6ºC. In Melbourne, the average number of days per year with maximum temperatures over 30ºC is approximately twenty-nine and the overnight temperature remains above 20ºC on about four nights per year.

Nights are coldest at places a considerable distance from the sea, and away from the city where heat retention by buildings, roads, and pavements may maintain the air at a slightly higher temperature. This 'heat island' effect, which is the consequence of asphalt and concrete absorbing daytime warmth and radiating it back into the environment during the night, is largely confined to the Central Business District (CBD). In the CBD minimum temperatures are now mostly between 1ºC and 2ºC above those of most metropolitan locations.

The frequency of very low air temperatures varies widely across the Melbourne metropolitan area. For example, there are approximately ten annual occurrences of 2ºC or less around the Bay, but the frequency increases to over twenty in the outer suburbs and to more than thirty a year in the more frost susceptible areas.

In Melbourne, rainfall is fairly evenly distributed throughout the year, averaging about 55mm per month with an annual average rainfall of 639mm, falling over 143 days. Spring is slightly wetter than other seasons. Although the total amount of rain received is about the same for winter and summer, it falls on twice as many days in winter than it does in summer.

2.5 HUMIDITY, RAINFALL AND FOG

	Relative humidity		Rainfall						
Month	9 am mean %	3 pm mean %	Mean monthly mm	Mean days of rain no.	Greatest monthly(b) mm	Least monthly(b) mm	Greatest in one day mm	Date(b)	Mean days of fog no.
Number of years of record	30	30	30	30	142	142	142	—	30
January	62	44	47.1	7.9	176 (1963)	(a) (1932)	108	29/63	0.0
February	65	45	45.8	6.8	238 (1972)	(a) (1965)	87	26/46	0.3
March	66	47	43.5	9.4	191 (1911)	4 (1934)	90	5/19	0.4
April	71	52	52.7	10.7	195 (1960)	Nil (1923)	80	23/60	1.1
May	77	59	67.8	14.5	142 (1942)	4 (1934)	51	15/74	1.7
June	81	63	42.5	13.2	117 (1990)	8 (1858)	44	22/04	2.3
July	79	61	48.8	14.8	178 (1891)	9 (1979)	74	*12/91	2.2
August	74	57	57.4	15.9	111 (1939)	12 (1903)	54	*17/81	1.2
September	67	52	53.0	14.0	201 (1916)	13 (1907)	59	23/16	0.8
October	63	50	65.2	13.9	193 (1869)	7 (1914)	61	21/53	0.5
November	63	47	56.9	11.8	206 (1954)	6 (1895)	73	21/54	0.9
December	62	45	58.1	10.4	182 (1863)	2 (1972)	100	4/54	0.2
Year									
Totals	. .	. .	638.8	143.3	. .	. .	. .	. .	11.1
Averages	69	52	. .	. .	. .	. .	. .	. .	. .
Extremes	. .	. .	. .	. .	967 (1916)	332 (1967)	108	29/1/63	. .

(a) Less than 1mm. (b) Bracketed figures indicate year of occurrence. Figures such as 29/63 indicate, in respect of the month of reference, the day and year of occurrence. Dates marked with an * relate to the nineteenth century.

Source: Bureau of Meteorology, Melbourne.

The eastern suburbs are significantly wetter than the western suburbs. For example, Scoresby has an average annual rainfall of 901mm, in contrast to Laverton's 569mm. The relatively low rainfall to the west of the city is due to a combination of the 'rain shadow' effects of the Otway Ranges and the ranges in the Ballarat region. The relatively high rainfall to the east of the city is due to moisture in the predominant westerly wind stream condensing as the stream approaches the foothills of the Dandenong Ranges.

Thunderstorms are more frequent during late spring and summer, when there is adequate surface heating to provide energy for convection, than at other times of the year. In February 1972, 78mm fell in one hour during a thunderstorm. Hail is observed more often during winter and spring.

The wind varies from day to night and from season to season. Wind speed is usually lowest during the night and early hours of the morning prior to sunrise. It increases during the course of the day as heating of the earth's surface induces turbulence in the wind stream. Examples of the daily variation are the sea breeze, which brings relief on many hot days, and the valley or katabatic breeze, which brings cold air from inland Victoria down valleys during the night and early morning towards Melbourne. These breezes are responsible for winds being more often from the north during winter, particularly during the morning and from the south during summer, particularly during the afternoon. There is a marked tendency for the strongest winds to occur during the late winter and early spring months.

Duststorms and tornados are rare. However, on February 8, 1983, a duststorm reduced visibility in the city to 100 metres.

2.6 BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS(a)

		Wind (height of anemometer 28 m)							
				Prevailing direction					
Month	Mean of 9 am and 3 pm atmospheric pressure reduced to mean sea level hPa	Mean of 9 am and 3 pm wind speed km/h	Highest gust speed km/h	9 am	3 pm	Mean amount evaporation mm	Mean days thunder no.	Mean cloudy days(b) no.	Mean clear days(c) no.
Number of years of record	30	30	88	30	30	(d)27	30	30	30
January	1 013.5	13.2	106	S	S	195	1.3	8.0	5.3
February	1 015.1	12.5	119	SE	S	167	1.2	6.9	5.7
March	1 017.4	11.9	106	N	S	133	1.3	9.4	5.3
April	1 019.5	11.1	108	N	S	87	0.4	11.2	3.9
May	1 019.8	11.5	116	N	N	53	0.4	13.5	2.5
June	1 020.3	11.7	103	N	N	36	0.0	12.6	2.2
July	1 018.9	13.5	109	N	N	40	0.3	12.2	2.4
August	1 017.5	14.1	108	N	N	59	0.5	12.9	1.9
September	1 016.9	15.2	121	N	S	81	0.7	10.9	2.8
October	1 015.7	15.0	111	N	S	121	1.3	11.9	2.9
November	1 014.5	14.3	114	W	S	144	1.5	11.4	2.7
December	1 012.9	14.1	104	SW	S	177	1.7	9.6	3.5
Year									
Totals	. .	. .	. .	. .	. .	1 293	10.6	130.4	41.1
Averages	1 016.8	13.1	..	N	S	. .	. .	. .	. .
Extremes	. .	. .	121	. .	. .	. .	. .	. .	. .

(a) Means except for sunshine and evaporation over standard 30-year period 1961–1990. (b) Mean number of days when cloud cover equalled or exceeded seven-eighths. (c) Mean number of cloud cover was less than or equal to one-eighth. (d) Class–A Pan.

Source: Bureau of Meteorology, Melbourne.

2.7 AVERAGE MEASUREMENTS OF CLIMATIC ELEMENTS, MELBOURNE

Meteorological element	Spring	Summer	Autumn	Winter
Atmospheric pressure (hectopascals)	1 018.2	1 013.6	1 018.7	1 018.9
Maximum temperature of air in shade (°C)	19.6	25.1	20.6	14.4
Minimum temperature of air in shade (°C)	10.3	13.7	11.8	7.0
Relative humidity at 9 a.m. (per cent, saturation = 100)	64.0	61.0	72.0	78.0
Rainfall (mm)	175.0	154.0	164.0	149.0
Number of days of rain	40.0	25.0	34.0	44.0
Amount of evaporation (mm)(a)	346.0	563.0	269.0	135.0
Daily amount of cloudiness (scale 0 to 8)(b)	4.9	4.2	4.8	5.2
Daily hours of sunshine(c)	6.5	8.4	5.6	4.5
Number of days of fog	1.4	0.6	5.7	10.1

(a) Measured by Class A Pan (records commenced 1967). (b) Scale: 0 = clear, 8 = overcast. (c) Measured at Laverton (records commenced 1968).

Source: Bureau of Meteorology.

Environment

Recognition is increasing of the interdependency between people and the environment. The health of the environment not only affects the quality of life experienced by people; it also determines the availability of the basic resources—air, water and land—which are essential for life.

In June 1994, an ABS survey collected information about people's concern for environmental problems and their views on environmental protection and economic growth. In Victoria, 67% of people expressed concern about environmental problems. Air and ocean pollution, destruction of trees/ecosystems and freshwater pollution were the environmental problems which raised the greatest concern.

Environmental protection and economic growth were ranked as being equally important by 71% of people.

Photo:

Whale Rock Tidal River

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Air

The Environment Protection Authority (EPA) began monitoring air quality in Victoria in the early 1970s. The major pollutants monitored were ozone, sulphur dioxide, nitrogen oxides, carbon monoxide, air-borne particles, hydrocarbons and lead.

Melbourne's air quality rates well by international standards for cities of similar size. The Victorian air quality objectives provide a framework for assessing air quality and are similar to internationally recognised standards. The number of breaches of objectives have declined significantly in the last 15 years in spite of significant increases in both population and motor vehicle numbers. Breaches are usually associated with particular weather patterns which are characterised by a temperature inversion and slow moving air mass, creating ideal conditions to allow the build-up of pollutants.

Problems are generally confined to photochemical smog (of which ozone is the main component) in summer, and fine particles in autumn and winter. Motor vehicle emissions are a major contributor to each problem, although fuel reduction burning and solid fuel combustion are also significant contributors to particle pollution during autumn and winter.

Lead level in air concentrations have shown a steady decrease. This downward trend is a result of a phased reduction of lead in petrol and the introduction of unleaded petrol in 1985. These combined actions have been a contributing factor to the reduction of blood lead levels in Victorian children, which have roughly halved since 1979.

Water

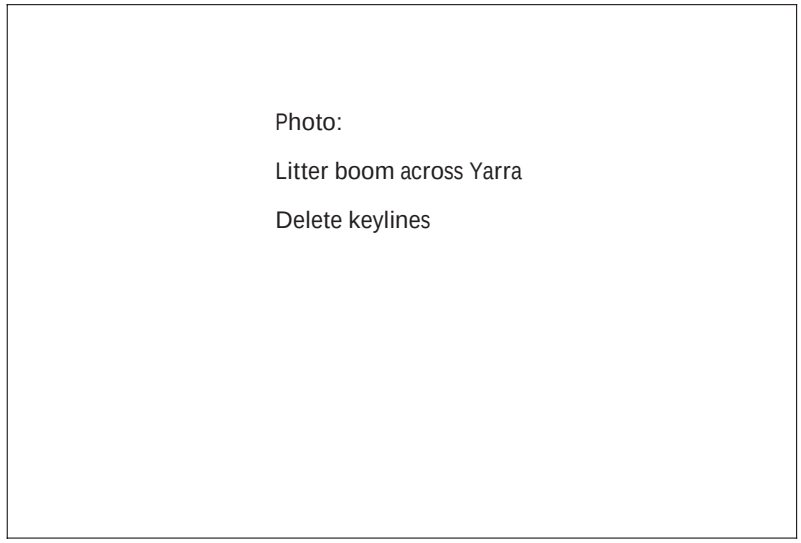
Good quality water is essential to maintain human life and protect natural ecosystems. As all people live in catchments, their activities have a direct impact on the water quality of streams and rivers and coastal waters. In Australia, a high proportion of people live in coastal urban centres. As a result, considerable pressure is exerted on coastal waters from urban run-off and recreational demands. Groundwater is important in supporting many aquatic ecosystems and wetlands. In addition, many communities rely on good quality groundwater for drinking, agricultural and industrial use.

Water pollution can be divided into two main types. The first is point-source pollution, in which the pollutant's source is localised and identifiable, e.g. the discharge drains of industrial or sewerage treatment plants. The second is diffuse water pollution, where the pollutant is derived from activities across a large area, for example, inputs of sediment associated with land use practises. The EPA facilitates the monitoring, and where necessary monitors, the quality of inland, coastal and groundwaters and works with industry, agricultural and community groups to address key problems.

The impact of point-source pollution in Victoria has steadily decreased as a result of education, licensing and waste minimisation programs. However, diffuse water pollution remains a significant concern. In Victoria, problems of this nature include high levels of nutrients, turbidity and salinity which adversely affect the quality of our waterways.

The major nutrients of concern are nitrogen and phosphorous. These are found in urban and rural run-off, erosion, sewage and animal faeces. Algal blooms, which can result in fouling of waterways, depletion of oxygen levels and the production of toxins, are one of the major problems caused by high nutrient levels. Nutrients are of particular concern in waterways across the State. The Victorian Nutrient Management Strategy released by the Victorian government in March 1995 provides a policy and planning framework to help local communities manage nutrient levels.

The Yarra River is a major feature of Melbourne. The quality of water in the Yarra is an important reflection on environmental management with the catchment. High turbidity, litter, suspended solids and E.coli are major concerns in the Yarra River Catchment. Urban development and areas of poor land management, including areas subject to erosion, affect the quality of run-off in this catchment.



Coastal and marine ecosystems are highly valued and sensitive environments, subject to intense commercial and recreational activities. The water quality around Victoria's coast is generally good with the exception of some areas where inputs from urban drainage and treated sewerage effluent affect water quality. Even at these locations, conditions are generally within acceptable limits. However, there is growing concern about the introduction of exotic plant and animal species such as the giant kelp (Undaria Pinnatifida) and the fanworm (Sabella Spallanzanii), via ballast water or attached to the hulls of ships.

Land

Land is a vital element of the environment. It provides the base for food production, recreational grounds, homes and industrial and commercial developments. Land use practises are important in maintaining and improving the quality of the environment whilst also meeting the economic and social needs of the community.

An increasing number of contaminated sites are being identified as a consequence of changing land use, in particular the redevelopment of inner urban industrial areas to residential use. Sites that are found to threaten the health of people using them or which have off-site impacts are monitored by the EPA, which maintains a register of sites that may be subject to clean- up under EPA direction. In Victoria, at December 1996 there were 13 such sites registered.

The EPA also maintains records of sites that are known to be contaminated but do not present a risk to health or the environment under the current or proposed use of the site. These sites are not listed on the Priority Sites Register, however site contamination assessments (statutory environmental audit reports) are retained by EPA and statements of the suitability of land for the existing or proposed land use are supplied to the relevant planning authority for future reference.

Deforestation and agricultural practices can have a significant impact on the environment, contributing to soil salinity, erosion and to turbidity, through siltation, in our waterways. Education and revegetation programs are being implemented along with changes to agricultural practices to redress these problems.

National Parks

The first Victorian national park was declared at Tower Hill near Warrnambool in 1892, followed by the temporary reservation of Mount Buffalo and Wilsons Promontory in 1898. By 1930, 9 other parks had been reserved. These parks were managed by individual committees of management comprised of volunteer members and had little access to government funding or trained staff.

Photo:

Cape Schanck, Mornington Peninsula

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During the first half of this century there was a lack of cohesion in the selection and reservation of land for park use and of consistency in the management of parks. A Land Conservation Council's Park and Forests Services Study in 1993 found that as far back as 1906, '.....local people and the Department of Lands were interested in the possibility of revenue generated by tourism' while '....naturalists were concerned primarily to preserve wildlife and forests but some also argued that they had a responsibility to future generations to reserve tracts of untouched bushland'.

In 1952, a number of groups and individuals, who had been intensively involved in the campaign to create national parks in Victoria, formed the Victorian National Parks Association (VNPA), an association which over the years has maintained an active involvement with parks. The VNPA was instrumental in achieving the establishment of national parks legislation in 1956 and a National Parks Authority. Subsequently, 11 new national parks were created between 1957 and 1972.

The 1970s saw the creation of the Land Conservation council which was given responsibility for advising the Government on the balanced use of public land in Victoria. Parks Victoria was created in December 1996 through the merger of the National Parks Service and Melbourne Parks and Waterways.

As well as caring for Melbourne's rivers, Parks Victoria manages the State's parks system, encompassing close to four million hectares of National, State, Regional and Metropolitan parks and key cultural properties.

In total, Parks Victoria manages 16% of Victoria's land area attracting over 25 million visits per year, in addition to the millions of visitors to the bays.

Photo:

Pillar Point (The Prom)

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Parks Victoria manages:

- 35 National Parks
- 3 Wilderness Parks
- 34 State Parks
- 11 Marine and Coastal Parks and Reserves
- 85 Regional Parks
- 3,000 Crown Reserves
- Key Heritage Properties such as Coolart Wetlands and Homestead and the Mansion at Werribee Park, plus over 200 historic places.
- Sanctuaries (e.g. Serendip Bird Sanctuary)
- Gardens (e.g. National Rhododendron Gardens, Seawinds)
- Port Phillip Bay and Western Port
- Yarra, Maribyrnong and Patterson Rivers

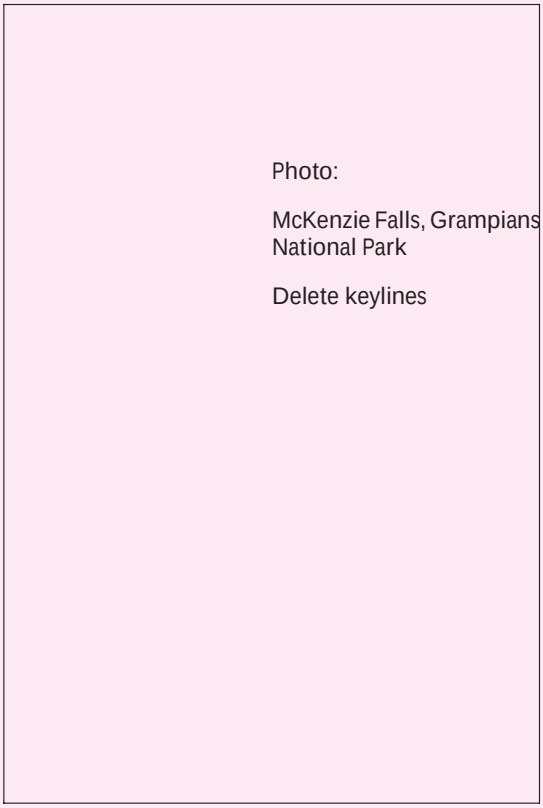

Photo:

McKenzie Falls, Grampians National Park

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Sources: Victorian Auditor-General's Office, Special Report No.34, *Managing Parks for Life*, 1995;

Parks Victoria.

Waste management

Governments in Australia are committed to reducing waste through avoidance, reuse and recycling. Local Government is responsible for provision of domestic waste management services such as garbage collection and also provides local recycling programs. The EPA is working with local councils and other bodies to promote waste reduction and in conjunction with EcoRecycle Victoria to improve the efficiency of kerbside recycling collections.

Improvements are also being made to the planning and management of landfill sites in Victoria through rationalisation of waste management across the State. As from May 1997 all municipalities are members of regional waste management groups responsible for regional waste planning and co-ordination.

Two agencies, the Recycling and Resource Recovery Council and the Waste Management Council, which were responsible for some waste management issues in Melbourne, Bendigo, Ballarat and Geelong have been succeeded by EcoRecycle Victoria with a State-wide ambit. The landfill levy has been extended to all licensed landfills across Victoria.

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