

GEOGRAPHY

PROTECTION OF THE ENVIRONMENT

Ministry for Conservation

Introduction

The broad aims of the Ministry are to protect and preserve the environment, and to facilitate the proper management and utilisation of natural resources. Various government departments and branches have been dealing with environmental and conservation matters for many years, and to facilitate the co-ordination of effort of these bodies, the Ministry for Conservation was created in January 1973. The Ministry originally covered the six agencies, Soil Conservation Authority, Fisheries and Wildlife Division, National Parks Service, Environment Protection Authority, Port Phillip Authority, and the Land Conservation Council. In 1975, the Victoria Archaeological Survey was added to the Ministry.

Within the Ministry itself the Environmental Studies Section co-ordinates the collection of scientific data and the Environment Assessment Group uses these and other data to assess likely environmental effects of proposed works. The Conservation Planning Group assists municipal councils, regional planning authorities, and government departments in their efforts to ensure that necessary environmental considerations are taken into account in the planning of projects, while the Information and Extension Branch is concerned with environmental education in the community. Each of these sections is dealt with in more detail below.

Environmental studies

To achieve proper management of natural resources, accurate information is needed, and it is the Ministry's Environmental Studies Section which has the responsibility of collecting this information. The Section does not have a large staff of scientists. The research work is mostly contracted out to universities and other research organisations. To date, the Section has concentrated on studies covering the regions centred on Port Phillip Bay, Western Port, and the Gippsland Lakes. Having collected the necessary information, the Section then formulates guidelines for the planning, development, and management of the natural resources of each region.

To assist in the implementation of these guidelines in the Western Port region, the Victorian Government has established the Western Port Regional Co-ordinating Group, with representatives of the shire councils, farmers, industry, conservation groups, and government bodies with an interest in the area. The Group has the responsibility of ensuring that the development and management of the Western Port catchment area is carried out in accordance with the Victorian Government's expressed aim of using the natural resources in the best interests of the whole community within the environmental constraints set out in reports from the Environmental Studies Section.

Marine studies

The Marine Pollution Study Group which was formerly part of the Fisheries and Wildlife Division, and the Marine Chemistry Unit, formerly part of the Department of Agriculture, are now both attached directly to the Ministry. They are concerned with the marine aspects of the environmental studies centred on Port Phillip Bay, Western Port, and the Gippsland Lakes. Having laboratory facilities, they are able to perform scientific research work themselves, whereas the Environmental Studies Section arranges for such work to be done by other organisations. The aim of the research is to assist in predicting the effect of developments in the three catchment areas. The Group also provides a marine environment study service for the Environment Protection Authority and the Fisheries and Wildlife Division.

Environment assessment

When any project, which could have a significant or controversial environmental effect, such as the building of a dam, bridge, or freeway, is planned, the Ministry's Environment Assessment Group becomes involved, collaborating with the engineers planning the project. This involvement ensures that all reasonable alternatives are considered, and that the opinion of the general public is obtained before the final decision is made. An Environment Effects Statement is prepared by the proposer of the works, and this is reviewed by the Ministry. The Ministry does not make the final decision, as that power remains with the authority responsible for the project, in consultation with the State Co-ordination Council and the Cabinet. The Ministry's role is to ensure that the decision makers are aware of the environmental consequences of the project.

The Victorian Government has issued a directive that this assessment procedure is to be adopted for all new government works that could have significant environmental consequences. Details of the procedure are given in the Ministry's publication, *Guidelines for Environment Assessment*.

Conservation planning

The Conservation Planning Section works in co-operation with municipal councils, government bodies, and private enterprise to obtain the best environmental solution to planning problems. Like the Environmental Studies Section, the Conservation Planning Section does not itself employ a large staff of technical experts; it relies on the expertise of the Ministry's agencies and others to give advice when needed. Members of the Section are frequently called upon to represent the Ministry in giving evidence at public enquiries and appeals tribunals when environmental issues are involved.

Community education

An important role of the Ministry is carried out by the Information and Extension Branch, in educating the community to realise the importance of careful management of natural resources. Conservation is more likely to be achieved if people are better informed and have a basic understanding of what causes environmental problems and how such problems can be solved.

To this end, the Branch is involved in extension activities with the general public and particularly with school students. Displays at the Royal Agricultural Show in Melbourne and at other exhibitions specialising in environmental matters have been used to engender interest in conservation.

The Branch is expanding its environment education service for the community at a level which is considered to be of most interest and relevance, namely, at a local level. A number of regional extension officers have been appointed in country areas, and it is intended that these officers will become focal points through which individuals and groups in the community will develop contact with

the Ministry and vice versa. It is hoped that this step will result in more involvement of the Ministry with local government, community service organisations, schools, and conservation groups.

Statistics

The total expenditure of the Ministry and its agencies amounted to \$24.7m in the financial year 1976-77. Of this amount, salaries accounted for \$12.4m. Staff of the Ministry and its agencies totalled about 1,350 persons at that time.

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

Particulars	1973-74	1974-75	1975-76	1976-77
Ministry				
General expenses	1,356	2,797	3,164	3,035
Land purchases	..	1,127	4,095	1,361
Environmental studies	742	906	1,181	1,614
Agencies				
National Parks Service	1,153	2,566	4,621	4,666
Environment Protection Authority	2,408	3,167	4,156	4,923
Soil Conservation Authority	1,992	3,184	4,325	4,096
Fisheries and Wildlife Division	2,370	3,266	4,433	4,348
Other (incl. Port Phillip Authority and Land Conservation Council)	338	384	631	698

Further reference, 1977

Environment Protection Authority

The *Environment Protection Act* 1970 set out a comprehensive waste management programme, encompassing the control of air and water pollution, disposal of wastes on land, environmental noise, and litter. The Act is administered by a three-man Authority supported by about 240 support and advisory staff of scientific, technical, and administrative personnel. The Authority is one of several agencies located within the Ministry for Conservation.

The following are some of the significant areas of activity of the Authority.

Reduction of lead in petrol

Regulations were introduced in 1975 designed to result in a phased reduction in lead levels in petrol. By 1979 lead levels, used as an additive to petrol to increase the octane rating, will be 0.45 grams per litre. The Authority's figures show that more than 2,000 tonnes of lead from cars are now being emitted annually into the air in Victoria, of which more than 1,200 tonnes are emitted in Melbourne.

Related projects are being carried out to check faulty exhaust systems in motor vehicles, to monitor Melbourne's air continuously through a network of stations and mobile vans, and to assess these readings through a computerised telemetry system.

Water quality

The Authority is responsible for the protection of water quality of Victoria's beaches, streams, and waterways. Lack of sewerage facilities and control of industrial waste discharges in the past has left a legacy of water quality problems

which are gradually being overcome. Improvement is now evident as the system of licensing wastes under the Environment Protection Act takes effect. All major discharges to coastal waters and the majority of discharges to inland waters have now been licensed. Increasing attention is being paid to the control of wastes which are not appropriate to the licensing system, e.g., stormwater run-off, septic tanks and sullage, ships and boats, and run-off from agricultural operations.

Wastes on land

The Land Waste Management Branch of the Authority works closely with local councils and health officials to ensure that controls are exerted over the huge wastes generated by the community under modern living styles. Encouragement is given to councils to plan together their future garbage disposal needs on a regional rather than local basis.

Planning and policy formulation

Environmental management needs to be based on long-term planning and objectives. State Environment Protection Policies are formulated under the Environment Protection Act. These Policies set out the guidelines under which the licensing system operates. The first Policy was declared by the Government, on the recommendation of the Authority, in 1975, for the waters of Port Phillip Bay. Further Policies have been circulated in draft form for publication and comment for Western Port Bay and its catchment, waters of the Western Metropolitan Region, the Yarra River and its tributaries.

Environmental noise

The *Environment Protection (Noise Control) Act 1975* introduced progressive legislation in the field of noise control, a growing problem in all cities of the world. The legislation controls noise from motor vehicles, motor boats, and domestic equipment used on residential premises. Regulations controlling noise from motor vehicles, including trucks, buses, and motor cycles have been introduced and a preliminary policy on overall noise at construction sites has been developed.

Licence appeals

The Environment Protection Act provides for a system of appeals against licences issued by the Authority to discharge wastes to the environment. An independent body, the Environment Protection Appeal Board, hears appeals by persons who feel aggrieved by the conditions of a licence, or whose application is refused. The Authority itself hears third party appeals from persons who feel that they would be affected by a licence being issued. Appeals can be made to the Supreme Court on points of law.

Further reference, 1977

Land Conservation Council

The Land Conservation Council was established in February 1971 with the proclamation of the *Land Conservation Act 1970*. The Council of twelve members is composed of an independent chairman appointed by the Governor in Council, and the heads of the following Victorian Government departments and agencies: the Soil Conservation Authority, Department of Agriculture, Forests Commission, Department of Crown Lands and Survey, Department of Minerals and Energy, State Rivers and Water Supply Commission, Fisheries and Wildlife Division, and the National Parks Service. The other three members are persons with experience in various aspects of conservation and are appointed by the Governor in Council.

The functions of the Council are:

- (1) To carry out investigations and make recommendations to the Minister on the use of public land in order to provide for the balanced use of land in Victoria (public land being defined as land which is not within a city, town, or borough);

and which is unalienated land; and includes land permanently or temporarily reserved under the Land Act, State Forest, land vested in any public authority other than a municipality or sewerage authority, and land vested in the Melbourne and Metropolitan Board of Works);

(2) to make recommendations to the Governor in Council on the constitution and definition of water supply catchment areas; and

(3) to advise the Soil Conservation Authority concerning policy on the use of all land in any water supply catchment area.

The legislation provides for consideration of land for all purposes, but it specifically requires that uses which tend to have been given less consideration and even a low priority since first settlement, should not be neglected in the future. In making any recommendation the Council must take into account the present and future needs of the people of Victoria in relation to the preservation of areas which are ecologically significant; the conservation of areas of natural interest, beauty, or historical interest; the creation and preservation of areas of reserved forest; the creation and preservation of areas for leisure and recreation, and in particular of areas close to cities and towns for bushland recreation reserves; the creation and preservation of reserves for the conservation of fish and wildlife; the preservation of species of native plants; and land required by government departments and public authorities in order to carry out their functions.

Victoria illustrates the problem of how modern civilisation demands land for various purposes, some compatible, others conflicting or competitive. Where there are conflicting or competitive demands for land, decisions must be made on the basis of significant scientific and other criteria.

The Council has divided the State into seventeen study areas. However, before the Council can make recommendations for a study area it must conduct an investigation and publish a factual report describing the resources and the forms of land-use in the area. Notices of intent to commence an investigation in an area are published in the *Victoria Government Gazette* and in newspapers, including those circulating within the districts concerned.

The report is compiled by the research staff of the Council from information supplied by government departments, universities, various organisations including local groups, and from information arising out of research commissioned by the Council. The report is a factual description of the resources of the area and contains chapters on the physical characteristics of the land such as the geology, physiography, climate, soils, flora and fauna. The report also describes the ways in which land in the study area is used. These uses include nature conservation and recreation, the production of food, fibre and timber, minerals and road making materials, and the provision of transport and power distribution systems. An account is given of these uses in terms of their physical requirements and the demands that each use places on the resources of the Study Area are assessed. The hazards to which the land may be prone such as soil erosion, salting, fire, and pests, and their effects on land-use, are also described.

When investigation of the study area is completed, notices are published indicating the availability of the report and inviting the public to make submissions to the Land Conservation Council on how the public land can best be used to serve the needs of the community. The publication of the report ensures that both the Council and members of the community will have the same information available for their consideration. It also enables all interested parties to participate, in an informed fashion, in the process of considering how public lands should be used. It is hoped that in making submissions, members of the community will use as a basis the information provided by the study. The Council makes its recommendations only after due consideration of all submissions.

The recommendations made by the Council are initially published as Proposed Recommendations, a copy of which is sent to all parties from whom submissions

were received and to all government agencies and local authorities in the study area concerned. Further submissions are then received and considered by the Council prior to publication of the Final Recommendations which are forwarded to the Minister for government consideration.

Of the 17 study areas, the Land Conservation Council has published descriptive reports for South West District 1, South Gippsland District 1, North East District 1, North East District 2, North East Districts 3, 4, and 5, Melbourne, East Gippsland, Mallee, Corangamite, Alpine, South West District 2, and North Central Areas. Of these, Final Recommendations have been published for South West District 1, South Gippsland District 1, North East Districts 1 and 2, Melbourne, North East Districts 3, 4, and 5, Mallee, East Gippsland, and Corangamite. A special investigation was carried out of a block of land known as the Stradbroke Area. This block is situated in the South Gippsland District 1 Area. The report and Final Recommendations have been published for this block.

To date the Land Conservation Council has recommended the creation of national, State, regional, and multi-purpose parks. The Council has also established several new categories of land-use and has recommended that land be set aside for the following purposes :

Reference Areas. Areas of land which are typical or important examples of a particular land type and which should be preserved in their natural state as far as possible, in order to serve as a standard against which altered or manipulated parts of the land type can be compared.

Education Areas. These are areas of land containing major land types to be used for environmental education.

Bushland Reserves. Relatively small and frequently isolated areas of land carrying remnants of native vegetation which provide diversity in predominantly agricultural regions and which should be used for passive recreations such as picnicking and walking.

Uncommitted Land. Areas of land of known or unknown capability which have been set aside to provide for the future needs of the community, both foreseen and unforeseen.

Wilderness Areas. Large areas of land with an environment unaltered by human intervention.

In addition to the above, the Land Conservation Council has reserved areas for the preservation of flora and fauna and set aside many small areas of public land to be used for recreation at a varying intensity according to the condition of the remaining natural vegetation. Areas have also been recommended to be used for timber production, mining, public utilities, and agriculture.

Further reference, 1977

Soil Conservation Authority

Under the *Soil Conservation and Land Utilization Act 1958* and associated legislation, the Soil Conservation Authority has extensive responsibilities involving mitigation and control of erosion; the promotion of soil conservation; the determination of land-uses to achieve these objectives; the provision of advisory and technical services to landholders and other government authorities directed towards the efficient use and development of land and farm water resources; the protection of water catchments; supervisory responsibility over all activities which may disturb the soil at altitudes over 1,220 metres; and the control and prevention of erosion along the Victorian coastline. In meeting these responsibilities, the Authority has to recognise the range of characteristics and capabilities of the widely differing land types involved. These are determined by the interactions of climate, geology, topography, hydrology, soils, and flora and fauna. Systematic classification of the landscape provides a means of coping with the wide range and combinations of physical conditions.

Until relatively recent times, land characteristics and soil conditions in particular have either been taken for granted or ignored during land development for a wide range of purposes. Land developers mostly ranked environmental conditions well down the list of criteria used in determining the various uses to which they intended to put the land.

This led to a wide range of costly problems such as flooding, erosion, siltation, and crop failures, particularly in the development of agricultural land-uses. Trial and error eliminated many of these inappropriate land-uses, but it is still apparent that some activities remain unsuitably located and are not being carried out within the capabilities of the land types involved. Where land-use developments and changes are being considered, it is imperative that the capability of land to support the intended activities be fully considered, to avoid the type of land deterioration which has occurred in the past.

To use land within its capability ensures a wide range of benefits for both the individual user and the community at large. Acceptable levels of production or performance are assured, input and maintenance costs are minimised, and resource deterioration is held to an acceptable level. In these circumstances, environmental quality is maintained.

The concept of recognising land capability as a planning criterion is now being more widely accepted as a major factor in establishing sound land-use. It is recognised that an understanding of land characteristics is a necessary prerequisite for determining land capability. To understand more fully the complex relationship between the variables involved (that is, land characteristics, levels of output or performance, levels of deterioration, and management inputs), it is essential that different land types be recognised and identified, and subsequently classified.

During the 1950s, in response to the need for identifying different land types, the Soil Conservation Authority initiated a programme of systematic mapping of land resources across Victoria. Recurring patterns of land forms, soils, and vegetation were mapped and the areas delineated were called land systems, as described on pages 38–43 of the *Victorian Year Book* 1976. The State-wide land system mapping programme, by categorising different types of land, is proving valuable for determining the location and success of many land based activities.

The advantages of this land system approach lie chiefly in the low survey costs per unit area of land being studied, and in the environmentally integrated nature of the data collected. Information supplied by such studies is essentially broad and consequently is very valuable in making decisions relating to land-uses which are carried out at a comparably broad scale, such as general agriculture.

In recent years, the emphasis relating to the use of this land classification data has to some extent moved from the traditional surveys of rural land for promoting sound agricultural land-use and management towards increasing involvement in land classification for non-rural uses, such as town, industrial, and other developmental planning. The growth in demand for data on land relating to non-rural activities is now influencing established land study procedures. Land characteristics, which were previously not critical within a broad categorisation, are now being considered and, in general, additional data oriented more towards engineering than to agronomic parameters is now being collected.

The original example of land capability ratings is the American Land Capability Classification. It is based on the degree, number, and kind of limitations to safe cultivation and to grazing, forestry, and recreational purposes. There are eight land classes, based on eight degrees of severity of limitation, imposed by various land characteristics. The class to which a particular area of land is allocated is determined by the greatest degree of severity or limitation encountered. The sub-classes are based on the kind and number of the most severe limitations. For example, Class 3WC means that moderate limitations, based on weather (W) and climate (C), restrict the choice of crops.

To make the ratings, there must be a rating system for each kind of land-use. These rating systems each consist of a list of the relevant criteria, plus a statement of their class limits, indicating the degree of limitation for the kind of land-use involved. The main change in rating of land capability is the use of separate ratings for each of several specified kinds of land-use, other than those already described, and also separate rating in respect to hazards of management and production.

The basic systems for mapping and the survey techniques developed by the Authority remain as useful methods for categorising land. However, as the requirements of physical data for specific land based activities become more detailed, the need to carry out special purpose surveys is becoming more apparent. A flexible approach to survey is developing, with the objective of coping with the varied requirements of different users of data. Scale and presentation have to be altered to meet the specific needs of users who now include local government bodies, planning agencies, land developers, contractors, private conservation groups and increasingly, government agencies, including the Authority's own Field Operations Division.

Another aspect of land systems mapping is a realisation that published land resources work has not always been used to its fullest potential. The reasons for this are not clear. It has been suggested that some users are unable to interpret the wide range of physical data presented or else do not fully understand the implications of the land systems approach. Further extension of the principles now being developed will ensure that a wider range of potential users can benefit from the Authority's research activities.

Difficulties may arise when users, who are unfamiliar with the disciplines involved, attempt to interpret complex land systems data. These problems can be largely overcome by having the resource survey groups interpret their own data in terms of particular activities. This approach has led to the development of land capability rating systems in which criteria relevant to a given activity are selected and assessed. The systems ensure that land can be classified into different classes of suitability on the basis of physical attributes. Currently, rating systems are being tested and refined and the range of land-uses under consideration is being extended.

Further reference, 1977 ; Destruction of vermin and noxious weeds, 1963 ; Soil, land-use, and ecological surveys, 1966 ; Farm water supplies, 1968 ; Group conservation, 1969 ; Land Utilization Advisory Council, 1970 ; Land Conservation Council, 1975

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 sea bed approximately 600 metres wide around the coastline of Victoria from Barwon Heads in the west to Cape Schanck 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 people can be expected to visit its many beaches. Besides its recreational importance the 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.

The government agencies nominated as representatives on the Authority are the Town and Country Planning Board, Public Works Department, Soil Conservation Authority, and the Department of Crown Lands and Survey. Attached to the Authority is a Consultative Committee which comprises representatives from the Ministry of Tourism, Municipal Association (four councillors), State

Rivers and Water Supply Commission, Victoria Police, Melbourne and Metropolitan Board of Works, Fisheries and Wildlife Division, and other bodies and organisations.

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 completed or commenced. The subjects covered include existing facilities, beach use, beach population, Swan Bay, flora of Port Phillip Bay, a shoreline unit classification, and a Coastal Vegetation Service. The Authority is also conducting a Coastal Study of Port Phillip Bay.

While these guidelines are being prepared the Authority also exercises an overview of all developments within its area. No structures can be erected or works commenced without its consent. Its approach to granting consent is based on the criteria of permitting those activities which must be located near the shoreline.

The Coastal Study for Port Phillip Bay is based on a concept by the Port Phillip Authority and aims to provide the Minister for Conservation with a set of comprehensive coastal management guidelines. The Authority has been producing a series of coastal feature maps of the Port Phillip Bay area. They are fairly detailed maps depicting the geographical make-up of the foreshore, status of the land, vegetation growth, man-made structures, car parks, sporting areas, etc.

An 80-page Topography and Vegetation Inventory has been completed. Cross sections of all the main areas around the bay have been taken and their topography and vegetation detailed in a legend form. A glasshouse has been constructed in Dromana and will be used to provide suitable plants for foreshore stabilisation around Port Phillip Bay. The Authority has also set up a Coastal Vegetation Service to advise foreshore bodies on vegetation matters.

Further reference, 1977 ; Port Phillip Bay Environmental Study, 1975 ; Western Port Bay Environmental Study, 1975 ; Gippsland Lakes Environmental Study, 1975

National Parks Service

Responsibilities

Until 1975, the National Parks Service was involved in running only traditional national parks. In many of these the day-to-day management was the responsibility of committees of management. The new National Parks Act, which was proclaimed on 1 December 1975, made basic changes to the responsibilities of the Service.

First, it provided for the Service to control not only traditional national parks, but many other types of parks as well. Second, the National Parks Service became directly responsible for the management of all parks, with Committees of Management becoming Advisory Committees; the Service thus retained local and specialised advice.

The new Act, together with the activities of the Land Conservation Council, has greatly increased the responsibilities of the National Parks Service. A re-organisation was undertaken in 1975 with substantial increases in staff and resources. The Service now has five branches at Head Office—Management, Administration, Resources and Planning, Protection, and Interpretation.

The Management Branch is responsible for district and park administration. Five district offices had been established by the end of 1975: South-west based on Portland; Nepean, with headquarters on Arthurs Seat; East Gippsland, based on Bairnsdale; South Gippsland, with headquarters at Yanakie, on the northern boundary of Wilsons Promontory National Park; and North-east with headquarters at Wangaratta. A district superintendent in each district is responsible for the district office and for the parks, park staff, management, and works. District staff was being appointed for three further districts being set up during 1977: North-west, based on Horsham; Geelong; and Melbourne.

As provided in the 1975 Act, the National Park Rangers have become officers of the Victorian Public Service. The National Parks Service has proceeded to recruit and train new field staff in line with its additional responsibility and the additional parks under its control. Beginning in 1975, groups of park Rangers have been sent each year to the Creswick School of Forestry to study for the Certificate of Applied Science (Conservation and Resource Management). Rangers will obtain this certificate on completion of the course, which involves twelve weeks of full-time study annually for three years.

Mt. Buffalo—"Tatra Inn"

In 1975 the Government acquired the interest of the developer in the "Tatra Inn" ski and holiday resort in Mt Buffalo National Park. Subsequently the Service has become heavily involved in the general management of the resort, and in providing and managing skiing facilities at both the Dingo Dell and Cresta ski runs. A resort manager has been appointed to control this aspect of the work at Mt Buffalo, and the accommodation and restaurant facilities of the "Tatra Inn" have been leased. These arrangements operated successfully during the 1976 and 1977 snow seasons when both Dingo Dell and Cresta had record numbers of visitors and the Service obtained substantial revenues from the operation of ski lifts.

Wilsons Promontory-Tidal River

A great deal of effort has been put into improving facilities in various national park camping areas. The largest of these is at Tidal River in Wilsons Promontory National Park. In the Tidal River resort, improvements have been made to the various tourist lodges, the camping ground facilities, and the various public utilities. A resort manager has been appointed to have direct responsibility for the operation of the resort.

State Parks and equivalent reserves

The National Parks Service is now a major resource and recreation manager responsible for protecting a wide variety of resources and enabling people to use and enjoy the parks. The Service's land management responsibilities include :

- (1) The 25 national parks ; and
- (2) a series of other categories of parks, many of which contain significant management difficulties, as well as a wide range of activities and fewer restrictions than are involved in national parks.

A brief outline of the parks in this second category follows.

The Cape Schanck Coastal Park covers an area of 900 hectares, including the popular ocean beaches between Cape Schanck and London Bridge on the Mornington Peninsula. This is a narrow coastal strip which receives high recreational use in the summer months. Numerous car parks have been developed by the former management bodies along the coastal strip and erosion is a problem at a number of points.

Associated with the Cape Schanck Park are the other responsibilities arising from the Victorian Government's conservation and land purchase programme on the Mornington Peninsula. At the end of June 1976 a further 886 hectares of land on the Mornington Peninsula at Cape Schanck, Arthurs Seat, Greens Bush, and the "Seawinds" ornamental gardens on Arthurs Seat, were being managed by the Service.

Warrandyte State Park is situated 24 kilometres from Melbourne and is proposed to cover an area of 390 hectares. This includes a number of bushland reserves both along the Yarra River and in the Warrandyte district. One hundred and thirty-five hectares have been reserved under the National Parks Act and a further 140 hectares are under Service control. Management will aim to accommodate the high intensity recreation pressures as well as to preserve the natural features for future generations. Some problems will be encountered in the sections of the park bordered by residential development.

Burrowa-Pine Mountain. Consequent upon the approval by the Governor in Council of the recommendations of the Land Conservation Council for the study area North East District 1, a national park of 16,720 hectares is to be declared north of Cudgewa and Corryong in the Mt Burrowa-Pine Mountain area for the purposes of protecting and preserving natural ecosystems with particular emphasis on the Pine Mountain flora and to provide opportunities for recreational and educational experiences related to enjoying natural environments. Legislation to declare the national park is being prepared and the Service is meanwhile establishing control over the area and has appointed a Head Ranger.

Discovery Bay Coastal Reserve. As a result of a recommendation of the Land Conservation Council, the Victorian Government has established a Discovery Bay Coastal Reserve of 8,000 hectares near Portland, and placed this reserve under the management of the National Parks Service. The purposes of this reserve are to :

- (1) Provide opportunities for recreation on the coast, lake, and river mouth (including water-skiing on the largest of the Bridgewater Lakes) ;
- (2) provide opportunities for recreation in the sand dunes ;
- (3) conserve floral, geomorphological, and archaeological features of the area for the enjoyment of visitors and scientific study ;
- (4) ensure the management and conservation of wildlife ; and
- (5) permit any necessary stabilisation of the dunes.

The management of this reserve includes provision for continued shooting in a section which was formerly a wildlife reserve, and the zoning of an area in the dunes for motorised recreation vehicles. These are two new activities for the Service.

The Lakes Coastal Reserve. In accordance with a recommendation from the Land Conservation Council, the Government is establishing the Lakes Coastal Reserve. The area of more than 17,000 hectares in the district managed by the National Parks Service includes the Lakes National Park on the Sperm Whale Head Peninsula, with a frontage on Lake Victoria and Lake Reeve ; an ocean frontage of over 90 kilometres along the Ninety Mile Beach, from Seaspray to the entrance to the Lakes ; and Lake Reeve. Special uses will include shooting of game species, including hog deer in the western sector of the coastal reserve. *Haining Park* is an operating dairy farm at Launching Place, with frontages to the Yarra and Don Rivers. It is being managed to provide an environmental study facility for city school children.

Cape Nelson. An area of 176 hectares at Cape Nelson, west of Portland, has been acquired in order to conserve coastal flora and scenery. The park is to incorporate the adjacent coastal strip. The area is managed in conjunction with the nearby Mt Richmond National Park.

Holey Plains. In accordance with a recommendation of the Land Conservation Council approved by the Governor in Council, steps are being taken to declare the Holey Plains State Park of 10,800 hectares. This area, south-west of Sale, has important floral values. The intention is to provide for public enjoyment and education, in a natural environment.

Mt Worth. For a number of years the Service has been working towards the declaration of a Mt Worth State Park in the western Strzelecki Range. Three blocks totalling 164 hectares have been acquired for this purpose. Arrangements are being made for land exchanges involving A.P.M. Forests Pty Ltd and the Forests Commission of Victoria in order to acquire the additional land required.

Warby Range. An area of 2,750 hectares of Crown land in the Warby Range between Wangaratta and Benalla has been placed under the control of the Service. The area has floral and scenic values, and is important for recreation.

Werribee Gorge. The Werribee Gorge Reserve, which was established in the early years of the century, has been placed under the control of the National Parks Service. This area of 207 hectares is of great interest for its geological associations and specialised wildlife aspects.

The land under the management and control of the National Parks Service is set out in the following table :

**VICTORIA—PARKS UNDER THE CONTROL OF THE
NATIONAL PARKS SERVICE, JUNE 1977**

Park	Area
<i>A. National parks</i>	<i>Hectares</i>
1. Alfred	2,300
2. Brisbane Ranges	1,132
3. Bulga	36
4. Captain James Cook	2,750
5. Churchill	193
6. Fern Tree Gully	450
7. Fraser	3,100
8. Glenaladale	163
9. Hattah Lakes	17,800
10. Kinglake	5,700
11. The Lakes	2,100
12. Lind	1,166
13. Little Desert	35,300
14. Lower Glenelg	27,300
15. Mallacoota Inlet	5,250
16. Morwell	140
17. Mount Buffalo	11,000
18. Mt Eccles	400
19. Mt Richmond	1,700
20. Organ Pipes	65
21. Port Campbell	700
22. Tarra Valley	140
23. Wilsons Promontory	49,000
24. Wingan Inlet	1,900
25. Wyperfeld	56,500
Total—national parks	226,285
<i>B. Other parks declared under the National Parks Act</i>	
1. Cape Schanck	900
2. Warrandyte	135
Total—other parks	1,035
<i>C. New parks approved by the Government and managed by the National Parks Service pending legislation to bring them under the National Parks Act</i>	
1. Arthurs Seat, Greens Bush, and Seawinds	625
2. Burrowa-Pine Mountain	16,720
3. Cape Nelson	176
4. Discovery Bay Coastal Reserve	8,097
5. Haining	61
6. Holey Plains	10,800
7. The Lakes Coastal Reserve	15,420
8. Mt Worth	164
9. Warby Range	2,750
10. Werribee Gorge	207
Total—new parks	55,020
<i>D. Land Act Reserves (mainly small blocks of purchased land) managed in conjunction with 14 existing parks.</i>	
	931
Total—all parks	283,271
Percentage of total area of Victoria	1.24
Percentage of public lands of Victoria	3.11

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, 1977

ROYAL MELBOURNE ZOOLOGICAL GARDENS

The Melbourne Zoo was the first to be established in Australia. Its history began at a meeting convened on 6 October 1857, in St Patrick's Hall, Melbourne, for the purpose of taking measures for the formation of an Ornithological Society—"having in view chiefly the rearing of the finer kinds of poultry and cage birds".

At the meeting it was suggested by a Dr Thomas Black that "it would be better at once to extend the original view, and consider the propriety of establishing a Zoological Society, since such an institution had long been a desideratum in the Colony, both for the purpose of science and for that of affording the public the advantage of studying the habits of the animal creation, in properly arranged Zoological Gardens".

A Society was formed under the name of the Zoological Society of Victoria. Its first patron was the then Governor of Victoria, Sir Henry Barkly. In 1861 the title was changed to the Acclimatisation Society of Victoria, and in 1872 to the Zoological and Acclimatisation Society of Victoria. The prefix "Royal" was added in 1910 after a Royal Charter had been granted. The Royal Zoological and Acclimatisation Society of Victoria controlled the Zoological Gardens until 1937, when financial difficulties were encountered. The Zoological Board of Victoria was then established as a statutory body by the Government of Victoria for the purpose of controlling the Melbourne Zoological Gardens, an authority which was extended in 1975 to enable the Board to control other areas, in particular, the Werribee Fauna Park. The Board consists of eleven honorary members.

When the original Zoological Society was formed in 1857, initial finance was provided by members' subscriptions and other donations, although building had to be delayed until the Victorian Government made a grant of £3,000 (\$6,000) and 33 acres (13.35 hectares) of land previously known as Richmond Paddock. This land, situated across the river from the Botanic Gardens, was found to be too cold and swampy; consequently the Government made available the present site of 55 acres (22.26 hectares) in Royal Park. The animals were transferred there in 1862. These included camels, alpacas, deer, sheep, goats, monkeys, koalas, kangaroos, wallabies, mongeese, jackals, squirrels, porcupines, tortoises, some 70 species of birds, and three species of reptiles.

Camels were among the first mammals to be introduced. Some of the Zoo's stock of camels were used for the ill-fated Burke and Wills expedition in 1860. Monkeys were listed by the Society in its 1858 records, having been imported beforehand as pets and then donated or sold to the Society. The first of the great cats—a leopard—appeared in 1871, followed by lions in 1872 and tigers in 1875. The first bear arrived in 1872. The first ape to arrive was an orang-utan in 1882 but chimpanzees were not represented in the collection until 1933.

"Ranee" was the first elephant, arriving in 1883. After being landed from the ship at Sandridge, she was kept at the local police station until the middle of the night to enable her to be taken to the Zoo when the streets were deserted. Giraffes and hippopotamuses made their first appearance in 1913.

Reconstruction of the Melbourne Zoological Gardens commenced in 1966 with the building of a lion park and new hippopotamus enclosures. A feature of the lion park is a viewing bridge which spans the 0.4 hectare park and from which visitors have an enclosed grandstand view of the roaming pride of lions. The hippopotamuses are also viewed from an enclosed gallery which provides close observation of these animals.

The elephant enclosure was reconstructed in 1967. High fences were removed and replaced by a moat to enable total viewing of the elephants. In the same year, an animal nursery was built so that visitors could see young animals. In recent years the building has been used for gorillas, lions, caracals, otters,

armadillos, and a chimpanzee, as well as for orphaned native animals. In 1968 a thickly vegetated island was transformed to a gibbon island for this non-swimming tree-dwelling ape.

The next new exhibit was the reptile house, which took over two years to build and was opened in 1969. Each unit is furnished with plants and natural materials to provide an environment resembling a habitat such as rainforest, desert, etc. A special reptile department was established at the Zoo when the reptile house was opened.

An otter and seal complex was opened in 1971. It consists of a deep pool and shore on each side of a hollow dividing wall from which creepers and grasses are growing.

In 1972 new enclosures were constructed for the great cats, and the following year smaller units were provided for the lesser cats. By 1975 the exhibition of wild cats had increased over a 10 year period from five to fifteen species.

Two fauna parks were also opened in 1972. These permit visitors to stroll among animals in a bushland setting. One park is devoted exclusively to Australian animals such as kangaroos, wallabies, and emus. The adjacent park is similar, but in addition to Australian fauna, some exotic animals (such as deer and rheas) are housed in it.

The first stage of the "World of Primates", a complex to house apes, monkeys, baboons, and other members of the Primate order, was opened on 15 March 1974. It provides new accommodation for the great apes, comprising gorillas, chimpanzees, and orang-utans. These enclosures feature front caves which can be heated, rear caves protected from the weather, and heated night quarters. The open display area in front of the dwellings is separated from spectators by a moat and low vegetation.

The first stage in the construction of new enclosures for mammals and water birds indigenous to Australia was also completed in 1974. An area of approximately 20,000 square metres containing old bird cages was cleared and replaced by moated enclosures for kangaroos and wallabies. These surround an island and lake for the breeding and exhibition of native water birds. Approximately 5,000 native trees and shrubs have been planted between enclosures and on the periphery of the area both for aesthetic effect and to encourage viewing from within. There are also plantings within the enclosures for wind protection.

Two new picnic shelters were constructed in 1975 to replace dilapidated iron sheds that have been used for many years by schools, social groups, and visitors generally. Located in the midst of the carnivore enclosures, the new buildings are designed to create a kraal effect, which is complemented by their proximity to the lion park.

A development plan, which is in fact a master plan for those areas of the Zoo yet to be reconstructed, was started in 1973 and completed in May 1975. It was formally presented to the Premier of Victoria, at a special function on 27 June 1975. The plan covers design of new enclosures, public facilities, reticulation of essential services, graphics, landscaping, and costing.

In 1969 the Zoological Board of Victoria established an education service when it appointed a trainee education officer. With only limited resources the Board converted a pavilion into a reasonably comfortable classroom and provided furniture and some basic audio-visual equipment.

The following year a teacher was seconded to the Zoo on a half-time basis from the Victorian Education Department. That there was a substantial demand for lessons in the Zoo became apparent during the year and, as a result a teaching staff of four full-time and three half-time teachers was seconded from the Education Department. The Zoological Board provided office space and appointed a full-time administrative officer to the Service.

The demand for lessons increased, and difficulties were experienced in trying to cater for the large numbers of children. There was no direct advertising by the

service to teachers; the demand was apparently created by teachers passing on information to other teachers. In 1973 another pavilion was converted into a classroom to help accommodate the ever-increasing numbers of children, and in 1974 two additional classrooms of a portable type were provided through private donations.

The staff in 1977 stood at eleven full-time and two part-time teachers, and a second administrative officer had been appointed. The increases in staff, and the need for more and better facilities have been necessitated by the great demand created by schools.

The Gardens became the Royal Melbourne Zoological Gardens when a Royal Charter was granted in 1977 at the time of the Queen's visit.

Royal Botanic Gardens and National Herbarium, 1977

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 Victoria* 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 Victoria* 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 Victoria* 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 Phillips Island 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 finally clarified with the passing of the New South Wales Constitution Statute (*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.

Cape Howe to the Murray River

In 1866 following the discovery of gold on the tributaries of the Snowy River near 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. This 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 115 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 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 careful 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 3.60 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 Victoria 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 (No. 161 of 1973), 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 airspace 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 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 sea-bed 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 50 feet (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 25 feet (7.62 metres), sometimes 20 feet (6.10 metres), or 30 feet (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.
- (3) Some land at Morwell and Hazelwood—305 metres.
- (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	Percentage of total area
	square kilometres	
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

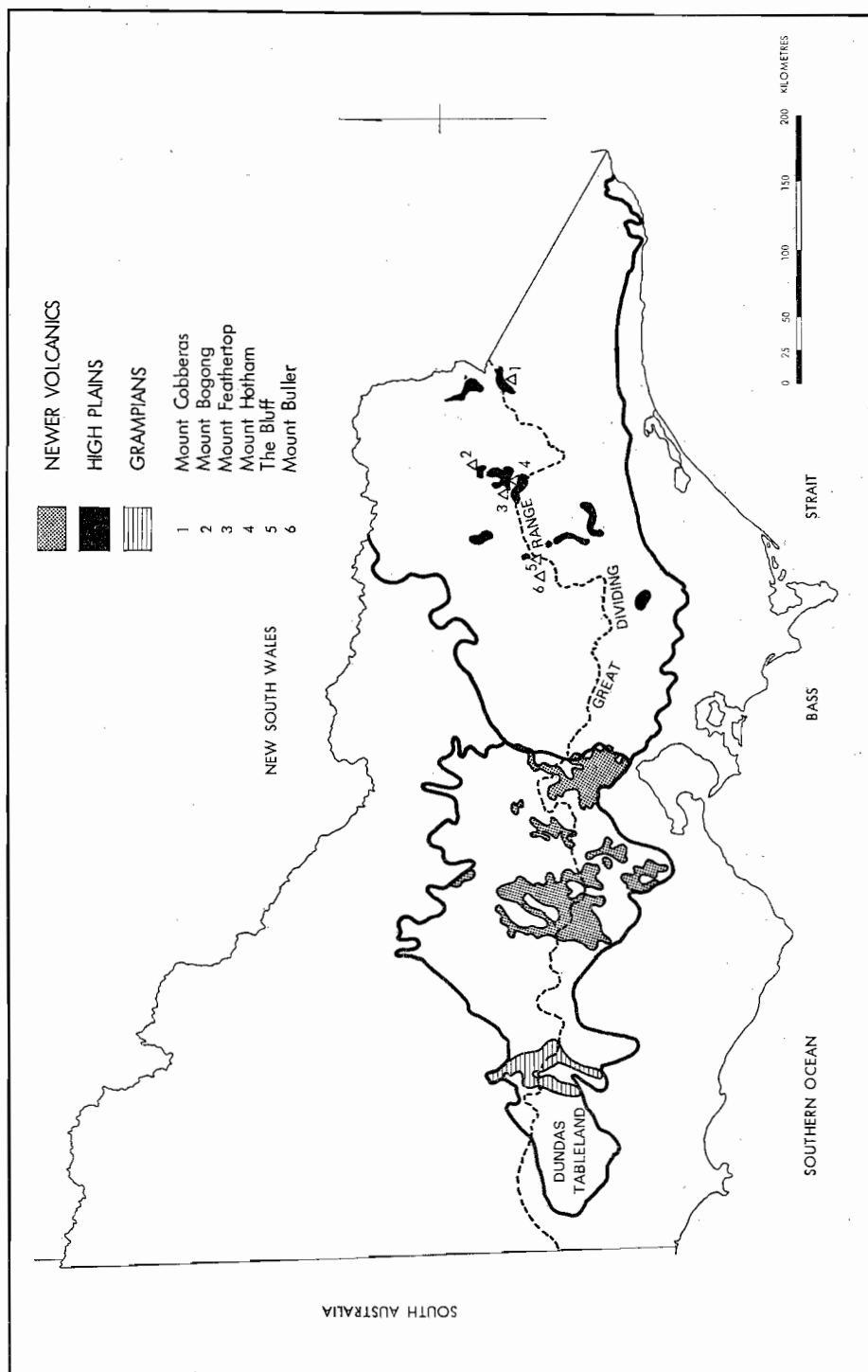


FIGURE 4. Mountain areas of Victoria.

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.

Considerable physiographic and geological variation occurs in the highlands with granitic intrusives, volcanic complexes, and sedimentary, metamorphic, and tectonic structures all in evidence. Broad plateaux, high plains, and extensive ridge and valley terrain 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 Feather-top (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 auriferous deep leads (gold-bearing gravels). 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

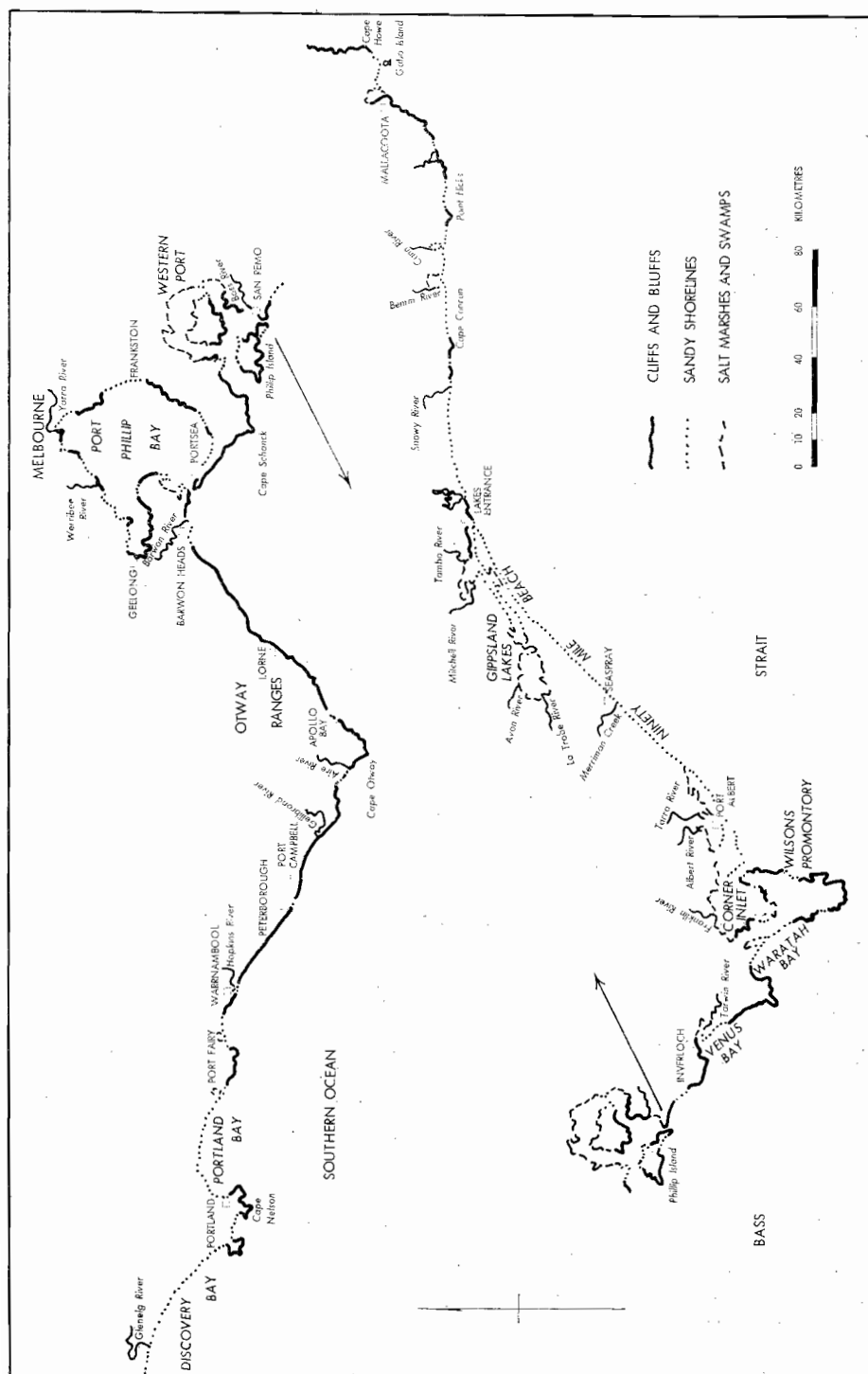


FIGURE 5. Predominant coastal landforms in Victoria.

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 and provide recreation and wildlife preservation opportunities.

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 and provide opportunity for port and harbour development.

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 clay rocks. Wave action has eroded along fractures 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 is 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 sand ridges are actively eroding and sand is spilling and blowing inland to cover coastal vegetation. Similar erosion is noted along the Ninety Mile Beach and on the sandy beaches and dunes further east between Lakes Entrance and Cape Howe.

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: in 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.

Survey and mapping

The Division of Survey and Mapping of the Department of Crown Lands and Survey is responsible for the development 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 provisions of the *Survey Co-ordination Act 1958*; surveys for the Housing Commission, the Rural Finance and Settlement Commission, and other departments and authorities; and the documentation of these surveys.

An Australia-wide primary geodetic survey was completed in 1966, and in Victoria this is continuously being extended to provide a framework of accurately fixed points for the control of other surveys and for mapping. A State-wide network of levels was completed in 1971. The datum, based on mean sea level values around the whole coast of Australia, is known as the Australia Height Datum (AHD), and its adoption obviates the multitude of local datums formerly in use throughout the State. Issued lists of level values on the AHD are in metres.

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 Department of National Resources and the Royal Australian Survey Corps. A joint Commonwealth-State Government mapping project, commenced in 1966, is proceeding with the production of topographic maps at a scale of 1:100,000 with a 20 metre contour interval. A number of these maps has been published. The Mines Department and the Forests Commission also contribute to State mapping by publishing maps for geological and forestry purposes.

A series of 26 maps at a scale of 1:25,000 showing streets, rivers, creeks, and municipal boundaries in Melbourne and its suburban area, including the Mornington Peninsula, has been produced. A long-term programme for production of general purpose standard topographic maps, at 1:25,000 scale with a 10 metre contour interval, has been planned to extend this map coverage over the greater metropolitan area, and to embrace many of the larger provincial centres. Other maps of urban and suburban areas at 1:10,000 scale, showing full subdivisional information, are being prepared of the Mornington Peninsula area;

similar maps of various rural centres are on programme in conjunction with Commonwealth Government maps at the same scale required for census purposes.

Large scale base maps have been prepared for rapidly developing areas throughout the State, including the outer metropolitan area, Mornington Peninsula, Ballarat, Geelong, Bendigo, Phillip Island, and a number of other rural areas. These maps were originally compiled at a scale of 1:4,800 (400 feet to 1 inch) with a 5 foot contour interval. However, with the introduction of the metric system, all new maps will be prepared at a scale of 1:5,000, generally with a 2 metre contour interval. The publication *Official Map and Plan Systems Victoria* has been issued setting 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 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. Recently further investigations have been made with the object of introducing a fully integrated topographic-cadastral map and plan system. Although cadastral requirements may result in the publication of plans using an additional range of scales, it will be a fundamental principle that the Australian Map Grid will be the basic framework of their compilation.

As part of its mapping activity, the Department provides an aerial photography service and maintains an aerial photography library of approximately 300,000 photographs from which prints and enlargements may be obtained. Maps, plans, and aerial photographs are available for purchase from the Central Plan Office of the Department.

Further reference, 1977 ; Hydrography, Coastline, 1966 ; Coastal physiography, 1967 ; Plant ecology of the coast, 1968 ; Marine animal ecology, 1969 ; Marine algae of the Victorian coast, 1970 ; Erosion and sedimentation on the coastline, 1971 ; Conservation on the Victorian coast, 1972

Physical divisions

This article should be read in conjunction with the sections on geographical features, area, and climate.

The chief physical divisions of Victoria are shown in Figure 6 on page 61. Each of these divisions has certain physical features which distinguish it from the others, as a result of the influence of elevation, geological structure, climate and soils, as is recognised in popular terms such as Mallee, Wimmera, Western District, and so on. The following is a table 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

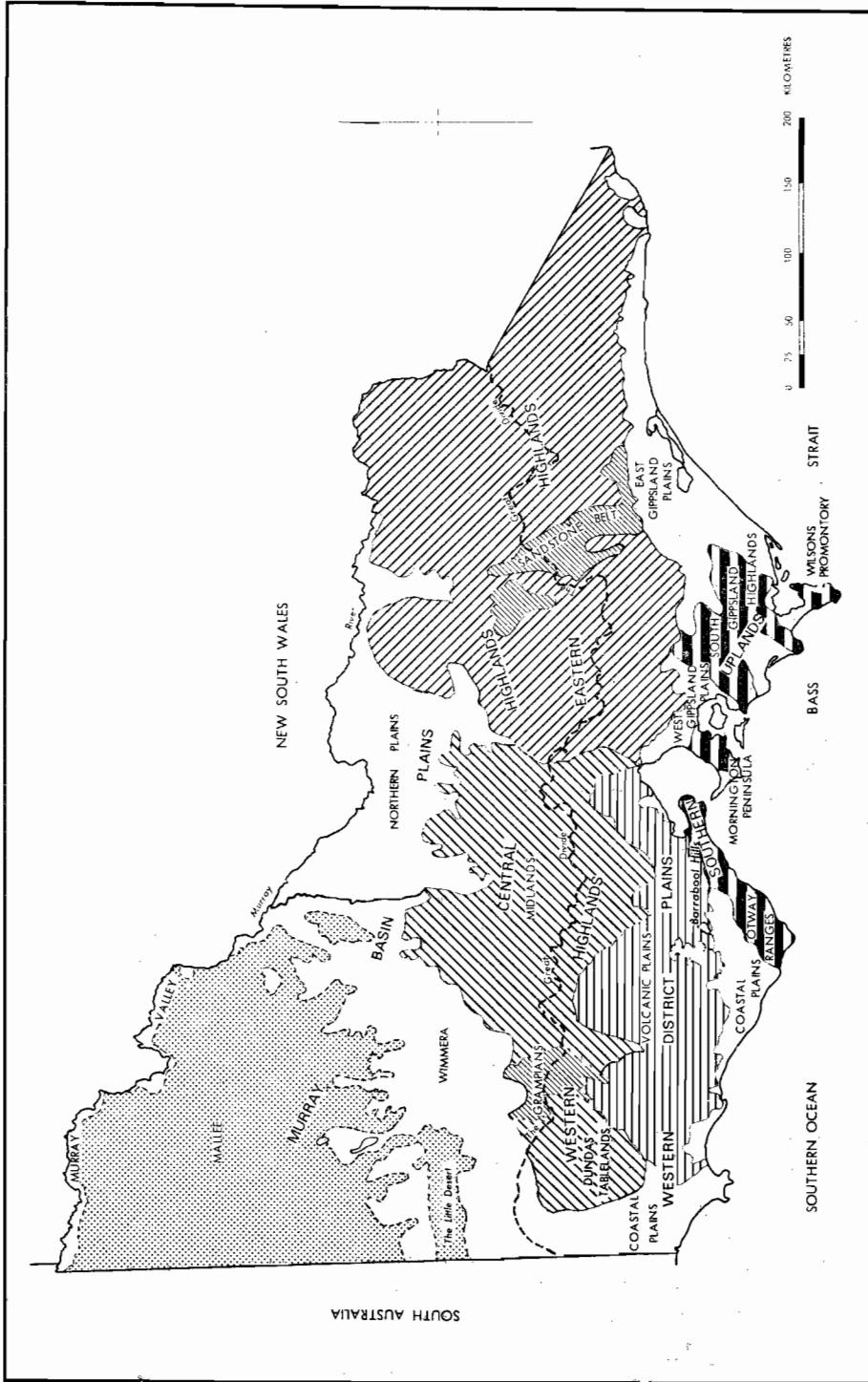


FIGURE 6. Physiographic divisions of Victoria.

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 Plains or Riverine Plains. The plains are effectively subdivided by a north-south fracture 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 the Murray, Loddon, and Campaspe Rivers, formed by fluvial sedimentation. Crossing the Riverine Plains is an extensive system of dry former stream courses now choked with sand, and known as prior streams.

West of the Leaghur Fault the landscape and soil are very different. Here the *Mallee* country starts, with its irregular surface of undulating sand ridges, mainly of fine sand, which largely trend north-south and appear to be stranded coastal ridges and dunes left on the margin of a retreating sea. The Mallee is in fact the marine plain from the former Murray Basin, with a mere veneer of wind-blown sands overlying fossiliferous Tertiary marine sands and silts, which reach eastwards to the Gredwin Ridge on the Avoca-Loddon divide near Kerang. Westward of the Loddon River, all the Mallee streams, because of low flow volumes, percolation and high evaporation, fail to reach the Murray River and terminate in brackish or saline shallow lakes commonly bordered with lunette ridges.

The *Wimmera* is essentially the low alluvial fans, alluvial plains, and abandoned river channels lying between the Western Highlands and the Murray Basin or the Mallee, as the sand-strewn surface of this basin is commonly known.

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 at least 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 mudstones.

The *Western Highlands*, in contrast to the Eastern, are much lower in elevation and generally are subdued hills rather than mountains. Rugged areas are mostly found only near fault scarps. The general elevation reaches a

maximum of about 600 metres at Ballarat, but elevations are 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 basalt from the Upper Tertiary 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 near Ballarat.

The Grampians, sharp-crested strike ridges of hard sandstone reaching 1,200 metres in height, are prominent mountains rising far above the declining general level of the highlands as they trend westwards. The westerly extremity of the Western Highlands is the Dundas Tablelands, a warped plateau reaching 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, apart from where rejuvenating movements have occurred along fault scarps to cause, in some cases, gorges.

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

Western District Plains

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

Volcanic Plains

With an area of 2,300 square kilometres, the Volcanic Plains are the third 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 shows extensive minor irregularities known locally as "Stony Rises", formed by lava collapse during solidification; these 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" can thus be linked with Mt Porndon (289.2 metres). Crater 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.

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 fractured 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 fresh-water sediments have accumulated, including the major brown coal seams of the Latrobe 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; earlier dunes are even 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 Cretaceous sandstones and mudstones, and all display a characteristic rounded topography, due in part to very extensive land-slipping 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. A subdued spit of calcareous dune rock extending westwards from the Peninsula to Portsea almost closes Port Phillip Bay.

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 lengths 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 uplifts.

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 gold-bearing 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 erosion surface on the Kinglake Plateau, the hill summits immediately east of Melbourne and around the Dandenong Ranges to Gembrook, 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 even Quaternary saw vast volcanic activity in central and western Victoria. From Melbourne to Hamilton basalts and tuffs were out-poured and ejected. Flows followed pre-existing valleys in the Western Highlands, burying auriferous gravels as deep leads in the Ballarat district.

Final downwarpings, 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 resultant of larger streams with more erosive power, and changing Quaternary climates are recognised in the changing regimes evident in the former lakes and prior streams of the Riverine Plains.

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 this will be elucidated by a long-term programme of investigation being carried out by the Victorian Mines Department.

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.

Rivers

Topography

The topography of Victoria is dominated by the Great Dividing Range, which extends from a triangular mountainous mass 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 51.)

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 Latrobe, 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 Woody-Yaloak 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. Water quality 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, distinctive 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	Drainage area	Annual stream flows in million cubic metres (to 1969)					No. of years gauged	Site of gauging station
			Mean	Max.	Min.				
	kilometres	square kilometres							
NORTHERN RIVERS									
Murray	1,926 (from source to Victorian border)	6,527 (upstream of Jingellie)	2,368	6,123	675	80			Jingellie, N.S.W.
Mitta Mitta	286	5,058	1,411	4,256	250	49			Tallangatta
Kiewa	185	1,145	632	2,071	166	84			Kiewa
Ovens	228	5,827	1,572	4,143	221	29			Wangaratta
Broken	193	1,924	247	1,091	19	84			Goorambat
Goulburn	566	10,772	2,139	7,369	145	88			Murehison
Campaspe	246	3,212	236	820	1	78			Elmore
Loddon	381	4,178	231	740	9	78			Laanecoorie Reservoir
Avoca	270	2,624	76	395	3	80			Coonooer
Wimmera	291	4,066	128	589	..	77			Horsham
SOUTHERN RIVERS									
Snowy	162 (in Victoria)	13,421	1,814	4,002	381	33			Jarrahrmond
Tambora	200	943	58	121	21	5			Swifts Creek
Mitchell	251	3,903	921	2,188	193	32			Glenaladale
Thomson	209	1,088	400	680	175	50			Cowwarr
Macalister	202	1,891	496	1,533	45	51			Lake Glenmaggie
Latrobe	251	4,144	940	3,240	271	55			Rosedale
Bunyip	63	661	153	304	69	47			Bunyip
Yarra	246	2,328	804	1,494	176	52			Warrandyte
Maribyrnong	183	1,303	107	327	4	39			Keilor
Werribee	124	1,155	79	314	7	53			Melton Reservoir
Moorabool	153	1,114	70	221	1	24			Batesford
Barwon	188	1,269 (excluding Leigh and Moorabool Rivers)	58	102	7	4			Inverleigh
Hopkins	282	1,347	32	127	1	38			Wickliffe
Gleneel	457	1,570	144	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 must exceed the rainfall: this is the case over most of Victoria.

Closed lakes occur mainly in the flat western part of the State. They fluctuate in capacity 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 the use of freshwater lakes is not extensive 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 lagoons in eastern Victoria, separated from the sea by broad sandy barriers bearing dune topography, and bordered on the ocean shore by the Ninety Mile Beach. A gap through the coastal dune barrier near Red Bluff, which was opened in 1889, 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. Coastal lagoons of this type rarely persist for more than a few thousand years and as deposition of sediment proceeds and bordering swamps encroach, the lakes will gradually be transformed into a coastal plain.

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.

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