

GEOGRAPHY

CONSERVATION AND THE ENVIRONMENT

Ministry for Conservation

Introduction

The Ministry for Conservation was created by an Act of Parliament in December 1972. It is an "umbrella" organisation bringing together the following government agencies concerned with conservation and environment protection: Environment Protection Authority, Fisheries and Wildlife Division, Land Conservation Council, National Parks Service, Soil Conservation Authority, and the Victoria Archaeological Survey. The Ministry also includes the Divisions of Assessment, Environmental Studies, and Administration.

At the head of this organisation is the Minister for Conservation, who is advised by the Director of Conservation and his staff. The Minister is responsible for achieving the objects of the *Ministry for Conservation Act 1972*, which are, first, the protection and preservation of the environment, and second, the proper management and utilisation of the land and living aquatic resources of Victoria. Through the Minister, the Ministry for Conservation provides a central focus of advice to government on a wide range of environment, management, and protection matters.

The Ministry's central Divisions have a total staff of approximately 146 officers. Besides providing administrative, financial, and technical support to the agencies, these Divisions carry out a number of specialist and inter-disciplinary activities.

Environment Assessment Division

This group assists the Minister for Conservation and proponents of developments to carry out the procedures laid down in the *Environment Effects Act 1978*. The Act requires that proposals for public works which may have a significant effect on the environment be referred to the Minister for advice before a decision is made to proceed with the work. There is also provision for private works to be considered by the Minister under certain circumstances.

In either case the Minister may require the proponent to prepare an Environment Effects Statement; this describes the proposed development, any alternatives to it, the potential bio-physical, economic, and social effects, and suggested measures to ameliorate any adverse effects. Environment Effects Statements are normally placed on exhibition and public comment sought, after which the Minister provides an assessment as advice to the decision maker.

Conservation Planning

The Conservation Planning Section of the Division works with agencies in the Ministry to co-ordinate reports and submissions on planning issues for presentation to planning tribunals, municipal councils, and other bodies. Its staff are frequently called upon for advice on government purchases of land for conservation purposes, such as for addition to national parks, wildlife reserves, and other conservation areas. Advice is also given to members of the public seeking assistance in finding the best environmental solution to planning problems.

Environmental Studies Division

The structure of the Environmental Studies Division has changed recently, as major long-term projects are completed, and this has been a redirection of effort into management related projects.

The Division's initial thrust was in regional studies of Port Phillip Bay, Western Port Bay, and the Gippsland Lakes, together with their respective catchments; this work is being finalised.

As the research programme evolved, it confronted issues in others parts of Victoria, including alpine and river ecology, dry land salting, energy, water-based recreation needs, the use of environmental data in planning, the economic development of the La Trobe Valley, and the ecology of the Otway region.

The Ecological Survey Unit, formerly with Environmental Studies Division, has become part of the Fisheries and Wildlife Division's Arthur Rylah Institute at Heidelberg.

Fisheries and Wildlife Division has also assumed responsibility for the Marine Science Laboratories, located at Queenscliff.

The Data Services branch has been developed as a co-ordinating advisory and service group for the whole department. Similarly, the Ministry retains a co-ordinating role for ecological and environmental investigation.

Administration Division

A wide range of services is provided through the Administration Division: Accounts, Personnel, Drafting, Information and Extension, the Library, Registry and Mail, Transport, Property, and Stores. The Division is also responsible for the framing of legislation, the administration of national estate matters, environmental design, and the Victoria Archaeological Survey.

Legislation

The Minister for Conservation administers sixteen Acts of Parliament, as follows: **Archaeological and Aboriginal Relics Preservation Act 1972*, **Environment Effects Act 1978*, *Environment Protection Act 1970*, *Fisheries Act 1968*, *Historic Shipwrecks Act 1981*, *Land Conservation Act 1970*, **Land Conservation (Vehicle Control) Act 1972*, **Ministry for Conservation Act 1972*, *National Parks Act 1975*, **Reference Areas Act 1978*, *Soil Conservation and Land Utilization Act 1958*, *Victoria Conservation Trust Act 1972*, *Victorian Fishing Industry Council Act 1979*, *Victorian Institute of Marine Sciences Act 1974*, *Wildlife Act 1975*, and *Zoological Parks and Gardens Act 1967*.

The central divisions of the Ministry are responsible for implementing the six Acts marked with an *. The other Acts form the basis of the activities of most of the agencies which combine to form the Ministry for Conservation. For example, the National Parks Act gives the responsibility for management of national parks and other parks to the National Parks Service. Recent significant legislative changes are detailed below.

Historic shipwrecks

This legislation has been passed to protect such historic resources from systematic plundering and resulting damage. Following its passing in 1981, it was ruled necessary to send the Act to London for Royal Assent (an uncommon occurrence for Victoria's statutes), allowing the Queen to exercise the Royal Prerogative. Royal Assent was received on 10 February and the Act proclaimed on 10 March 1982, with the concurrent declaration of the "City of Launceston" in Port Phillip Bay.

The legislation complements the Commonwealth Act; together they protect both the estuarine waters and the waters adjacent to Victoria's coast. The Act, *inter alia*, allows for declaration of wrecks and surrounding protective zones, for appointment of an advisory committee, for permits, rewards and substantial penalties for contravention. The legislation is administered by the Ministry's Victoria Archaeological Survey.

Other legislative changes

These included a rise in fees for a range of licences under both the Fisheries and Wildlife Acts and substantial increases in the maximum fees for discharges under the Environment Protection Act. These fees had remained unchanged since the Act's inception in 1972, and the increases applied from various dates in 1982.

Another amendment to the Environment Protection Act which came into effect on 1 October 1982, doubled most penalties and aligned them with the unit penalty system provided for by the *Penalties and Sentences Act* 1981. The current unit penalty is \$100.

A number of amendments were made to the Soil Conservation and Land Utilization Act to streamline procedures and generally update the legislation.

An amendment was made to the Wildlife Act to complement a Commonwealth Act, in line with Australia's commitment to a worldwide ban on whaling. This inserted a new section to provide protection for whales (cetaceans). While the Act has significant penalties for contravention, it makes exceptions under permit for actions taken relating to education and research.

Further reference: *Victorian Year Book* 1982, pp. 21-2

Victoria Archaeological Survey

The Victoria Archaeological Survey was created by the *Archaeological and Aboriginal Relics Preservation Act* 1972. The main purpose of the Survey is to record and protect sites. The Act makes it an offence to deface, damage, buy, or sell Aboriginal relics.

Victoria is being progressively surveyed so that important sites can be identified and management plans formulated. To date, eight outstanding sites have been declared as Archaeological Areas, a status affording long-term protection through restriction of access. About 7,000 known Aboriginal sites in Victoria, over which wardens and inspectors maintain a watch, have been recorded.

Increasingly, the Survey is being asked to provide an archaeological input to Environment Effects Statements.

Statistics

The total expenditure of the Ministry and its agencies amounted to \$40.6m in the financial year 1980-81. Of this amount, salaries accounted for \$20m. The Ministry and its agencies employed 1,272 staff in that period.

VICTORIA—REVENUE AND EXPENDITURE OF THE MINISTRY FOR CONSERVATION AND ITS AGENCIES (\$'000)

Particulars	1976-77	1977-78	1978-79	1979-80	1980-81
REVENUE					
Ministry and agencies	3,924	4,595	5,321	4,833	5,338
EXPENDITURE					
Ministry (central Divisions)—					
Salaries, grants, and expenses	3,035	4,301	4,951	6,349	6,351
Land purchases	1,361	2,658	2,310	1,570	1,550
Environmental studies	1,614	2,211	2,516	2,299	2,380
Agencies—					
National Parks Service	4,666	6,083	6,459	7,345	8,846
Environment Protection Authority	4,923	5,684	5,913	5,936	7,574
Soil Conservation Authority	4,096	4,553	4,736	4,786	5,590
Fisheries and Wildlife Division	4,348	5,145	5,944	6,197	7,234
Other (incl. Port Phillip Authority and Land Conservation Council)	698	908	892	834	1,113

Environment Protection Authority

The Environment Protection Authority, constituted under the *Environment Protection Act* 1970, is responsible for protecting and improving the air, land, and water environments of Victoria through the management of wastes, control of noise, and prevention of pollution, including litter. The three-member Authority is responsible to the Minister for Conservation and is supported by about 240 professional, technical, and administrative staff. The Authority is one of several agencies within the Ministry for Conservation.

The major activities of the Authority centre on the management of air and water quality, wastes on land, environmental noise, and waste control systems. The Authority exercises immediate control over the discharge of wastes through a licensing system and team of investigators to monitor discharges and investigate complaints.

The Authority proposes environmental protection objectives through the formulation of draft State Environment Protection Policies. The draft Policies are published for public comment and review. When adopted by the Victorian Government, the Policies provide the statutory framework for decision making matters relating to pollution control.

Three State Environment Protection Policies were proclaimed prior to 20 August 1982. All aim at protecting the beneficial uses of the water in the Policy areas. The Policies proclaimed were:

- (1) *State Environment Protection Policy (Waters of the Latrobe Catchment)*, proclaimed 20 November 1981;
- (2) *State Environment Protection Policy (The Waters of the Western District Lakes)*, proclaimed 11 February 1982; and
- (3) *State Environment Protection Policy (The Waters of Lake Colac and Catchment)*, proclaimed 18 February 1982.

Further reference: *Victorian Year Book* 1982, p. 23

Land Conservation Council

Increasing concern throughout the 1960s regarding the management of Victoria's natural resources culminated in the 1969 controversy over land-use in the Little Desert. This controversy resulted in the proclamation of the *Land Conservation Act* 1970 which established the Land Conservation Council in February 1971 to replace the Land Utilisation Advisory Council originally formed in 1950.

The Council consists of thirteen members and comprises an independent chairman; the heads of government departments concerned with soil conservation, agriculture, forests, lands, rivers and water supply, minerals and energy, fisheries and wildlife, and national parks; as well as one member with experience in industry and commerce and three other members with experience in various aspects of conservation. The latter four members are appointed by the Governor in Council, two being selected from a panel of names submitted by the Conservation Council of Victoria.

The primary function of the Council is to carry out investigations and make recommendations to the Minister for Conservation on the balanced use of public land in Victoria. The *Land Conservation Act* 1970 requires that the Council must take into account the present and future needs of the people of Victoria in relation to:

- (1) Preservation of ecologically significant areas;
- (2) conservation of areas of natural interest, beauty, or historical interest;
- (3) creation and preservation of areas of reserved forest, areas for leisure and recreation, and reserves for the conservation of fish and wildlife;
- (4) preservation of species of native plants; and
- (5) land required by government departments and public authorities in order to carry out their functions.

For this purpose the Council has divided Victoria into 17 study areas and has submitted final recommendations on land-use to the Victorian Government for 15 of these areas. A map of these study areas can be found on page 32 of this *Year Book*.

The Council was also required to carry out a number of special investigations in accordance with the provisions of section 8 of the *Land Conservation Act* 1970. Three of these concerned the Stradbroke area, situated in the South Gippsland District 1 area, Gelliondale within the South Gippsland District 2 area, and the Ovens Softwood Plantation Zone in north-eastern Victoria. Final recommendations have been published for these areas.

More recently two other special investigations were undertaken at the request of the Victorian Government. One of these involved public land in the Melbourne area—Hill End and final recommendations for this area have been published.

The other was a special investigation of public land in the Alpine area, to make recommendations, bearing in mind the Victorian Government's conservation policy for the Alpine region, on those areas that might be added to the Alpine Parks system. A descriptive report has been published for this area.

In addition, the Council has conducted a review of the South-western area District 1, and has published a descriptive report and proposed recommendations. The Council has also commenced a review of the North-eastern area District 1.

Over a period of ten years, an important effect of the Council's recommendations has been the substantial increase in the area of the State permanently reserved for conservation

purposes. This has been achieved mainly through a system of national, State, and regional parks dedicated for conservation and/or recreation purposes. The Council has also established other categories of land-use primarily for conservation, or low intensity recreation, or education. These include reference areas, wilderness areas, natural features and scenic reserves, flora reserves, flora and fauna reserves, bushland reserves, coastal reserves, river, stream and lake reserves, education areas, and historic areas.

In February 1971, there were 22 national parks in Victoria covering some 196,000 hectares, or 0.86 per cent of the State. Since that time the Land Conservation Council has reviewed land-use for much of Victoria's public land and, as a result of its recommendations, many of the existing parks have been enlarged, new parks have been created, and two wilderness areas established.

As well as its role in preserving areas of special conservation significance, the Council has a responsibility to ensure that sufficient natural resources are available to meet the current and future needs of the community. One of the most important resources affected by the Council's recommendations is timber. Throughout rural Victoria the timber industry is an integral and often principal component of the total regional economy and many rural communities rely heavily on the timber industry for their economic viability.

In each of its study areas the Council has recommended, therefore, that large areas be reserved for hardwood production. These areas generally include the most highly productive hardwood stands, and although they are managed primarily for timber production, provision is made for other uses such as water production, conservation of flora and fauna, and many forms of outdoor recreation. To ensure these other values are protected adequately the Council has published principles for forest operations covering soil conservation and catchment protection, recreation and aesthetics, nature conservation, and historic sites. In addition to the timber reserved for hardwood production, the Council has also allocated large tracts in some study areas for softwood production.

Some additional resources are also retained in areas left as uncommitted land. This category of land-use ensures that land is retained to meet future requirements, although it may also be used to meet certain present needs provided the use does not bring about changes in the land that are difficult to reverse. In addition to these major categories of land-use, the Council has recommended smaller areas for agriculture, mining, and public utilities.

Soil Conservation Authority

The Soil Conservation Authority is charged under the *Soil Conservation and Land Utilization Act 1958* with the prevention and mitigation of soil erosion; the promotion of soil conservation; the determination of matters relevant to the use of all land, including Crown land, in such a manner as to achieve the above two objectives; and the promotion of efficiency in the use and development by landholders of the water resources available to them.

Working through Committees of Management, the Soil Conservation Authority provides advice and financial assistance for control of erosion on the 1,600 kilometres of Victoria's coastal foreshores. Responsibility for supervisory control of earthworks and grazing on land over 1,200 metres has the aim of minimising erosion in Victoria's valuable alpine snowfields and water catchment areas.

To achieve these aims, the Authority carries out a variety of tasks. It gives technical advice to individual landholders, local government organisations, and other government departments on the prevention and control of wind and water erosion and soil salting. It provides a service to farmers on the siting, design, and survey of dams and pipeline water supply systems for stock and domestic purposes and outside irrigation areas, and it advises farmers on irrigation development.

In the catchments to town water supplies and major storages, the Authority has responsibilities for determining land-use which will ensure the continuous production of high quality water.

Many of the above activities demand continuous research. Data on land, including geology, soil, topography, vegetation, and climatic characteristics, is being documented by the Authority on a State-wide basis. This data is used to assess the capability of land for various uses. Planning authorities are major users of this information.

The Authority carries out studies into water movement and water yield in pastured and forested catchments, as well as laboratory studies into a variety of soil characteristics

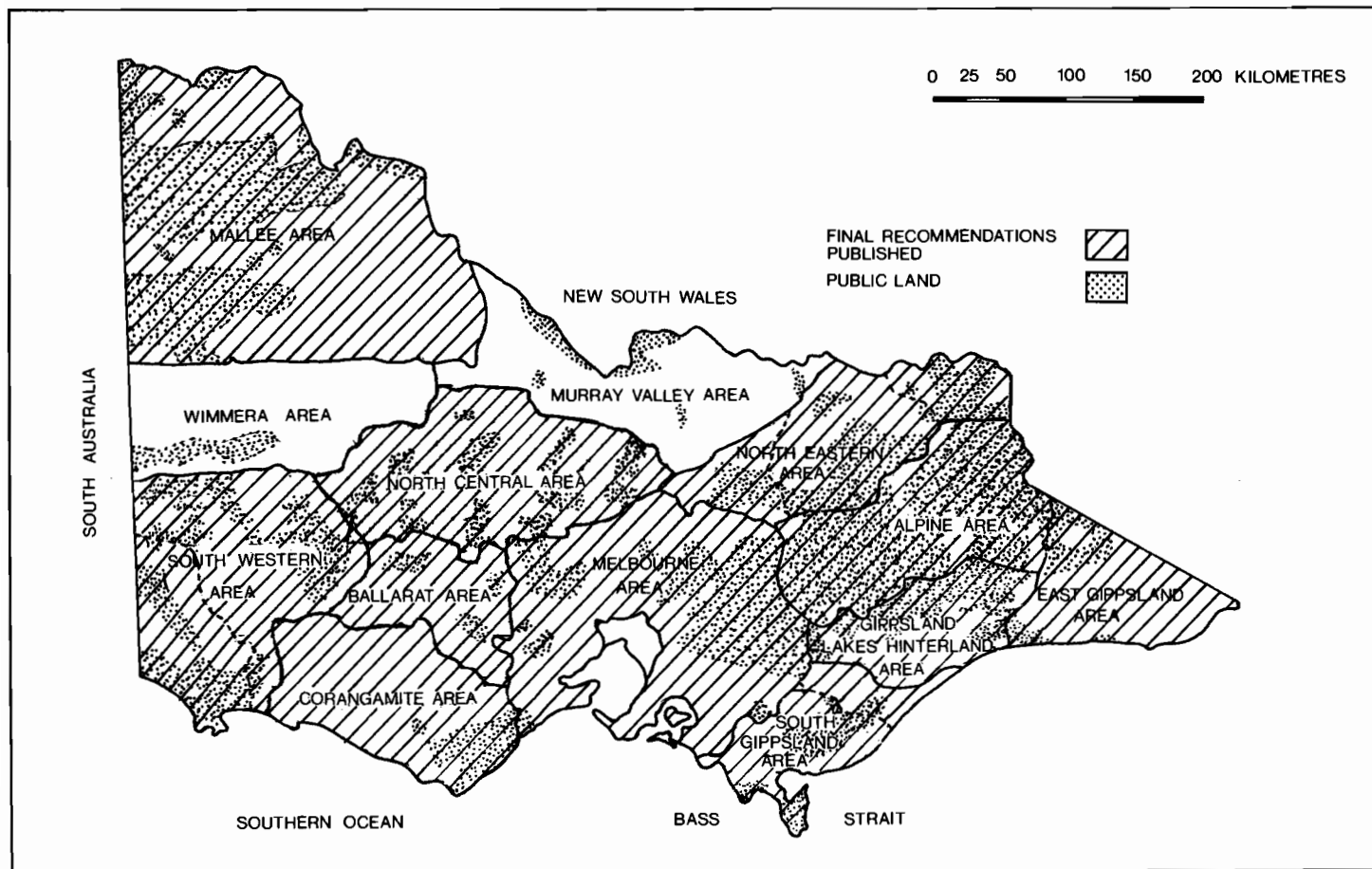


FIGURE 12. Victoria—Land Conservation Council study areas.

related to its structural or agronomic qualities. Field operations are also supported by agronomic research into the prevention and control of erosion.

In seeking to make the community aware of the problems associated with soil erosion and what can be done to check them, the Authority encourages and conducts educational excursions for schools, universities, and colleges; appraises the economics of soil conservation and land-use practices, and organises field days, competitions, and exhibits for farmers. As a further service, in association with the Victorian Education Department, the Authority prepares teacher and class project materials and guides for field excursions on soil conservation matters related to secondary school syllabuses.

The Authority provides assistance to encourage landholders to participate in approved erosion control schemes and to adopt soil conservation management practices. Grants are provided towards the cost of approved works and long-term loans are provided for extensive soil and water conservation programmes.

Further references: Destruction of vermin and noxious weeds, *Victorian Year Book* 1963, pp. 491-2; Soil, land-use, and ecological surveys, 1966, pp. 465-6; Group conservation, 1969, pp. 295-6; Land Utilization Advisory Council, 1975, pp. 288-9; 1978, pp. 41-3; Dryland farming and land restoration, 1979, pp. 31-2; Dryland salting in Victoria, 1980, pp. 42-3

Port Phillip Authority

The Port Phillip Authority was established in 1966 to advise the Victorian Government on methods of co-ordinating development within, and preserving and improving the condition of, the Port Phillip area. This area is defined as a belt of public land 200 metres to 800 metres wide; and the inshore waters and seabed approximately 600 metres wide around the coastline of Victoria from Point Lonsdale in the west to Point Nepean in the east, including Port Phillip Bay.

Around this coastline live two-thirds of the population of the State, and in very hot weather crowds of up to 300,000 persons can be expected to visit its many beaches. Besides its recreational importance Port Phillip Bay provides this population with some of its food, many of its commercial facilities, and the two main ports of Melbourne and Geelong through which the largest proportion of Victoria's sea trade is conducted.

New legislation was enacted in 1980 which changed the membership of the Authority. The Authority now consists of seven members appointed by the Governor in Council, comprising a full-time chairman of the Authority and representatives of the Department of Crown Lands and Survey, the Public Works Department, the Municipal Association of Victoria (two Councillors), the Conservation Council of Victoria, and one person nominated by the Minister having special knowledge of the use and enjoyment of the Port Phillip area by the public.

The Authority exercises an overview of all developments within its area. No structures can be erected, works commenced, vegetation removed, or uses changed without its consent. In consideration of any proposed structure or works or removal of vegetation the Authority shall have regard to the effect on the natural beauty and on the future use and enjoyment of the Port Phillip area by the public, and whether any such proposal is likely to cause any deterioration of the Port Phillip area by virtue of erosion or the deposition of sand or silt, and may grant or refuse its consent accordingly. Its approach to granting consent is further based on the criterion of permitting those activities which must be located near the shoreline. In 1977, the Authority concluded a major coastal resource study with extensive public participation. The resulting report entitled *The Port Phillip Coastal Study* provides a background to the present work of the Authority's staff in preparing guidelines for the future use and management of the Port Phillip area. The Study Report recommends that segments of the coastline be allocated for recreation of high, medium, and low intensities, for nature conservation, for ports; and that some segments be left unallocated to meet future demands.

The Authority permits activities appropriate to these designations to occur to varying extents. Further to this, a strategy has been prepared which aims to rationalise the provision of boating facilities around Port Phillip Bay. This strategy has been included in two reports, *Recreational Boating Facilities in Port Phillip Bay*, and *Aspects of Recreational Boating Facilities*. The former provides a basis for assessment of boating development proposals, which are presently under consideration.

Management plans are currently being prepared to provide for co-ordinated development of the resources of Port Phillip Bay. A number of studies aimed at providing

data from which guidelines can be determined for the optimum use and enjoyment of the coastline have been undertaken. The subjects covered include existing facilities, beach use, beach population, attitudes to the foreshore, vegetation of Port Phillip Bay, and shoreline unit classifications. A number of booklets and pamphlets have been produced for general public information. They deal with areas of the foreshore, as well as aspects of use of the Bay such as boating safety.

The Authority operates a coastal plant nursery at "Seawinds", Dromana, where coastal species indigenous to the Port Phillip region are propagated and grown. They are available to Committees of Management, conservation groups, and other bodies dealing with foreshore land. The Authority's Coastal Vegetation Service provides advice on aspects of vegetation management and landscaping.

Further references: Port Phillip Bay Environmental Study, *Victorian Year Book* 1975, pp. 48-50, p. 382; Western Port Bay Environmental Study, 1975, pp. 50-1; Gippsland Lakes Environmental Study, 1975, p. 51; 1981, pp. 33-4

National Parks Service

The National Parks Service manages just under one million hectares of land in Victoria, or 4.3 per cent of the State's total area. Under the *National Parks Act* 1975 there is provision for the National Parks Service to manage various types of parks and reserves.

National parks

In defining national parks, the Act provides: "that certain Crown land characterised by its predominantly unspoilt landscape, and its flora, fauna or other features, should be reserved and preserved and protected permanently for the benefit of the public".

At 1 July 1982, the area reserved as national parks under Schedule Two of the National Parks Act was 685,808 hectares.

Other parks

The Act provides: "that certain areas of Crown land with landscape or other features of particular interest or suitability for the enjoyment, recreation and education of the public or in matters appertaining to the countryside should be reserved permanently and made available for the benefit of the public and in particular that there should be so reserved and made available:

- (a) areas with scenic, historical, archaeological, biological, geological or other features of scientific interest that are worthy of preservation but, whether by reason of the limited size of the areas or the limited significance of the features, are not suitable for reservation as national parks;
- (b) areas that demonstrate man's effect on his environment whether through his agricultural or pastoral pursuits or otherwise;
- (c) areas in or adjacent to urban areas of natural beauty of interest or otherwise suitable for recreational use;
- (d) areas of natural beauty or interest primarily for recreational and educational use but parts of which may be used for primary industry, hunting, shooting, fishing or other uses appropriate to the area; and
- (e) areas in their natural state for scientific study or reference".

At 1 July 1982, the area reserved as other parks under Schedule Three of the National Parks Act totalled 298,080 hectares. The National Parks Service also manages 1,225 hectares under arrangement with other authorities or special provisions of the National Parks Act.

New parks and reserves

Major recent developments have included the declaration of three major national parks and the acquisition of significant smaller reserves.

(1) Wonnangatta-Moroka National Park (Declared 1 July 1982)

Located in the headwaters of the Howqua, King, Catherine, Wonnangatta, Moroka, Caledonia, and Macalister Rivers, this park of 107,000 hectares contains the alpine summit of Mt Howitt and the distinctive peaks of Mts Cobbler, Speculation, and Kent. It is now the largest national park in Victoria.

Nature conservation values are very high. Vegetation communities include alpine herbfields on Mt Howitt, snow gum woodlands and grasslands on the Howitt and

Bennison Plains, and alpine ash and riverine forests. Rare plant species include Willow-herb and Alpine Finger-fern at Conglomerate Creek Falls, and Maidenhair Spleenwort at Bryces Gorge.

The park can be approached from north-eastern Victoria, the La Trobe Valley, or Mansfield.

(2) *Bogong National Park* (Declared 1 October 1981)

This very important area of 81,000 hectares contains the most extensive and spectacular alpine scenery in the State. It encompasses nine of Victoria's ten highest peaks, including Mt Bogong and Mt Feathertop, and the Bogong High Plains. The park provides outstanding opportunities for many forms of outdoor recreation, particularly cross-country skiing, bushwalking, and sightseeing.

(3) *Otway National Park* (Declared 1 July 1981)

The wet mountain forests of the Otway Ranges are quite distinctive. Their plants and animals show affinities with eastern Victoria and Tasmania, and differ from those in other parts of the State.

The Otway National Park of 12,750 hectares is representative of this wet mountain forest. It contains the Calder, Parker, and Elliott River catchments, as well as foothill forest, coastal vegetation, and heathy to shrubby woodland, with their associated fauna.

Geological diversity and several uncommon plant and animals species enhance nature conservation values. Scenic features include examples of myrtle beech gullies, streams, and undeveloped coastlines. The park includes the coastline from Princetown to the Elliott River, but excludes the Cape Otway Lightstation Reserve, an area of Commonwealth land which contains Cape Otway itself.

(4) *Sorrento Historic Site*

The first official settlement in Victoria, from October 1803 until early in 1804, was at Sorrento. On 1 June 1981, the Victorian Government agreed to match funds raised by a public appeal to purchase the site. Sponsors of the appeal included the National Trust, the Shire of Flinders, the Royal Historical Society, and the Sorrento-Portsea-Blairgowrie Conservation Group. The appeal raised substantial funds, and the Victorian Government took possession of the site on 23 April 1982. The property is under the control of the Director of National Parks. At the initial stage the Service's control will be of the actual grave sites (an existing Crown Reserve of 693 square metres) and the recently acquired land, an area of approximately 4.4 hectares. Acquisition of this site is of particular significance in view of the State's official sesquicentenary celebrations of 1834-1984.

(5) *Long Forest Flora Reserve*

An area of 147.6 hectares of land in the Parish of Merrimu, Shire of Bacchus Marsh, was reserved by Order in Council dated 20 October 1981.

The Director of National Parks was appointed to manage the property under the *Crown Land (Reserves) Act 1978* on 22 December 1981. The land was acquired under Planning Scheme provisions by Bacchus Marsh Shire Council and subsequently transferred to the Crown. The acquisition was put in hand because of the high conservation values of the land, and especially the importance of conserving for scientific purposes the unjoined Mallee communities of the area. Control of the use of the area and protection of its values will be achieved by appropriate regulations.

Volunteer assistance in parks

The Service is receiving considerable and growing support from volunteers. In a time of constraints on staffing levels and finance, the contribution made by volunteers enables the Service to undertake projects which might not otherwise be possible.

The number of "Friends" groups organised under the auspices of the Victorian National Parks Association has increased to ten, in Organ Pipes, Wilsons Promontory, Wyperfeld, Nepean, Baw Baw, Mt Worth, Kinglake, Warrandyte, Nyerimilang, and Gellibrand Hill parks. All are providing valuable assistance in the parks, engaged on projects such as weed control, rubbish removal, tree planting, and resource surveys.

A number of other organisations are providing valuable assistance in the form of various projects. Examples are the Victorian Association of Four Wheel Drive Clubs and its member clubs, which undertake a wide range of tasks; the Federation of Victorian

Walking Clubs, which conducts track clearing and maintenance weekends; and the recently formed Australian Trust for Conservation Volunteers, assisting in vermin control and tree planting projects.

Conclusion

The addition of the most recent new parks brings the area managed by the National Parks Service to 985,113 hectares. This system of parks, still developing as the Land Conservation Council continues its work, will cater for both conservation and recreation needs in the years to come. The National Parks Service, which has grown considerably in the past decade, is planning and developing the parks with both these needs in mind.

VICTORIA—AREAS UNDER THE CONTROL OF THE NATIONAL PARKS SERVICE, JULY 1982

National parks		Other parks (a)	
	Area (hectares)		Area (hectares)
1. Alfred	2,300	1. Beechworth H.P.	1,130
2. Baw Baw	13,300	2. Big Desert Wilderness	113,500
3. Bogong	81,000	3. Cape Nelson S.P.	210
4. Brisbane Ranges	7,485	4. Cape Schanck C.P.	1,075
5. Bulga	80	5. Cathedral Range S.P.	3,570
6. Burrowa-Pine Mountain	17,300	6. Chiltern S.P.	4,250
7. Churchill	193	7. Coopracambra S.P.	14,500
8. Croajingolong	86,000	8. Discovery Bay C.P.	8,530
9. Fern Tree Gully	466	9. Eildon S.P.	24,000
10. Fraser	3,750	10. Gellibrand Hill P.	645
11. Glenaladale	183	11. Gippsland Lakes C.P.	16,100
12. Hattah-Kulkyne	48,000	12. Glenample Homestead	(b) 8
13. Kinglake	11,290	13. Haining Farm	66
14. The Lakes	2,380	14. Holey Plains S.P.	10,450
15. Lind	1,166	15. Lake Albacutya P.	10,700
16. Little Desert	35,300	16. Langwarrin F.F.R.	(b) 206
17. Lower Glenelg	27,300	17. Long Forest F.R.	(b) 147
18. Morwell	283	18. Lysterfield P.	1,150
19. Mt Buffalo	31,000	19. Melba Gully S.P.	48
20. Mt Eccles	400	20. Mt Samaria S.P.	7,600
21. Mt Richmond	1,707	21. Mt Worth S.P.	1,000
22. Organ Pipes	85	22. Murray-Kulkyne P.	1,550
23. Otway	12,750	23. Nepean S.P.	1,149
24. Port Campbell	1,750	24. Nyerimilang	(b) 176
25. Snowy River	26,200	25. Pink Lakes S.P.	50,700
26. Tarra Valley	140	26. Pirianda Garden	(b) 11
27. Tingaringy	18,000	27. Sorrento Historic Site	(b) 5
28. Wilsons Promontory	49,000	28. Steiglitz H.P.	658
29. Wonnangatta-Moroka	107,000	29. Wabonga Plateau S.P.	21,200
30. Wyperfeld	100,000	30. Warby Ranges S.P.	3,320
Total national parks	685,808	31. Warrandyte S.P.	384
		32. Werribee Gorge S.P.	375
		33. Yea River P.	220
		Miscellaneous areas (mainly purchased lands)	(b) 672
		Total other parks	299,305

(a) C.P. = Coastal Park; H.P. = Historic Park; P = Park; S.P. = State Park; F.R. = Flora Reserve; F.F.R. = Flora and Fauna Reserve.

(b) Managed by National Parks Service but not declared under the National Parks Act.

A special article on national parks in Victoria, supported by photographs and a map, appears on pages 1–35 of the *Victorian Year Book* 1975.

Further reference: *Victorian Year Book* 1982, pp. 28–31

NATIONAL MUSEUM OF VICTORIA

The National Museum of Victoria was founded in 1854 and is constituted by an Act of Parliament, the *National Museum of Victorian Council Act* 1970. The control and management of the museum is vested in the National Museum of Victoria Council, a body corporate responsible to the Minister for the Arts. Staff are appointed under the *Victoria Public Service Act* 1974.

Soon after it was founded, the Museum was established at the University of Melbourne with a subsequent move, in 1899, to the current premises in Russell Street. The Museum is a centre for scholarship and research in the fields of natural history (zoology and geology) and anthropology, and for education in these fields. It also functions, under the Act, as the repository for the State Collections of natural history, ethnological, and archaeological specimens. The collections provide the basic materials for both the research and education activities of the Museum.

Collections

Through the efforts of its staff and the generosity of Victorians, the National Museum of Victoria has amassed collections of major international standing during its 126 years of activity.

These collections include millions of zoological and geological specimens and over 100,000 human artefacts. Although the emphasis is on the natural history and anthropology of Victoria and the south-eastern corner of Australia, the collections include a great deal of material from other parts of Australia and from other countries. The collections of Australian and Oceanic ethnology are particularly significant, ranking among the finest in the world.

The collections form a valuable resource for scientific study. The records associated with the specimens form a "data base" of zoological, geological, and anthropological information which may be used in many ways in the service of the community. The collections are also a vast source of material which may be used in exhibitions and other ways to inform and inspire the public about Australian wildlife, geological history, and the cultural achievements and lifestyles of the peoples of the region.

Research

Research in the National Museum is principally oriented towards collections. In Zoology, most research concerns the classification, distribution, evolution, and descriptive ecology of Australian fauna. It includes environmental surveys on behalf of other Victorian organisations in terrestrial, inland water, and marine environments. Palaeontologists in the Division of Geology study the taxonomy and distribution of fossil species giving a time dimension to the understanding of the Australian fauna and environment. In mineralogy and petrology, the main objective is to record and describe systematically the minerals and rocks of the region. In Anthropology, the emphasis is on material culture of Aboriginal and Oceanic societies.

Although research emphasis is given to the natural history and anthropology of south-eastern Australia, the study of comparative material from elsewhere is generally necessary to keep the results in scientific context.

Research results by staff are published in professional journals throughout the world and in the Museum's own journal entitled *Memoirs of the National Museum of Victoria* (which is also available to other scientists who have studied material in the Museum's collections or matters of interest to the Museum).

In 1982, another journal *Reports of the National Museum of Victoria* was established to publish documents which are factual rather than interpretative studies but which are of sufficient importance to be preserved and are not appropriate for primary scientific publication.

Education

The National Museum plays a diverse role in public education. The "schools programme" is run by teachers seconded from the Education Department and the Catholic Schools System. During the school year, classes attend the Museum and are instructed by the teachers in the exhibition galleries and in special teaching facilities. In addition, many children visit the Museum, supervised by their own class teachers, and assisted by written material produced in the Museum's Education Office.

Public gallery exhibitions of specimens from the collections put into environmental, cultural, or other context, tell of the wildlife and geological history of the region and of the lifestyles and material cultures of its peoples from pre-historic times to the present. Although the exhibitions at present are often old-fashioned and limited in scope, the National Museum has great potential to provide a quality exhibitions programme because of its possession of such extensive historic collections. A long-term exhibitions development programme is now being planned.

The first stage of this programme has been the redevelopment of Spencer Hall, the entrance to the Museum, as a location for temporary displays. The Museum's most famous exhibit *Phar Lap* has been placed here in a new display case. Funds for this redevelopment were raised through the National Museum Appeal inaugurated in October 1980, the Victorian Government contributing on a dollar for dollar basis to a maximum of \$250,000. Spencer Hall was opened in December 1980.

The second stage of the redevelopment was a major exhibition in McCoy Hall, *Dinosaurs from China*, which ran from October 1982 through to February 1983.

A modern museum can be a place where learning is entertaining, where persons can participate in activities as well as observe and enjoy beautiful and interesting items exhibited in glass cases. A new building is now being planned where a museum service appropriate to the rich scientific and cultural collections can be established.

Friends of the National Museum Society

In 1979, the Friends of the National Museum Society was established through initiatives from the public and with support of the National Museum of Victoria Council. By the end of that year there were over 800 members. The Society has an active programme of lectures, films, field trips, workshops, and social events. The objectives of the Society are to lend its support to the re-development of the Museum and stimulate contact between the Museum and the public.

Further references: *Zoological Board of Victoria*, 1980, pp. 47-8; 1982, pp. 32-3; *Royal Botanic Gardens and National Herbarium*, 1982, pp. 31-2

PHYSICAL FEATURES

Boundaries and areas

Creation of Victoria

The boundaries of the Port Phillip District of New South Wales were defined in *Imperial Act 5 & 6 Victoriae* c.76 of 30 July 1842 ('An Act for the Government of New South Wales and Van Diemen's Land') as follows:

'... the Boundary of the District of Port Phillip on the North and North-east shall be a straight Line drawn from Cape Howe to the nearest Source of the River Murray, and thence the Course of that River to the Eastern Boundary of the Province of South Australia.'

Previously, by *Imperial Act 4 & 5 William IV* c.95 of 15 August 1834, *Letters Patent* of about 19 February 1836, and *Imperial Act 1 & 2 Victoriae* c.60 of 31 July 1838, the eastern boundary of the Province of South Australia was fixed as '... the One hundred and forty-first Degree of East Longitude ...'.

By *Imperial Act 13 & 14 Victoriae* c.59 of 5 August 1850 ('An Act for the better Government of Her Majesty's Australian Colonies'), the District of Port Phillip was granted the right to separate from New South Wales.

Boundaries

On 2 May 1851, The Victoria Electoral Act of 1851 was passed (*New South Wales Act 14 Victoria* No. 47) which provided for the division of the Colony of Victoria into electoral districts. A schedule to the Act set forth the boundaries of the electoral districts, being based on the boundaries of the counties then in existence. Those boundaries of the electoral districts which formed the boundaries of Victoria were described as:

'a line running in a westerly direction from Cape Howe to the source of the nearest tributary of the Murray';

'the River Murray';

'the South Australian frontier';

'the 141st meridian being the line dividing the Colony of New South Wales from South Australia';

'the sea';

'the sea shore';

'the sea coast';

'including the Lawrence and Lady Julia Percy's Islands';

'including all the islands at Port Fairy';

'Port Phillip Bay';

'the shores of Port Phillip Bay';
'the waters of Port Phillip';
'including the small islands near the channels at the mouth of Port Phillip and those of Geelong Bay';
'including French and Phillip Islands and the small islands in Western Port Bay'.

Writs for the election of a Legislative Council in Victoria were issued on 1 July 1851, thereby establishing the Colony of Victoria.

Murray River

The separation of Victoria from New South Wales in 1851, and the successful navigation of the Murray by steam vessels, encouraged widespread evasion of New South Wales customs duties on articles taken across from Victoria and South Australia. The question arose as to which Colony had jurisdiction over the waters of the Murray River. The position was determined by the New South Wales Constitution (*Imperial Act 18 & 19 Victoriae c.54 of 16 July 1855*), which decreed that the whole watercourse of the Murray River from its source to the eastern boundary of the Colony of South Australia was thereafter to be within the Territory of New South Wales, thus fixing the left bank as the boundary between Victoria and New South Wales.

In May 1980, the High Court of Australia clarified the situation further by ruling that the northern boundary of Victoria followed the top of the southern (left) bank of the Murray River, all territory to the north being within New South Wales.

Cape Howe to the Murray River

In 1866, following the discovery of gold on the tributaries of the Snowy River near the position where the boundary was thought to be, it became evident that the remaining portion of the New South Wales-Victoria boundary should be marked on the ground. A definitive point at Cape Howe was agreed upon by the two colonies following an on-site conference between the New South Wales Surveyor General (P. F. Adams) and the Victorian Government Astronomer and Superintendent of Geodetic Survey (R. L. J. Ellery). This point was marked and named Conference Point.

Late in 1869, Alexander Black, a Victorian geodetic surveyor, was directed to determine the headwaters of the Murray River. These he identified as a certain spring near Forest Hill. Black then proceeded to clear and mark the western portion of the boundary while another Victorian geodetic surveyor, Alexander C. Allan, marked the eastern portion. The marking was completed in early 1872 and the line, which extended some 176 kilometres through extremely rugged country, passed within 5.6 metres of the provisionally established Conference Point.

The official technical description of the boundary gave as the initial azimuth $116^{\circ} 58' 09'' .42$ from the spring to Station No. 1 on Forest Hill (452.6 metres away), while from a point on the coast at Cape Howe, 176,492.1 metres from the spring, the azimuth of the same line extending out to sea was given as $115^{\circ} 53' 41'' .36$ to a point distant one league (5.56 kilometres) from high water line at Cape Howe.

The total length of the New South Wales boundary including the Murray River is about 2,050 kilometres.

Victoria-South Australia border

The boundary between South Australia and Victoria has had an interesting history, involving heroic work by surveyors and later much litigation between the colonies which culminated in an appeal to the Privy Council.

Prior to the creation of the Province of South Australia, New South Wales covered all of the mainland of Australia as far west as the 135° east meridian. South Australia was established in the 1830s, the boundaries being '... on the North the Twenty-sixth Degree of South Latitude, on the South the Southern Ocean, ... , and on the East the One hundred and forty-first Degree of East Longitude ...'. Thus the western boundary of New South Wales between the 26° south parallel and the coast was defined by the 141° east meridian.

By the late 1830s, it had become apparent that the south-eastern corner of South Australia would need to be located and marked on the ground, as the Hentys of Portland Bay had extended their pastoral activities over the Glenelg River to Mount Gambier and

there were disputes as to which Government (South Australia or New South Wales) had jurisdiction there.

Late in 1846, surveyors Henry Wade from New South Wales and Edward R. White from South Australia commenced the marking of the 141° east meridian. Their starting point was some 2 kilometres west of the mouth of the Glenelg River which had previously been determined to be the most likely position of the meridian. In July 1847, after completing 198 kilometres of the boundary, the party was forced to discontinue the survey due to sickness. Subsequently both colonies issued proclamations adopting the boundary as marked. Surveyor White was requested to proceed with the survey and in December 1850 reached the Murray River after suffering months of overwhelming privations which contributed to his early death.

Doubts about the accuracy of the determination of the 141° east meridian (upon which Wade's and White's surveys were based) were expressed in the 1840s and grew in the 1850s, but no action was taken until the late 1860s. Although there was no conclusive evidence, the Governments of South Australia and New South Wales were agreed that it was desirable to verify the longitude of the line marked by Wade and White, before proceeding with the marking of the boundary between those two colonies north of the Murray River.

There was reason to believe that a more accurate location of the 141° east meridian could be established. Since the determinations of the position of the 141° east meridian near the coast between 1839 and 1845 there had been increases in scientific knowledge, larger and more accurate instruments were available, and the electric telegraph had been developed. Furthermore, as the result of the appointment of government astronomers in Sydney and Melbourne, there were more accurate values for the longitudes of these cities. In May 1868, a temporary observatory was established at Chowilla and as a result of precise observations, and with the aid of the newly developed electric telegraph, George Smalley, New South Wales Government Astronomer, and Charles Todd, South Australian Superintendent of Telegraphs, determined the 141° east meridian to be approximately 3.6 kilometres east of the boundary marked by White.

After many years of vain efforts asking Victoria to relinquish the land between the marked boundary and the more accurately determined 141° east meridian, the South Australian Government in 1911 appealed to the High Court of Australia. When this appeal failed, it appealed to the Privy Council which ruled in favour of Victoria in 1914. Thus ended the dispute; the boundary as marked, approximating to a longitude of 140° 58' east, was confirmed as the State boundary.

There remains the question of the location of the border in the far north-western corner of Victoria, along the Murray downstream from the 141° meridian (as determined by Smalley and Todd) to Wade and White's line. The length of this section of the river is about 10 kilometres with Victoria to the south and South Australia to the north of the river.

Recent legal opinion suggests that ordinary common law principles would apply; consequently, the boundary is presumably the centre thread of the Murray as at 1842 (as modified by slow and imperceptible natural changes in its course since then).

Offshore boundaries

The *Imperial Act 13 & 14 Victoriae c.59* of 5 August 1850 which separated the Colony of Victoria from New South Wales described only the land boundaries of the new Colony; no southern boundary was defined. However, the northern boundary of Van Diemen's Land (Tasmania) was defined in 1825 as the latitude 39° 12' south and this has generally been accepted as the southern limit of Victoria's jurisdiction. It lies about 7 kilometres south of Wilsons Promontory. The lateral offshore boundaries between Victoria and the adjoining mainland States have not been defined.

In 1973, the Commonwealth Government passed the *Seas and Submerged Lands Act 1973* (No. 161), and it received the Royal Assent on 4 December 1973. The Act declares that the sovereignty in respect of the territorial sea of Australia, and in respect of the air space over it and in respect of its bed and subsoil, is vested in and exercisable by the Crown in right of the Commonwealth. The Act gives the Governor-General power to proclaim the breadth of the territorial sea, and the power to proclaim the baseline from which the breadth of the territorial sea is to be measured. The Act declares that the

sovereignty in respect of the internal waters of Australia (that is to say, any waters of the sea on the landward side of the baseline of the territorial sea) not within the limits of a State, and in respect of the airspace over those waters and in respect of the seabed and subsoil beneath those waters, is vested in and exercisable by the Crown in right of the Commonwealth.

Baselines from which the territorial sea is to be measured are delimited according to procedures spelt out by the Convention on the Territorial Sea and the Contiguous Zone which was signed at Geneva on 29 April 1958, and under which Australia has obligations under international law.

The six Australian States challenged the validity of the Seas and Submerged Lands Act in the High Court of Australia, but in the decision handed down on 17 December 1975, the High Court dismissed all actions thereby confirming that, broadly speaking, the sovereignty of the Crown in right of the States extends only to low-water line. This applies both to the mainland and to islands off the coast which belong to the State, which in the case of Victoria would probably mean all islands between 140° 58' and 149° 58' east longitude (approximately) to the north of 39° 12' south latitude.

Depth

Although no depth limitation for Victoria was given in the Imperial Statutes defining the boundaries of Victoria, it has always been accepted that the Crown has sovereignty to the centre of the earth. The Land Act of 1891 imposed a depth limit in new Crown grants and, since 8 August 1892, 99 per cent of Crown grants issued have been limited to the surface and down to a depth of 15.24 metres below the surface. Since 3 July 1973, the depth limitation for new Crown grants has been 15 metres. A well or spring to obtain water from the ground is not necessarily subject to the depth limitation imposed in the Crown grant.

The exceptions to the 15 metres depth limitation on freehold tenure are:

- (1) In areas close to coal mines, gravel deposits, etc., where the depth limits were fixed in 1909 at 7.62 metres, sometimes 6.10 metres, or 9.14 metres—e.g., Wonthaggi, Kirrak, Korumburra, Woolamai, and Tarwin. Crown grants issued since 3 July 1973 in Wonthaggi and Kirrak are to be the same as elsewhere, namely 15 metres;
- (2) on sites for buildings with deep foundations, e.g., 30 metres, 60 metres;
- (3) some land at Morwell and Churchill—305 metres; and
- (4) lands vested in the Commonwealth. The depth limitation is usually 76 metres (occasionally 15 metres) but by sections 8 and 10 of the *Lands Acquisition Act 1955-1973*, the Commonwealth can compulsorily acquire Crown lands to unlimited depth, thus implying that the State of Victoria extends to the centre of the earth.

Height

Although no height limitation for Victorian territory was given in the Imperial Statutes defining the boundaries of Victoria, it has generally been accepted that the Crown has complete and exclusive sovereignty over the air space above its territories.

The Convention on Civil Aviation of 1944 (the Chicago Convention), to which Australia was a party, recognises that every contracting State has complete and exclusive jurisdiction over the air space above its territory. Territory is defined for the purposes of the Convention as being the land areas and territorial waters adjacent thereto under the sovereignty of the contracting State.

The Commonwealth Parliament has the constitutional power to legislate to give effect to the Chicago Convention and in relation to air navigation with respect to trade and commerce with other countries and among the Australian States.

The Victorian Parliament has power to make laws relating to the control and use of the air space above its territory which are not inconsistent with laws made by the Commonwealth Parliament on the matter.

In pursuance of its constitutional powers the Commonwealth Parliament has passed legislation regulating air navigation within the air space over the whole of Australia. The Victorian Parliament has passed the Air Navigation Act of 1958 which provides that the Air Navigation Regulations made under the Commonwealth Air Navigation Act, to the extent that they do not apply to the air space over Victoria of their own force, apply to air navigation within that air space as Victorian law.

Geographic position and area

The most southerly point of Wilsons Promontory, in latitude 39° 08' S., longitude 146° 22½' 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, 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.

Victoria covers an area of about 227,600 square kilometres. It is therefore slightly smaller than Great Britain which (if inland water is included) contains 229,900 square kilometres.

The following table shows the area of Victoria in relation to that of Australia, the other States, and mainland Territories:

AUSTRALIA—AREA OF STATES AND TERRITORIES

State or Territory	Area square kilometres	Percentage of total area
Western Australia	2,525,500	32.88
Queensland	1,727,200	22.48
Northern Territory	1,346,200	17.52
South Australia	984,000	12.81
New South Wales	801,600	10.44
Victoria	227,600	2.96
Tasmania	67,800	0.88
Australian Capital Territory	2,400	0.03
Australia	7,682,300	100.00

Mountain areas

A wedge of mountainous country extends across Victoria; it tapers from the high peaks of the north-east and far east of the State to the western limits of the highlands at the lower Dundas Tableland near the South Australian border. This belt of high country, which includes the Great Dividing Range, separates the Northern, Wimmera, and Mallee Plains from the plains and uplands of the coastal areas and forms the watershed dividing the northern flowing tributaries of the Murray River from the southern flowing streams. Further information on the Great Dividing Range in Victoria can be found in Chapter 1 of the 1980 edition of the *Victorian Year Book*.

Considerable geological variation occurs in the highlands with granitic intrusives, volcanic complexes, sedimentary and metamorphic rocks and tectonic structures all in evidence. Broad plateaux, high plains, and extensive ridge and valley terrains are the chief topographic characteristics with only occasional high peaks and deep gorges occurring. A broad low pass to the north of Melbourne (the Kilmore Gap) provides an easy route across the highlands and this is utilised by the major road and rail links to the north. The Kilmore Gap provides a convenient reference point at which to divide the highlands into eastern and western sections.

Eastern section

The highlands of eastern Victoria consist of strongly dissected and steeply sloping forested country with narrow ridges and deep V-shaped valleys. The area which includes the highest peaks is contiguous with the Kosciusko massif in New South Wales, but the Victorian mountains lack the clear evidence of past glacial activity that can be found in limited areas of Kosciusko. Frost weathering has been intensive at higher elevations and some spectacular accumulations of weathered rock occur as block streams or rock rivers such as at Mt Wombargo near the headwaters of the Murray River.

The high country is not typically alpine in character: sharpened peaks and precipitous bluffs are rare, although the Cobberas, The Bluff, and the Mt Buffalo gorge all have impressive cliffs. One distinctive feature of the generally dissected mountain landscape is the High Plains country. Flat to gently undulating topography at elevations of 1,300

metres and above occurs, for example, as the Nunniong, Bogong, and Dargo High Plains, and the High Plains of the Snowy Range. These plains are remnants or residuals of formerly more extensive upland surfaces and include many different rock types—the basalts of the Bogong and Dargo High Plains being two of the best known.

Although snow capped for the winter season with a snow line at about 1,000 metres, even the highest peaks—Mt Bogong (1,986 metres) and Mt Feathertop (1,922 metres)—become free of snow in summer.

Western section

The highlands here are of much lower relief than the eastern section and in places lack the clearly defined watershed of the eastern ranges. A notable feature is the concentration of volcanic activity (Newer Volcanics) extending from just north of Melbourne to the Ballarat district in the west. Over 200 eruption points have been identified with many of the lava flows now forming ridges which bury the pre-volcanic stream channels and give rise to deep leads some of which are gold bearing. Diversion and modification of river courses by lava flows has led to the formation of waterfalls, for example, on the Coliban River at Trentham Falls where the river runs across lava and cascades over 20 metres onto bedrock.

The following table lists some of Victoria's highest mountains:

VICTORIA—HEIGHT OF SELECTED MOUNTAINS
(metres)

Mountain	Height	Mountain	Height
Bogong	1,986	Niggerhead	1,843
Feathertop	1,922	McKay	1,843
Nelse North	1,883	Cobberas No. 1	1,838
Fainter South	1,877	Cope	1,837
Loch	1,874	Spion Kopje	1,836
Hotham	1,861	Buller	1,804

The most rugged section of highland in western Victoria is The Grampians, a series of resistant sandstone ridges etched out by differential weathering and removal of softer siltstones and shales. The highest peak, Mt William (1,167 metres), has a spectacular easterly facing escarpment and a broad plateau-like summit surface. The Grampians form a major water catchment for the Wimmera and Glenelg systems.

Coastline

The Victorian coastline comprises many types of environments. Broad sandy beaches and impressive cliffed headlands along the ocean coast contrast with mangrove-fringed mudflats and marshland of the sheltered embayments and estuaries. There are approximately 1,200 kilometres of ocean coast between Cape Howe and the South Australian border; in addition three large embayments—Port Phillip Bay (260 kilometres), Western Port (140 kilometres), and Corner Inlet (80 kilometres)—partially enclose protected waters where most of the ports and harbours are situated.

Much of the ocean coast is exposed to high wave energy from strong and regular ocean swells and storm wave activity generated in the Southern Ocean. In western Victoria, swells arrive predominantly from the west and south-west, while the coastline of eastern Victoria (particularly east of Wilsons Promontory) is subject to swell from the south-east across the Tasman Sea. The shape of the long, gently curving Ninety Mile Beach from Corner Inlet to Lakes Entrance is determined by wave action from this swell.

Three general coastal types may be recognised: cliffed coasts, sandy coasts, and salt marsh and swamp coasts. The most extensive cliffed section is west of Port Phillip Bay from Torquay to Warrnambool, including a zone where the Otway Ranges lie adjacent to the coastline. The sandstone rocks of the Otways generally dip seaward and form steep cliffs, commonly with a level rock bench called a shore platform lying between high and low tide marks. Intricate weathering and erosion forms develop, etching out details of rock structures in the cliffs and platforms. Along this sector, sandy beaches are rare, being confined to small embayments or river mouths and often containing a high component of gravel.

West of Cape Otway to Warrnambool and particularly from the Gellibrand River to Peterborough is a spectacular cliffed coastline cut into soft horizontally bedded limestones

and marls. Wave action has eroded along joints and weaknesses in the rock to produce near-vertical cliffs up to 60 metres high and forming blowholes, arches, and isolated rock stacks. Many of these features may be observed in the Port Campbell National Park.

High cliffed sectors are formed in volcanic rocks near Portland where Cape Duquesne and Cape Bridgewater illustrate many of the features associated with volcanic explosions and lava flows. As well, the coast at Cape Schanck and the ocean coast of Phillip Island are cliffed into layers of early Tertiary lava flows. Along the Gippsland coast sandstones form high cliffs at Cape Paterson and Cape Liptrap, while the plunging cliffs of Wilsons Promontory are of granite. Shore platforms occur in both the sandstone and the volcanic rocks but no such feature is found along the granite sectors.

Sandy beaches backed by extensive dune topography extend around Discovery Bay in far western Victoria. In many places these dunes were actively eroding and sand was spilling and blowing inland to cover coastal vegetation. Similar erosion was also present along the Ninety Mile Beach and on the sandy beaches and dunes further east between Lakes Entrance and Cape Howe. Some of this erosion is now being controlled by soil conservation measures.

Estuary and lagoon systems occur at river mouths or where embayments have been partially or wholly enclosed by sand. Rivers such as the Snowy, the Barwon, and the Glenelg have lagoons occupying their lower reaches and the river mouth may be constricted by the growth of sandy spits. These may be breached and modified by flood discharge. During the floods of early 1971 the Snowy River shifted its outlet over one kilometre to the west by breaking through the dune-capped barrier that deflects the entrance eastward of Marlo.

The Gippsland Lakes are an extensive lagoon system enclosed behind broad sandy barrier systems. In the sheltered lake waters deposits of silt and mud have accumulated among the reed swamps at the mouths of rivers to form long silt jetties or deltas. The largest of these, the Mitchell delta, and its companion at the mouth of the Tambo River are no longer extending, but are subject to erosion by wave action.

In the shallow and sheltered waters of Western Port and Corner Inlet, mangrove swamps and salt marsh form a broad coastal fringe. Creeks and channels cross the soft, sticky mud-flats exposed in front of the mangrove fringe and form intricate patterns of tidal drainage. Smaller areas of mud and mangrove occur in the estuaries of the Barwon River and the Tarwin River; in the latter, the rapid spread of an introduced, salt-tolerant plant (*Spartina anglica*) is of particular interest.

Physical divisions

The chief physical divisions of Victoria are shown in Figure 13 on page 45. Each of these divisions has certain physical features (elevation, geological structure, climate, and soils) which distinguish it from the others. The following is a list of these divisions:

1. Murray Basin Plains:
 - (a) The Mallee
 - (b) The Riverine Plains
 - (c) The Wimmera
2. Central Highlands:
 - A. The Eastern Highlands
 - B. The Western Highlands:
 - (a) The Midlands
 - (b) The Grampians
 - (c) The Dundas Tablelands
3. Western District Plains:
 - (a) The Volcanic Plains
 - (b) The Coastal Plains
4. Gippsland Plains:
 - (a) The East Gippsland Plains
 - (b) The West Gippsland Plains
5. Southern Uplands:
 - (a) The Otway Ranges
 - (b) The Barrabool Hills
 - (c) The Mornington Peninsula
 - (d) The South Gippsland Highlands
 - (e) Wilsons Promontory

Murray Basin Plains

These plains include the areas commonly known as the Mallee, the Wimmera, and the Northern or Riverine Plains. The plains are effectively subdivided by a topographic feature known as the Leaghur Fault which runs sub-parallel with the Loddon River immediately west of Kerang.

From the Murray River to the Central Highlands, eastwards of the Leaghur Fault, is the remarkably flat landscape of the Riverine Plains, which are coalescing alluvial plains of

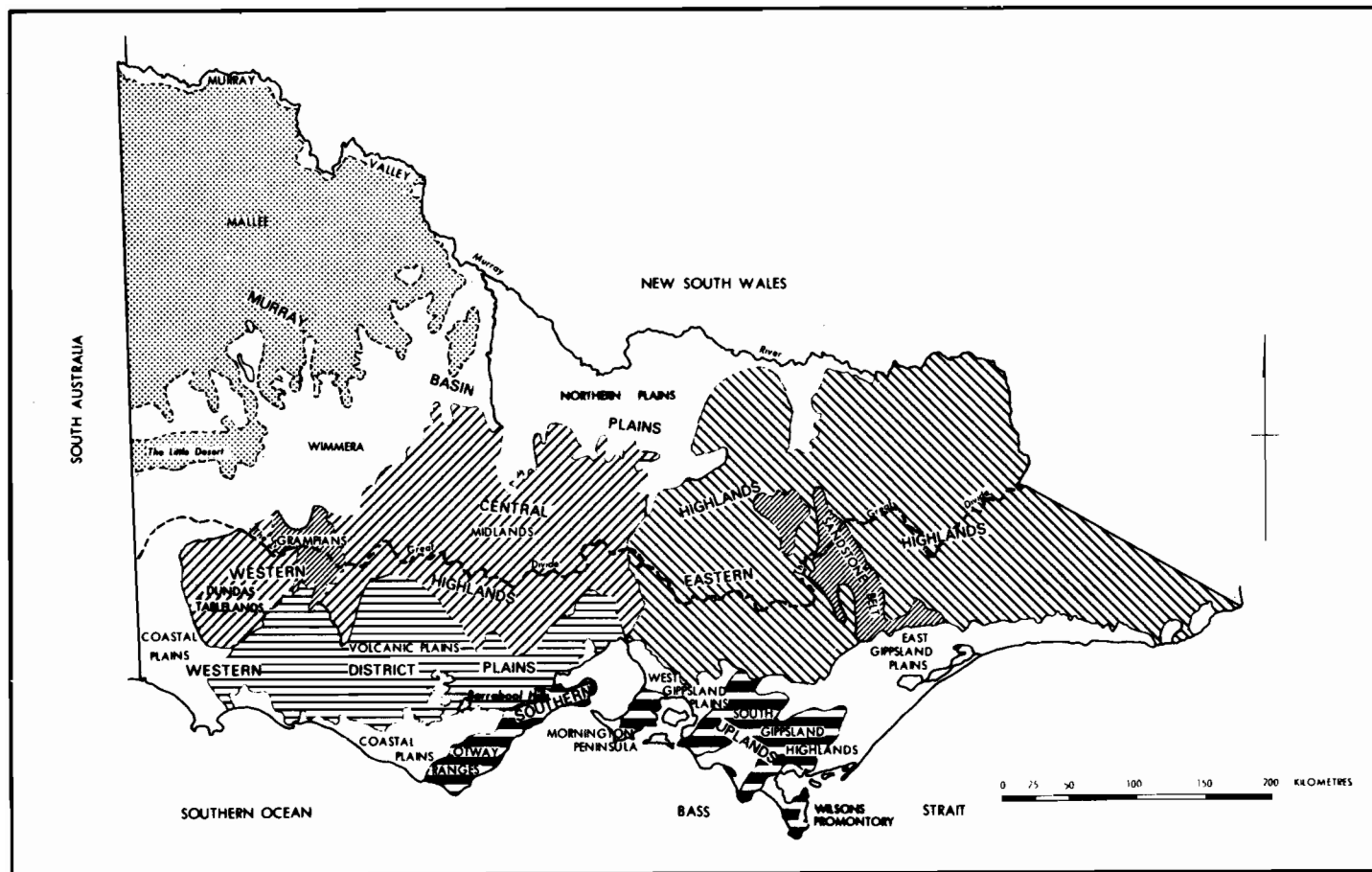


FIGURE 13. Physiographic divisions of Victoria.

the Murray, Ovens, Broken, Goulburn, Campaspe, and Loddon Rivers, formed by fluvial sedimentation. Also crossing the Riverine Plains is an extensive system of dry abandoned stream courses known as prior streams.

West of the Leaghur Fault the landscape and soil are very different. Here the *Mallee* country starts, with its surface cover predominantly of fine sands. Parallel north north-west to south south-east orientated Pliocene beach ridges or dunes which ripple the landscape are the basic landscape element of the Mallee, and formed on the margin of a retreating sea. Hollows between these ridges are partly filled by Pleistocene fluvio-lacustrine clays; the ridges are partly obscured by younger east to west oriented longitudinal dunes, parabolic dunes, and sand plains. Of significance are areas of groundwater discharge such as the gypsum playas and salinas, as exemplified by Lake Tyrrell.

The Mallee is the marine plain of the former Murray Basin, with a veneer of wind-blown sands overlying fossiliferous marine Tertiary sands and silts, which reach eastwards to the Gredgwin Ridge on the Avoca-Loddon divide near Kerang. Westward of the Loddon River the streams fail to reach the Murray River and terminate in brackish or saline shallow lakes commonly bordered by lunettes. This is because of the low flow volumes and high rates of evaporation and infiltration.

The *Wimmera* is essentially the low alluvial fans, alluvial plains, and abandoned river channels lying between the Western Highlands and the Mallee.

Central Highlands

Extending east to west across Victoria is a mountainous and hilly backbone known as the Central Highlands. In eastern Victoria, it is rugged and mountainous, and with plateau-like features commonly capping elevated mountain areas. Known as the *Eastern Highlands*, these mountains in eastern Victoria attain elevations of above 1,800 metres at the highest points such as Mt Bogong and Mt Hotham, and elevations of 1,200 metres are common. The major rivers of Victoria with high flow-rates, with the exception of the Glenelg River, all rise in the Eastern Highlands, and characteristically show steep-sided deep and narrow valleys. Residuals of Lower Tertiary basalts occur in the Eastern Highlands, filling old valleys as at the Dargo High Plains and the Bogong High Plains.

The topography of the Eastern Highlands has been strongly influenced by the variety of rock types and structures present. Thus a flat-topped and step-like landscape is found in the hard almost flat-lying Upper Devonian sandstones and rhyolites between Briagolong and Mansfield; plateaux are preserved in granite at Mt Buffalo and the Baw Baws; and lower elevations with dendritic drainage are generally seen in areas of folded Lower Palaeozoic sandstones and mudstones.

The *Western Highlands*, in contrast to the Eastern, are much lower in elevation and are generally subdued hills rather than mountains. Rugged areas are mostly found near fault scarps. The general elevation is about 600 metres at Ballarat, but usually considerably less. Resistant masses of igneous rocks such as Mt Macedon and Mt Cole rise well above the general level, but fall well short of the main peaks in the Eastern Highlands. Extensive flat and only slightly dissected areas of Upper Tertiary to Quaternary basalt cover parts of the Western Highlands, conspicuously in the Ballarat area where they have yielded rich soils, and above the basalt flows rise prominent eruption points such as Mt Warrenheip and Mt Buninyong.

The Grampians, sharp-crested strike ridges of hard sandstone reaching 1,200 metres in height, are prominent mountains rising far above the general level of the highlands which decrease in height westwards. The westerly extremity of the Western Highlands is the Dundas Tablelands, a tilted block extending to Dergholm, formed in contorted Lower Palaeozoic rocks capped with laterite and dissected by the Glenelg River system.

Valleys in the Western Highlands are generally broad rather than deep, except where rejuvenating movements have occurred along fault scarps leading to the formation of gorges in some cases.

The Central Highlands owe their elevation—and relief caused by resultant erosion—to varied upwarping movements and faulting during Tertiary time.

Western District Plains

The Western District Plains stretch westwards from Melbourne to Camperdown, Hamilton, and Portland. They subdivide naturally into volcanic plains and coastal plains.

Volcanic Plains

With an area of 15,000 square kilometres, the Volcanic Plains are one of the largest volcanic plains in the world. They begin at an east-west line through Colac and Warrnambool and reach northwards to the foot of the Grampians.

The Volcanic Plains are almost horizontal, with only a slight southward inclination, and are composed of Pliocene to Holocene basalt flows and some basaltic ash. The Camperdown area and several other areas show extensive minor irregularities known locally as "Stony Rises", formed by lava collapse during solidification; these lava flows are so young that they are unmodified by erosion and soil formation. Volcanic cones, frequently of scoria, rise sharply from the plains as at Mt Elephant (394.4 metres) and Tower Hill (98.4 metres), and to some cones can be traced extensive areas of basalt. Much of the scoriaceous basalt of the "Stony Rises" between Colac and Camperdown can be linked with Mt Porndon (289.2 metres). Lakes in some cones occupy craters formed by explosive vulcanism.

The plains are crossed by some streams such as the Hopkins River with narrow incised valleys, but much drainage is internal, with precipitation finding its way to shallow lakes and underground.

Coastal Plains

Coastal plains, interrupted by the Otway Ranges, extend from Torquay to Warrnambool and northwards to Colac. They are flat or undulating, and are essentially the uplifted surface of Tertiary sedimentary rocks, including limestones, partly dissected by streams and commonly veneered with Quaternary dune limestone and sands. The limestones beneath the plains are cavernous, and are high yielding aquifers for groundwater. A broad coastal plain, bounded by a fault-scarp to the north-east, lies to the west and north-west of Portland.

Gippsland Plains

As a planar surface, the Gippsland Plains begin near Yallourn and Port Albert, and spread eastwards to the Bairnsdale area, between the ocean and the Eastern Highlands. Further east, through Orbost to Cann River, they form coastal downs—a dissected coastal plain—rather than a plain.

West of Yallourn, the Gippsland Plains continue, but they are displaced by late Tertiary block faulting to give the Moe Swamp and the Western Port Sunkland down faulted blocks, and uplifted areas such as the Drouin block and the Haunted Hills which are now maturely dissected. Faulting is responsible for related plains bordering the South Gippsland coast in the Wonthaggi area and landward from Cape Liptrap.

The present plains are the upper surface of a Tertiary and Quaternary basin, in which thick sequences of marine and freshwater sediments have accumulated, including the major brown coal seams of the La Trobe Valley. The plains are generally covered with piedmont-type sands, sandy clays, and gravels, which originated from the Eastern Highlands during the final late Tertiary movements which elevated them to their present height, and into these gravels the streams have cut broad alluvium filled valleys with flights of terraces that can be traced back into the Highlands.

A former coastline can be recognised behind the present coastline in the Bairnsdale-Lakes Entrance area. The conspicuous Ninety Mile Beach is a barrier bar which has cut off some of the Gippsland Lakes from the sea, and both spits and islands inland from the beach betray a complex history of barrier formation and erosion related to changed sea levels. Present day coastal dunes are prominent along sections of the Ninety Mile Beach, and earlier dunes and beach ridges are found on the barriers; still older dunes are found north of Woodside and east of Stratford.

Southern Uplands

South-west of the Gippsland Plains is a steep mountainous region, the Southern Uplands, formed by upwarping and faulting, and separated from the Eastern Highlands by the westerly extension of the Gippsland Plains appropriately named by J. W. Gregory as the "Great Valley of Victoria". These mountains, together with the Barrabool Hills near Geelong and the Otway Ranges, are formed of freshwater Lower Cretaceous sandstones and mudstones, and all display a characteristic rounded topography, due in part to very extensive landslipping and structural weakness in these rocks.

Areas of weathered basalt from the Lower Tertiary are found on the Uplands in plateau-like form at Thorpdale and Mirboo North in South Gippsland, and many smaller remnants are found elsewhere in these ranges; the basalts yield rich soils.

The Otway Ranges similarly originated by upwarping and faulting during Tertiary time.

A further element in the Southern Uplands is the Mornington Peninsula, which is a raised fault block of Palaeozoic granites and sedimentary rocks separating the downwarped Western Port Sunklands and the Port Phillip Sunklands.

Land surface of Victoria

The present topography of Victoria is the result of interaction between the rock types present, themselves events in geological history, changes in elevation and deformation recorded in that history, processes such as weathering and erosion—including climatic effects—and the stage of development reached by these processes. Hard resistant rocks, for example, will after prolonged erosion tend to stand out in relief, whereas softer more weathered rocks will be topographically more depressed. Over extensive periods of geological time without major sea-level changes, erosion will tend to wear down a land mass to a surface of low relief—known as an erosion surface—not far above sea-level. In the highlands of Victoria remnants of several such erosion surfaces can be recognised as plateau-like features raised to elevations of hundreds of metres by uplift.

Jurassic erosion surface

In the Eastern Highlands, plateau remnants are widespread as, for example, the Cobberas, the Mt Hotham area, Mt Buffalo, the Snowy Plains, Mt Wellington, and the Baw Baw Plateau: they are all in hard rocks such as granite, rhyolite, and massive sandstone. These plateau remnants, and ridge tops at similar levels are relics of the most ancient landscape or erosion surface preserved in Victoria. They are the surviving parts of a sub-planar surface which was close to sea-level in Jurassic time, before uplift and warping late in the Jurassic commenced its destruction, and began to form troughs or sedimentary basins in which the sediments represented in the Otways and the South Gippsland Highlands were deposited during Cretaceous time. These upwarps had already begun to define the Central Highlands.

Later evolution

Uplift and downwarping continued intermittently during Tertiary time, with the development of sedimentary basins such as the Murray Basin in north-west Victoria and the Gippsland and Otway Basins in southern Victoria. In the basins was deposited detritus carried down by streams from the rising Highlands, and in swamp conditions great thicknesses of brown coal were laid down in the Gippsland Basin. Deep valleys were cut into the Central Highlands, which were then lower than their present height; in some of these valleys goldbearing gravels were deposited. Parts of the landscape and some of the valleys were filled with Lower to Mid-Tertiary basalts.

Erosion proceeded to advanced stages during parts of the Tertiary Period, as attested by remains of younger erosion surfaces, preserved at lower levels than the Jurassic surface on the hill summits immediately east of the centre of Melbourne and around the Dandenong Ranges to Gembrook, on the Kinglake Plateau, and elsewhere in the Central Highlands.

By Miocene time, downwarping movements were at their maximum. Embayments of the sea covered much of Gippsland, the Port Phillip Basin, an extensive area of western Victoria south of Lismore and the Grampians (the Otway Basin), and north of the Grampians the Murray Basin spread as far as Broken Hill, New South Wales. The record of this transgression is left in limestones and other sedimentary deposits. Retreat of the sea towards its present position during the Pliocene was accompanied by further uplift of the Central Highlands, leading to further erosion, valley deepening, and the accumulation of extensive sheets of sands, clays, and gravels both on the lowland plains and as piedmont gravels on the spurs leading down to the lowlands.

The Upper Tertiary and Quaternary saw vast volcanic activity in central and western Victoria. From Melbourne to Hamilton basalts and tuffs were outpoured and ejected. Flows followed pre-existing valleys in the Western Highlands, burying gravels as deep leads in the Ballarat district.

Final downwarps, assisted by the melting of glacial ice at the end of the Pleistocene, led to the drowning which has given Port Phillip Bay and Western Port their present

configurations, and concomitant upwarps in the Central Highlands elevated them to their present level.

Changing climate has played a role in this physiographic evolution. Thus the Mid-Tertiary, with the rich flora evident in the brown coals, appears to have been a time of higher rainfall than at present, with the result of larger streams with more erosive power. Changing Quaternary climates are also recognised in the changing regimes evident in the former lakes and prior streams of the Riverine Plains.

Further reference: *Geology of Victoria, Victorian Year Book 1976, pp. 77-80*

Hydrology

Water resources

The average annual rainfall over Victoria is about 660 mm. As the area of the State is 227,600 square kilometres, the total precipitation is, therefore, about 148 million megalitres. Only 21 million megalitres appear in the average annual flow of the State's river systems. It is not yet known how much of the remainder soaks underground to recharge groundwater resources, but total storage of groundwater with less than 1,000 parts per million salinity is very large. Groundwater resources are being assessed by a long-term programme of investigation being carried out by the Victorian Department of Minerals and Energy.

Victoria's surface water resources are unevenly distributed in both space and time. Their distribution in space can be conveniently described by considering the State as being divided into four segments, by an east-west line along the Great Dividing Range and a north-south line through Melbourne. The north-west segment contains 40 per cent of the State's area, and the other three segments 20 per cent each. Surface water resources, represented by average annual river flow, are heavily concentrated in the eastern segments, each accounting for about 40 per cent of the total. The western segments account for only 20 per cent of total flow, with only 3 per cent in the north-west segment.

Quality of stream flow also deteriorates from east to west. Waters of the eastern rivers mostly contain less than 100 parts per million of total dissolved solids. In the western rivers the figure is generally above 500 parts per million, except near their sources, and increases downstream to figures in excess of 1,500 parts per million.

River flows in Victoria exhibit a marked seasonal pattern, and marked variability in annual flow from one year to another and from place to place, affecting the usability of the transitory local surface supplies of fresh water.

Over the State as a whole, about 60 per cent of the average annual flow is accounted for between July and October. In western streams this percentage approaches 75 per cent. Everywhere, flows typically recede in the summer and autumn, at the time of year when water requirements for most uses are at a peak.

Topography

Rivers

The topography of Victoria is dominated by the Great Dividing Range, which extends from a triangular mountainous region in the east, through the narrower and lower central highlands, and terminates at the Grampians in the west. This divide separates the State and its rivers into two distinct regions: those rivers flowing northwards towards the Murray River and those flowing southwards towards the sea. The only other significant high country within Victoria is formed by the Otways in the south-west and the Strzelecki Ranges in South Gippsland.

Geography

Of all the major Victorian rivers, the Snowy River is the only stream not wholly situated within the State, the headwaters of this river being in the Snowy Mountains of New South Wales. The Murray River, although an important water supply source for Victoria, is legally wholly in New South Wales as the State boundary coincides with the southern bank of this stream. (See page 39.)

Of the major northern rivers, all except three flow into the Murray River. The three exceptions—the Avoca, Richardson, and Wimmera Rivers—finish their course at inland lakes in the Wimmera-Mallee region, with the Avoca, on rare occasions, overflowing its lakes system to reach the Murray River.

Of the major southern rivers, the La Trobe, Thomson, Macalister, Avon, Mitchell, and Tambo Rivers all flow into the Gippsland Lakes system, which is linked with the sea by an artificial cut constructed many years ago for navigation purposes. The Woady-Yallock River in the west flows to the inland Lake Corangamite, while the remaining southern rivers find their way directly into the sea.

Water availability

The eastern rivers of Victoria, both northerly and southerly flowing and those rising in the Otway Ranges, have their sources in high rainfall country and provide abundant water resources, while those in the western portion of Victoria, with the exception of the Glenelg, have limited useful yield and many are frequently dry in summer. In fact, approximately 78 per cent of Victoria's available water resources originate in the eastern half of the State and only 22 per cent in the lower ranges to the west.

Physical properties

The actual physical properties of Victorian rivers differ markedly from the east to the west. Rivers in the far east to north-eastern regions of Victoria flow for most of their journey through mountainous terrain in deep gorges, and then into flood plains, before reaching either the Murray River or the sea. Heavy shingle has been scoured from the bed and banks of these fast flowing mountainous streams and finally deposited downstream in the plain area. The water of these streams is clear and free from excessive suspended mud and silt.

Rivers in central and western Victoria, on the other hand, have comparatively short mountainous sections, and for the majority of their length wander sluggishly through undulating to flat country. Velocities of flow are far less than for their mountainous counterparts, and material carried by these streams consists of fine silt and clay which causes the muddy turbid waters, typical of these central and western rivers.

For those rivers that flow to the sea, there is a tendency at the river mouth to form sand spits and dunes, with the consequent obstruction of the mouth. Some of the smaller streams become blocked entirely and breach only in times of flood.

Salinity

Rivers in the Eastern Highlands, flowing mainly through heavily timbered mountain tracts, generally have very good quality water suitable for all purposes. In the lower Central Highlands, salinities vary from stream to stream but generally flows are fresh in the winter and spring and slightly saline in the summer and autumn. In the south-west regions of Victoria, catchments consist mainly of grasslands, with scrub regions in the north-west, and streams here are slightly to moderately saline for most of the year.

Flooding

Rainfall throughout Victoria is erratic during the year and hence the majority of the State's rivers are prone to flooding at any time, with rivers in Gippsland often subject to summer flooding. Flooding problems on a number of major streams have been markedly reduced by the construction of dams which, although designed for the supply of water and not for flood mitigation, provide substantial temporary storage above the full water supply level.

VICTORIA—MAIN STREAM FLOWS

Stream	Length (kilometres)	Drainage area (square kilometres)	Annual stream flows in million cubic metres				Site of gauging station
			Mean	Max.	Min.	No. of years gauged	
NORTHERN RIVERS							
Murray	1,926 (from source to Victorian border)	6,527 (upstream of Jingellic)	2,507	6,148	675	90	Jingellic, N.S.W.
Mitta Mitta	286	5,058	1,411	4,256	250	49	Tallangatta
Kiewa	185	1,145	567	2,071	166	94	Kiewa
Ovens	228	5,827	1,312	4,897	221	64	Wangaratta
Broken	193	1,924	227	1,091	19	94	Goorambat
Goulburn	566	10,772	2,211	7,369	145	98	Murchison
Campaspe	246	3,212	236	820	1	78	Elmore
Loddon	381	4,178	235	740	9	85	Laanecoorie Reservoir
Avoca	270	2,624	76	395	3	80	Coonoor
Wimmera	291	4,066	128	589	—	77	Horsham

VICTORIA—MAIN STREAM FLOWS—*continued*

Stream	Length (kilometres)	Drainage area (square kilometres)	Annual stream flows in million cubic metres				Site of gauging station
			Mean	Max.	Min.	No. of years gauged	
SOUTHERN RIVERS							
Snowy	162 (in Victoria)	13,421	1,838	4,002	381	43	Jarrahmond
Tambo	200	943	58	121	21	15	Swifts Creek
Mitchell	251	3,903	959	2,834	193	42	Glenaladale
Thomson	209	1,088	400	680	175	50	Cowwarr
Macalister	202	1,891	502	1,533	45	61	Lake Glenmaggie
La Trobe	251	4,144	937	3,240	271	65	Rosedale
Bunyip	63	661	153	304	69	47	Bunyip
Yarra	246	2,328	783	1,494	176	62	Warrandyte
Maribyrnong	183	1,303	107	327	4	49	Keilor
Werribee	124	1,155	92	314	7	63	Melton Reservoir
Moorabool	153	1,114	76	221	1	34	Batesford
Barwon	188	1,269 (excluding Leigh and Moorabool Rivers)	141	328	7	14	Inverleigh
Hopkins	282	1,347	32	127	1	48	Wickliffe
Glenelg	457	1,570	127	540	3	60	Balmoral

Lakes

Lakes may be classified into two major groups: those without natural outlets which are called closed lakes, and those with a natural overflow channel which may be termed open lakes. For closed lakes to form, annual evaporation plus infiltration must exceed the rainfall in the catchment; this is the case over most of Victoria.

Closed lakes occur mainly in the flat western part of the State. They fluctuate in level much more than open lakes and frequently become dry if the aridity is too high. For example, Lake Tyrrell in the north-west is usually dry throughout the summer and can consequently be used for salt harvesting.

The level of water in an open lake is more stable because as the lake rises the outflow increases, thus governing the upper lake level and partially regulating streams emanating from it. This regulation enhances the economic value of the water resources of open lakes, but Victoria does not possess any natural large lake-regulated streams. However, there are small streams of this type in the Western District, such as Darlots Creek partly regulated by Lake Condah and Fiery Creek by Lake Bolac.

Salinity is often a factor which limits the use of lake water; even freshwater lakes are not used extensively in Victoria due to the cost of pumping. The average salinity of closed lakes covers a wide range depending upon the geological conditions of the catchments and the water level.

Lake Corangamite is Victoria's largest lake. It can be regarded as a closed lake, although during the wet period in the late 1950s it rose to within 1.2 metres of overflowing. The total salt content of the lake is about 16.32 million tonnes, giving it a salinity somewhat higher than seawater under average water level conditions.

The Gippsland Lakes are a group of shallow coastal lakes in eastern Victoria, separated from the sea by broad sandy barriers bearing dune topography, and the Ninety Mile Beach. A gap through the coastal dune barrier near Lakes Entrance, which was completed in 1888, provides an artificial entrance to the lakes from the sea. However, seawater entering this gap has increased the salinity of some lakes, which in turn has destroyed some of the bordering reed swamp and led to erosion. The Gippsland Lakes have been of value for commercial fishing and private angling and also attract many tourists.

A number of Victorian lakes and swamps have been converted to reservoirs. Waranga Reservoir is an example of this, as are Lake Fyans, Batyo Catyo, and Lake Whitton in the Wimmera. A good example of lake utilisation is the Torrumbarry irrigation system on the riverine Murray Plains near Kerang in north-west Victoria.

Groundwater resources

Groundwater resources move slowly through pores and cracks in soil and rock and respond sluggishly to seasonal and annual fluctuations in recharge. For this reason,

groundwater can be regarded as a generally more reliable source of water through drought periods. However, mapping of resources in terms of depth, yield, and quality is much more complex than the mapping of visible surface resources.

The present position, very broadly stated, is that there are groundwater resources of reasonable quality and yield for domestic and irrigation purposes over about 4,000,000 hectares or about one-sixth of Victoria's area, mainly in the far west and south-west and in alluvial valleys in the north and south-east.

On the other hand, there is about half the State's area, in the central and western sectors, where groundwater is generally not available at qualities better than 3,000 parts per million of total dissolved solids.

Groundwater has played a very important part in providing supplies of water for domestic and stock use in pastoral settlement. It is also used for some isolated town supplies, and is being increasingly used for irrigation, the area irrigated from groundwater now being about 12,000 hectares.

For the future, there are prospects of generally increased use for irrigation, and for the augmentation of town water supplies on the south-west coast, in the Barwon Valley, and in Gippsland. However, these prospects can only be clarified by continuing investigation.

Additional information can be found in the publications entitled *Groundwater Investigation Program Reports, 1971-1981* which are issued annually by the Victorian Department of Minerals and Energy.

Further references: Natural Resources Conservation League, *Victorian Year Book*, 1965, p. 47

Survey and mapping

The Division of Survey and Mapping of the Department of Crown Lands and Survey is responsible for the maintenance and intensification of the National Geodetic Survey within Victoria; the preparation of topographic maps in standard map areas; the survey of Crown lands under the provisions of the *Land Act* 1958; the co-ordination of surveys throughout the State under the provisions of the *Survey Co-ordination Act* 1958; surveys for other departments and authorities; and the documentation of these surveys.

The National Geodetic Survey provides a framework of co-ordinated ground points for the control of mapping and other surveys. The current co-ordinate values for these points were determined in 1966, but are presently being re-evaluated on the basis of the intensified network together with positions based on satellite observations. Within Victoria there exists a network of levels based on the Australian Height Datum. This network is constantly being maintained and extended, and level values are available from the Central Plan Office of the Department.

An official map of Victoria showing highways, roads, railways, watercourses, towns and mountains, together with other natural and physical features has been published in four sheets at a scale of 1:500,000. A less detailed map of Victoria is also available in one sheet at a scale of 1:1,000,000. Topographic maps at a scale of 1:250,000 providing a complete map coverage of the whole State have been published by the Division of National Mapping of the Commonwealth Department of National Development and Energy and the Royal Australian Survey Corps. A joint Commonwealth-State project to produce topographic maps at a scale of 1:100,000 is nearing completion. Other departments and authorities also contribute to State mapping by producing various large scale maps for specific purposes.

A series of 26 maps at a scale of 1:25,000 showing streets, rivers, creeks, and municipal boundaries is available for Melbourne and environs. A long-term programme for production of general purpose standard topographic maps, at a scale of 1:25,000, is being carried out with 300 maps out of a total of 1,300 already printed. This series will cover most of the settled areas of the State. A series of maps at a scale of 1:10,000 is being prepared for regional growth areas such as Portland, Bendigo, Ballarat, Warrnambool, and Albury-Wodonga. Also, production has commenced on a fully integrated topographic-cadastral map and plan system at a scale of 1:25,000.

The publication *Official Map and Plan Systems Victoria* sets out the standard format size and numbering systems which have been adopted for the production of maps and plans at the standard scales of 1:20,000, 1:16,000, 1:10,000, 1:5,000, 1:2,500, 1:1,000, 1:500, and 1:250. The systems are based on the Australian Map Grid (AMG) which fulfils the basic principles necessary for the complete integration of surveys. The Division

publishes twice yearly a brochure entitled *Maplist* indicating the coverage of standard mapping throughout the State. The Division has also produced a whole range of maps for inclusion in the *Victorian Atlas* which was published in September, 1982.

The Division carries out cadastral surveys of Crown lands for the purpose of defining boundaries and for determining dimensions and areas of reservations and of allotments for the subsequent issue of Crown grants. This information forms the basis for the compilation of county, parish, and township plans, which are published at various scales and show details of the original subdivision of Crown lands.

The Division provides an aerial photography service for its own and other users' requirements. The Aerial Photography Library currently comprises approximately 400,000 photographs dating from 1931, and providing a comprehensive coverage of the State.

The Map Sales Centre at 35 Spring Street, Melbourne, is the main outlet for maps and plans, and provides facilities for the inspection and ordering of aerial photography and enlargements. The Centre is also the sole Victorian agent for Landsat imagery and holds microfiche copies for inspection.

Further references: Hydrography, Coastline, *Victorian Year Book* 1966, pp. 33-6; Coastal physiography, 1967, pp. 32-6; Plant ecology of the coast, 1968, pp. 31-7; Marine animal ecology, 1969, pp. 36-40; Marine algae of the Victorian coast, 1970, pp. 39-43; Erosion and sedimentation on the coastline, 1971, pp. 44-6; Conservation on the Victorian coast, 1972, pp. 37-43; Illustrated flora of Victoria, 1979, p. 36; Victorian Institute of Marine Sciences, 1980, pp. 49-50; Recent land legislation, 1981, pp. 55-6; Settlement of Victoria, 1981, pp. 24-6

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