

GEOGRAPHY

PROTECTION OF THE ENVIRONMENT

Ministry for Conservation

Introduction

The broad aims of the Ministry are to protect and preserve the environment, and to ensure 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, the Soil Conservation Authority, Fisheries and Wildlife Division, National Parks Service, Environment Protection Authority, Port Phillip Authority, and the Land Conservation Council; and 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 Marine Studies Group carries out marine chemical and biological research for the Environmental Studies Section and other Ministry groups. 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 described in more detail below.

Environmental studies

To achieve the best 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 Catchment 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, have recently been combined into a new Ministry unit — the Marine Studies Group. With a total staff of about 80, the Marine Studies Group services all sections of the Ministry which require marine chemical and biological information, and also undertakes a variety of marine research for the Ministry's Environmental Studies Section.

The marine laboratory, built and equipped at a cost of \$500,000, was opened in December 1976 at Melbourne's North Wharf. Much of the marine research work is carried out here and at the marine chemical laboratory located in Parliament Place, Melbourne. The Group operates two fully equipped research vessels, the 16.7 metre *Melita*, and the similar sized *Capitella*.

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 assessed 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*. Recent legislation formalised these arrangements.

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 inquiries 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 available to individuals and groups in the community who wish to 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 \$31.5m in the financial year 1977-78. Of this amount, salaries accounted for \$15.4m. Staff of the Ministry and its agencies totalled about 1,310 persons at that time.

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

Particulars	1973-74	1974-75	1975-76	1976-77	1977-78
Ministry					
General expenses	1,356	2,797	3,164	3,035	4,301
Land purchases	..	1,127	4,095	1,361	2,658
Environmental studies	742	906	1,181	1,614	2,211
Agencies					
National Parks Service	1,153	2,566	4,621	4,666	6,083
Environment Protection Authority	2,408	3,167	4,156	4,923	5,684
Soil Conservation Authority	1,992	3,184	4,325	4,096	4,553
Fisheries and Wildlife Division	2,370	3,266	4,433	4,348	5,145
Other (incl. Port Phillip Authority and Land Conservation Council)	338	384	631	698	908

Environment Protection Authority

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

Some of the major activities of the Authority are as follows:

Air quality

New vehicles from manufacturers and in-service vehicles are tested at the Altona vehicle emission and noise testing station for compliance with the Environment Protection (Motor Vehicle Emission Control) Regulations 1976.

A draft Environment Protection Policy for Victoria's air quality has been developed. Following reaction from interested parties and adoption by the Government, the State Policy will form the basis of air licensing decisions by the Authority. The Policy includes parameters to be used in describing air quality, standards to be adopted for each parameter, future standards, identification of regions requiring special consideration, and land-use.

Melbourne's air is continuously monitored through a network of stations and mobile vans. A major survey of the air quality and related meteorological conditions in the La Trobe valley has commenced. The survey will be carried out by the State Electricity Commission, the Environment Protection Authority, and the Latrobe Valley Water and Sewerage Board, with assistance from CSIRO. Its main aim is to assess the effect of emissions on the environment in the La Trobe valley from present and future major sources such as power stations.

Water quality

The Authority is responsible for the protection of the water quality of Victoria's beaches, streams, and waterways. Lack of sewerage facilities and inadequate control of industrial waste discharges in the past have left a legacy of water quality problems which are gradually being overcome. Improvement is now evident as the system of licensing waste discharges under the Environment Protection Act takes effect. All major discharges to coastal waters and the majority of discharges to inland waters have now been brought under strict controls. Increasing attention is being paid to the control of certain categories of wastes which are not appropriate to the licensing system, e.g., stormwater run-off, septic tanks and sullage, discharges from ships and boats, and run-off from agricultural operations. Other significant advances have occurred in the formulation of State environment protection policies for various water bodies, and in the establishment of a

comprehensive water quality data processing system to handle both discharge data from licences and ambient data from the regular sampling of receiving waters.

Wastes on land

Community wastes deposited on land are controlled by the Authority's licensing system. Legislation has been introduced amending the Local Government Act to enable councils to form regional groups for waste disposal.

A waste exchange system was introduced to achieve the benefits of resource conservation and waste disposal by providing industry with a current comprehensive list of wastes generated in Victoria.

Environmental noise

The Environment Protection (Noise Control) Act 1975 introduced progressive legislation in the field of noise control, which is a growing problem in cities. 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. A regulation controlling noise from audible intruder alarms has been passed by Parliament. Legislation controlling noise emissions from industrial and trade premises is under preparation. This legislation allows the serving of noise control notices on noisy industry.

Waste control system

Licensing is the main method used by the Authority to prevent pollution of the environment. A licence is required for all discharges to air, land, or water unless the discharge has been specifically exempted. Licence conditions may require treatment of the discharge to meet environmental objectives.

Licensing decisions are open to appeal. The licence applicant and affected third parties can appeal within 45 days against the granting, amendment, or the removal of a suspension of a waste discharge licence. Appeals against licensing decisions are heard by an independent body, the Environment Protection Appeal Board. Appeals can be made to the Supreme Court on points of law.

Further reference: *Victorian Year Book 1978*, pp. 38-9

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.

Descriptive reports have been published for 15 of the 17 study areas as follows:— South West Districts 1 and 2, South Gippsland District 1, North East Districts 1, 2 and 3, 4 and 5, Melbourne, East Gippsland, Mallee, Corangamite, Alpine, and North Central Study Areas. Of these, Final Recommendations have been published for South West District 1, South Gippsland District 1, North East Districts 1, 2 and 3, 4 and 5, Melbourne, Mallee, East Gippsland, Alpine, 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.

Wilderness Areas. Areas of land in which man may experience isolation, the challenge of exposure to the elements, and refuge from the pressures, sights, and sounds of modern urban life.

Uncommitted Land. Areas which have been set aside to provide for future needs of the community. Provided that the capability of these areas to meet future demands is not reduced, they can be used to produce goods and services such as forest products, grazing, and military training.

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. Large areas have been recommended to be used for timber production, and smaller areas recommended for mining, public utilities, and agriculture.

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 on-farm water resources; the protection of water catchments; supervisory responsibility over all activities which may disturb the soil at altitudes over 1,200 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. The history of the extensive drylands areas of Victoria is typical of this need.

Dryland farming in north-central and north-western Victoria

During the middle of the nineteenth century, the development of a strong agricultural industry became essential to the prosperity of the State and it expanded rapidly following the decline of the gold mining boom. As part of this development, large tracts of the more freely available but marginal rainfall areas in the north-central and north-western parts of Victoria were closely settled, to be rapidly cleared and cultivated for cereal cropping.

In the north-western zone much of the cleared land proved unsuitable for this form of land-use. Early crop cultivation techniques were based on ploughing up and down slopes, supposedly to provide better drainage, and because of limitations of the horse-drawn ploughs then in use. The topsoils were mostly shallow and the cultivation methods exposed the erosion prone sub-soils. Run-off water from the severe summer thunderstorms, which are a feature of the climate, became channelled in the furrows and washed extensive quantities of the top-soils downslope. Severe gully and sheet erosion then developed in the exposed sub-soils.

After the closer settlement period, cropping gave way to sheep grazing on the native pastures in many areas. Heavy grazing, by both sheep and the introduced rabbit, often resulted in loss of the vegetative ground cover and high rates of run-off over the bare soil. Sheet and gully erosion again resulted.

Land restoration

Restoration of these badly eroded grazing areas is now based on a replacement of the shallow-rooted, native grasses with highly productive, deep-rooted perennial grasses, which use much of the rainfall where it falls, and the extensive use of fertilisers, particularly superphosphate. Currently, economic constraints affecting profitability are threatening continuation of this development, which has been very successful.

Cultivation is now confined to more suitable areas, and yields are being improved with new cropping management techniques. In the past, frequent cultivations, associated with long periods of bare fallow, were aimed at conserving soil moisture and nitrogen levels.

This sometimes resulted in damage to soil structure and susceptibility to erosion during severe storms. Adoption of techniques such as crop rotations, the utilisation of legumes to provide organic matter and improve soil structure, and the use of tillage implements have reduced the risks of erosion. Many steeper areas have been protected by installation of graded banks across the slope to intercept run-off and carry it to safe disposal areas.

In the Mallee region, in the north-west of the State, a special problem exists where the prime erosive agent is wind. Early settlers were unaware of the problem, which centred on the vulnerability of the sandy soils when unprotected by vegetation. It is now known that an optimum soil moisture level should exist, before cultivation is undertaken, to reduce the risk of erosion. The use of more efficient equipment ensures that cultivation can usually be completed within the seasonal time limits imposed by this factor. As in many other cropping areas, rotations, including the use of legumes, are an integral part of the cropland management. Cereal varieties, developed to suit the short growing season of the area, are now available. These boost yields and obviate the need to expand cropping into marginal areas.

Many early mistakes in dryland farming, both in grazing and cropping areas, were made through a lack of understanding of soil characteristics. These weaknesses are now recognised, but further improvement of farming techniques is still needed if existing land-uses are to be fully compatible with the objectives of maintaining the land in a permanently productive and stabilised condition.

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

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. Consent is required for a structure or works or removal of vegetation and is based on the premise of permitting only those activities which must be located in the coastal zone. Others may be permitted, but subject to condition.

The area over which the Port Phillip Authority has jurisdiction is the area 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 to the east including Port Phillip Bay.

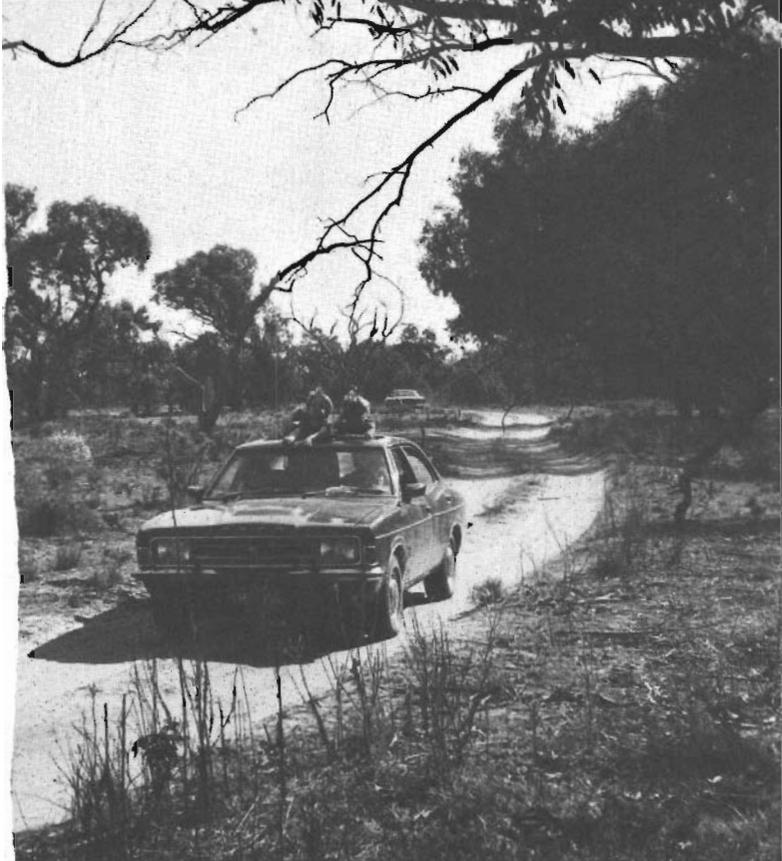
The Port Phillip Authority itself consists of a full-time chairman and part-time representatives from the Town and Country Planning Board, Public Works Department, Soil Conservation Authority, and the Department of Crown Lands and Survey.

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 with a special interest in the Port Phillip Authority area.

A number of studies aimed at providing data from which guidelines can be determined for the optimum use and enjoyment of the coast have been completed or commenced. These include a coastal inventory of vegetation and geomorphology, coastal features maps, and a Port Phillip Coastal Study.

The latter was implemented to develop a balanced approach to the use of the coastal resource that considers both priorities for use and compatibility between proposed uses and preservation of the coastal resource. The Study identified existing uses and in part through a public involvement programme recommended a strategy for the future development, improvement, and protection of the coastal reserves of the Port Phillip area.

Acceptable uses included coastal dependent recreation and tourism; scientific, educational, and cultural activities; ports, harbours, and marinas; commercial fishing, agricultural and pastoral activities; coastal dependent secondary industry; and concentrated and well planned communities. Priorities must be established among these competing uses to assure orderly balanced use and preservation of the coastal lands and offshore waters.



Nature drives at Hattah Lakes National Park help visitors to a better understanding of its features.

National Parks Service

Visitors to Mt Buffalo National Park take part in a guided walk as part of a holiday nature programme.

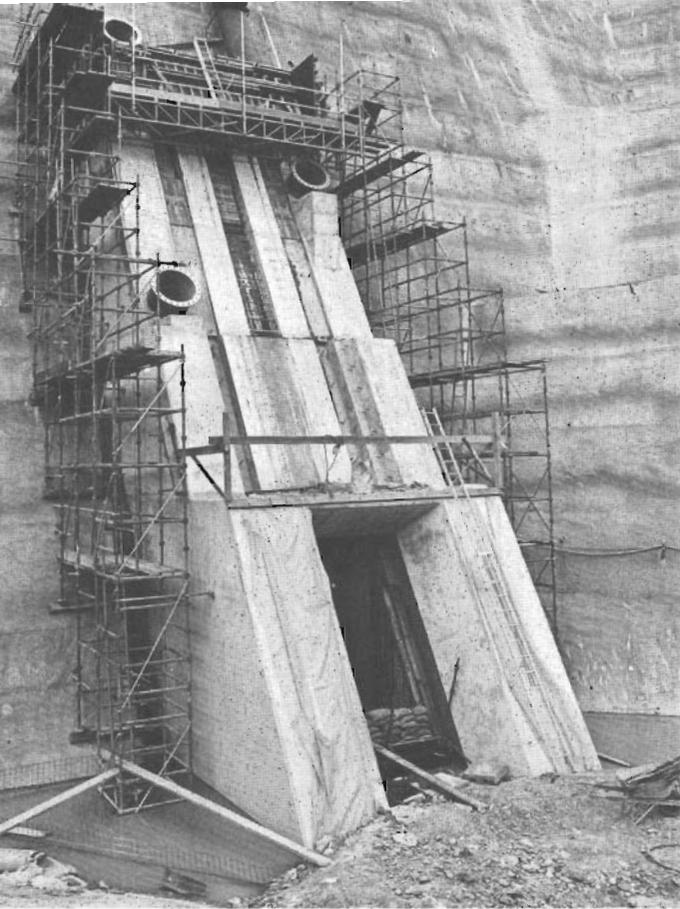
National Parks Service





Excavation for the draw-off channel which will convey water from the Sugarloaf Reservoir in the Christmas Hills area for delivery to the water treatment plant.

Melbourne and Metropolitan Board of Works



The inlet structure at Sugarloaf Reservoir through which water will be pumped into the reservoir from the Yarra River.

Melbourne and Metropolitan Board of Works



Support columns for the roof of the Sugarloaf Reservoir clear the water storage which will have a capacity of 200 megalitres.

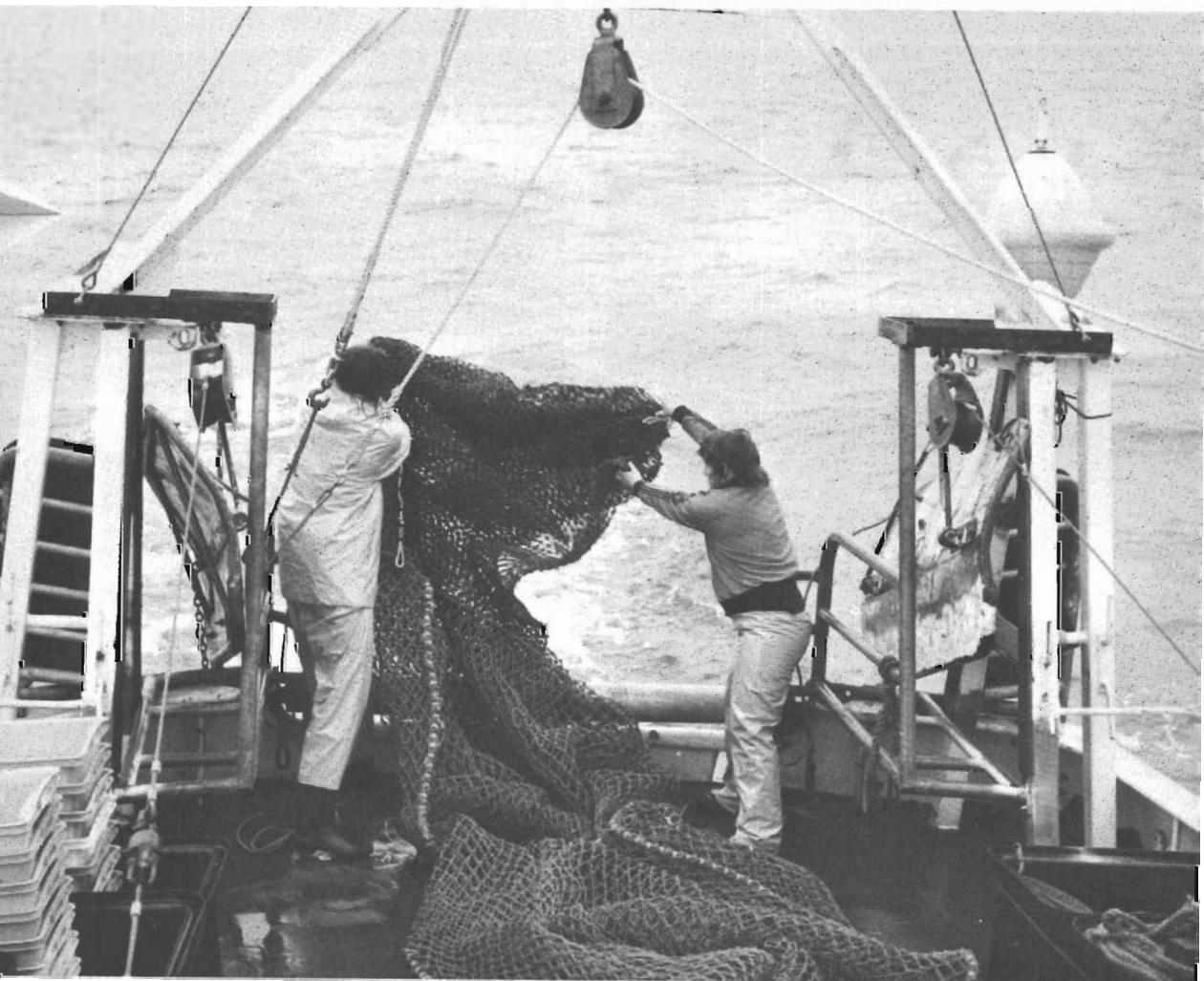
Melbourne and Metropolitan Board of Works

Youthful visitors make the acquaintance of a Cape Barren goose at the Serendip Wildlife Research Station at Lara, near Geelong.

Ministry for Conservation

Research into deep water trawling off Portland being carried out by the *Sarda*, the exploration fishing vessel of the Fisheries and Wildlife Division.

Ministry for Conservation



The Authority has recently established a Coastal Plant Nursery to provide native plants suited to foreshore conditions for committees of management and government authorities that are responsible for coastal reserves, as well as schools, conservation groups, and in special circumstances, private individuals. A Coastal Vegetation Service has also been formed to provide advice on horticultural techniques, and the preparation of landscape plans. Landscape plans have recently been prepared for the Werribee and Sandringham coastal regions.

Further references: Port Phillip Bay Environmental Study, *Victorian Year Book* 1975, pp. 48-50, 382; Western Port Bay Environmental Study, 1975, pp. 50-1; Gippsland Lakes Environmental Study, 1975, p. 51; 1978, pp. 43-4

National Parks Service

The National Parks Service administers a variety of areas under the provisions of the *National Parks Act* 1975. In addition to 26 national parks, the Service also manages three coastal parks, several State parks, a farm, and two formal gardens. It is also becoming involved with the management of historic sites and buildings, one of which is located at Steiglitz, an old gold mining town in the Brisbane Ranges.

The Service has five branches at Head Office — administration, management, resources and planning, protection, and interpretation. However, its Head Office branches employ a relatively small portion of the total staff, the majority being located in the parks and districts.

The Management Branch is responsible for district and park administration. Eight district offices have been established: South-west (based at Portland); Nepean (Arthurs Seat); East Gippsland (Bairnsdale); South Gippsland (Wilsons Promontory National Park); Melbourne (Fern Tree Gully); North-east (Wangaratta); North-west (Horsham); and Geelong. Further districts are planned as the number of parks increases.

A rapidly expanding part of the Service's work is park interpretation, which combines public information and environmental education programmes. People visiting parks gain more enjoyment from their visits if good interpretative services are provided. In addition to the usual brochures, nature trails and information services, extensive programmes of talks and guided walks are provided during the holiday seasons at national parks such as Wilsons Promontory, Wyperfeld, Fraser, and Mount Buffalo.

The Service encourages schools to use the parks for environmental education. At least 7,000 children on school excursions camp in Wilsons Promontory National Park each year and large numbers visit other parks such as Wyperfeld and Fern Tree Gully.

The Organ Pipes and Glenaladale are very popular national parks for environmental studies and the Service has produced teachers' guides for these. "Haining", a dairy farm in the Yarra Valley which is managed by the Service, provides the opportunity for school children from the suburbs to make close contact with rural life.

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 1978

Park	Area
<i>A. National parks</i>	<i>Hectares</i>
1. Alfred	2,300
2. Burrowa-Pine Mountain	17,300
3. Brisbane Ranges	1,182
4. Bulga	80
5. Captain James Cook	2,750
6. Churchill	193
7. Fern Tree Gully	459
8. Fraser	3,100
9. Glenaladale	183
10. Hattah Lakes	17,800
11. Kinglake	5,836
12. The Lakes	2,380
13. Lind	1,166
14. Little Desert	35,300
15. Lower Glenelg	27,300

VICTORIA—PARKS UNDER THE CONTROL OF
THE NATIONAL PARKS SERVICE, JUNE 1978—*continued*

Park	Area
16. Mallacoota Inlet	5,318
17. Morwell	140
18. Mount Buffalo	11,000
19. Mt Eccles	400
20. Mt Richmond	1,707
21. Organ Pipes	85
22. Port Campbell	700
23. Tarra Valley	140
24. Wilsons Promontory	49,000
25. Wingan Inlet	1,900
26. Wyperfeld	56,500
Total—national parks	244,219
B. Other parks declared under the National Parks Act	
1. Cape Schanck Coastal Park	994
2. Haining Farm	64
3. Holey Plains State Park	10,450
4. Melba Gully State Park	48
5. Mt Worth State Park	221
6. Nepean State Park	908
7. Warby Range State Park	2,775
8. Warrandyte State Park	218
9. Werribee Gorge	207
Total—other parks	15,885
C. New parks approved by the Government and managed by the National Parks Service pending legislation to bring them under the National Parks Act	
1. Cape Nelson State Park	176
2. Discovery Bay Coastal Park	8,350
3. Gellibrand Hill	266
4. Gippsland Lakes Coastal Park	15,420
5. Mt Samaria State Park	6,960
6. Pirianda Garden	11
Total—new parks	31,183
D. Land Act Reserves (mainly small blocks of purchased land) managed in conjunction with 11 existing parks	
	17
Total—all parks	291,304
Percentage of total area of Victoria	1.29
Percentage of public lands of Victoria	3.21

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

Further reference: *Victorian Year Book* 1978, pp. 44-7

ROYAL BOTANIC GARDENS AND NATIONAL HERBARIUM

The Royal Botanic Gardens and National Herbarium is a Division of the Department of Crown Lands and Survey.

The Gardens were established on the present site in 1846 and now occupy 36 hectares, approximately 2 kilometres from the centre of Melbourne. They contain a reference collection of plants from all over the world. The plants are used for scientific and educational purposes and they are arranged to form one of the most beautiful examples of the English "Paradise Gardens" designs of the eighteenth and nineteenth centuries.

The basic landscaping was carried out by W.R. Guilfoyle in his period as Director from 1873-1909, although Baron von Mueller, his predecessor, was responsible for the importation of much of the material as seed.

Mueller, who was also Government Botanist for 43 years prior to his death in 1896, was also responsible for the establishment of the National Herbarium. This collection of dried and pressed plant specimens is the largest in the southern hemisphere, containing over one million sheets including many of the specimens collected on historic expeditions.

Associated with the herbarium is a magnificent archival library of taxonomic and horticultural material.

Both the Gardens and Herbarium form a resource for scientific, educational, legal, horticultural, and recreational purposes for which there is an ever increasing demand.

The Gardens are open to the public, free of charge, on every day of the year from 7.30 a.m. until sunset, except Sundays and holidays when they open an hour later. For the convenience of the visitors the Department operates a kiosk and restaurant.

The Gardens and the Herbarium provide an official plant identification service for Victoria. This includes catering for the legal requirements under the Poisons Act, identifying material for other government departments and interested bodies working in the environmental fields, and providing home gardeners or interested collectors with the correct name of the plants they possess.

The professional botanists have a research function in which they investigate the taxonomic affinities of various groups of plants and revise any anomalies that may be apparent. Areas of special interest include the genus *Casuarina*, native orchids, and aquatic genera.

To enable specimens to be readily found in the Gardens a survey of each plant growing there is being made. The locations are based on a new metric map, at a scale of 1:500, being produced by the Department's Division of Survey and Mapping. The resulting information will be collated on a computer and will be updated constantly by the insertion of new plantings and removal of deaths. This is the first full assessment for nearly 90 years.

While the gardens are financed principally by the Victorian Government, they are assisted by the "Miss M.M. Gibson" Trust and its associated Gardens Branch Research Trust formed from gifts and bequests. The charter of these trusts is to assist the Gardens and Herbarium in many ways that have significant interest to the trusts. They have financed the initial issue of the *Key to Victorian Plants*, the recent issue of a guide book on the gardens, and the printing, for sale to the public, of examples of botanical art by Margaret Stones and Betty Connabere. (See *Victorian Year Book 1977*, page 65.)

Revenue from the sale of these items is used for other new projects.

Cranbourne Annexe

The Cranbourne Annexe of the Royal Botanic Gardens was, until its purchase in 1970, a Commonwealth Government military reserve. Apart from its limited military use, clearing, grazing, and small but intensive sand operations, it has remained in a near natural state of bushland and heathland association.

The reserve containing 180 hectares is located 2 kilometres from the southern edge of Cranbourne township and 50 kilometres south-east of Melbourne. It was purchased to provide a regional botanic garden predominantly of native character and to develop part of the area for a display of native plants useful for urban horticulture.

It is one of the last large areas of heathland on acid sands, which was a predominant plant association type of the Mornington Peninsula, and acts as the habitat for some endangered faunal species including the New Holland Mouse.

Postgraduate students in the faculties of botany and zoology of Monash University have been encouraged to carry out projects within the heathland, and this research work is resulting in valuable understanding of the ecology of the area. This field work represents the most intense study undertaken in Victoria of this type of plant association and its interacting fauna.

Development of the annexe will be undertaken in stages over several years commencing with the areas heavily disturbed by the sand operation.

Re-fencing and windbreak planting with some 2,500 plants have been undertaken and a new house constructed for the Senior Resident Gardener. As the micro-climate provided by the windbreak plantings improves, further plantings will be made of genera suited to the area and experimental landscape designs using native plants can then be started.

The heathland will continue to be used for research purposes, while it is proposed to cut paths so that visitors may enjoy the views from the top of the ridge. Explanatory signs and names will allow visitors to learn a little about the plant associations while enjoying a nature walk.

Cranbourne will be designed to complement the Melbourne site of the Royal Botanic Gardens.

Werribee Park

When Thomas Chirnside built his elaborate mansion at Werribee Park in 1875 he had the garden designed in the eighteenth century English landscape style. The garden was similar in character and landscaping to the Melbourne Botanical Gardens which W. R. Guilfoyle was producing at that time. It was based on the English "Paradise Garden" designs involving large vistas broken by groups of shrubs and trees and complemented by curving paths and an ornamental lake with an ice house. Planting was on a grand scale and the species used were suitable for a large garden.

During the past fifty years the property was under the control of the Roman Catholic Church. The garden has been tended with varying amounts of care, but many features of the original design are still present as mature trees and shrubs.

When the Victorian Government purchased the property in 1973, it was decided to restore the mansion and the gardens to their original conception. The Royal Botanic Gardens have been entrusted with the re-creation of the garden area which will be the mature version of the designer's vision.

A series of photographs of the gardens in the early years supply details of the design and, as far as possible, plants of the same type used will be replanted. Some trees of later eras will be left, as it would not be practicable to imitate the earlier planting completely.

Work is proceeding on the general maintenance of the garden and the correcting of obvious faults. The lake will soon hold water permanently for the first time in many years; the glass house, which is partly sunken, is being rebuilt and a new water supply installed.

Although it will take several years to restore the garden to its pristine condition, it is already showing signs of its former beauty.

Illustrated flora of Victoria

Over 100 years ago Mueller, the Government Botanist, described many new species of plants then being discovered in Victoria. He had illustrations prepared to complement the written description. Since then floral and diagnostic keys for the Victorian plants have been drawn up, but no attempt made to illustrate the groups systematically. However, in 1977 a start was made to produce an illustrated flora of Victoria, a project that will take several years to complete. The series is intended for botanists, horticulturalists, conservationists, and anyone who wants to enjoy and learn more about Victoria's native plants.

It is aimed to take plants and describe each Victorian species showing a flowering shoot, habitat, and other diagnostic features. The text will contain a description, the place, and date of first publication of the species, as well as selected references and synonyms. Wherever possible, distribution ranges will be indicated with details of variation and any known horticultural or cultural details. The project will be published in serial form in uniform format, so that readers can use parts as soon as they are prepared.

Drawings are used in preference to photographs because an artist can be more selective in the detail to be incorporated and thus produce a more useful illustration. The source of the drawings will be voucher specimens in the National Herbarium and the habitat sketches will be from nature.

The first genera to be described are *Boronia* with twelve species being illustrated and *Correa* with six species: they will be available from the National Herbarium.

Further reference: *Victorian Year Book* 1977, pp. 57-61

NATIONAL MUSEUM OF VICTORIA

The National Museum, established in 1854, operates under the *National Museum of Victoria Council Act* 1970, which defines the functions of the museum and provides for a council of nine members to manage and control the museum through the appointed staff. The museum is a branch of the Ministry for the Arts and is located at 285 Russell Street, Melbourne. An annexe is located at 71 Victoria Crescent, Abbotsford.

The principal functions of the museum are to collect and maintain collections of zoological, geological, and anthropological specimens for research, display, and

educational purposes, to conduct research on them, and to make the collections available to interested persons for research and educational purposes. The museum as constituted is the official place of lodgement for all State collections of natural history and anthropological specimens.

The staff, appointed under the Victorian Public Service Act, consists of 50 members, of which seventeen are graduate scientists; there are also six education officers seconded from the Education Department. The curatorial departments of the museum, responsible for the collections, are those of Minerals, Invertebrate Fossils, Vertebrate Fossils, Mammals, Birds, Fish, Reptiles and Amphibians, Insects, Crustacea, Invertebrates (general), and Anthropology. There are also departments of photography, display and preparation, biological survey, and the library. The library of over 40,000 volumes houses the most comprehensive collection of books on natural history and anthropology in the State. The principal publication of the museum is the *Memoirs of the National Museum of Victoria*, issued annually since 1901, which contains research papers produced by museum staff and other scientists.

In 1974, a working party, appointed by the Premier to consider re-development of the Queen Victoria Market site, recommended that the Museum and the State Library be relocated on the south end of the Market site. The State Library and National Museum Buildings Committee Act was passed in 1977 to enable a committee to be appointed to begin planning for the new buildings. In the meantime, the problem of space for the collections had become so acute that one display gallery, the Upper McAllan Hall, was closed to the public and part of the fossil collection re-located in it. An annexe at Abbotsford was also established to which the departments of biological survey, birds, insects, and crustacea were moved from the Russell Street premises in 1977.

There were 557,882 visitors to the museum in 1976, of which 62,103 were school children. The Education Officers provided lessons for 31,217 of the school children and another 31,969 received information and activity sheets to assist them in their visit to the museum. The Education Office also provides a loan service of museum specimens for the use of teachers in schools.

Current research activities of museum staff cover a wide spectrum of the natural sciences and anthropology. The zoological departments and biological survey department are heavily committed to environmental impact studies of which the most important are those on potential dam sites on the Thomson, Mitchell, and Mitta Mitta Rivers.

Specimens from these surveys and others, carried out by other government departments, are lodged in the museum for future reference and cause major space problems in the institution. Research in anthropology has centred on traditional Aboriginal food plants, canoe making, and basketry. Major discoveries of fossil kangaroos at Morwell and diprotodons at Bacchus Marsh are currently under investigation by the palaeontologists.

With the assistance of a substantial donation from The William Buckland Foundation, supplemented by a grant from the Victorian Government, an X-ray Diffractometer was purchased in 1974 and this has enabled the minerals in the collection to be re-identified by the use of an accurate modern technique. Many new mineral records for the State have resulted from the survey of the collections.

In 1973 the museum entered into an agreement with the University of Melbourne whereby it undertook to house, classify, and catalogue The Donald Thomson Collection of anthropological specimens, photographs, and field notes for the University. This collection is rich in material from Cape York, Arnhem Land, and Central Australia, and is one of the best documented collections of its kind; it is of major research significance. Owing to its size, the cataloguing and arrangement of the collection will continue until 1979, with funds made available by the Victorian Government, the University of Melbourne, and the Australian Institute of Aboriginal Studies.

Further reference: *Victorian Year Book* 1969, p. 463; 1972, p. 415

ROYAL MELBOURNE ZOOLOGICAL GARDENS

The Royal Melbourne Zoological Gardens were the first to be established in Australia. In 1857 a Society known as the Zoological Society of Victoria was formed.

The original site of the Zoological Gardens was known as Richmond Paddock, and was located opposite the Botanic Gardens, on the Yarra River. The collection was moved to the present site of 22 hectares in 1862.

In 1910 the Society, which had been incorporated with the Acclimatisation Society, was granted a Royal Charter, and became known as the Royal Zoological and Acclimatisation Society of Victoria. This Society controlled the Zoological Gardens until 1937, when the Government of Victoria assumed responsibility for the administration of the Gardens through the Zoological Board of Victoria. The responsibility for ministerial jurisdiction of the Zoo was transferred from the Chief Secretary's Department to the Ministry for Conservation as from 1 June 1973.

A reconstruction programme for the Zoological Gardens commenced in 1965 and embraced all aspects of animal exhibition, essential services, catering, and gardens beautification.

In 1975 the Board was given powers to manage areas other than the Melbourne Zoological Gardens, and this applied in particular to the Werribee Zoological Park, a rural area of 120 hectares, which formed part of an estate purchased by the Government in 1973 to preserve the area and the historic home on the site. (See also Chapter 29.). The development of Werribee Fauna Park, predominantly for hoofed mammals, Australian animals and water birds, commenced in 1975.

In 1969 the Zoological Board of Victoria established an education service with the appointment of a trainee education officer. The following year a teacher was seconded to the Zoo on a half-time basis from the Victorian Education Department. There was such a substantial demand for lessons in the Zoo during 1970 that the next year 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. By 1977 the total teaching and administrative staff in the Zoo's Education Division had risen to fifteen, including a teacher experienced in handling handicapped children. The Board, through the generosity of donations from industry and community service foundations, had by this time also provided four classrooms, as well as a building specially equipped for handicapped children.

On 6 October 1977, 120 years following the first meeting of the then Zoological Society, the Gardens received the Royal prefix, and became known as the Royal Melbourne Zoological Gardens.

Further reference: *Victorian Year Book* 1978, pp. 48-50

PHYSICAL FEATURES

Boundaries and areas

Creation of Victoria

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

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

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

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

Boundaries

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

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

'the River Murray';
 'the South Australian frontier';
 'the 141st meridian being the line dividing the Colony of New South Wales from South Australia';
 'the sea';
 'the sea shore';
 'the sea coast';
 'including the Lawrence and Lady Julia Percy's Islands';
 'including all the islands at Port Fairy';
 'Port Phillip Bay';
 'the shores of Port Phillip Bay';
 'the waters of Port Phillip';
 'including the small islands near the channels at the mouth of Port Phillip and those of Geelong Bay';
 'including French and Phillip Islands and the small islands in Western Port Bay'.

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

Murray River

The separation of Victoria from New South Wales in 1851, and the successful navigation of the Murray by steam vessels, encouraged widespread evasion of New South Wales customs duties on articles taken across from Victoria and South Australia. The question arose as to which Colony had jurisdiction over the waters of the Murray River. The position was 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. These he identified as a certain spring near Forest Hill. Black then proceeded to clear and mark the western portion of the boundary while another Victorian geodetic surveyor, Alexander C. Allan, marked the eastern portion. The marking was completed in early 1872 and the line, which extended some 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 waterline 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 precise observations, and with the aid of the newly developed electric telegraph, George Smalley, New South Wales Government Astronomer, and Charles Todd, South Australian Superintendent of Telegraphs, determined the 141° east meridian to be approximately 3.60 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 Victoriae c.59 of 5 August 1850* which separated the Colony of Victoria from New South Wales described only the land boundaries of the new Colony; no southern boundary was defined. However, the northern boundary of Van Diemen's Land (Tasmania) was defined in 1825 as the latitude 39° 12' south and this has generally been accepted as the southern limit of Victoria's jurisdiction. It lies about 7 kilometres south of Wilsons Promontory. The lateral offshore boundaries between Victoria and the adjoining mainland States have not been defined.

In 1973 the Commonwealth Government passed the *Seas and Submerged Lands Act*

(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 breadth of the territorial sea is to be measured. The Act declares that the sovereignty in respect of the internal waters of Australia (that is to say, any waters of the sea on the landward side of the baseline of the territorial sea) not within the limits of a State, and in respect of the airspace over those waters and in respect of the 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, e.g., 30 metres, 60 metres;
- (3) some land at Morwell and Churchill — 305 metres; and
- (4) lands vested in the Commonwealth. The depth limitation is usually 76 metres (occasionally 15 metres) but by sections 8 and 10 of the *Lands Acquisition Act 1955-1973*, the Commonwealth can compulsorily acquire Crown lands to unlimited depth, thus implying that the State of Victoria extends to the centre of the earth.

Height

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

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

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

The Victorian Parliament has power to make laws relating to the control and use of the

air space above its territory which are not inconsistent with laws made by the Commonwealth Parliament on the matter.

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

Geographic position and area

The most southerly point of Wilsons Promontory, in latitude 39° 08' S., longitude 146° 22½' E., is the southernmost point of the mainland of Victoria and similarly of the mainland of Australia; the northernmost point is where the western boundary of the State meets the Murray, latitude 33° 59' S., longitude 140° 58' E.; the point furthest east is Cape Howe, situated in latitude 37° 31' S., longitude 149° 58' E. The westerly boundary lies upon the meridian 140° 58' E., and extends from latitude 33° 59' S. to latitude 38° 04' S.—a distance of 451 kilometres.

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

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

AUSTRALIA—AREA OF STATES AND TERRITORIES		
State or Territory	Area	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 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 Feathertop (1,922 metres)—become free of snow in summer.

Western section

The highlands here are of much lower relief than the eastern section and in places lack the clearly defined watershed of the eastern ranges. A notable feature is the concentration of volcanic activity (Newer Volcanics) extending from just north of Melbourne to the Ballarat district in the west. Over 200 eruption points have been identified with many of the lava flows now forming ridges which bury the pre-volcanic stream channels and give rise to 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

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 have 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, 35 Spring Street, Melbourne, Vic. 3000.

Further references: Hydrography, Coastline, *Victorian Year Book* 1966, pp. 33-6; Coastal physiography, 1967, pp. 32-6; Plant ecology of the coast, 1968, pp. 31-7; Marine animal ecology, 1969, pp. 36-40; Marine algae of the Victorian coast, 1970, pp. 39-43; Erosion and sedimentation on the coastline, 1971, pp. 44-6; Conservation on the Victorian coast, 1972, pp. 37-43

Physical divisions

The chief physical divisions of Victoria are shown in Figure 1 on page 46. 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

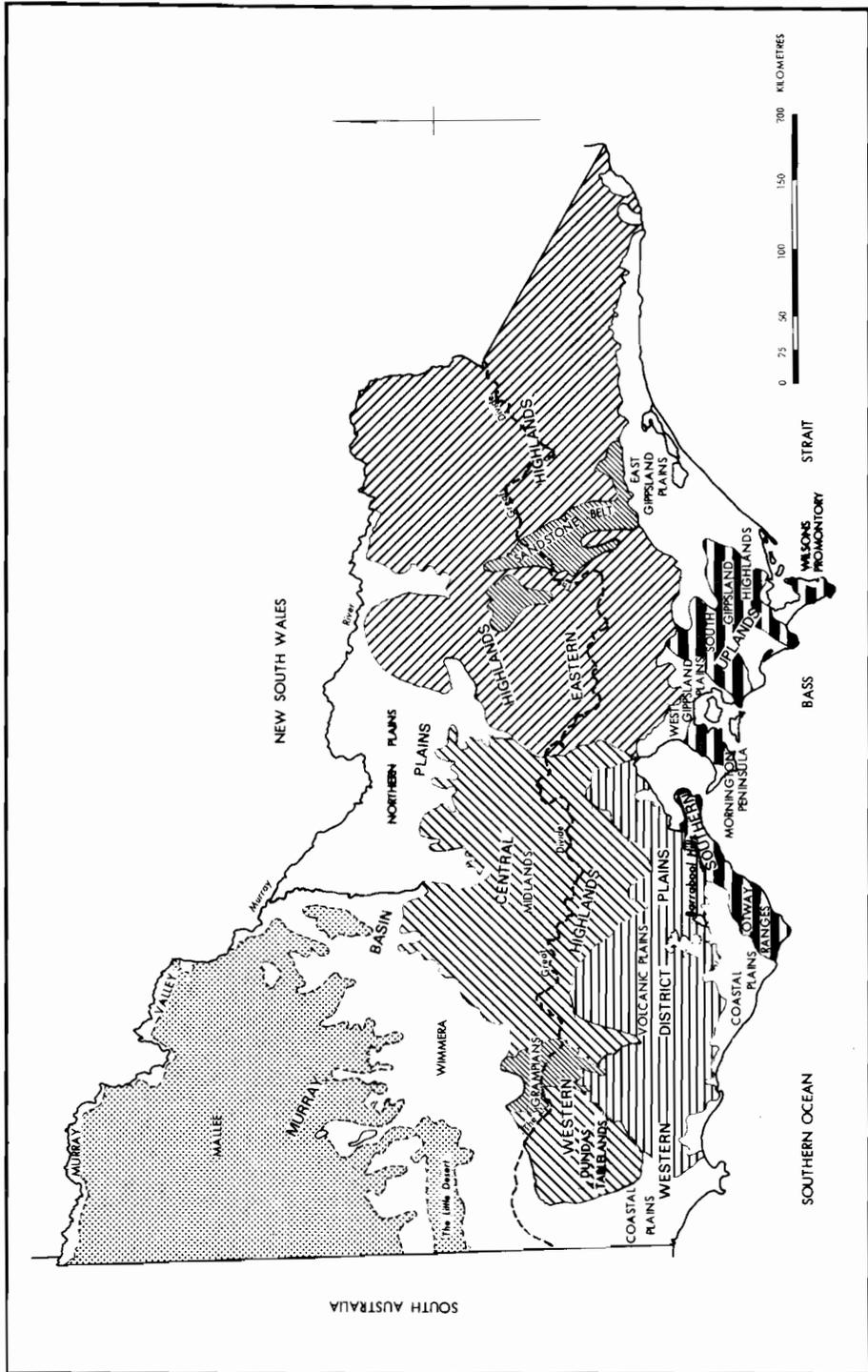


FIGURE 1. Physiographic divisions of Victoria.

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

Murray Basin Plains

These plains include the areas commonly known as the Mallee, the Wimmera, and the Northern 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 abandoned stream courses known as prior streams.

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

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

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 upwarping movements and faulting during 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. A broad coastal plain, bounded by a fault-scarp to the north-east, extends to the west and north-west from Portland.

Gippsland Plains

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

West of Yallourn, the Gippsland Plains continue, but they are 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 La Trobe valley. The plains are generally covered with piedmont-type sands, sandy clays and gravels, which originated from the Eastern Highlands during the final late Tertiary movements which elevated them to their present height, and into these gravels the streams have cut broad alluvium-filled valleys with flights of terraces that can be traced back into the Highlands.

A former coastline can be recognised behind the present coastline in the Bairnsdale-Lakes Entrance area. The conspicuous Ninety Mile Beach is a barrier bar which has cut off some of the Gippsland Lakes from the sea, and both spits and islands inland from the beach betray a complex history of barrier formation and erosion related to changed sea levels. Present-day coastal dunes are prominent along sections of the Ninety Mile Beach, and earlier dunes and beach ridges are found on the barriers; 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 outpoured and ejected. Flows followed pre-existing valleys in the Western Highlands, burying auriferous gravels as deep leads in the Ballarat district.

Final downwarps, assisted by the melting of glacial ice at the end of the Pleistocene, led to the drowning which has given Port Phillip Bay and Western Port their present configurations, and concomitant upwarps in the Central Highlands elevated them to their present level.

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

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

Hydrology

Water resources

The average annual rainfall over Victoria is about 660 mm. As the area of the State is 227,600 square kilometres, the total precipitation is, therefore, about 148 million megalitres. Only 21 million megalitres appear in the average annual flow of the State's river systems. It is not yet known how much of the remainder soaks underground to recharge groundwater resources, but 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 39.)

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

Of the major southern rivers, the La Trobe, Thomson, Macalister, Avon, Mitchell, and Tambo Rivers all flow into the Gippsland Lakes system, which is linked with the sea by an artificial cut constructed many years ago for navigation purposes. The 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)				
			Mean	Max.	Min.	No. of years gauged	Site of gauging station
	kilometres	square kilometres					
NORTHERN RIVERS							
Murray	1,926 (from source to Victorian border)	6,527 (upstream of Jingellic)	2,368	6,123	675	80	Jingellic, 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	Murchison
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	Jarrahmond
Tambo	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
La Trobe	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
Glenelg	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 Fieri 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 lakes 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.

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.

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

BIBLIOGRAPHY

- CURRY, D. T. *Lake Systems*. Western Victoria, Australia Society for Limnology Bulletin, 3 December 1970, pages 1-13.
- HIGH COURT OF AUSTRALIA. *The States of New South Wales, Victoria, Queensland, South Australia, Western Australia and Tasmania versus The Commonwealth of Australia* : judgment delivered 17 December 1975. 230 pages.
- HILLS, E. S. *Physiography of Victoria*. Revised edition. Melbourne, Whitcombe and Tombs, 1975.
- HOMWOOD, E. T. *The computation of geodetic areas of standard map sheets in Victoria*. Empire Survey Review, Vol. XIII, No. 101. London, Crown Agents for Overseas Governments and Administrations, July 1956.
- JENKIN, J. J. 'Geomorphology' in *Geology of Victoria* : edited by J. G. Douglas and J. A. Ferguson. Spec. Publ. Geological Society of Australia No. 5, pages 329-342, 1976.
- NEILSON, J. L. *Notes on the geology of the high plains of Victoria*. Proceedings of the Royal Society of Victoria, Vol. LXXV, No. 2, 1962.
- VICTORIAN YEAR BOOK. *Coastal physiography*. Vol. 81, pages 32-6, 1967.
- VICTORIAN YEAR BOOK. *Geology of Victoria*. Vol. 90, pages 71-80, 1976.