NORTH–EASTERN AREA (BENALLA–UPPER MURRAY) REVIEW

Land Conservation Council Victoria

Price $6.00

TELEPHONES:
267 1311, 267 1098

GOVERNMENT OF VICTORIA

LAND CONSERVATION COUNCIL

464 ST. KILDA ROAD, MELBOURNE VICTORIA, 3004

REPORT

NORTH-EASTERN AREA
(BENALLA-UPPER MURRAY) REVIEW

This report is published to allow all who are interested in the use of public land the opportunity to comment by making written submissions to the Land Conservation Council.

All such submissions must reach the Secretary no later than Friday 26 October 1984.

These submissions will be considered by the Council before Proposed Recommendations are made on the use of public land in the study area.

I. KUNARATNAM
Secretary
Land Conservation Council

REPORT
ON
NORTH-EASTERN AREA (BENALLA-UPPER MURRAY) REVIEW

LAND CONSERVATION COUNCIL
MELBOURNE: AUGUST, 1984

79652/84—6092(F1)

ISBN 0 7241 9200 X

CONTENTS

page

APPENDICES

MAPS

FOREWORD

The Land Conservation Council was established by the Victorian Government in 1971 as an independent statutory body, to make recommendations to the government on the balanced use of public land. Since that time 22 reports have been published and each of these has had a Foreword written by Mr Sam Dimmick, the founding Chairman of the Council. Mr Dimmick died suddenly on July 9, 1984.

For thirteen years Sam Dimmick chaired the Council with great dedication, determination, and distinction. He was an achiever, a man who brought wisdom, discretion, and judgement to the Council table, as well as a fine appreciation of community needs. His job was to resolve differences while developing recommendations which provided for the diverse and often conflicting needs of the public. Sam Dimmick had the rare ability to resolve conflict through persistent negotiations and discussion. In framing the recommendations for the future use of public land, he was always concerned that the Council should consider all land use options. His service to the community will long be remembered.

As with past reports, this report provides a factual basis for the preparation of submissions to the Council, by describing and assessing the natural resources of public land in the North-Eastern (Benalla--Upper Murray) area. It ensures that all those persons and bodies who have an interest in the future use of public land in this area can obtain and study the basic information which the Council itself will study, and so make informed and constructive suggestions to the Council for its consideration. The Council will make its recommendations only after due consideration of all these submissions.

EVAN WALKER
MINISTER FOR PLANNING AND ENVIRONMENT

LAND CONSERVATION ACT 1970

EXTRACT

Public land

Section 2.

(1) "Public land" means -

(a) land which is not within a city town or borough and is -

(i) unalienated land of the Crown including land permanently or temporarily reserved under section 4 of the *Crown Land (Reserves) Act* 1978, State forest and parks within the meaning of the *National Parks Act* 1975;

(ii) vested in any public authority (other than a municipality or a sewerage authority within the meaning of the *Sewerage Districts Act* 1958); or

(iii) vested in the Melbourne and Metropolitan Board of Works; and

(b) any other land which the Governor in Council declares under sub-section (2) to be public land for the purposes of this *Act*.

"Reserved forest" and "State forest" have the same meanings as in section 3 of the *Forests Act* 1958.

(2) The Governor in Council may on the recommendation of the Minister made after consultation with -

(a) any Minister of the Crown in whom any land is vested; or

(b) the Minister responsible for a public authority in which any land is vested -

by proclamation published in the *Government Gazette* declare any such land to be public land for the purposes of this *Act*.

Functions of the Council

Section 5.

(1) The Council shall -

(a) carry out investigations and make recommendations to the Minister with respect to the use of public land in order to provide for the balanced use of land in Victoria;

(b) make recommendations to the Governor in Council as to the constitution and definition of water supply catchment areas under the *Soil Conservation and Land Utilization Act* 1958; and

(c) advise the Soil Conservation Authority concerning policy on the use of land (whether public land or any other land however vested) in any water supply catchment area.

(2) In making any recommendation the Council shall have regard to the present and future needs of the people of Victoria in relation to -

(a) the preservation of areas which are ecologically significant;

(b) the conservation of areas of natural interest beauty or of historical interest;

(c) the creation and preservation of areas of reserved forest;

(d) the creation and preservation of areas for National Parks.

(e) the creation and preservation of areas for leisure and recreation, and in particular of areas close to cities and towns for bushland recreation reserves;

(f) the creation and reservation of reserves for the conservation of fish and wildlife;

(g) the preservation of species of native plants; and

(h) land required by government departments and public authorities in order to carry out their functions.

(3) Where the Council recommends the alienation of any land the recommendation shall include the Council's opinion as to the best method of alienating the land to ensure the most satisfactory use and management of the land in the public interest.

(4) Any person or body may make submissions to the Council as to how any public land can be better used to meet the needs of the people of Victoria and the Council shall consider any such submissions before making any recommendation under paragraph (a) of sub-section (1)

Investigations, notices and reports

Section 9.

(1) The Council shall not make any recommendation under this *Act* in relation to any district or area without a prior investigation of the district or area.

(2) Before commencing any investigation under paragraph (a) of sub-section (1) of section 4 the Council shall publish a notice in the *Government Gazette*, in a newspaper circulating throughout the State and in a newspaper circulating particularly in or in the vicinity of the area or district to be investigated stating that an investigation of the district or area described in the notice is to be carried out for the purposes of this *Act*.

(3) On completing an investigation of a district or area under paragraph (a) of sub-section (1) of section 5 the Council shall -

(a) publish a report of the investigation;

(b) give notice in the *Government Gazette* of the publication of the report, the address where copies of the report may be obtained or inspected and stating that any submissions to the Council in relation to such report will be considered by the Council if they are made within 60 days of such notice; and

(c) publish notice in a newspaper circulating throughout the State and in a newspaper circulating particularly in or in the vicinity of the area or district investigated of the publication of the report, the address where copies of the report may be obtained or inspected and stating that submissions may be made to the Council and the date before which they should be made.

(4) The Council shall consider any submissions in relation to such report made by any person or body within 60 days of notice being given under paragraph (b) of sub-section (3).

Notice to be given to public departments and authorities in certain cases

Section 10

(1) Not earlier than 60 days after notice being given under paragraph (b) of sub-section (3) of section 9, the Council shall send a copy of its proposed recommendations to -

(a) the Council of any municipality in the municipal district of which any part of the area or district to which the recommendation relates is situated;

(b) any other public authority or government department that in the opinion of the Council has an interest in the area of the proposed recommendation; and

(c) any person or body who made a submission under section 9 -

and shall consider any submissions received within 60 days of the sending of such copy to the council, authority, department, person or body or in the case of a public authority or government department within such longer period as may be agreed upon between the Minister and the Minister administering that department or responsible for that authority.

(2) Where any recommendation is made to the Minister under this *Act* it shall be accompanied by a copy of any submissions received from any person body department authority or council pursuant to the provisions of sub-section (4) of section 9 or sub-section (1) of this section.

Government departments and authorities to give effect to recommendations

(3) Where the Council has made a recommendation to the Minister under paragraph (a) of sub-section (1) of section 5 the Minister may, after he has given not less than fourteen days notice of his intention so to do to the Minister administering a government department or responsible for a public authority recommend to the Governor in Council that notice of the recommendation or that part of the recommendation that affects the government department or public authority be given to the government department of public authority concerned and where notice of that recommendation or part is so given by the Governor in Council it shall be the duty of the government department or public authority to use all diligence and dispatch to give effect to such recommendation so far as it effects any land vested in or controlled by it.

Copy of every recommendation and of proposals to be tabled in Parliament

Section II

A copy of every recommendation of the Council made under sub-section (1) of section 5 and of the proposals of the Council submitted to the Minister pursuant to section 7 shall be laid before both Houses of Parliament within fourteen days of the making thereof if Parliament is then sitting and if Parliament is not then sitting within fourteen days after the meeting of Parliament.

A copy of the *Land Conservation Act* can be obtained from the Government Printer Sales Office, 41 St Andrews Place, East Melbourne, 3002.

ACKNOWLEDGEMENTS

This report covers so wide a field that its compilation would not have been possible without the generous assistance and co-operation of a great many individuals and organizations.

Information for maps and chapters was supplied by: the Departments of Conservation, Forests and Lands, Agriculture, and Minerals and Energy; the Rural Water Commission; the Victoria Archaeological Survey; LaTrobe University Prehistory Division; the National Museum; and the Albury--Wodonga (Victoria) Development Corporation. Several of these bodies supplied photographs.

The following staff from these organizations were involved in the preparation or revision of chapters for the report: J. Alker Jones, K. Boundy, S. Campbell, W. Chamley, A. Holmes, D. Hooley, R. King, R. Paul, G. Presland, P. Robertson, K. Rowe, D. Runge, P. Sheehan, J. Taylor, and J. Wood.

Special studies were carried out for this area by the following consultants: Aboriginal associations - D. Zobel; history since settlement - G. Butler; vegetation - D. Frood and R. Williamson; fauna - survey team from Arthur Rylah Institute for Environmental Research.

Many others also readily gave information, checked drafts, or contributed valuable discussion and advice. They include other Victorian and Australian government bodies, local government agencies, representatives of various industries, apiarists, outdoor recreation and sporting organizations, and individuals with expert knowledge of specific disciplines or particular localities. Their assistance is gratefully acknowledged.

PART 1
INTRODUCTION

1. INTRODUCTION

The study area lies in two parts in the north-eastern corner of Victoria, as shown in map 1.

When the Land Conservation Council originally divided the State into study areas, the north-eastern area was split into the five sub-regions or districts shown in Map 2. The Council published separate reports and recommendations for the North-eastern Area District 1 and District 2, but amalgamated Districts 3, 4, and 5 and published a combined report and combined recommendations for these three.

Districts 3 and 5 were reviewed by the Council in 1981 during the course of a Special Investigation of the Ovens Softwood Plantation Zone that the government directed the Council to undertake.

The investigation area that this report covers is in accord with the Council's policy to review areas at about 10-year intervals. It is confined to the balance of north-eastern Victoria that was not subject to the special investigation - that is, Districts 1, 2, and 4. In addition, some land within the Rural City of Wodonga is included (see below). Map 2 shows the boundaries of the area to be reviewed by the Council.

Advertisements stating that the Council intended to review the North-eastern Area, District 1, appeared in the Government Gazette and in local and Victorian newspapers on 17 March 1982. As outlined above, and as stated in advertisements published on 25 January 1984, the Council now intends to review the use of public land in District 1 as part of this review.

Land within the Rural City of Wodonga is included in this review following its declaration as public land in accordance with section 2(2) of the *Land Conservation Act* 1970. The bulk of this land is currently vested in the Albury--Wodonga (Victoria) Development Corporation, but the Corporation, following its recent examination of its long-term goals, no longer requires the land. The balance comprises small parcels of Crown land within the Rural City. The Corporation's land is further discussed in Chapter 4, and its location is shown on Map 3, Public Land Use.

Previous Investigations

The Council first investigated the North-eastern Area District 1 in 1972/73 and published its final recommendations in November 1973.

The Council's original investigations in the North-eastern Area District 2 also commenced in 1972/73 and final recommendations for that area were published in July 1974. North-

eastern Area District 4 was originally investigated as part of the Council's study of North-eastern Area District 3, 4, and 5 in 1974/75, for which final recommendations were published in April 1977.

In its final recommendations for the various districts, the Council recommended that certain areas be set aside as parks, reference areas, flora reserves, and other conservation reserves as well as for hardwood production, softwood production, and other community uses (see Map 3, Public Land Use and Appendix I, Recommendation Key). With one exception, all of the Council's previous recommendations for this study area have been accepted by the government. The one exception is the Euroa Hill bushland reserve, where a decision has been delayed pending determination of the route of the Hume freeway.

Although many of the Council's recommendations have been implemented, some have been delayed because of various administrative procedures including boundary surveys.

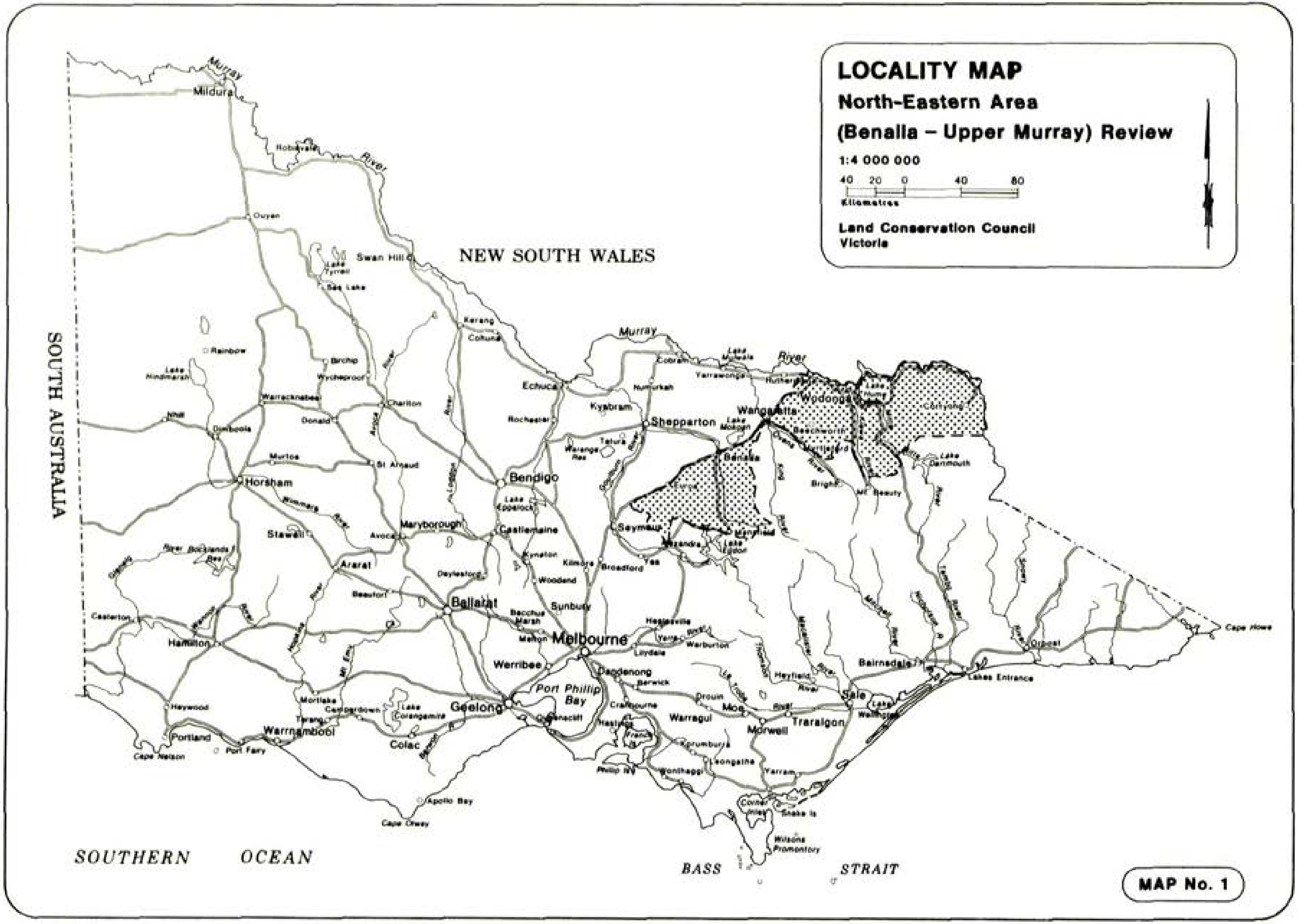
Aims and Methods

In its original investigations, the Council recommended substantial areas as uncommitted land. (This land was recommended to be used for a number of low-intensity purposes - including outdoor recreation, hardwood production, gravel extraction, and grazing - with no one use predominating.) Uncommitted land is to be managed to protect the natural ecosystems, in order to keep open the options for future use and to produce those goods and services required by the community that can be supplied without seriously reducing the ability of the land to meet future needs. In its recommendations, the Council has indicated that, as community needs changed and more information on resources became available, it would be necessary to review the use of this land.

The review will cover all public land in the study area including the land designated as public land in the Rural City of Wodonga. Emphasis will be placed, however, on the resources and potential uses of the land categorized as uncommitted as well as the land in the Rural City of Wodonga, which has not previously been investigated by the Council.

This report refers to the physical and biological characteristics of the land, examines alternative forms of land use, and assesses the hazards and conflicts associated with such uses. To give a proper perspective, the report considers the general regional characteristics of freehold and committed public lands, as well as the specific nature of the uncommitted public land.

It summarizes or makes reference to information contained in the Council's original resources reports for the North-eastern Area: namely, 'Report on the North-eastern Study Area - District 1' published in 1972, 'Report on the North-eastern Study Area - District 2' published in 1973, and 'Report on the North-eastern Study Area - Districts 3, 4, and 5' published in 1975. In particular, information has been updated and additional material that was not then available has been



LOCALITY MAP
North-Eastern Area
(Benalla – Upper Murray) Review
1:4 000 000
40 20 0 40 80
Kilometres
Land Conservation Council
Victoria
NEW SOUTH WALES
SOUTH AUSTRALIA
SOUTHERN OCEAN
BASS STRAIT
Mildura
Murray
River
Ouyen
Swan Hill
Kerang
Echuca
Bendigo
Shepparton
Wangaratta
Wodonga
Benalla
Beechworth
Bright
Corryong
Lake Dartmouth
Horsham
Stawell
Ararat
Maryborough
Castlemaine
Ballarat
Melbourne
Geelong
Werribee
Port Phillip Bay
Dandenong
Seymour
Hamilton
Portland
Warrnambool
Colac
Apollo Bay
Cape Otway
Warragul
Moe
Morwell
Traralgon
Sale
Bairnsdale
Lakes Entrance
Orbost
Cape Howe
Wilsons Promontory
MAP No. 1

incorporated. For a more comprehensive description of the study area, readers are referred to the original reports, copies of which are held in many libraries and by government departments. Copies are also available for inspection at the offices of the Land Conservation Council.

This report is the first stage in the decision-making process to determine the future use of public land in the study area. It does not contain recommendations; rather, it provides the information on which land use decisions can be based.

It is divided into four main parts: Part I is an introduction; Part II describes the physical and biological nature of the land; Part III deals with the major forms of land use; and Part IV provides more detailed information. In Part IV the study area has been divided for convenience into descriptive blocks, and a consistent format of headings is used so that the reader can readily find specific information for any block and compare one with another. Explanatory tables, maps, and a number of appendices complete the report.

Information has been supplied by government departments, public authorities, and interested individuals, and has also been obtained from published reports and other sources.

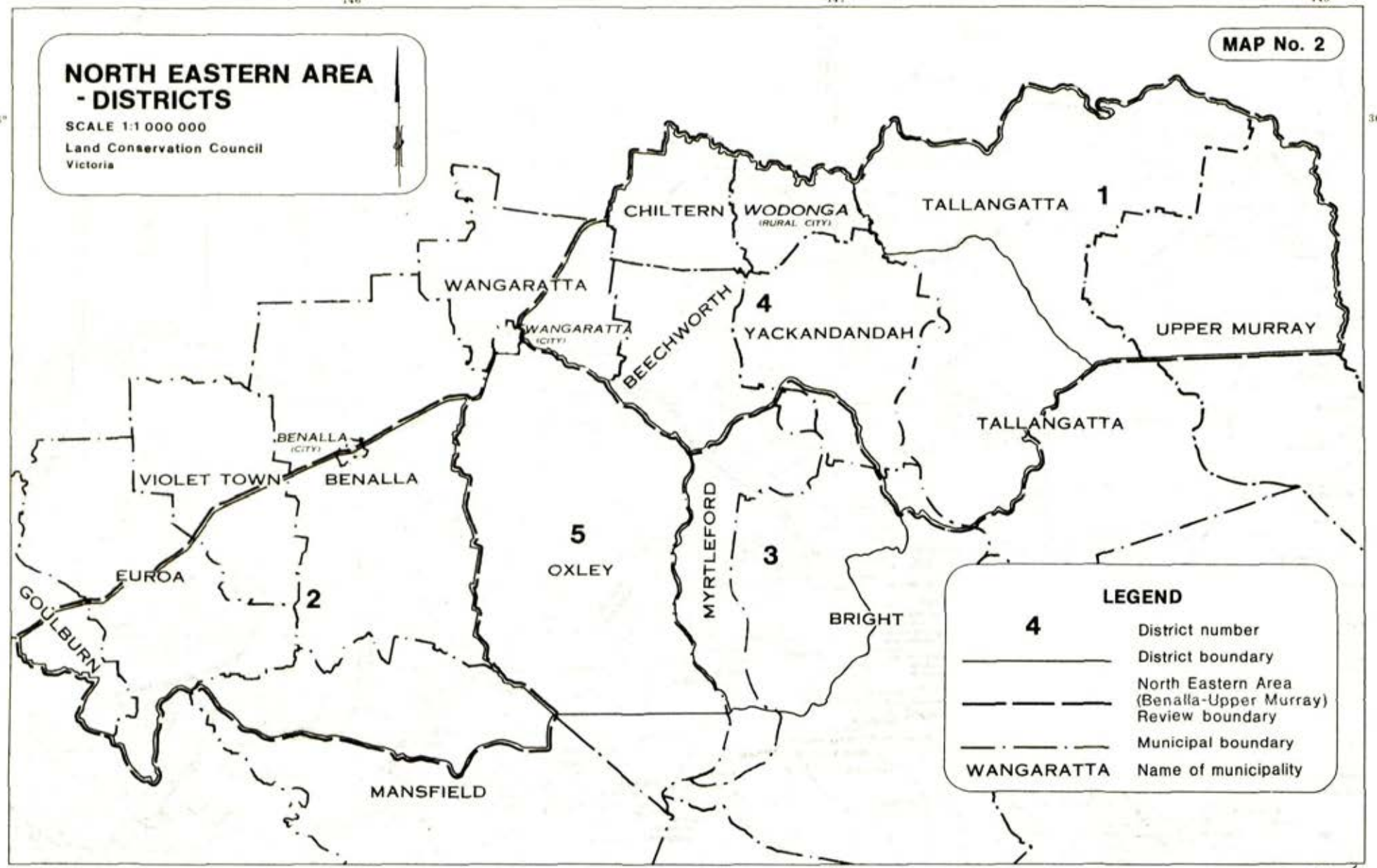
The Study Area

The larger section of the study area lies in the upper reaches of the Murray River, and consists of land in the Shires of Upper Murray, Tallangatta, Yackandandah, Beechworth, Chiltern, and Wangaratta together with small areas in the Shires of Bright and Myrtleford as shown on Map 2. The smaller section covers land in the Benalla area and includes land in the Shires of Benalla, Mansfield, Euroa, Violet Town, and Goulburn. The study area does not include Crown land in the Cities of Benalla and Wangaratta or in the Rural City of Wodonga, apart from that land within the Rural City that has been designated as public land by the Governor in Council.

The study area covers approximately 1,063,000 ha, of which approximately 400,000 ha or 38% is public land in substantial blocks.

Most of the Benalla portion of the study area lies within the catchment of the Broken River and includes the Strathbogie Ranges, Tolmie Highlands, and Reef Hills. Topography here varies from the flat Benalla--Mansfield Plains to steep slopes and undulating uplands. The Upper Murray portion has a similar range of topography. This varies from open alluvial plains around Wangaratta, Wodonga, and Corryong, through dissected hills and valleys between Yackandandah and Biggara, the undulating Stanley and Koetong uplands, the Burrowa, Pine Mountain, and Mount Mitta Mitta massifs, and the mountainous land along the southern boundary.

The predominant vegetation on public land throughout the study area comprises broad- and narrow-leaf peppermint forests with grass or bracken understorey. Other vegetation



© Crown (State of Victoria) Copyright 1984

types present include red stringybark--long-leaf box, with snow gum--candlebark gum and alpine ash occurring at highest elevations and low scrubby stands of black cypress pine on the drier northerly slopes in the north-eastern corner. Large stretches of softwood plantations have been established on suitable land throughout the study area. The bulk of the land to be investigated within the Rural City of Wodonga has been cleared and used for agriculture for many years and generally little native vegetation remains with the exception of the river and stream frontages, which contain areas of river red gum.

Table 1

DEMOGRAPHY

Local government area	Population		
	1961	1971	1981
Shires[1]			
Beechworth	4,845	4,506	4,673
Benalla	1,807	1,615	2,049
Bright	110	118	172
Chiltern	1,652	1,400	1,959
Euroa	4,140	3,531	3,497
Goulburn	232	243	258
Mansfield	2,480	2,372	2,748
Tallangatta	4,004	3,551	3,615
Upper Murray	2,938	2,667	2,463
Violet Town	851	741	796
Wangaratta	980	873	1,158
Yackandandah	2,930	2,842	3,315
Cities[2]			
Benalla	8,234	8,235	8,151
Wangaratta	13,784	15,586	16,202
Wodonga (Rural City)	12,968	13,074	19,208

Notes:

1. All of these Shires apart from Beechworth and Chiltern include land outside the study area; population figures have been adjusted to include only those census collectors' districts in the study area.

2. None of these cities are included in the study area apart from those areas in the Rural City of Wodonga that have been designated as public land.

Table 1 shows the population of the various shires in the study area. The table also shows the populations of the Cities of Benalla, Wangaratta, and Wodonga, all of which adjoin the study area.

Populations in the various shires have remained reasonably constant over the last 20 years, with some shires declining in population (for example, Euroa and Upper Murray) and others showing a small increase (for example, Mansfield and Yackandandah). The population of the Rural City of Wodonga, however, has increased by more than 50% in the last 5 years. This reflects the fact that Wodonga is part of the Albury--Wodonga growth complex that has been developed jointly by the Commonwealth, New South Wales, and Victorian governments in order to encourage decentralization.

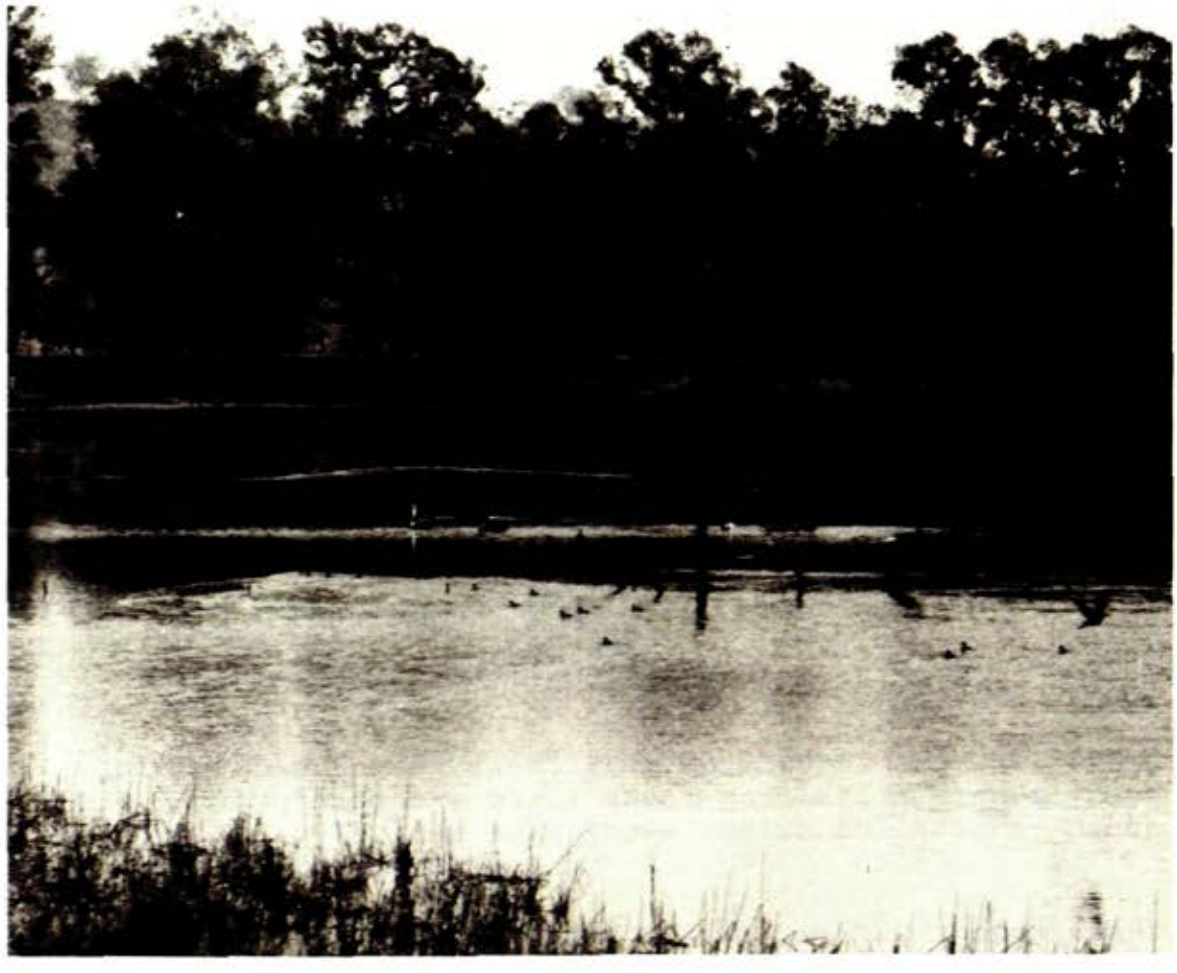
Access to and within the study area is well developed. The Hume Highway (the main arterial link between Melbourne and Sydney) and the Maroondah, Midland, Murray Valley, Omeo, Ovens Valley, and Kiewa Valley Highways provide major access routes. In addition, the main Sydney--Melbourne railway line runs parallel to the Hume Highway, and airport facilities are located at Albury, Benalla, Wangaratta, and Corryong.

North-eastern Victoria has a wide range of tourist attractions including snowfields, historic towns such as Beechworth and Chiltern, numerous attractive rivers and streams, and high peaks that offer splendid views of the surrounding countryside. Tourism is growing rapidly here and this, combined with the wide range of employment opportunities becoming available in the cities such as Wodonga, Albury (in New South Wales), and Wangaratta, is likely to place increasing pressures on the use of public land in the study area for various forms of outdoor recreation.

2. LAND VESTED IN THE ALBURY--WODONGA DEVELOPMENT CORPORATION

On 23 October 1983, the then Prime Minister of Australia and Premiers of Victoria and New South Wales signed the Albury--Wodonga Development Agreement. That Agreement provides for the establishment of a development corporation 'to create an Australian city with a high quality of environment, imaginatively planned and developed with respect for human requirements, and for public involvement'.

As a result the Albury--Wodonga Development Corporation was established in 1974. This is a statutory authority constituted under legislation passed jointly by the three participating governments. It is responsible to a Ministerial Council, which consists of the Federal Minister for Industry and Commerce, the New South Wales Minister for Industry, Development and Decentralization, and the Victorian Minister for Industry, Commerce and Technology (previously the Minister for Economic Development). Its main functions are to undertake, supervise, and carry out regional planning and development to construct the growth centre city under the direction of the Ministerial Council.



Billabong with waterbirds, Albury--Wodonga Corporation land

Land Conservation Council Investigation

Under the provisions of the *Albury--Wodonga Development Agreement Act* 1973, the Corporation had the power to acquire land in areas designated for urban and associated development. Following a number of changes to the Corporation's long-term plans and goals, the Albury--Wodonga Ministerial Council resolved that certain lands that had been purchased by the Corporation were no longer required. A program to dispose of this land was prepared, but it was decided that the Land Conservation Council should investigate some of the land to identify values associated with it and to make recommendations to the government about its future use.

On 20 December 1983, the Governor-in-Council declared some of the land within the Rural City of Wodonga (which is currently vested in the Corporation but which it no longer needs) and some other areas of Crown land in the Rural City to be public land in accordance with section 2(2) of the *Land Conservation Act* 1970. Some other land vested in the Corporation and included in the study area is located outside the Rural City. The location of the land is shown on Map 3.

3. ABORIGINAL ASSOCIATIONS

The earliest Aboriginal colonists of Australia are now believed to have arrived some 40,000 years ago. The earliest dated site in the study area is at Mudgeegonga, dated 3,445 years before present, but evidence from other Victorian sites suggests that Aborigines have probably lived in the area for at least 10,000 years.

Tribal Society

Aboriginal social structure is complex, and exists on several levels. In general, individuals identified with at least a tribe, a moiety, and a band. These structures determined people's social interactions, marriage, and residence.

According to Tindale, the Minjambuta, Duduroa, Pangerang, and Taungurong tribes occupied the study area. The term tribe has been defined as being a group of people who speak one language, or similar dialects. The groups in which people lived on a day-to-day basis were more complex however. Tribes were divided socially into two moieties, each associated with a totem, either the Eaglehawk or the Crow. Moieties determined many social relationships, marriage customs, and descent. Each tribe contained many bands, which were the basic living units, consisting of several extended families.

Religion

Aboriginal religion provided a rich and complex way of understanding the world, and played an integral part in the day-to-day life of the people. Members of a clan (a larger group than band level) had a spiritual attachment to the land, termed their 'estate'. The estate was not necessarily equivalent to the range that bands moved over in the food quest.

The clan's relation to the estate was maintained in the myths of the group, often directly related to natural features of the landscape. In a society without written records, myths and religion play an important part in ensuring that knowledge is passed on, and in ensuring the preservation of the social structure.

Intertribal relations

At some times of the year there were large gatherings. Members of the Duduroa tribe, for example, travelled up into the mountains during the Bogong moth aestivation period in early summer. Many activities took place there: stones and possum pelts were traded; marriages were arranged; and songs were transmitted between tribes. It is also likely that some groups or tribes were on unfriendly terms.

Relation to the land

Tribal boundaries are not equivalent to the rigid systems of land ownership in European terms, although Aboriginal people did associate strongly with particular areas as being both their estate and their range. Many tribal boundaries coincide with drainage basins, indicating that the tribal groupings might have had an ecological basis. Localized water and food sources in the valleys - and the framing of the basins by the surrounding, less-productive, ridgelines--would have been important to people engaged in a hunter--gatherer economy.

All members of a tribe required an intimate knowledge of the land, in contrast with a society in which much knowledge is vested in specialists. Different levels of social groupings led to a complex use of the land and a distinction was made between use of land for subsistence and ownership of land in a spiritual sense.

Culture

Aboriginal people living here had a culturally rich existence. In addition to social and religious aspects of life, rock art skills were well developed. Some examples of such art exist on sheltered faces of granite outcrops in many parts of the north-eastern area. Motifs present include human figures, animals, anthropomorphic designs, and animal tracks.

Hunter--gatherer economy

The economic basis of the former Aboriginal life style is termed as one of hunting and gathering - that is, food is generally consumed within the boundaries of the group and within 48 hours of its collection. Victorian Aborigines used various animals and fish, and more than 450 plant species.

The lack of plant and animal husbandy required mobility, and the settlement pattern was centred around semi-permanent base camps. Groups of several bands were probably based at such camps for several months. Work parties left the base to collect food, and made overnight or temporary camps. Seasonal abundance of particular resources (such as the Bogong moth) enabled, and provided a focus for, larger meetings - of perhaps several tribes.

Evidence of the hunter--gatherer life style can be found at present. Two archaeological sites at Baranduda contain the remains of camps, including quartz artefact assemblages, and food refuse such as fish and turtle remains along with burnt bones, probably from wallabies and possums. This indicates that the people used a range of ecological zones in the food quest. Mounds, found near rivers and creeks, were used for the preparation of cooking ovens, and perhaps as camp sites during floods. Aborigines removed bark from trees to manufacture food and water containers, shelters, and canoes. To facilitate climbing for food, they cut toe-holds into some trees, and scarred trees remain to the present.

The relation between tribal boundaries and ecologically defined land zones is in part based on the requirements of a hunter--gatherer existence.

Population before 1788

Estimates of the population prior to European settlement depend on various assumptions, owing to the lack of written data. Early estimates for Victoria, made by Radcliffe-Brown, suggest a population of 800 to 900 for the north-eastern area on a proportional basis. Butlin argues, however, that the early estimates take little account of the immediate depopulating effects of disease, random killings, and competition for resources, following appropriation of land by Europeans. His models suggest a population for the study area of from 2,400 to 4,800.

Colonial History

Population after 1788

Soon after the arrival of the first fleet at Port Jackson in 1788, the first fatal epidemic disease, probably smallpox, spread. Other introduced causes of Aboriginal mortality included venereal diseases, measles, whooping cough, tuberculosis, and influenza. As well as causing deaths, these diseases had long-term effects on the fertility and age/sex structure of the population. Dr W.H. Baylie visited the north-east in 1841, to report on the health of the Aborigines. He considered that there were 'about one thousand natives in this district'. Considering this and other reports, a population figure of 800--900 persons for the study area during the early contact period does not seem unreasonable.

In 1863, however, the north-eastern district was officially reported as having a population of 110 Aborigines; by 1877 this number had declined to 24.

Settlement

Aborigines fiercely resisted occupation of their land by squatters. They took sheep as they had previously taken the native animals, in conflict with the squatters' concept of property. The rapid decline in Aboriginal population following settlement suggests the degree of violence that took place. The government repudiated Batman's 'treaty' of 1835. Official recognition of such a treaty would, however, have entailed accepting that the Aborigines had prior ownership of the land under British law.

The Protectorate and the Protection Board

The Protectorate was initiated in 1838, with two aims: to provide physical protection, and to 'civilize' Aborigines. One Protector was assigned to the north-east area, but the system was not a success.

In 1860 a Central Board for the Protection of Aborigines was

set up. It established five major stations, where remaining Aborigines were encouraged to settle. Tangambalanga Reserve (near Kiewa) was gazetted in 1862. This was simply land temporarily set aside where Aborigines could camp, and where rations were issued.

Recent history

Since the Tangambalanga reserve was revoked and sold in 1873, no land in the study area has been either reserved or operated for the benefit of Aborigines. Today the number of Aborigines living in the area is very small, for several reasons. Probably the most important reason is the lack of continued family associations with the area. The population reduction and the lack of reserved land after 1873 have removed the focus for a local kin group to be maintained. Some of the people who lived in the area were probably removed to Protection Board stations in other parts of the State, Corranderrk Station being the most likely to have received north-eastern people.

References

Baylie, W.H. (1843). On the Aborigines of the Goulburn District. *Port Phillip Magazine*, 1, 86--92, 188--91.

Butlin, N.G. (1983). 'Our Original Aggression.' (George Allen and Unwin: Sydney.)

Christie, M.F. (1979). 'Aborigines in Colonial Victoria 1835--86.' (Sydney University Press: Sydney.)

Foxcroft, E.J.B. (1941). 'Australian Native Policy.' (M.U.P.: Melbourne.)

Peterson, C. (1976). The natural and cultural areas of Aboriginal Australia. In 'Tribes and Boundaries in Australia', ed. N. Peterson. (A.I.A.S.: Canberra.)

Radcliffe-Brown, A.R. (1930). Former numbers and distribution of the Aborigine. *Official Year Book of the Commonwealth of Australia*, 23.

Stanner, W.E.H. (1965). Aboriginal territorial organization: Estate, range, domain and regime. *Oceania*, 36, 1--26.

Tindale, N.B. (1976). Some ecological bases for Australian tribal boundaries. In 'Tribes and Boundaries in Australia', ed. N. Peterson. (A.I.A.S.:Canberra.)

4. HISTORY SINCE SETTLEMENT

In 1824 Hume and Hovell crossed the River Murray near Wodonga on the first overland trip from New South Wales to Port Phillip. In 1835, while following cattle straying from the run he managed near Albury, William Wyse forded the Murray and discovered the magnificent flats at the junction of the Kiewa and Mitta Mitta Rivers with the main stream. There he started the Bonegilla Run. Charles Huon arrived on the Murray in 1836 and took up Wodonga run, followed in 1837 by Roland Shelley and family, who established stations at Tintaldra, Cudgewa, and Wermatong.

Hume and Hovell crossed the Ovens River near Wangaratta on November 24, 1824. The first settler to settle in the Wangaratta district was George Faithfull in 1837. By 1840 land had been taken up along the Broken River, Seven Creeks , and the Mansfield plain.

These were hard times for the settlers, known as squatters. They required substantial finance to purchase their stock and materials, and many of them - being inexperienced or unsuited to the life - failed. They were fairly mobile and frequently moved. Some of their runs changed hands many times in a few years. The rushes following the discovery of gold in 1852 gave them a profitable market for their stock and grain. As a result of a series of free-selection *Acts* passed during the 1860s, however, the squatters' runs were considerably reduced in area. Land settlement was originally for cattle grazing, but in later years sheep were widely introduced. As the region became more settled, and with the decline of the gold rushes, agricultural activities increased. The first hop garden in Australia was planted out at Everton in 1860, and tobacco plantations were established in the Ovens Valley. Large areas were cultivated for wheat, and dairy herds were introduced into the rich grazing land along the river valleys.

Alluvial gold was first discovered at Beechworth in February 1852, and by the end of that year the area had become one of the most famous gold diggings in the State. In 1853 as many as 20,000 people were camped in and around Beechworth (then known as May Day Hills). At the Woolshed field near Beechworth fine gold was taken out in shovelfuls.

Diggings at Yackandandah, particularly the Nine Mile Creek field, and Ovens were also popular in the days of the gold rush. Alluvial mining also extended to many other districts, such as Dry Creek and Toombullup, and later Thowgla. Extensive quartz reef mining replaced this form of gold-mining as returns reduced, and as capital became available to introduce new technology. Later, large-scale hydraulic sluicing and dredging were carried out - for example, at Eldorado and Mitta Mitta.

Cudgewa railway trestle bridge, near Koetong

The present Hume Highway became the established route between Melbourne and Sydney, and the first mail run between these cities took place in 1838. The River Murray was important for river traffic, especially during the gold rush. It declined in importance as a transport route, however, as the railway and roads were developed.

Railways considerably changed transport within the region. The Melbourne--Wodonga line reached Wangaratta and Wodonga in 1873. Other railways constructed shortly afterwards covered the following routes: Tallarook-Mansfield, Benalla --Tatong, Wangaratta--Bright, Wangaratta--Yackandandah, and Wodonga--Tallangatta--Cudgewa. The railway system in turn declined in importance with the development of motorized transport, and most of these branch lines have now closed.

Initially the settlers considered forests a hindrance to the development of land for agriculture and destroyed them by axe and fire. Timber later became important for mining, and following over-exploitation it became necessary to prevent the uncontrolled use of forests.

According to early records, 200--300 men worked in the forests of the Strathbogie Ranges and Tolmie Highlands in the 1890s. They used the pit saw, adze, and broad axe to produce bridge timbers, sleepers, split timbers (palings and

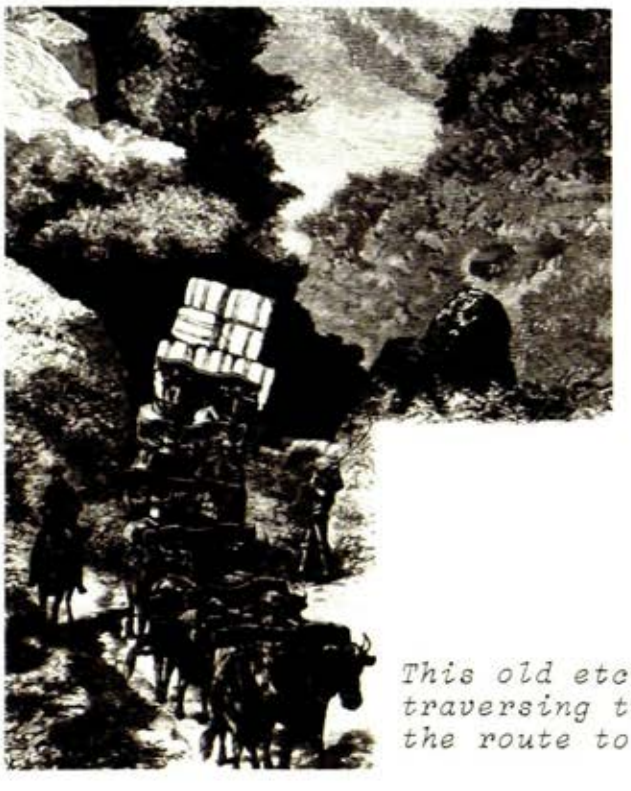
shingles), and fencing materials. Sawmills were established during 1916--18. Until about 1936, log haulage to the mills used horse and bullock teams, and also steam winches associated with wooden tramways. Private sawmilling in the Granya--Darbyshire area catered for local rural demand and retail trade in Albury--Wodonga during the early 1920s.

The first conifer plantation in the area was established at Myrtleford in 1927 to utilize land infested with St John's wort, and the Stanley plantation commenced in 1931 on old gold-workings.

Most early industries were established to meet local needs and were associated with food manufacture from local products. In 1856 John Reid built the first steam flour-mill in the region, at Ovens. Breweries at Stanley and Beechworth and a foundry at Beechworth were established in the same year. Many types of factories were established from then on in various parts of the region, including coach factories, flourmills, a tannery, a boot factory, a pottery, sawmills, butter factories, and wineries. The establishment of secondary industry served to stabilize certain of the towns that boomed during the gold rush days.

Local government has a complex history in the study area, following proclamation of the first 'Roads District' (later Shire) in 1856 at Beechworth.

This area has many ties with bushranging: in the late 1850s, Daniel Morgan and Harry Power operated here, and the famous bushranging Kellys also had connections. It contains the remains of Mrs Kelly's homestead, the site of the Stringybark Creek massacre near Toombullup, and the towns of Mansfield, Euroa, Benalla, and Glenrowan - all associated with the Kellys' saga.



This old etching depicts a bullock-wagon traversing the Pilot Range in 1880, on the route to the Beechworth gold-field.

PART II
PHYSICAL AND BIOLOGICAL RESOURCES

5. GEOLOGY AND GEOMORPHOLOGY

The oldest outcrops in the area are basic igneous rocks of Cambrian age, which occur between Mount Samaria and Wrightley.

Ordovician period marine sedimentation, followed by intensive folding in the middle Silurian, has resulted in the steeply dipping beds of sandstones, siltstones, shales, and mudstones that outcrop east of Eskdale, between Yackandandah and Myrtleford, and in the Chiltern and Lurg Hills.

Associated with the middle Silurian folding, broad areas were highly metamorphosed; also at this stage the earliest granites in the area were intruded, related to this metamorphic event arising 430 million years ago. These granites outcrop in the Corryong, Koetong, and Yabba areas and are enveloped by regionally metamorphosed rocks - predominantly schist. Schists also occur in a broad belt running from Tallandoon southwards, and alternate with gneiss (often rapidly) from Wodonga south to Glen Creek. More extensive areas of gneiss occur near Bethanga and Tallangatta. The bedrock, particularly the metamorphics, contains a sub-rectangular pattern of faults, which define many creek alignments and also boundaries of rock types.

The folding and metamorphism did not destroy the sedimentary basin completely and sedimentation continued to the southwest of Benalla. The resulting rocks now outcrop around Merton and Tallangalook. Elsewhere in the study area extensive and rapid erosion occurred and so, by the end of the Silurian, metamorphics and granite were exposed prior to the onset of a further phase of igneous activity about the start

Granite tor

Horizontally bedded sediments, exposed along the Mansfield--Tolmie road

of the Devonian (about 415 million years ago) and ending during the middle Devonian (about 375 million years ago). This igneous activity generally intruded high in the crust - as indicated by thin hornfels aureoles around the granites - and in part is associated with acid volcanism. In the north-east of the study area, sub-volcanic granites occur at Mount Mittamatite and Pine Mountain and are surrounded by dykes that in part form feeders for the volcanic rocks at Mount Burrowa. These granites also occur south-west of Wodonga at Yackandandah, Mount Pilot, Mount Stanley, Kergunyah, and the Strathbogie Ranges. Associated volcanic rocks occur around Molyullah--Wrightley.

In the Carboniferous period, beds of purple to red sand-stones, conglomerates, siltstones, and shales were deposited in the non-marine Mansfield basin. These beds were only slighly tilted by subsequent tectonic activity and the present topography around Mansfield--Tolmie--Barjarg is characterized by gentle dip slopes and hilltops.

Alluvial deposition following erosion of pre-existing rocks in the Tertiary period led to accumulation of gold and tin placer deposits in certain stream-beds. Limited volcanic extrusion occurred, and isolated plateaux remain near Tolmie and Archerton. Movement along various faults continued in the Tertiary, as indicated by the alignments of many streams and the presence of uplands such as Koetong and Bungil.

During the Quaternary, alluvial deposition has continued and been influenced in part by further earth movements along pre-existing fault lines. Building up and subsequent dis-section of alluvial terraces and plains have occurred on the Benalla Plain, along the Murray, Ovens, Kiewa, and Mitta Mitta River valleys, and along the larger creeks.

Map 4 shows a simplified version of the geology of the area, with the major geomorphic units mentioned in the block des-criptions also shown.

6. SOILS

Soils are formed by the weathering of rocks or unconsolidated material near the earth's surface. Complex interactions between climate, parent material, topography, and living organisms - and the time span over which these have operated - all influence soil formation. Their relative importance varies from one site to another.

The soils in the upper catchments of several rivers in the north-east of the State have been studied by R.K. Rowe, and the reports of these studies - with additional information provided by Rowe - form the basis for this chapter.

Generalized descriptions of the eight most common soil types in the study area follow, grouped according to the major land forms on which they usually occur.

For each soil, the description covers the following points: where in the landscape it can be found; a typical profile; some of its properties; and the uses of both public and freehold land with this soil type. A glossary of terms used appears as Appendix II.

Table 2 lists the soils according to their geological parent material and the land systems in which they occur (see chapter 11 and Map 7).

Mountains, Plateaux, and Scarps

Friable brown gradational soils

These are the most extensive soils on the steep slopes of the higher-rainfall mountainous areas. A typical profile has a litter layer overlying a dark-brown friable loam with strongly developed fine structue. With increasing depth, the colour intially becomes paler then more strongly red or brown as textures change to clay loam or light clay.

The soils are friable and porous and tend to be deep, with high surface porostiy and high permeability throughout. Their plant nutrients are concentrated near the surface, where the cation exchange capacity is moderately high.

They occur mainly on public land used for timber production, nature conservation, and recreation. Areas with these soils are important for water production in catchments. Occurrences in freehold land at lower elevations are used for grazing, and some pasture-seed production.

Friable red gradational soils

These are widespread, being found on plateaux and broad ridge-tops where the rainfall exceeds 900 mm, on moderate hillslopes, and on upper river terraces and fans.

A typical profile has about 6 cm of moderately structured dark brown loam over about 8 cm of yellow-red or red-brown loam to clay loam that merges with depth into a dark red or red-brown light clay.

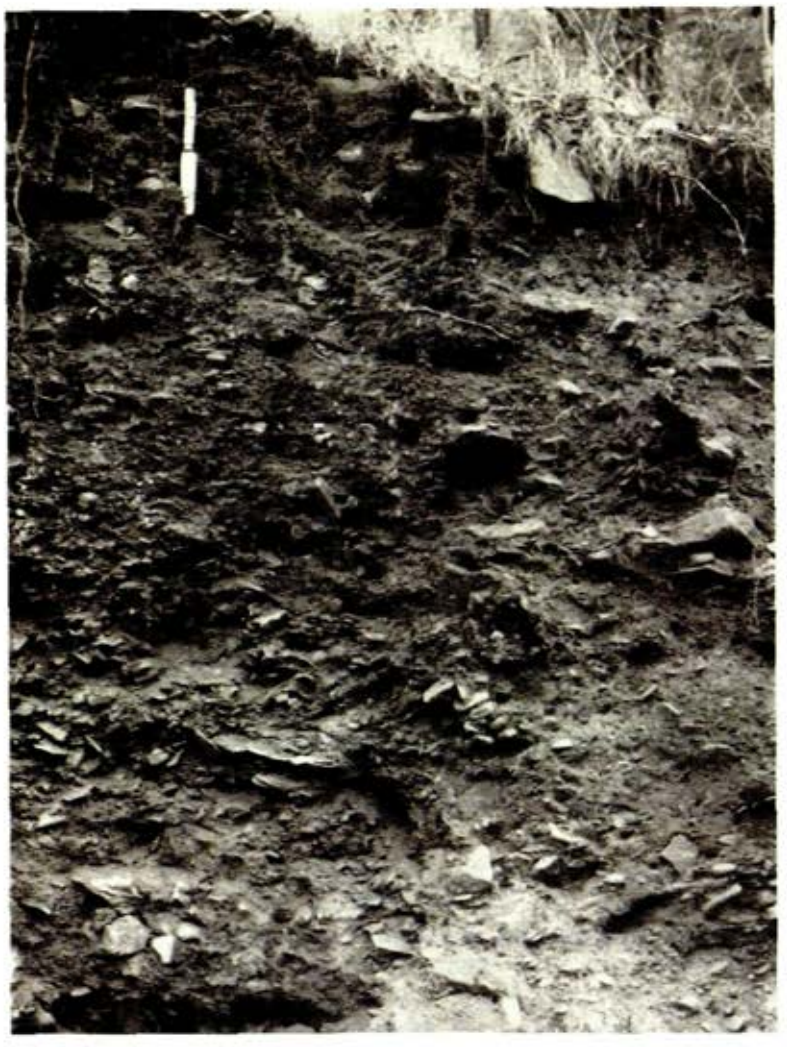
Profile depth depends on the parent material. In deep old alluvium or colluvium it may be 2.5 m or more, but on *in situ* rock it is generally about 1.2 m. Natural fertility is moderate for potassium and low for phosphorus.

The soils have desirable physical qualities for agricultural uses, and as a result their distribution is reflected partly

Table 2

SOILS IN RELATION TO LAND FORM, COMMON PARENT MATERIAL AND LAND SYSTEM

Land form and soils	Parent material	Land systems
Mountains, plateaux, and scarps		
Friable brown gradational soils	Palaeozoic sediments, granite, Carboniferous sediments	Mo,C,Tw,Ps,BN, Ti,Sv,BB,Mg,Lo
Friable red gradational soils	Palaeozoic sediments, Cambrian greenstones, basalt	Ps,BN,St,Ar,Sy, BB,K,Wr
Weakly bleached gradational soils	Various parent materials	Most land systems
Hills and older terraces		
Undifferentiated stony loams	Palaeozoic sediments	C,Tb,Bu,To,Mg, Wr,L,Lu
Red duplex soils	Various alluvial--colluvial parent materials	Mo,Ps,St,To,Mg, Bn,Ba,L,BE,A, Lu,Ch,Yh,Md,Db, Tc,BR,Mu
Yellow duplex soils	Older alluvium, various rock types	To,Mg,Lo,Bn,Ba, L,Sw,Ch,Db,Ma, Bk,B
Younger terraces, fans, and plains		
Red and brown gradational soils	Quaternary alluvium	Bt,Md,Mu,B
Alluvial brown loams	Quaternary alluvium	Mu,B



A friable brown gradational soil developed on colluvium

in land tenure. On freehold land they are commonly used for beef cattle and sheep grazing, while localized occurrences support fruit and nut orchards, vegetables, and tobacco - for example, at Stanley, Tawonga, and Koetong. Public land with these soils is used for hardwood and softwood timber production, and water production.

Weakly bleached gradational soils

Soils of this broad group show considerable variation in subsoil colour and structure.

They mainly occur on lower drier mountain slopes and hills in public land, and on terraces, fans, and low hills in freehold land. The profile usually has a grey-brown loamy surface with moderate to weak structure overlying a weakly bleached horizon. At depths of 30--40 cm, the colour becomes stronger red or yellow-brown and the clay content increases. Subsoils commonly have a light clay texture, with massive to weak structure, and may be dispersible.

Fertility and permeability are moderate, but available water capacity is low, particularly where textures are sandy.

Freehold land use is commonly grazing of beef cattle and sheep with some dairying close to the main rivers. On public land hardwood and softwood timber production and nature

conservation are the main uses. Water production from these areas is also important.

Hills and Older Terraces

Undifferentiated stony loams

In these uniform-textured soils, partly weathered rock fragments predominate in a loamy soil matrix. The low proportion of soil to rock makes the water-holding capacity low, but permeability and infiltration rates are high and bedrock usually occurs at shallow depth.

Stony loams are common on the limited areas with steep slopes and narrow ridge-tops, particularly on rocks that fracture readily. On gentler freehold land, they are used for grazing of sheep, while nature conservation is the main use on public land.

The remaining soils occur mainly on freehold land, reflecting the less-dissected topography and agricultural productivity of these areas. Where they occur on public land they are used for timber production, nature conservation, and recreation.

Red duplex soils

Although occurring extensively on mid slopes, terraces, low hills, fans, and plains on freehold land, the red duplex soils are of limited extent on the more rugged public land.

Surface horizons of weakly structured hard-setting brown and grey-brown loams abruptly overlie red-brown clay sub-soils with moderately well-developed structure. Weathered rock may occur at a depth of 1 m or less and there may be much fragmented rock throughout the profile.

The shallower and more stony soils have low water-holding capacities. Further, the subsoil clays may limit penetration of rainfall.

Red duplex soil in the north of the study area

The main land use is beef cattle grazing, with some dairying.

Yellow duplex soils

These soils are common on freehold land on the northern plains, where they are usually gilgaied. Dark loam to gritty loam surface horizons overlie pale grey structureless loams or silty loams of variable depth, with iron oxide concretions lower in the horizon. These abruptly overlie a strongly structured yellow-brown heavy clay subsoil.

While fertility tends to be moderate, the physical characteristics present problems. The highly dispersible subsoils are only slowly permeable and surfaces frequently become waterlogged, particularly in winter.

Shallow yellow duplex soils with mottling at depth occur on dry slopes, rolling hills, and terraces. The slow permeability of subsoils promotes overland flow during heavy rains, giving rise to serious erosion hazards on the slopes.

Grazing - of beef and dairy cattle and of sheep for wool and meat - is the main land use. Some cereal cropping is practised on the plains around Wangaratta and Benalla.

Younger Terraces, Fans, and Plains

Red and brown gradational soils on alluvium

These soils occur on alluvial fans, intermediate-level stream terraces, and well-drained lower terraces. Structure is weakly developed but fertility is moderate. Profiles usually overlie coarse material and this ensures free drainage.

Common usage is grazing - of dairy cattle, beef cattle, and sheep - with cereal or fodder cropping practised occasionally

Alluvial brown loams

Uniform-textured alluvial brown loams have developed on young alluvium along the stream flats. The surfaces of lighter-textured soils are well-structured, but at depth the colour becomes paler and the structure weakens. The profiles are well-drained, being underlain by gravels. Heavier-textured soils are weakly structured and very compact. These soils are commonly used for grazing of dairy cattle, and for some fodder cropping.

References

Rowe, R.K. (1967). A study of the land in the Victorian catchment of Lake Hume. *Soil Conservation Authority Technical Communication* No. 5

Rowe, R.K. (1972). A study of the land in the catchment of the Kiewa River. *Soil Conservation Authority Technical Communication* No. 8

Rowe, R.K. (1984 in press). A study of the land in the catchments of the Upper Ovens and King Rivers. *Soil Conservation Authority Technical Communication* No.16.

Rundle, A.S., and Rowe, R.K. (1974). A study of the land in the catchment of the Broken River. *Soil Conservation Authority Technical Communication* No. 9

7. CLIMATE

The study area has hot, relatively dry summers and cool, wet winters, with annual average rainfall ranging from about 600 mm to 1,200 mm. Topography has a marked effect, with higher areas and deeply dissected valleys experiencing a wetter, cooler climate. Some snow has been recorded at high elevations.

Precipitation

Map 5 shows the average annual isohyets within the study area. These begin between 600 mm and 700 mm on the Benalla Plain and increase to between 700 and 1,000 mm for the bulk of the study area. In the more elevated parts, such as the Strathbogie Ranges, Mount Stanley, Mount Burrowa, and the area east of Cravensville, the average annual rainfall increases to more than 1,200 mm.

Light snow-falls occur at elevations above 800 m fairly regularly and make some contribution to precipitation in these areas. Hail and dew do not contribute significantly to annual totals.

A number of rain-shadow areas can be identified from the Map. These include the Lake Nillahcootie area northwest of Mansfield and those around Eskdale in the Mitta Mitta Valley and around Corryong.

Table 3 gives the monthly rainfall pattern for a number of locations throughout the study area. The distribution of rainfall shows a winter peak, with June the wettest month at most stations. The driest months are January and February, and the rainfall increases fairly sharply in autumn. The difference between summer and winter rainfall is less marked on the plains than in the more dissected areas.

Temperature

Maximum and minimum daily temperature are shown in Table 4. The hottest months are December, January, and February - average maximum summer temperature ranges from 27°C at Beechworth to 30.8°C at Corryong. July is normally the coldest month with average maximum temperatures varying between 10°C at Beechworth and 12.6°C at Benalla and Wangaratta. Maximum daily temperature can be very high in parts of the study area. For example, the temperature has exceeded 44°C on several days at a time at Benalla on the plains.

Average minimum temperatures range from around 12°--16°C in February to 1--4°C in June. Minimum temperatures, however, vary greatly from locality to locality due to the influence of topographic features (such as valleys and depressions) on overnight temperatures.

Table 3

AVERAGE MONTHLY RAINFALL IN MILLIMETRES

Study district	Station name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
North-eastern District 1	Corryong	49	46	56	51	61	78	77	77	67	78	61	59	760
	Koetong	55	55	90	75	85	155	125	110	100	95	72	79	1,096
	Nariel Creek	55	57	70	77	85	115	117	125	85	110	75	67	1,038
	Tallangatta East	49	45	57	58	74	93	90	87	75	82	62	63	835
	Walwa	51	47	55	65	69	88	85	86	73	82	61	61	823
North-eastern District 2	Benalla	41	37	46	49	64	77	71	71	61	64	47	42	670
	Euroa	36	33	46	48	65	77	68	71	60	61	44	40	649
	Mansfield	45	43	55	60	55	62	65	70	60	65	60	43	683
	Strathbogie North	50	35	75	77	90	120	123	100	95	90	80	80	1,015
North-eastern District 4	Beechworth	43	50	60	63	90	110	100	95	70	73	65	58	877
	Mitta Mitta	60	61	62	88	109	96	126	137	103	108	86	75	1,111
	Wangaratta	38	40	48	48	56	72	64	64	59	63	46	42	640
	Wodonga	38	38	50	50	65	84	81	75	61	72	48	51	713

Table 4

AVERAGE DAILY MINIMUM AND MAXIMUM TEMPERATURES

Study District	Station name	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North-eastern District 1	Corryong (no other stations available)	Max.	33.2	28.2	25.2	20.9	15.3	11.9	11.9	12.9	18.3	21.4	25.5	31.0
		Min.	16.4	15.0	9.4	7.3	3.9	1.1	1.9	3.3	4.9	8.1	8.6	13.1
North-eastern District 2	Benalla	Max.	31.2	30.0	26.8	22.0	16.5	14.8	12.6	14.2	17.4	20.9	24.9	28.2
		Min.	14.4	14.1	11.4	8.2	5.3	3.4	2.9	4.0	5.0	7.5	9.7	12.2
	Euroa	Max.	30.2	29.9	25.9	21.1	15.8	13.2	11.9	13.7	16.2	20.7	23.8	27.1
		Min.	15.2	16.2	13.0	9.7	6.3	4.1	3.5	4.6	5.7	8.1	10.1	12.6
	Mansfield	Daily av.	19.9	19.6	16.9	12.7	9.0	7.3	5.8	7.6	10.2	12.7	15.6	18.1
	Strathbogie North	Daily av.	19	17	16	13	9	7	6	7	10	13	15	17
North-eastern District 4	Beechworth	Max.	28	27	24	19	15	12	10	11	13	16	22	25
		Min.	14	14	11	7	5	3	2	3	5	7	10	11
	Mitta Mitta	Max.	29.9	30.1	27.1	21.3	13.1	11.9	11.3	13.0	15.2	21.0	23.2	26.9
		Min.	11.7	12.4	9.7	6.2	3.4	0.9	1.0	2.2	2.7	5.4	7.2	9.8
	Wangaratta	Max.	31.3	30.7	27.4	22.5	16.7	14.0	12.6	14.4	17.2	21.1	25.0	28.4
		Min.	15.0	14.8	8.4	8.4	5.4	3.5	2.8	4.3	5.5	8.3	10.4	12.9
	Wodonga	Max.	31.9	31.3	28.2	22.8	16.7	14.2	12.5	14.7	17.8	21.6	25.9	28.7
		Min.	15.3	15.2	12.7	8.9	5.5	4.0	3.0	4.2	5.7	8.4	10.6	13.4

Frosts

Frosts generally occur in the period between April and September even at the lower altitudes, with the most severe generally confined to the period June to August. At higher elevations frosts are more frequent and may occur throughout the year, although they are unlikely to be severe during summer.

Winds

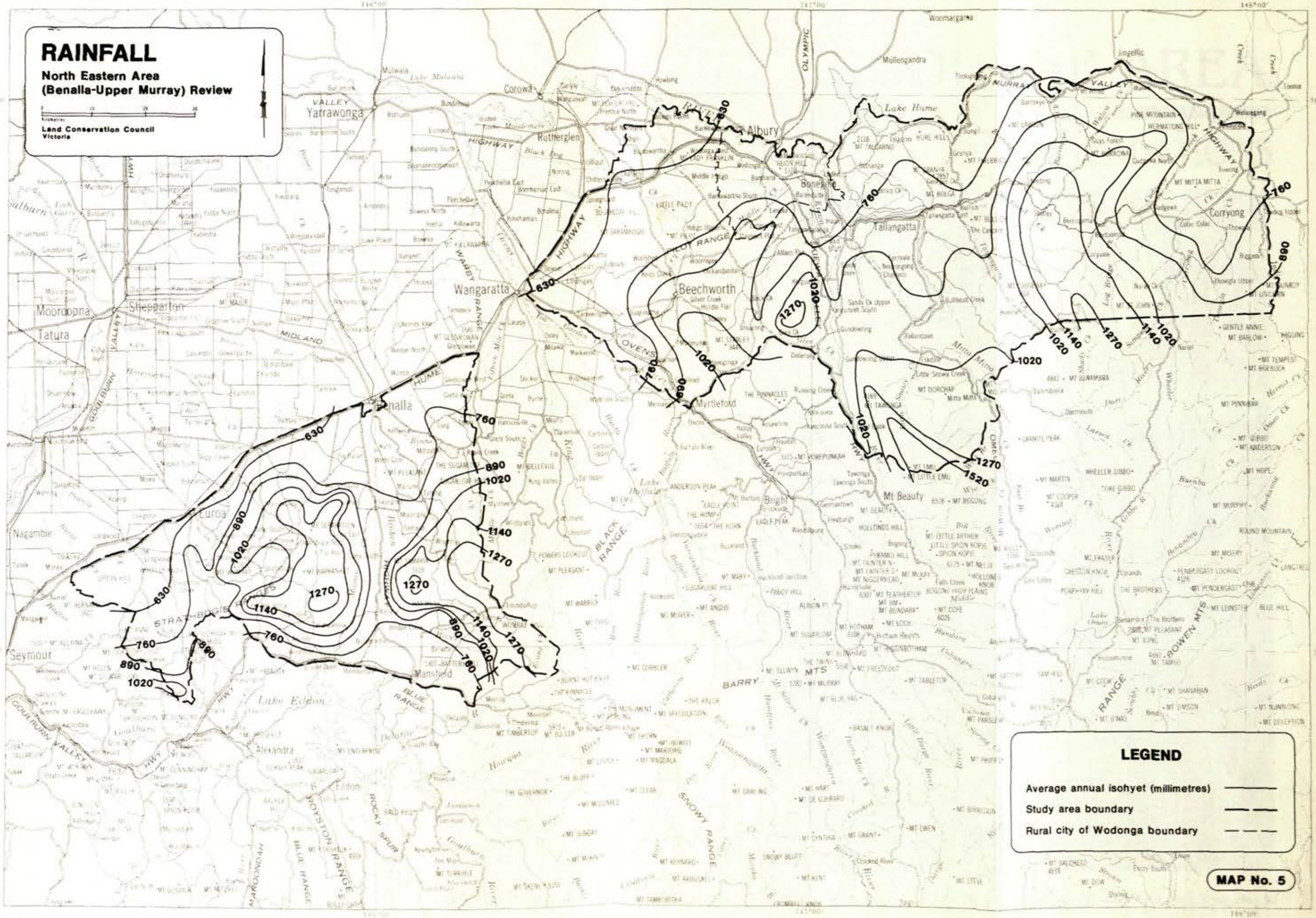
The predominant winds in the Benalla-Wangaratta area come from the north-west or south-west. East of Tallangatta, north-westerlies or north-easterlies predominate. Most of the rain, however, falls when south-westerly winds prevail and occasionally with strong cold southerly or south-easterly winds in mid winter. Heavy rainfall may accompany northerly winds in summer. Easterlies are infrequent, except those resulting from local effects. Tornadoes occur from time to time and cause uprooting and breaking of trees and other damage, usually in a narrow swath across the country.

RAINFALL

North Eastern Area
(Benalla-Upper Murray) Review

Kilometres

Land Conservation Council
Victoria



LEGEND

- Average annual isohyet (millimetres) ——
- Study area boundary — — —
- Rural city of Wodonga boundary — — —

MAP No. 5

8. WATER RESOURCES AND UTILIZATION

Surface Water

Yield of run-off water from a catchment is related to both precipitation rates and the percentage of this precipitation lost as evaporation, transpiration, deep seepage, and impounded water. The mountainous parts of the study area receive higher rainfall than the lower valley sections, and are also more conducive to run-off as they have steeper slopes and shallower soils. It follows that these areas supply a high percentage of the total run-off from the catchments.

Major streams

The study area contains the bulk of the following major water systems:

- Broken River and tributaries (from the source to Benalla)
- Mitta Mitta River (from Mitta Mitta to Lake Hume)
- Kiewa River (from Tawonga to Wodonga)

  Its boundaries follow two other rivers

- Ovens River (from Myrtleford to Wangaratta)
- Murray River (from Bunroy to Indigo Creek)

The most significant of the lesser streams in the study area are Seven Creeks, and Holland, Reedy, Black Dog, Yackandandah, Tallangatta, Cudgewa, and Corryong Creeks.

Gauging stations

A number of gauging stations have been established in the study area and Table 5 (on pages 32--33) presents records of annual discharge and salinity for each of the major streams.

Water quality

The range of factors characterizing water quality includes hardness, turbidity, colour, organic matter content, and the concentration of total dissolved solids (TDS). For practical purposes, TDS level is the most commonly used indicator of chemical water quality. Within the study area, TDS levels range from 20 to 176 mg per L (see Table 5). Water with TDS levels less than 1,000 mg per L is suitable for domestic and industrial use and for livestock and irrigation.

Storages

The largest storage in the study area is Lake Hume on the Murray, which has a capacity of 3,038,000 ML and regulates

Table 5

STREAM GAUGING AND SALINITY

Gauging station	Catchment area (sq. km)	Years of operation	Annual discharge (ML)			Mean salinity (mg per L)
			Maximum	Minimum	Mean	
Hughes Creek at Tarcombe Road	471	1958--	174,000	18,100	80,600	176
Seven Creeks at Euroa	251	1945--63	237,000	24,300	70,400	40
Seven Creeks at Euroa Township	332	1963--	161,000	20,200	80,700	90
Seven Creeks at Polly McQuinns	153	1965--	85,000	14,500	50,700	52
Moonee Moonee Creek at Lima	93	1963--	48,500	7,950	21,700	40
Broken River at Moorngag	497	1957--	187,000	6,400	79,900	82
Hollands Creek at Kelfeera	451	1960--	266,000	17,200	96,100	100
Ovens River at Wangaratta	5,824	1891--1945	5,020,000	176,000	1,410,000	40
Ovens River at Myrtleford	1,143	1961--	1,140,000	134,000	573,000	23

Reedy Creek at Woolshed	210	1964--	110,000	3,350	37,600	67
Yackandandah Creek at Osbornes Flat	272	1964--	156,000	14,200	56,600	51
Kiewa River at Kiewa	1,145	1885--	2,070,000	166,000	616,000	42
Mitta Mitta River at Tallandoon	4,716	1934--	3,860,000	354,000	1,260,000	41
Tallangatta Creek at Bullioh	635	1953--	402,000	16,200	131,000	46
Little Koetong Creek at Burrowye	31.2	1935--43	13,700	1,000	4,160	N/A
Burrowye Creek at Burrowye	145	1935--43	62,200	4,410	18,500	N/A
Cudgewa Creek at Berringama	350	1953--	308,000	27,600	103,000	34
River Murray at Jingellic	6,527	1890--	6,470,000	732,000	2,500,000*	29
Nariel Creek at Upper Nariel	262	1914--	352,000	38,700	138,000	27

* Includes 590,000 ML diverted into the River Murray as part of the Snowy River scheme.

an average annual flow of 4,000,000 ML. It is augmented by 590,000 ML from the Snowy Scheme in New South Wales and 4,000,000 ML of water from the Dartmouth Dam, recently completed on the Mitta Mitta river just outside the area.

The only other large storage in the study area is Lake Nillahcootie on the Broken River, which has a capacity of 39,500 ML. Two others - Lake Mokoan (365,000 ML) and Lake William Hovell (13,500 ML) - lie outside its boundaries, but utilize water from the Broken River and Evans Creek respectively.

Irrigation

Lake Hume is operated by the River Murray Commission. Water allocations may be made to South Australia, New South Wales, and Victoria in all but years of extreme drought. In conjunction with water from the Goulburn River, Lake Hume services about 160,000 ha of land in Victorian irrigation districts downstream of the study area. Lake Nillahcootie supplies water to some of those districts as well as irrigators along the Broken River. The Bonnie Doon arm of Lake Eildon extends into the study area along Brankeet and Glen Creeks. Water from this lake is used for irrigation and domestic supplies, through the Goulburn Irrigation system.

Within the study area permits and licences are issued to irrigate either a specific area or to use a specific volume of water from a number of rivers and streams - mainly the Mitta Mitta, Kiewa, and Broken Rivers and their tributaries. The water is used for pasture production (mostly for dairy cattle), for lucerne and crops such as tobacco and hops, and for small areas of horticultural enterprises such as apple production and market gardening.

Table 6 lists the numbers of these irrigation permits and licences issued for the various water systems and the areas of irrigated agricultural enterprises they cover.

Lake Kerferd, water supply for Beechworth

Table 6

WATER UTILIZATION

Source	Permits and licences issued			Area irrigated (ha)			
	Irrigation	Domestic --stock	Industrial	Perennial pasture	Annual pasture, crops, and lucerne	Other	Total
Broken River and tributaries							
- Broken River	92	45	-	692	1,701	23	2,416[1]
- Broken Creek[2]	32	13	2	307	906	1	1,214
- Other tributaries	41	35	2	26	33	4	63
Kiewa River and[3] tributaries	218	113	1	917	-	416	1,333
Lake Eildon tributaries	5	11	-				
Mitta Mitta River and tributaries	68	93	4	821	-	-	821
River Murray and tributaries upstream of Lake Hume	41	79	2	224	87	7	318
Upper Goulburn tributaries	17	24	-	41	22	-	63

Notes:

1. About 360 ha within the study area is irrigated from the Broken River; the rest is outside it.
2. Outside study area, but derives water from it.
3. Only northern portion of catchment in the study area.

Source: Rural Water Commission (1984).

Table 7

URBAN USE OF WATER

Centre	Source	Average daily demand (ML)	Treatment and water quality
Beechworth	Lake Kerferd	3.0	Sand filter beds
Benalla	Ryans Creek	6.6	Water chlorinated
Chiltern	Barambogie Creek and two bores and springs	0.3	High iron content; otherwise creek water very turbid but bore water good; untreated
Corryong	Corryong Creek	1.2	Untreated
Cudgewa	Cudgewa Creek	0.14	Water chlorinated
Euroa	Seven Creeks and Mountain Hut Creek	1.9	Water chlorinated but open storage may result in recontamination
Glenrowan	Fifteen Mile Creek and Mount Glenrowan catchment	0.1	Generally poor bacteriological quality; chlorinator to be installed within 3 years
Kiewa	Kiewa River	0.1	Untreated
Longwood	Nine Mile Creek	0.1	Untreated
Mansfield	Delatite River	0.3	Untreated
Myrtleford	Buffalo Creek and two bores	2.5	Quality generally satisfactory but past bacteriological tests often below standard; untreated
Springhurst	Diddah Diddah Creek	0.06	Quality generally satisfactory; untreated
Tallangatta and Bellbridge	Lake Hume	0.51	Water chlorinated
Violet Town	Honeysuckle Creek	0.5	Water chlorinated
Walwa	Murray River	0.13	Untreated
Wangaratta	Ovens River and a bore	18.9	Treatment includes sedimentation, filtration, and chlorination
Wodonga	Wodonga Creek	13.8	Quality reasonable but colour and turbidity problems; chlorinated
Yackandandah	Nine Mile Creek	0.37	Untreated

Source: Rural Water Commission (1984)

As in most other parts of the State, the majority of streams in the study area are fully committed for irrigation by direct pumping. Permits are still issued, however, for the filling of on-stream and off-stream storages that utilize winter flows for irrigation.

Domestic supplies

A number of small storages for domestic water dam the local streams. These include Loombah Weir (680 ML) and Lake McCall Say (1,000 ML) on Ryans Creek, Polly McQuinns Reservour (137 ML) on Seven Creeks, the dam (14 ML) on Mountain Hut Creek, two small dams (46 and 4.6 ML) on Honeysuckle Creek, Diddah Diddah Reservoir (50 ML), Lake Kerferd and Barambogie Reservoir (45 ML).

Table 7 sets out the current usage of domestic water for the principal towns from these storages and other sources. The bacteriological quality of waters used for town supplies is consistent with that derived from catchments with a multiplicity of uses. In many such supplies the water is treated, either by detention or disinfection (see the table).

Groundwater

With respect to groundwater quality and yield the study area can be divided into two provinces: the highlands, made up of basement rocks of Palaeozoic age; and the younger alluvial sediments that form the plains at the highland front. The sediments also partially fill the numerous valleys that dissect the highlands.

Basement rocks

The Palaeozoic basement rocks of the area consist of granite, gneiss, volcanics, schist, and marine and non-marine sediments. Any usable groundwater in them lies in the upper-most 30 m, where they are weathered, and in general these rocks cannot yield large quantities of groundwater because of their low effective porosity.

The best groundwater is found in the extensive granites, volcanics, and gneisses. Its quality is in the range of 0--10,000 mg total dissolved solids (TDS) per litre, but the distribution is patchy and yields rarely exceed 0.5 litres per second. At depth, areas of fresh granite are unlikely to contain usuable water unless open master joints are present. This groundwater in weathered granite, volcanics, and gneiss feeds numerous springs in the colluvium surrounding the rocks, and many of them provide stock and domestic supplies.

The Carboniferous sediments near Mansfield contain good-quality groundwater with salinities in the range of 1,000--20,000 mg TDS per litre. Existing small-scale utilization has indicated yields are low, but the potential of these rocks to yield higher volumes of good-quality groundwater is as yet untested.

Large parts of the study area are made up of schists and marine sediments of Ordovician age. As found elsewhere in

Victoria, the quality of groundwater in these rocks is poor, with salinities in excess of 2,000 mg TDS per litre. Yields are low, generally being less than 0.8 litres per second.

Cainozoic alluvium

The alluvial deposits infilling the major valleys and extending out onto the plains have the greatest potential to yield large quantities of high-qaulity groundwater. Important aquifers of sand and gravel are contained within the alluvium occupying the following valleys: Upper Murray River and the lower reaches of its tributaries; Mitta Mitta River and tributaries; Kiewa River; and Ovens River and tributaries. The aquifers occur at depths ranging down to 60 m, and can yield in excess of 37 litres per second with salinities generally less than 1,000 mg TDS per litre.

In the 1982--83 drought, 1,500 shallow bores were drilled at Benalla and Wangaratta for domestic and garden purposes. At Wangaratta more substantial bores were constructed to tap the deep lead gravel aquifers beneath the Ovens system to supplement the town supply. The aquifer being utilized lies at 126 m depth; it yields 34 litres per second, with a salinity of 400 mg per litre. Other production bores tapping the same aquifer system were also drilled to provide water for industrial use in the woollen-mills.

Groundwater recharge

A proportion of the precipitation in the study area infiltrates the alluvial deposits and forms part of the recharge of the underground water of the Murray Basin. At present there does not appear to be any threat to the quality of the recharge water, as a result of the generally low levels of fertilizer and pesticide applications. Increased agricultural development could result in higher recharge and ultimately in increased nitrate levels in the groundwater. Any such changes should be taken into account when considering changes in the land use.

9. VEGETATION

The vegetation on the public land has been discussed in some detail in previously published descriptive reports for the respective districts. This chapter comprises three sections: the first describes the overstorey vegetation as interpreted on the vegetation map, and is based on vegetation chapters from past reports; the second section describes some of the understorey vegetation types found in the area, and is based on recent studies commissioned by the Council; the third section comprises a list of significant plant species occurring on public land outside the existing conservation reserves.

Map 6 classifies the vegetation occurring on public land in the study area, according to the height, crown density, and major species of the tallest stratum. The classification is based on that developed by Specht (shown in Table 8), but has been modified to better suit the vegetation of the study area and the data already available.

Table 8

STRUCTURAL FORMS OF VEGETATION
(modified from Specht 1970)

Form and height of tallest stratum	Projective foliage cover of tallest stratum		
	Dense (70--100%)	Mid-dense (30--70%)	Sparse (10--30%)
Trees > 40m		Open forest IV	
Trees 28--40m		Open forest III	
Trees 15--28m		Open forest II	Woodland II
Trees 5--15m		Open forest I	Woodland I
Shrubs 2--8 m	Closed scrub	Open scrub	
Shrubs 0--2 m	Closed heath	Open heath	
Herbs (including moss, ferns, lichens)		Mossland	Open mossland

Within the structural framework, the vegetation has been grouped according to commonly occurring combinations of main

species of the tallest stratum, or vegetation units. A more detailed description of the units is contained in previously published descriptive reports for the area.

It should be noted that no distinction is made on the map between mountain gum (*Eucalyptus dalrympleana*) and candlebark gum (*E. rubida*), as they are very similar both botanically and in their appearance in the field. At the scale of mapping adopted, it has not been possible to show the vegetation of all of the small blocks of public land and river frontages.

Vegetation Units Based on Major Species of the Tallest Stratum

Candlebark gum--snow gum, open forest I

This forest type is found at elevations above 1,160 m, on drier aspects and exposed ridges, in areas where soil moisture is less than optimum for alpine ash. Duration and persistence of winter snows and low temperatures during the growing season are probably important factors limiting the occurrence of other tree species on these sites.

In the study area, candlebark gum and snow gum (*E. pauciflora*) principally occur in combination in the unit; at its lower and upper elevation limits respectively, however, restricted occurrences of the two species also grow separately. An associated species, broad-leaf peppermint (*E. dives*), comes into the combination on dry, rocky sites.

The unit has restricted occurrence - high on the Mount Burrowa massif, at the summit of Mount Big Ben, on the peak of Mount Emu, and in the Buckland Spur--Bald Hill area.

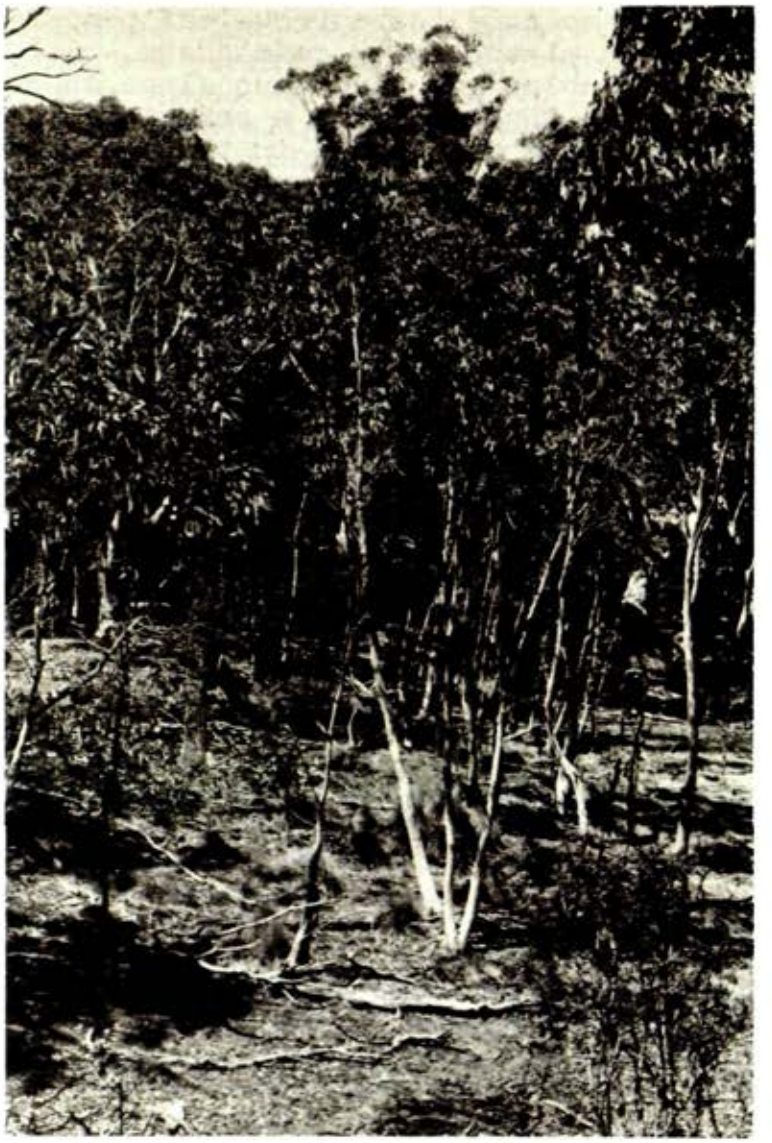
Alpine ash, open forest IV

Small stands of this species are scattered across the high elevations of the study area. Alpine ash (*E. delegatensis*) occurs here, as its seeds require low winter temperatures to break their dormancy. Subsequent chances of seedling survival, however, are reduced by spring frosts and heavy snowfalls in succeeding years. To become established, the seedlings need freedom from shading and competition. Paradoxically, fire intensity sufficient to kill alpine ash produces conditions that favour seedling establishment.

The unit grows at elevations of about 1,070 m to 1,200 m in this study area. Precipitation exceeds 1,020 mm per annum and soils remain moist throughout the year. Other species occur in mixture with it as the site conditions become marginal, and include candlebark gum and narrow-leaf peppermint (*E. radiata*).

This vegetation unit is confined to: sheltered aspects high on the Burrowa massif; a broad ridge east of Cravensville; sites on Mount Big Ben; sheltered aspects of peaks along the Dorchap Range, and Eskdale Spur in the vicinity of Mounts Emu and Tawonga; the headwaters of Evans Creek; and a site near Archerton.

Snow gum - on Mount Strathbogie



Messmate, open forest III and IV

Messmate (*E. obliqua*) occurs in pure stands or associated with manna gum (*E. viminalis*), narrow-leaf peppermint, blue gum (*E. bicostata*), and candlebark gum, and has a restricted distribution in Victoria north of the Great Dividing Range. Distribution of the unit within the study area is restricted to around gullies and sheltered aspects in the headwaters of Evans and Ryans Creeks and the Broken River, in Mount Samaria State Park, and on the Strathbogie Ranges.

Narrow-leaf peppermint, open forest III

The major species of the unit, narrow-leaf peppermint, requires a moderately high soil moisture status throughout the year. It sometimes forms stands in drier situations but the trees have poor crowns and generally do not grow vigorously. Deep, well-drained soils in areas receiving more than 1,020 mm of rainfall per annum characterize the main sites this species occupies, although it is sometimes found in locally moist sites such as southerly aspects and moist, sheltered basins in low-rainfall areas. It occurs over the whole range of elevations from 300 m to 1,100 m and is a major component of plateaux vegetation.

On cool moist sites narrow-leaf peppermint is frequently found in mixture with candlebark, blue gum, or manna gum, although blue gum may occur alone in some basins and moist gullies. There is also a restricted occurrence of manna gum growing as a pure stand in the headwaters of Evans Creek. On drier sites broad-leaf peppermint, brittle gum (*E. mannifera*), and red stringybark (*E. macrorhyncha*) may be present.

The vegetation unit is extensively represented on public land throughout the study area, with the major exception of low-rainfall areas in the foothills, and on the plains.

Broad-leaf peppermint, open forest II

This species has a greater ecological range than its near relative, narrow-leaf peppermint, and covers a higher proportion of the forested landscape in the study area. It grows on shallower well-drained soils within the narrow-leaf peppermint range as well as on drier northern aspects.

Although sometimes occurring in pure stands, broad-leaf peppermint is usually found associated within its range with candlebark gum, especially in locally moist sites, and with blue gum in moist sheltered basins. At lower elevations and on generally drier sites, it is commonly associated with brittle gum, red stringybark, and but but (*E. bridgesiana*), and also with red box (*E. polyanthemos*) and long-leaf box (*E. goniocalyx*) as the vegetation gradually changes to the box type. Broad-leaf peppermint extends up to the edge of the snow gum country on drier aspects. This vegetation unit is distributed extensively through the study area from the Strathbogie Ranges to the Bunroy area.

Red Stringybark--long-leaf box, open forest I and II

The main species of this unit, red stringybark and long-leaf box, have slightly different ecological requirements. Red stringybark occurs widely on freely drained soils under annual rainfalls varying from 630 mm to 1,020 mm. The species may occur in high-rainfall areas in association with broad-leaf peppermint if soil moisture-holding capacity is low, but low winter temperatures probably help to restrict it to

Open forest of narrow-leaf peppermint

below about 760 m elevation. Long-leaf box generally occupies soils subject to marked variations in soil moisture between winter and summer in areas receiving up to 1,020 mm of rainfall per annum. It is generally limited to elevations below about 600 m; its range overlaps those of Blakely's red gum (*E. blakelyi*), black cypress pine (*Callitris endlicheri*), red box, but but, white box (*E. albens*), yellow box (*E. melliodora*), and broad-leaf peppermint.

Although the same major tree species are usually present in the open forest I and II units, the height of the canopy, associated tree species, and understorey in the open forest I indicate a drier environment than in the taller form. Red box, Blakely's red gum, and black cypress pine are typical trees commonly associated with the open forest I form.

This vegetation unit is extensively distributed on foothills, lowland ranges, and undulating country throughout the study area.

Red ironbark, open forest I and II

The principal occurrence of red ironbark (*E. sideroxylon*) is in north-central Victoria. It is typically found in poor, shallow soils, including sands, gravels, ironstones, and clays, in auriferous country. Within the study area it is now only found on public land in the hills surrounding Chiltern and as scattered trees along roadsides near Lurg.

At Chiltern, red ironbark occurs on soils developed from sedimentary rock. Annual rainfall averages about 685 mm and the elevation ranges from 200 m to 400 m - soils are generally shallow and usually have an abundance of quartz gravel on the surface. On dry ridges the species is present in pure stands, and on the slopes it grows in mixture with red stringybark, red box, white box, grey box (*E. microcarpa*), and Blakely's red gum. Tree heights vary from 8 to 25 m depending on soil depth.

Grey box open forest II

An open forest of grey box has developed on soils derived from the Ordovician sediments around Chiltern, in association with the red ironbark forests of that area, and in the Reef Hills near Benalla. It grows in areas where the concentration of drainage results in excessive wetness in winter. Tree heights are about 15--25 m.

River red gum, open forest II and woodland II

River red gum (*E. camaldulensis*) occurs in pure stands confined to stream flats from about 180 m to 300 m elevation. The soils these units occupy are periodically waterlogged and have a moderately high water table throughout the year. The species grows under a wide range of climatic conditions, and its best representations on public land grow outside the study area.

Although the species was originally more widespread within the area, very little public land now carries it,

with the exceptions of Reef Hills Regional Park, an area near Wangaratta, and some river and stream frontages.

Blakely's red gum, open forest I and II and woodland I and II

These vegetation units have been mainly cleared for agriculture. The species now exists on public land in a few drainage lines and on hillocks. Blakely's red gum occurs typically on hillocks or terraces, where a perched water table may be expected during winter and where soils dry out during summer. It does not occur at elevations above 600 m and often takes on a mosaic patterning where co-dominant species form small clusterings. Associated tree species include white box, long-leaf box, but but, yellow box, red stringybark, broad-leaf peppermint, grey box, red box, and black cypress pine.

Scattered occurrences are found in the Mount Wombat--Garden Range Flora and Fauna Reserve, the Strathbogie Ranges, Pilot Range, and Mount Lawson areas.

Black cypress pine complex

This unit comprises a number of different formations, including closed to open heaths and open mosslands, which often occur in intimate mixture. Rainfall is usually less than 760 mm per annum and the soils are of granitic origin and free-draining. Open forests less than 15 m in height, comprising black cypress pine and Blakely's red gum, grow on the deepest soils of the complex. Associated trees include long-leaf box, red stringybark, red box, and, in the Mount Lawson Multi-purpose Park, occasionally kurrajong (*Brachychiton populneus*).

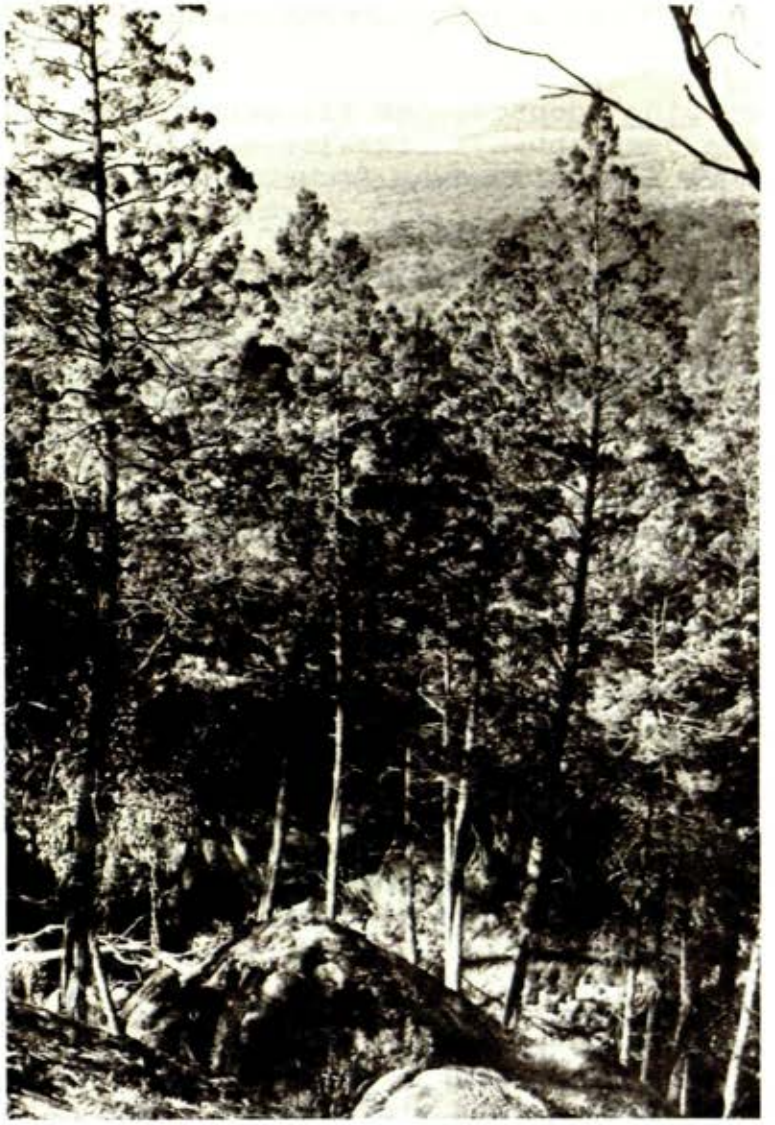
Closed to open heath consisting mainly of common fringe-myrtle (*Calytrix tetragona*) and heath-myrtle (*Micromyrtus ciliata*) is found on the shallower soils. Other species in this formation are dagger wattle, woolly wattle, and rock fern (*Cheilanthes tenuifolia*). The heath may cover large continuous areas or may surround isolated rocky outcrops. The outcrops themselves carry open mossland of lichens and mosses.

This complex is restricted to the northern portion of the study area and is almost all included within conservation reserves in the Mount Pilot and Mount Lawson Multi-purpose Parks, and in Burrowa--Pine Mountain National Park.

Mountain swamp gum, open forest II

At elevations higher than about 300 m, stream flats carry mountain swamp gum (*E. camphora*). Black sallee (*E. stellulata*) has a restricted occurrence with or near swamp gum in the north of the study area near Lucyvale, but on better-drained sites; low temperatures and moderate rainfall seem to be correlated with its presence.

In the southern part of the study area mountain swamp gum alone occurs, in areas of poor drainage, especially in the



Black cypress pine near Mount Pilot, growing between granite boulders; this species often forms pure stands

Mountain swamp gum open forest II

headwaters of Ryans, Watchbox, and Sam Creeks and the King River.

Due to the scale of mapping adopted, not all occurrences of mountain swamp gum have been shown - likewise some occurrences are shown as more extensive away from the drainage lines than is the case.

Softwood forest, grassland, and/or scrub

Plantations of the exotic radiata pine (*Pinus radiata*) have been established in the Koetong--Shelley area, also near Stanley and at Toorour and Warrenbayne, mainly on sites formerly occupied by narrow-leaf peppermint open forest III.

Grassland and/or scrub units are areas of public land that have previously been cleared and in some cases have been partly recolonized by native vegetation.

Understorey Types

The following descriptions of the understorey types are drawn from studies of the vegetation of the study area recently commissioned by the Land Conservation Council. These descriptions are based on visual analysis of the vegetation, not on a detailed quantitative analysis of species data. The units do not reflect all the subtle species and cover changes that in reality occur along any environmental continuum as a result of the different ecological requirements of the individual plant species.

Thus, the relatively small number of understorey types discussed here, while they may be identified in the field, are nevertheless only the more recognizable fractions of a vegetation that is far more complex when viewed over a larger area.

Each of the types has been described in terms of its most characteristic species and occurrence, and is cross-referenced in Table 9 with the vegetation units used in preparing the vegetation map. Where appropriate, reference has also been made to the roles that fire, grazing, or other disturbances play in the establishment of particular understorey types. Table 9 characterizes these vegetation types into their widespread and conspicuous identifying components and variations in the vegetation fractions present.

Common elements in understories

Two species, bracken fern (*Pteridium esculentum*) and silver wattle (*Acacia dealbata*), are present in many of the understorey types through a wide ecological range in the area. Their extensive occurrence has precluded them from being listed in the table, in favour of separate description.

Bracken fern

This is a very common component of many understories in relatively moist areas of all but the driest of the open forest alliances. Its occurrence and density are related to

the fire history of the area. It will often dominate when stimulated by fire.

Silver wattle

With its very wide ecological range, silver wattle is a common shrub through many understories. It varies greatly in density from sporadic individuals to a closed scrub and in height from 1 to 4 metres tall. Dogwood (*Cassinia aculeata*) is frequently associated with it.

Descriptions of Some Understorey Types

Sub-alpine wet heath--bog

This shrubby formation usually occurs as an understorey to mountain swamp gum in poorly drained areas, swamps, or bogs in higher valleys. The heath is dominated by coral heath (*Epacris microphylla*) and prickly tea-tree (*Leptospermum juniperinum*). A range of shrubs - often with sub-alpine affinities - may also occur, especially alpine bottle-brush (*Callistemon sieberi*), mountain baeckea (*Baeckea utilis*), and small-fruit hakea (*Hakea microcarpa*). The ground layer varies, but may be sphagnum bog, sedges (*Juncus* spp., *Carex appressa*), ferns (*Blechnum* spp.), or *Poa labillardieri* grassland.

Wet sclerophyll gully species

This unit is found in the wetter, more sheltered areas of narrow-leaf peppermint and messmate forests. It is characterized by tall shrubs such as hazel pomaderris (*Pomaderris aspera*), daisy bush (*Olearia* spp.), blanket-leaf (*Bedfordia*

Wetter areas carry a wet sclerophyll gully vegetation

Table

UNDERSTOREY TYPES OF THE

Overstorey unit	Understorey type	
	Identifying component	Variations
Candlebark gum--snow gum open forest I	*Poa sieberana* tussock grassland	Shrub layer, where present, consists of various low leguminous shrubs or hop bitter-pea--handsome flat-pea
Alpine ash open forest IV	*Poa sieberana* tussock grassland	Shrub layer, where present, consists of hop bitter-pea --handsome flat-pea
Messmate, open forest III, IV	*Poa sieberana* tussock grassland	Shrub layer, where present, comprises wet sclerophyll gully species
	Wet sclerophyll gully species	See description
Narrow-leaf peppermint open forest III	*Poa sieberana* tussock grassland	Shrub-layer, where present, consists of dry sclerophyll shrubs or hop bitter-pea--handsome flat-pea
	Poa labillardieri tussock grassland	Shrub layer, where present, consists of hop bitter-pea --handsome flat-pea or wet schlerophyll gully species
	Wet sclerophyll gully species	See description
Broad-leaf peppermint open forest II	*Poa sieberana* tussock grassland	Shrub layer, where present, consists of hop bitter-pea --handsome flat pea or dry sclerophyll shrubs
	Hop bitter-pea--handsome flat pea	
	Danthonia spp. grassland	Layer of dry sclerophyll shrubs may be present
	Dry sclerophyll shrubs (heathy)	Various herbs

9

NORTH-EASTERN AREA VEGETATION

Overstorey unit	Understorey type	
	Identifying component	Variations
Red stringybark —long-leaf box open forest I and II	*Poa sieberana* tussock grassland	Shrub layer, where present, consists of dry sclerophyll shrubs or *Xanthorrhoea* spp.
	Danthonia spp. grassland	
	Dry sclerophyll shrubs (heathy)	
	Kangaroo grass grassland	Layer of dry sclerophyll shrubs may be present
Red ironbark open forest I and II	*Poa sieberana* tussock grassland	Layer of dry sclerophyll shrubs may be present
	Danthonia pallida grassland	
Grey box open forest II	*Danthonia pallida* grassland	Layer of dry sclerophyll shrubs may be present
River red gum open forest II, woodland II	Sedges (*Carex* spp. and *Cyperus* spp.)	
	Pasture	Layer of dry sclerophyll shrubs may be present
Blakely's red gum open forest I and II, woodland I and II	*Danthonia* spp. grassland	Layer of dry sclerophyll shrubs may be present
	Variously shrubby to open	See description
Black cypress pine	As for Blakely's red gum	See description
	Myrtle heath	See description
	Pasture	Layer of dry sclerophyll shrubs may be present
Mountain swamp gum open forest II	Sub-alpine wet heath--bog grading into 'montane' wet heath	See description

Source: Williamson, R. (1984)

salicina), and *Coprosma* spp.; dogwood, blackwood (*A. melanoxylon*), and silver wattle are also often present. It occurs specifically in gullies, where it may form tall closed scrub. A less dense, more open form may occur in very sheltered and/or wet areas on mainly southern and south-eastern facing slopes.

Ground cover varies, but more common types consist of *Poa sieberana* and *Poa labillardieri* tussock grasslands, ferns (*Blechnum* spp., *Polystichum proliferum*), shrubs (*Leptospermum* spp., *Lomatia myricoides*), and sub-alpine wet heath.

Various low leguminous shrubs

These are chiefly associated with the candlebark gum--snow gum unit. Major species include narrow-leaf bitter-pea (*Daviesia virgata*), gorse bitter-pea (*D. ulicifolia*), handsome flat-pea (*Platylobium formosum*), and trailing oxylobium (*Oxylobium procumbens*).

Hop bitter-pea--handsome flat-pea

The very variable low shrubby layer of hop bitter-pea (*Daviesia latifolia*) and handsome flat-pea varies in both the relative proportions and the density of these two species. Where hop bitter-pea is the major species, the character of the vegetation tends to be shrubby, with a sparse ground cover. Elsewhere, a grassy ground cover (*Poa sieberana, Danthonia pallida*) with a variety of herbs develops. Local floristics appear to vary with the fire regime. The type is widespread throughout the area, through a wide range of vegetation units. It also intergrades with a variety of other understorey types - due, principally, to the influence of the frequency and intensity of fire.

Dry sclerophyll shrubs

This type varies considerably in both density and species composition. It is often dominated by peas, especially *Daviesia* spp., small-leaf parrot-pea (*Dillwynia retorta*), flat-peas (*Platylobium* spp.), and grey bush-pea (*Pultenaea cunninghamii*), and wattles - especially box-leaf wattle (*Acacia buxifolia*), red-stem wattle (*A. rubida*), and ploughshare wattle (*A. gunnii*). A range of other shrubs may also be present, such as *Grevillea* spp., dwarf cherry (*Exocarpos strictus*), and pink bells (*Tetratheca* spp.). On well-drained sandy soils, grass-trees (*Xanthorrhoea* spp.) are often present.

The type is widespread on the drier ridges and slopes and it intergrades with grassy understories with a diverse herb element.

Myrtle heath

This form of heath is dominated by fringe-myrtle. Violet kunzea (*Kunzea parvifolia*) and heath-myrtle are also usually co-dominant. Its distribution is associated with particular granite forms, and this understorey type occurs as either a treeless heath or as an understorey to black cypress pine.

Dry sclerophyll shrub understorey to open forest of broad-leaf peppermint and candlebark gum

Several other shrub species may be present, and there may also be a sparse herb and grass component.

Poa sieberana tussock grassland

This understorey type occurs under a wide range of vegetation units. Its chief characteristic is a high proportion of *Poa sieberana* tussocks, but other grass genera (especially *Danthonia*) may also be present. It is also frequently associated with a high herb diversity. It is widespread throughout the area and is often associated with a variable shrub layer.

Poa labillardieri tussock grassland

Restricted to moister more sheltered sites than the *Poa sieberana* tussock grassland, this is often associated with narrow-leaf peppermint and/or drainage lines. Frequently herb diversity is high. This type has a scattered occurrence, notably in valleys and on plateaux.

Silvertop wallaby-grass (*Danthonia pallida*) grassland

This species forms large and conspicuous tussocks where soil moisture is limiting to *Poa sieberana*. Other grasses (*Poa* spp., *Agropyron* spp.) and herbs (various species but usually diverse) may co-dominate. A sparse shrub layer of various dry sclerophyll species, predominantly wattles and peas, is also often present

Danthonia spp. grassland

Various wallaby-grasses form the major components of several understorey types. Other grasses (such as *Stipa*, *Poa*, and *Agropyron* spp.) are usually co-dominant.

The understories are common and widespread throughout the drier open forest and woodland types. Many of these areas have been grossly disturbed by grazing.

Kangaroo grass (*Themeda australis*) grassland

Widespread throughout the drier open forests of Victoria, kangaroo grass in some places becomes the major component in the ground cover vegetation. It may vary from being almost pure in some undisturbed areas to being co-dominant with other grasses - especially tussock grass, wallaby-grass, and some introduced species. It is often associated with a sparse shrub layer of dry sclerophyll species.

Pasture (and disturbed forest grasslands)

This understorey type varies from the largely introduced annual 'improved pasture' species on cleared agricultural land to the grazed grasslands of lower-altitude overstorey alliances. It often contains a high proportion of weed species. Grasses include fescue (*Vulpia* spp.), brome (*Bromus* spp.), barley-grass (*Hordeum* spp.), silvery hair-grass (*Aira caryophyllea*), and quaking grass (*Briza* spp.). Native grasses - notably wallaby-grass and weeping grass (*Microlaena stipoides*) - and herbs are also often present, especially in grazed forests.

Significant Plant Species

The following plant species, extremely localized in their distribution in Victoria and/or rare, occur outside the existing system of conservation reserves in the study area.

They have been identified using the locality data of Willis, supplemented from various sources including previous Land Conservation Council descriptive reports, the National Parks Service, and field observation.

1. *Acacia dawsonii* (poverty, or mitta wattle) - Localized in drier open forests (peppermint--gum--box types) of the New South Wales Tablelands. Very rare in Victoria - known only as a few isolated occurrences on rocky hillsides near Mitta Mitta and above Dartmouth township.

2. *Acacia penninervis* (hickory wattle) - Occurs chiefly in New South Wales. Very localized distribution in Victoria; confined to rocky declivities along the Hume Highway between Avenel and Longwood and on the slopes of the Strathbogie Ranges.

3. *Amphibromus gracilis* (graceful swamp wallaby-grass) - Very localized. Known only in the Yarra River flats near Melbourne, the Barmah Forest, Walwa, and in the Albury and Millewa districts of New South Wales.

4. *Bertya findlayi* (mountain bertya) - Rare and very localized in the western Grampians and in the upper Murray area. Has limited occurrences in the Bunroy block (Thowgla Creek, and Murray River at Bunroy) and at Surveyors Creek to the near south of that block.

5. *Brasenia schreberi* (water-shield) - Extremely localized. Recorded last century for lower Mitta Mitta River, Lake Moodemere, and the north-east district (Biggara). Known only at a few locations, including the Goulburn Weir and near Nagambie and recently (1976) in the upper Murray at Snowdons Lagoon, Bonegilla (Victoria), and between Tolmalmo and Jingellic (New South Wales).

6. *Calochilus grandiflorus* (beard-orchid) - Extremely rare in Victoria; only known in Queensland and far northern coast of New South Wales. Recently rediscovered near Mitta Mitta.

7. *Chiloglottis pescottiana* (bronzy bird-orchid) - In Victoria was believed to be endemic to Cravensville, where it is presumed extinct. Has also been listed at a few sites in East Gippsland, but the status of these populations is uncertain. Also reported from Tasmania (at Mount Barrow).

8. *Cyperus unioloides* (flat-sedge or mussel leaf-rush) - Rare and very localized in Victoria, where apparently confined to Towong.

9. *Digitaria diffusa* (umbrella grass) - Very localized in Victoria, recorded only at Walwa on the Upper Murray River.

10. *Eucalyptus dealbata* (tumbledown red gum) - Mainly occurs on rocky hills on western slopes in New South Wales, but has recently been found in Victoria on the Georges Creek Road, between the Granya block and Jarvis Creek plateau.

11. *Hypsela tridens* - Rare, recorded in Goulburn and Mitta Mitta Rivers and, more recently, Lakes Glenmaggie, Hume, and Eildon and Barmah Island.

12. *Leptospermum multicaule* (silver tea-tree) - New South Wales on dry hills, mainly in Tableland region. Small. very rare shrub confined in Victoria to the Mitta Mitta River and Beechworth Regional Park.

13. *Polygala japonica* (dwarf milkwort) - Rare and localized in Victoria - in East Gippsland and the far north-east. Occurs near Bunroy Creek.

14. *Pterostylis hamata* (scaly greenhood) - Very rare and localized in north-east. Recorded at Pine Mountain, Beechworth, and Benalla. It has a disjunct distribution in the west of the State near Maldon and Rainbow.

15. *Spirodela polyrrhiza* (syn. *Lemna polyrhiza* - large duckweed) - Very rare and localized in Victoria. Known only in lagoons at Towong and Biggara, and also at Heyfield.

16. *Sporobolus creber* (rat-tail grass) - Recently described species, has been collected near Rochester and 7 kilometres east-south-east of Walwa.

79652/84—3

17. *Thesium australe* (austral toad-flax) - Very rare plant of grasslands and herbfields. Only certain present-day occurrence is in East Gippsland, but reported near Mitta Mitta River.

18. *Uncinia riparia* (river hook-sedge) - Extremely rare in Victoria, the only apparent occurrence being at Towong.

19. *Viola caleyana* (swamp violet) - Uncommon in Victoria, apparently confined to the far north-east and East Gippsland, with scattered and localized distribution. Recorded at Biggara and Towong.

References

Churchill, D.M., and de Corona, A. (1972). 'The Distribution of Victorian Plants.' (Dominion Press: North Blackburn.)

Cochrane, G.R., Furher, B.A., Rotherham, E.R., and Willis, J.H. (eds.) (1968). 'Flowers and Plants of Victoria.' (Reed: Melbourne.)

Costermans, L.F. (1981). 'Native Trees and Shrubs of South-eastern Australia.' (Rigby Publishers Ltd: Melbourne.)

Frankenberg, Judith.(1971). 'Nature Conservation in Victoria: a Survey.' Ed. J.S. Turner. (Victorian National Parks Association: Melbourne.)

Frood, D. (1983). 'The Vegetation of the North-Eastern Area, District 1.' A Report to the Land Conservation Council (unpublished).

Rowe, R.K. (1967). A study of the land in the Victorian catchment of Lake Hume. *Soil Conservation Authority Technical Communication* No. 5.

Specht, R.L. (1970). Vegetation. In 'The Australian Environment', ed. G.W. Leeper. (C.S.I.R.O. and M.U.P.: Melbourne.)

Williamson, R. (1984). 'The Vegetation of the North-Eastern Area Districts 2 and 4.' A Report to the Land Conservation Council (unpublished).

Willis, J.H. (1970). 'A Handbook to Plants in Victoria: Volume I, Ferns, Conifers and Monocotyledons.' Second Edition. (M.U.P.: Melbourne.)

Willis, J.H. (1972). 'A Handbook to Plants in Victoria: Volume II, Dicotyledons.' (M.U.P.: Melbourne.)

The following report has been prepared for the Forests Commission, Victoria:

Willis, J.H. (1978) - 'A list of Rare, Very Localized and Endangered Indigenous Plants of Victoria.'

10. FAUNA

The wide variety of vegetation types found in the Benalla--Upper Murray study area support a diverse vertebrate fauna. At least 347 species of terrestrial vertebrates are known to occur there, comprising 50 mammal, 233 bird, 45 reptile, and 19 amphibian species. The distribution of many of these has been greatly affected by land use changes resulting from European settlement. Some species have become extinct; some greatly reduced; some more numerous; and some alien species have been introduced. Lists of the species - together with their habitat preferences, relative abundance, and distribution in the descriptive blocks - are given in Appendix IV and Appendix V.

Information presented here is derived largely from surveys conducted by the Fisheries and Wildlife Division in 1982, 1983, and 1984. Further information was provided by the Museum of Victoria, Royal Australian Ornithologists Union, Forests Division, and National Parks Service. Various literature records and information from naturalist groups have also been included.

Following a discussion of habitats by vegetation type and vertebrate fauna each contains, this chapter comments on the value of roadside reserves as habitat, and on changes to habitat, and describes the significant and notable species found in the area.

Habitats

The distribution of Victoria's wildlife may be discussed in terms of zoogeographic regions, which often contain distinct groupings of species. The two main regions are Eyrean (in the drier north-west of the State), and Bassian (in the cool temperate south and east), while a broad transition zone occurs between the two. The grassland and woodland habitats characteristic of the transition zone proved most suitable for agricultural development, and as a result the species endemic to that zone have become rarer. Zoogeographic regions contain a variety of faunal habitats listed in Table 10 and discussed below. (The classification follows the vegetation alliances described in Chapter 9 and shown on Map 6.) The absence of a species from any of the lists below does not necessarily mean that it does not occur in the habitat, only that it has not been recorded there.

Wet open forest

Within this habitat, the candlebark--snow gum community is restricted to altitudes greater than 1,000 m; the alpine ash community consists of a few stands, most of which are regrowth; the narrow-leaf peppermint community is widespread; and the messmate and mountain swamp gum communities contain similar fauna to that in the peppermint areas.

Table 10

VEGETATION COMPOSITION OF THE FAUNA HABITATS

Habitat type	Vegetation unit	Representative locality
Wet open forest	Candlebark gum, snow gum	Bald Hill Buckland Spur
	Alpine ash	Dorchap Range
	Narrow-leaf peppermint	Lucyvale Creek
	Messmate	Evans Creek
	Mountain swamp gum	Mount Barranhet
Dry open forest	Broad-leaf peppermint	Beetoomba Spur
	Red stringybark, long-leaf box	Mount Samaria
	Blakely's red gum	Thologolong
Dry open forest and woodland	Red ironbark	Chiltern
	Grey box	Reef Hills
	Blakely's red gum	Pilot Range
	Black cypress pine complex	Pilot Range
River red gum	River red gum	Reef Hills
Softwood	Softwood forest, grassland, and/or scrub	Warrenbayne
Wetland		Kiewa River
Farmland		
Urban		

These communities support a wide diversity of mammal species - including the highest densities of brown antechinus, bush rat, greater glider, and wombat. The dusky antechinus, feathertail glider, and yellow-bellied glider have only been recorded in this habitat. Brush-tailed phascogale records come from narrow-leaf peppermint forests with dry, sparse understorey. Koalas are very common in the narrow-leaf peppermint forests of the Strathbogie Ranges. The only record of common bent-wing bat comes from this habitat, and some other bats - such as chocolate wattled bat, King River

eptesicus, and large forest eptesicus are more common than in the drier habitats. Most great pipistrelle sightings have occurred in wet open forest.

Many native bird species have been observed here. Those characteristic of the habitat include the superb lyrebird, eastern whipbird, pilotbird, satin bowerbird, olive whistler, rufous fantail, White's thrush, rose and pink robins, Australian king parrot, and wonga pigeon.

Common species observed include striated and spotted pardalotes, red wattlebird, yellow-faced and white-naped honeyeaters, crimson rosella, pied currawong, grey shrike-thrush, white-throated treecreeper, brown and striated thornbills, white-browed scrubwren, eastern yellow robin, and Australian raven. Among the less common species are the black-faced cuckoo-shrike, grey fantail, crested shrike-tit, laughing kookaburra, fan-tailed cuckoo, red-browed treecreeper, brown goshawk, collared sparrowhawk, Australian hobby, yellow-tailed black cockatoo, and emu.

Many migratory birds appear in the spring and, having bred, depart after summer. These include the olive-backed oriole, leaden and satin flycatchers, sacred kingfisher, fan-tailed and brush cockatoos, white-throated gerygone, and cicadabird.

Reptiles characteristic of wet open forest include Spencer's skink, McCoy's skink, mountain dragon, and highland copperhead snake, while the commonly occurring amphibians are the froglet *Geocrinia victoriana* and the southern toadlet.

Dry open forest

This habitat includes the broad-leaf peppermint community (which is widespread, with boundaries often merging with narrow-leaf peppermint) and the red stringybark--long-leaf box and Blakely's red gum communities.

It has a diverse mammal fauna. The long-nosed bandicoot is found in areas with dense cover along creeks. The mountain brushtail possum is less common here than in wet open forest, and the reverse applies to the common brushtail possum.

The long-nosed bandicoot

The greater glider often occurs in the broad-leaf peppermint community but is seldom recorded in the red stringybark. Swamp wallabies are widespread throughout, but mostly occupy areas with a moderately dense understorey cover.

The broad-nosed bat has only been recorded here in red stringybark communities, although it is also likely to occur in the 'dry open forest and woodland' habitat.

In the dry open forest habitat, more than 55 species of native birds have been observed, including the endangered peregrine falcon and the rare barking owl. Common species include the crimson rosella, gang-gang cockatoo, laughing kookaburra, eastern yellow robin, grey shrike-thrush, brown thornbill, striated thornbill, superb fairy-wren, white-browed scrubwren, white-throated treecreeper, and Australian raven. Less common species include the crested shrike-tit, buff-rumped thornbill, white-winged chough, and spotted quail-thrush.

Many of the migratory birds found in narrow-leaf peppermint --messmate--mountain swamp gum communities also occur and breed here, as do the dusky wood swallow and western gerygone.

The habitat supports a large number of reptile species, including the tree goanna, copper-tailed skink, small-eyed snake, and the uncommon blind snake.

Dry open forest and woodland

This habitat comprises the red ironbark, grey box, Blakely's red gum, and black cypress pine communities.

It has a lower animal diversity than the previous types. The yellow-footed antechinus is common and this is the only habitat in the study area where the squirrel glider occurs.

Birds commonly observed here include the regent, fuscous, yellow-tufted, black-chinned, painted, and white-plumed honeyeaters (especially in the red ironbark community), the brown, striated, and buff-rumped thornbills (in the black cypress pine community), turquoise parrot, spotted and striated pardalotes, brown and white-throated treecreepers, red wattlebird, noisy friarbird, silvereye, western gerygone, grey shrike-thrush, speckled warbler, grey-crowned babbler, and eastern rosella. Less common species are the white-browed babbler, crested bellbird, hooded robin, and painted button quail.

Reptiles of this habitat include the sand goanna, rainbow skink, Cunningham's skink, and the rare bandy bandy. The red-groined toadlet is also found here.

River red gum

The river red gum habitat has simple floristics, and high diversity of mammals would not be expected. Bats are well represented, however, and the mature red gum provides ample hollows.

Interesting species of bird observed in river red gum areas include the declining bush thick-knee and regent honeyeater, the peregrine falcon, and the yellow rosella, which is restricted to this habitat.

Characteristic species observed here are the white-plumed honeyeater, brown treecreeper, striated pardalote, sulphur-crested cockatoo, little friarbird, and peaceful dove. Some of the less common species are the common bronzewing, crested shrike-tit, and white-browed babbler.

Softwoods

Wombats and eastern grey kangaroos utilize the margins of older plantations where native vegetation has re-colonized, and are often also abundant in young pines, feeding mostly on the native species growing with the pines. Fallow deer have been introduced into the pines near Koetong.

A number of bird species are known to utilize softwood plantations at some stage, but show much lower diversity there than in surrounding eucalypt forests.

Wetland

Only two specialist wetland mammals - the water-rat and platypus - live in this habitat, and they do not appear to be abundant through the area. Water-rats are common in the upper reaches of Lake Hume, and both species have been recorded at Sandy Creek Reservoir.

Wetlands of the study area - such as the River Murray and Kiewa River flats - are important for the declining Latham's snipe and brolga, the rare freckled duck, and many other species of waterfowl.

A diversity of amphibians utilize this habitat.

Farmland

Tiger quolls have been caught in farmland adjacent to native forest, and eastern grey kangaroos and wombats are common at the farmland--forest interface. Such animals may forage in the cleared land while using the forest for shelter. Although long-nosed bandicoots usually live in dense vegetation, near Creightons Creek they have been found in dry rocky outcrops in farmland with scattered wattles and tussock grasses. Bats forage over farmland, use farm dams, and can roost in isolated trees.

Bird species characteristic of farmland areas are Australian magpie, Australian magpie lark, common starling, willie wagtail, Richard's pipit, yellow-rumped thornbill, eastern rosella, galah, sulphur-crested cockatoo, brown falcon, and Australian kestrel. Species occurring around farm dams include masked lapwing, pacific black and maned ducks, white-faced heron, and great egret. Among the less common species are the stubble quail, spotted harrier, yellow-billed spoonbill, and plumed whistling-duck. The rare and declining bush thick-knee occurs in this habitat.

Urban areas

Few native mammal species have adapted to urban living - common brushtail possums being one of the more successful ones. Bats are often able to utilize urban areas for foraging and sometimes roosting.

Among common bird species are the house sparrow, common starling, Australian magpie-lark, Australian magpie, welcome swallow, superb fairy-wren, willie wagtail, and white-plumed honeyeater. Less common species include the tree sparrow, masked lapwing, Australian kestrel, and Australian hobby.

The value of roadside reserves as habitat

In the study area many of the roadside reserves - such as the Old Coach Road, Siems Road, Reef Hills Road, and Georges Creek Road - have great value as wildlife habitat. In many cases they contain remnants of plant communities that formerly existed in the area, and may be important for future survival of the fauna dependent on those communities, especially where little suitable habitat otherwise remains. Road reserves are of particular value as links between larger areas of public land. They may be threatened by road construction or widening, due to the associated tree removal and burning.

Habitat changes affecting native fauna

Most species of native wildlife are afforded legal protection from destruction, but more subtle factors, particularly alteration and disturbance of habitats, have been responsible for declining status of many vertebrate species. Such factors have included clearing freehold land, conversion of eucalypt forests to softwoods; fire, with subsequent changes to understorey floristics; and the use of pesticides and herbicides.

Survey data indicate that softwood plantations support fewer native animals than the indigenous forests. Many bird species cannot feed in pine plantations; and birds that nest in hollows, such as owls, parrots, and treecreepers, cannot breed among pines.

The abundance and diversity of mammals in exotic forests depend on plantation age and the extent of native vegetation remaining. Some evidence suggests that areas of retained vegetation such as those along streams enable small ground-dwelling mammals to exist, and native species that normally inhabit the area are found here. The extent to which these fragmented areas can sustain populations of native animals remains doubtful, however. Arboreal species like the greater glider and the sugar glider cannot endure in areas where native forests have been cleared for softwood establishment, and the evidence suggests that some species at least cannot successfully recolonize adjacent suitable areas.

Fire has always been an important component of forest ecosystems, and the timing, frequency, and intensity of fires, whether wildfire or burning to reduce flammable fuels, can influence the structure of the understorey. Thus fuel-

reduction burning - where it occurs at a frequency, timing, or intensity that differs from the natural regime - can alter the floristic composition.

Although not widely carried out in the study area, a further factor that can result in habitat changes is silvicultural practice that leads to the removal of older trees containing hollows. Table 11 lists the species found here that are known to utilize hollows.

Table 11

SPECIES UTILIZING TREE HOLLOWS

Mammals

Tiger quoll
Yellow-footed antechinus
Brown antechinus
Brush-tailed phascogale
Mountain brushtail possum
Common brushtail possum
Feathertail glider
Eastern pygmy possum
Yellow-bellied glider
Sugar glider
Squirrel glider
Common ringtail possum
Greater glider
Little mastiff-bat
White-striped mastiff-bat
Gould's wattled bat
Chocolate wattled bat
King River eptesicus
Large forest eptesicus
Little forest eptesicus
Broad-nosed bat
Lesser long-eared bat
Gould's long-eared bat
Great pipistrelle

Birds

Australian shelduck
Pacific black duck
Grey teal
Chestnut teal
Pink-eared duck
Maned duck
Peregrine falcon
Brown falcon
Australian kestrel
Yellow-tailed black cockatoo
Gang gang cockatoo
Galah
Sulphur-crested cockatoo
Musk Lorikeet
Purple-crowned lorikeet
Little lorikeet
Australian king parrot
Cockatiel
Budgerigar
Swift parrot
Crimson rosella
Yellow rosella
Eastern rosella
Red-rumped parrot
Blue-winged parrot
Turquoise parrot
Powerful owl
Southern boobook
Barking owl
Barn owl
Australian owlet-nightjar
Laughing kookaburra
Sacred kingfisher
Dollar bird
Tree martin
Grey shrike-thrush
White-throated treecreeper
Red-browed tree-creeper
Brown treecreeper
Spotted pardalote
Striated pardalote
House sparrow
Common starling
White-breasted wood swallow
Masked wood swallow
White-browed wood swallow
Dusky wood swallow

Reptiles

Tree goanna
Perrons tree frog
Tree skink
Spencer's skink

Significant and Notable Species

Ten terrestrial vertebrates found in the study area may be considered significant, on the basis that this region is important for the conservation and/or scientific investigation of each species. In addition, a number of notable species are included because of their general rarity, restricted distribution, specialized habitat requirements, or conservation status. The species are listed in Appendix VI by their status, distribution, and population trend.

Significant Mammals

Tiger quoll (*Dasyurus maculatus*)

The tiger quoll is the largest native marsupial carnivore on the mainland. It is distributed along the Great Dividing Range from northern Queensland to southern Victoria and Tasmania. Although still widespread, its Australian status is 'rare', and it occurs only sparsely throughout much of the eastern Victorian highlands and foothills. It is now found only in three small localities. In the study area most records have come from the range between Tallangatta and Mount Beauty - giving the area some significance for this species.

Squirrel glider (*Petaurus norfolcensis*)

This glider depends on tree cavities for breeding sites and daytime refuge retreats. In Victoria it is mainly uncommon, with a patchy distribution inland from the Great Dividing Range. The species utilizes relatively simple plant communities in open forests or woodlands, and remnants of these in roadside verges or streamside strips. At Chiltern State Park, glider densities were found to be higher in areas containing suitable tree hollows. Squirrel gliders have also been observed near Warrenbayne.

Squirrel glider, a nocturnal, volant, arboreal possum

Significant Birds

Brolga (*Grus rubicundus*)

Despite a widespread distribution in northern and eastern Australia, the brolga is generally uncommon and localized.

In Victoria it is rather rare and is restricted to the swampy plains of the south-west and some wetlands of the north. The birds have been recorded at several localities in the study area - for example at Towong - however, numbers have gradually decreased.

Bush thick-knee (*Burhinus magnirostris*)

The bush thick-knee occurs throughout Australia, but is now rare in cleared or settled parts of its former range in the south. While its numbers in Victoria have declined steeply in recent years, it is still known to occupy several localities in the study area, including one near Tatong and the Reef Hills Regional Park. Although well camouflaged, the species feeds and nests on the ground, making it vulnerable to feral cats.

Turquoise parrot (*Neophema pulchella*)

The turquoise parrot has a discontinuous distribution from south-eastern Queensland, through eastern New South Wales, to north-central Victoria. After being thought to be almost extinct in Australia in 1920, it has progressively recovered and expanded its range. In Victoria it is rare, breeding regularly only in the Warby Ranges, at Chiltern, and nearby in dry forested foothills. It has also been recorded in the Reef Hills Regional Park.

It feeds on or near the ground on seeds of grasses or herbaceous plants, and nests in low hollows of small trees, stumps, posts, or logs on the ground.

Grey-crowned babbler (*Pomatostomus temporalis*)

Although it occurs in mainland eastern, northern, and western Australia, in Victoria the bird has suffered a dramatic decline in recent years and is considered rare. It is still found at Chiltern, however. Grey-crowned babblers forage on the ground and nest and roost communally in bulky, domed twig nests constructed in shrubs and bushy trees.

Regent honeyeater (*Xanthomyza phrygia*)

The regent honeyeater - a nomadic species occurring in the forests and woodlands of south-eastern Australia - is now rare and endangered, having seriously declined in numbers. In the study area it has been recorded in Reef Hills Regional Park and is still found in the flowering red ironbark open forest in Chiltern State Park. This very active, brightly plumed bird feeds on flowering trees and shrubs, chiefly eucalypts, banksias, and grevilleas.

Significant Reptiles and Amphibians

Bandy bandy (*Vermicella annulata*)

Once widespread in the box woodlands of northern and central Victoria, this small snake has now become extremely rare; the few recent records have all come from the north-east - for example, at Chiltern. It is an extremely specialized

burrowing species, feeding entirely on blind snakes (*Ramphotyphlops* spp.), which are also now uncommon in Victoria.

Red-groined toadlet (*Uperoleia rugosa*)

This amphibian reaches the southern limit of its distribution in the study area and is extremely restricted in Victoria, being known only in the River Murray and the Mitta Mitta River valleys. The species as currently recognized needs revision as it is considered to contain more than one taxon.

Giant bullfrog (*Limnodynastes interioris*)

Only three sightings of this inland species have occurred in Victoria, making it one of our rarest frogs. It has been recorded near Bethanga in the study area, and may be more widespread in the river flats and low hills near Lake Hume.

Significant Fish

Trout cod (*Maccullochella macquariensis*)

A rare and endangered species. Within the study area the trout cod is confined to the Seven Creeks near Euroa; it also occurs in the Upper Murray River system.

Macquarie perch (*Macquaria australasica*)

This species is present in the Seven Creeks and in low numbers in Ryans Creek, Hollands Creek, Lake Nillahcootie, Lake Eildon, Lake Hume, and the Kiewa, Mitta Mitta, and Murray Rivers.

River blackfish (*Gadopsis marmoratus*)

Although widely distributed in Victoria's river systems, the species has low population numbers. It is present in the study area in Seven Creeks, Hughes and Creighton Creeks, the Broken River, Ryan and Hollands Creeks, and the Kiewa River. It is also present in low numbers in the Murray River.

Notable Mammals

Brush-tailed phascogale (*Phascogale tapoatafa*)

The brush-tailed phascogale (or tuan) is still widespread, but numbers have diminished over much of its Victorian range during the past few decades. Within the study area records are concentrated in the Chiltern, Beechworth, Myrtleford, and Warrenbayne areas, and particularly at Reef Hills. Most records were made in drier woodland--open forest habitats. An apparent drastic decline in numbers between the 1980 and 1984 surveys at Reef Hills may be explained by the 1982 drought.

Eastern horse-shoe bat (*Rhinolophus megaphyllus*)

This small, distinctive, cave-roosting bat is distributed through coastal eastern Australia. In the south, where its preferred warm humid caves are rare, numbers and densities

The eastern pygmy-possum occurs near Yackandandah

are low, its status being classified as vulnerable. One male was found in a disused mineshaft south of Tatong in September 1983, and in 1980 a horseshoe bat was captured on a tributary of the Moonee Moonee Creek. These records approach the western limit of the species' distribution in Victoria.

Little mastiff-bat (*Mormopterus planiceps*)
Broad-nosed bat (*Nyctiicieus* sp.)

Within the study area both bats have been found in the drier woodland--forest areas such as Reef Hills Regional Park, Chiltern State Park, and the Barambogie Range. These areas represent the eastern limit of the 'inland-type'.

Yellow-bellied glider (*Petaurus australis*)

Although widespread throughout the wetter regions of Victoria, the yellow-bellied glider is uncommon. In the study area recent records have come from south-east of Tolmie, the headwaters of the King River west branch, two localities near Ryans Creek, and along Lords and Trappers Creeks.

Eastern pygmy-possum (*Cercartetus nanus*)

The eastern pygmy-possum is a moderately common - but rarely detected - species. It is found from the rainforest through sclerophyll forest to tree-heath habitats. In the study area it has recently been recorded in the southern Strathbogie Ranges, Mount Samaria State Park, south-west of Tolmie, at Trappers Gap, and east of Lockhart Gap.

Brush-tailed rock-wallaby (*Petrogale penicillata*)

In Victoria this wallaby is considered an endangered species, due probably to overshooting, predation by dogs and

foxes, and competition from introduced species such as the rabbit.

In the study area it was once common on the top of Pine Mountain, but has not been recorded in the area since 1895. The Pine Mountain--Mount Burrowa National Park could be considered as a possible site for reintroduction, if this is contemplated.

Notable Birds

The 11 notable species of birds found in the area are shown in Appendix 6, with their status, distribution, and population trend noted.

Notable Reptiles and Amphibians

Mountain dragon (*Amphibolurus diemensis*)

This small dragon is restricted to the high country in the south of the study area, where it occurs in forests with diverse heathy understories. Reduction in understorey diversity resulting from fire would decrease available habitat and affect the reptile's numbers.

Sand goanna (*Varanus gouldii*)

The sand goanna is widespread but uncommon in western Victoria. In eastern Victoria it is extremely rare, with only one small population centred on the Warby Ranges. The eastern limit of that population is in the study area, where the species occupies dry open forest and woodland.

Red-throated skink (*Leiolopisma platynota*)
Copper-tailed skink (*Ctenotus taeniolatus*)
Dwyer's snake (*Unechis dwyeri*)

These three reptiles are restricted in Victoria to the extreme east of the State, and occur in the dry open forest of the north-east, usually in association with rocky outcrops. Dwyer's snake is a specialist predator of skinks, preying on the other two species.

Rainbow skink (*Carlia tetradactyla*)

The only member of this largely tropical genus occurring in southern Australia, *C. tetradactyla* is rare in Victoria and restricted to open dry forests and woodlands of the north-east, where it is known at several localities in this and the adjacent Murray Valley study areas. Its interest lies in the fact that it retains the tropical reproductive pattern of small multiple egg clutches in a temperate environment, a factor possibly limiting its distribution in Victoria.

Blind snake (*Ramphotyphlops nigrescens*)

This burrowing snake feeds entirely on ants and termites. It is uncommon, and restricted in Victoria to rocky areas in the dry open forests of the north-east, where it is the sole prey of the rare bandy bandy.

Brown tree frogs (*Litoria ewingii*)
(*Litoria paraewingii*)

Although virtually indistinguishable in appearance, the two species have been separated on the basis of incompatibility in artificial hybridization experiments. *Litoria paraewingii* reaches the northern and eastern limits of its distribution in the study area, where it forms a narrow hybrid zone with *L. ewingii*. The ecological factors maintaining that hybrid zone are of scientific interest, and any artificial disturbance of the habitat of these two species could affect the zone's stability.

Brown toadlet (*Pseudophryne bibronii*)
Southern toadlet (*Pseudophryne dendyi*)

These two closely related species also form a hybrid zone in the study area. *P. bibronii* occurs only in the extreme south-east.

Invertebrates

The study area has a diverse invertebrate fauna, including such groups as spiders, ticks, mites, scorpions, crustaceans, and insects, all of which play a significant role as disposers of dead material, pollinators of flowering plants, or eaters of (or food for) other life forms; nevertheless, little information is available on the status of individual species, owing to limited surveys.

Some species of scientific interest are:

* a caddis fly (*Ulmerochorema luxaturum*) - a recently described species collected in Nariel Creek near Nariel.

* a cicada (*Diemenia neboissi*), known to occur only in the Biggara locality

The area also contains important populations of native snails and slugs, and several restricted species of land planarian and land nemertean.

References

Ahern, L.D. (1982). Threatened wildlife in Victoria and issues related to its conservation. *Fisheries and Wildlife Paper* No. 27.

Dixon, J.M., and Huxley, L. (eds.) (1981 a). 'Report on the Mammalian Fauna of the North-eastern District 1, Victoria.' (Department of Mammology, National Museum of Victoria: Melbourne.)

Dixon, J.M., and Huxley, L. (eds.) (1981 b). 'Report on the Mammalian Fauna of the North-eastern Districts 3, 4, and 5, Victoria.' (Department of Mammology, National Museum of Victoria: Melbourne.)

Emison, W.B. (1982). Wildlife. In 'Atlas of Victoria'. (Government Printer: Melbourne.)

Frith, H.J. (ed.) (1976). 'Birds in the Australian High Country.' (Read: Sydney.)

Macfarlane, M.A., Walters, B.L., and Suckling, G.C. (1982). Mammals of the Reef Hills State Forest in north-eastern Victoria. *Forests Commission Victoria, Forestry Technical Paper* No. 29, 15--24.

Meredith, C. (1982). Fauna survey, Chiltern State Park. *Report for Research Branch, National Parks Service, Victoria.*

Pizzey, G. (1980). 'A Field Guide to the Birds of Australia.' (William Collins: Sydney.)

Rawlinson, P.A. (1980). Conservation of Australian amphibians and reptile communities. *Papers, Melbourne Herpetic Symposium, 1980.*

Robertson, P. *et al.* (1982). 'Report to the Land Conservation Council on the Vertebrate Fauna of the North-eastern Study Area, District 1.' (Arthur Rylah Institute for Environmental Research, Melbourne, unpublished.)

Robertson, P. *et al.* (in preparation). 'Report to the Land Conservation Council on the Vertebrate Fauna of the North-eastern Study Area, District 2.' (Arthur Rylah Institute for Environmental Research, Melbourne, unpublished.)

Robertson, P. *et al.* (in preparation). 'Report to the Land Conservation Council on the Vertebrate Fauna of the North-eastern Study Area, District 3.' (Arthur Rylah Institute for Environmental Research, Melbourne, unpublisned.)

Wakefield, N.A. (1961). Victoria's rock-wallabies. *Victorian Naturalist,* 77, 322--32.

11. LAND SYSTEMS

Preceding chapters have described individual bio-physical components of the natural environment. No single environmental factor, however, determines the potential for land uses. Rather, it is the combined or integrated effect of them all that determines the capability of land for a particular use.

The need to consider the interrelated effects of a number of environmental variables has resulted in the land-systems approach. This allows each feature of the environment to be considered in relation to the others, more systematically than in surveys of single features such as soils or vegetation.

The most detailed unit for mapping and description - the land component - contains only limited variation in climate, parent material, soil, and vegetation. Land components usually occur in a consistent repetitive sequence, and an area containing such a sequence is termed a land system.

Map 7 shows 34 land systems identified in the study area. These have been grouped into six broad land-form categories.

Table 12 summarizes the characteristics of geomorphology and geology, rainfall, soils, and vegetation for each land system, with comments on the hazards of soil deterioration and associated effects.

(continued on page 82)

Steep hills of the Benambra land system rise behind the low hills of the Berringama land system

TABLE

LAND

Landform	Land system	Geomorphology and geology	Av. annual rainfall (mm)
Mountains	Mo Moonee Moonee	Dissected slopes of high relief on Upper Devonian granite: elevation 240--1,000 m	600--1,250
	C Cambatong	Deeply dissected slopes on Lower Carboniferous sediments: elevation 500--1,000 m	1,000--1,250
	Tw Tawonga--Wermatong	Steep to very steep ridge and spur complex on Ordovician sediments, schist, and gneiss: elevation 450--900 m	750--1,000
	Tb Tawonga--Baranduda	Steep to very steep ridge and spur complex on Ordovician sediments, gneiss, and schist: elevation 300--760 m	1,000--1,250
	Ps Pinnacles	Steep to very steep slopes with inter-ridge basins and small plateaux on Devonian granite: elevation 500--1,100 m	900--1,100 (estimated)

12

SYSTEMS

Soils	Native vegetation	Land stability and erosion hazard
Red duplex soils; friable brown gradational soils; red gradational soils (with weakly structured subsoils)	Narrow-leaf peppermint open forest III; broad-leaf peppermint--red stringybark open forest II; red stringybark--long-leaf box--red box open forest I and II; some messmate stringybark open forest III and IV; heaths and mossland	Low to moderate erosion hazard generally; moderate sheet erosion hazard on steep slopes and foothills
Friable brown gradational soils; weakly bleached friable gradational soils on foothills; undifferentiated stony loams on ridges and steep westerly slopes	Narrow-leaf peppermint open forest III; broad-leaf peppermint--candlebark open forest II; messmate open forest III; alpine ash open forest IV; candlebark--snow gum open forest I and broad-leaf peppermint--red stringybark open forest II	High sheet erosion hazard on steep slopes; otherwise low hazard
Friable red and friable brown gradational soils; humic friable brown gradational soils	Narrow-leaf peppermint open forest III; broad-leaf peppermint--candlebark open forest II; alpine ash open forest IV	Moderate sheet erosion hazard; fire, roading; and land disturbance lead to increased peak flows, and later erosion and stream turbidity
Weakly bleached red gradational soils; massive red and brown gradational soils; undifferentiated stony loams	Broad-leaf peppermint--candlebark open forest II; narrow-leaf peppermint open forest III; long-leaf box open forest II	High sheet erosion hazard; compaction reduces ability of soils to absorb and hold water, increasing peak flows
Red gradational soils; weakly bleached gradational soils on steep slopes; on less-steep slopes, friable red and brown gradational soils; red duplex soils at lower elevations	Open forest III of narrow-leaf peppermint with candlebark and some broad-leaf peppermint in the higher or wetter areas; open forest II to III of long-leaf box in lower or drier parts	High erosion hazard; clearing of slopes on granite may result in excess seepage flows and gullying

Landform	Land system	Geology and geomorphology	Av. annual rainfall (mm)
Mountains (continued)	Bn Benambra	Steep to very steep slopes on Devonian granite, Ordovician schist and sediments: elevation 350—1,220 m	750—1,250
	Bu Burrowa	Steep to very steep slopes with small plateaux on Devonian rhyolite, and Devonian and Silurian granites: elevation 750—1,100 m	750—1,000
	St Strathbogie	Rolling to hilly plateaux and scarps on Devonian granite: elevation 450—900 m	650—1,250
	Ti Tiger Hill	Undulating plateaux on Devonian volcanics: elevation 500—900 m	1,000—1,250
	To Tolmie	Rolling plateaux on Lower Carboniferous sediments: elevation 500—1,100 m	1,000—1,250
	A Archerton	Rolling plateaux with scarps on Tertiary basalt: elevation 760—1,100 m	1,150—1,250
	Sy Stanley	Plateaux with rolling fans and some steep slopes on Ordovician shales and mudstones: elevation 700—900 m	1,175—1,250

Soils	Native vegetation	Land stability and erosion hazard
Weakly bleached massive gradational soils grading into friable brown gradational soils on moister sites; some friable red gradational soils	Red stringybark--long-leaf box open forest I and II; some broad-leaf peppermint open forest II and narrow-leaf peppermint open forest III	Moderate to high sheet erosion hazard on exposed soils; land disturbance may result in increased flows, causing gully erosion on adjacent land systems
Weakly bleached massive gradational soils; undifferentiated stony loams, friable red gradational soils	Red stringybark--long-leaf box open forest I and II; broad-leaf peppermint open forest II; narrow-leaf peppermint open forest III	Moderate to high sheet erosion hazard; careful disposal of road drainage is important
Red duplex soils; weakly bleached friable gradational soils; friable red gradational soils (with weakly structured sub-soils	Messmate stringbark open forest III and IV; narrow-leaf peppermint open forest III; some swamp gum open forest II	Low erosion hazard generally; moderate streambank erosion hazard
Friable brown gradational soils; some friable red gradational soils with weakly structured subsoils	Messmate stringybark open forest III and narrow-leaf peppermint open forest III; swamp gum open forest II	Low erosion hazard on plateaux; land disturbance on slopes may cause sheet and gully erosion
Mainly red and yellow duplex soils; some weakly bleached friable gradational soils and undifferentiated stony loams	Broad-leaf peppermint—candlebark open forest II and narrow-leaf peppermint open forest III, some messmate stringybark open forest III and swamp gum open forest II	Low erosion hazard generally; moderate hazard of sheet erosion on ridgetops
Friable red gradational soils (with well-structured subsoils)	Narrow-leaf peppermint open forest III and and messmate stringybark open forest III	Low erosion hazard; minor rilling of tracks likely
Red-brown gradational soils; weakly bleached red-brown gradational soils	Open forest III of narrow-leaf peppermint with candlebark and some blue gum; open forest II of long-leaf box on dry sites	Low erosion hazard generally; roading on steep slopes raises peak flows resulting in erosion and raised stream turbidity

Landform	Land system	Geomorphology and geology	Av. annual rainfall (mm)
Plateaux and scarps (continued)	BB Big Ben	Rolling plateaux on deeply weathered Ordovician gneiss and schist: elevation 600--1,100 m	875--1,125
	K Koetong	Rolling plateaux and steep to very steep slopes on Devonian granite: elevation 600--900 m	1,000--1,150
Steep hills and hills	Mg Moorngag	Slopes with high relief on Silurian-Devonian sediments: elevation 300--900 m	750--1,150
	Lo Loombah	Broad ridges, slopes, and foothills on Upper Devonian volcanics: elevation 300--550 m	750--1,275
	Wr Wrightley	Steep hills with small areas of rolling plateaux on Cambrian greenstones and cherts: elevation 300--700 m	750--1,150
	Bn Bowman	Hilly with steep slopes off narrow ridges; some gentler slopes on piedmont surfaces in northern parts on Ordovician sediments: elevation 200--900 m	700--1,020

Soils	Native vegetation	Land stability and erosion hazard
Friable red gradational soils; friable brown gradational soils; some stony loams	Open forest II and III of narrow-leaf peppermint and broad-leaf peppermint with candlebark gum and blue gum; some small areas of open forest IV of alpine ash; open forest II of snow gum	Low erosion hazard, except on steeper slopes
Friable red gradational soils dominant, with weakly bleached massive gradational soils on steeper slopes and in drainage lines	Narrow-leaf peppermint open forest III and broad-leaf peppermint open forest II; some swamp gum open forest II	Low sheet erosion hazard in general; cultivation and roading may cause excess run-off adding to stream turbidity; slumping of road batters
Weakly bleached friable gradational soils; friable red gradational soils (with weakly structured subsoil); stony loams, friable brown gradational soils, red and yellow duplex soils	Red stringybark--long-leaf box--red box open forest I and II; broad-leaf peppermint--red stringybark open forest II; some narrow-leaf peppermint open forest III	High sheet erosion hazard on northerly aspects; low to moderate hazard in higher rainfall areas
Friable brown and yellow gradational soils,friable red duplex soils (with weakly structured subsoils) on broad ridges; yellow duplex soils on slopes and foothills	Red stringybark--long-leaf box--red box open forest II and broad-leaf peppermint--red stringybark open forest II; narrow-leaf peppermint open forest III	Low erosion hazard on broad ridges; high hazard on steep northerly slopes; moderate sheet and gully erosion hazard on foothills
Friable red gradational soils (with well-structured subsoils); weakly bleached gradational soils and undifferentiated stony loams on some steep slopes	Long-leaf box—yellow box open forest II in the north; manna gum—narrow-leaf peppermint open forest III and broad-leaf peppermint--red stringybark open forest II in the south	Low erosion hazard on plateaux; high sheet erosion hazard on steep westerly slopes; mass movement risk on steep slopes
Red duplex soils on gentle upper slopes, weakly bleached gradational soil on steep mid slopes, and yellow duplex on poorly drained lower slopes	Open forest II of Blakely's red gum and long-leaf box; open forest II--III of narrow-leaf and broad-leaf peppermint	High erosion hazard on steeper slopes; close association of steep and less-steep areas makes management difficult

Landform	Land system	Geomorphology and geology	Av. annual rainfall (mm)
Steep hills and hills (continued)	Ba Barambogie	Predominantly hilly with steep slopes to the north-west; small areas of rolling plateaux and shallow basins, on Devonian granite: elevation 750—1,750 m	650—1,000 (estimated)
	L Leneva	Steep slopes and residual hills with some rolling to hilly plateaux and flat-topped ridges, on Ordovician gneiss and schist: elevation 400—600 m	700—900
	BE Bethanga	Steep to very steep higher slopes and rolling hills at lower elevations on Devonian gneiss and granite: elevation 300—760 m	625—750
	A Adjie	Steep to very steep slopes with rolling to steep hills at lower elevations, on Devonian granite and some metamorphics, and Ordovician sediments: elevation 460—1,100 m	750—1,150
Low hills and plains	Sw Swanpool	Rolling hills of low relief on Devonian granite and valley slopes and floors on Quaternary alluvium	625—1,025
	Ma Mansfield	Plains, cuestas, and flat-topped ridges on Lower Carboniferous sediments and Quaternary alluvium	625—750

Soils	Native vegetation	Land stability and erosion hazard
Coarse sandy loams and pale massive gradational soils, weakly bleached on less-steep slopes; some red and yellow duplex soils; relict clay and weathered rock (both red) at depths below 1 m	Generally open forest I and woodland I of Blakely's red gum, with long-leaf box on the deeper soils; open forest II of long-leaf box on the more clayey soils with higher rainfall	High erosion hazard; gully-head erosion and increased peak flows would follow clearing of slopes
Red duplex soils on the less-steep slopes, weakly bleached gradational soils and some undifferentiated stony loams on steep mid slopes; yellow duplex soils in depressions	Open forest I and II of long-leaf box and some Blakely's red gum	Moderate to high sheet and gully erosion hazards on all cleared slopes; moderate risk of mass movement on south-facing slopes
Weakly bleached massive gradational soils; red duplex soils on less-steep slopes	Red stringybark—long-leaf box open forest I and II; some broad-leaf peppermint open forest II and narrow-leaf peppermint open forest III	Moderate to high sheet and gully erosion hazards; risk of mass movement of steeper slopes and batters in wet years
Weakly bleached massive gradational soils on steeper slopes and red duplex soils on less-steep country	Red stringybark—long-leaf box open forest I and II; broad-leaf peppermint open forest II; some narrow-leaf peppermint open forest III at higher elevations	Moderate sheet and gully erosion hazard; moderate to low hazard in wetter areas
Yellow duplex soils; weakly bleached friable and also massive gradational soils	Red stringybark—long-leaf box--red box open forest I and II; red gum open forest II	Low erosion hazard generally; moderate hazard in drier areas to the west
Gilgaied yellow duplex soils; weakly bleached friable and also massive gradational soils; some friable brown and red gradational soils on more dissected landscapes	red gum open forest II	High gully and streambank erosion hazard

Landform	Land system	Geomorphology and geology	Av. annual rainfall (mm)
Low hills and plains (continued)	Lu Lurg	Undulating to rolling hills on Palaeozoic sediments	625--750
	Ch Chiltern	Rolling to hilly with short steep slopes flanking prominent ridges, and small areas of valley bottoms, on Ordovician sediments, some metamorphosed	approx. 700
	Yh Yackandandah	Dissected elevated terraces, residual hills, and rolling to hilly fans, on Silurian granite, gneiss, and schist	875--1,000
Fans and terraces	Bt Benalla	Gentle outwash fans and mid-valley slopes, terraces, flats and swamps on Quaternary alluvium	625--1,150
	Md Myrtleford	Undulating high terraces; rolling to hilly valley slopes with fans and some residual hills on Ordovician sediments and Quaternary alluvium and colluvium	600--1,025

Soils	Native vegetation	Land stability and erosion hazard
Undifferentiated stony loams on westerly slopes; red duplex soils on easterly slopes; weakly bleached friable and massive gradational soils	Grey box open forest II; red stringybark—long-leaf box—red box open forest I and II; some red gum open forest II	High to moderate sheet erosion hazard on slopes; moderate stream-bank and gully erosion hazard
Red duplex soils on convex slopes; yellow duplex soils in depressions; weakly bleached gradational soils predominate on steeply-sloping land	Open forest II of grey box and red stringybark with some red ironbark, red box, long-leaf box, and Blakely's red gum; red ironbark along the reddish soils of the ridges and red gum in depressions	Poorly structured gradational soils are highly erodible; clearing of steeper slopes increases peak run-off, exacerbating gully erosion
Red duplex soils; friable red gradational soils; some weakly bleached gradational soils	Open forest II of broad-leaf peppermint —long-leaf box— narrow-leaf peppermint on wetter fringe; open forest II of red gum on flats	Low to moderate sheet and moderate gully erosion hazard
Yellow duplex soils (some with gilgai); weakly bleached gradational soils; red and brown gradational soils with weakly structured subsoils	Red gum open forest II and grey box open forest II	Generally low hazard; moderate gully erosion hazard on gentle fan slopes
Red-brown gradational soils; red duplex soils; weakly bleached yellow-brown gradational soils	Woodland and open forest II of Blakely's red gum grading into long-leaf box open forest II	Moderate sheet and gully erosion hazard

Landform	Land system	Geomorphology and geology	Av. annual rainfall (m
Fans and terraces (continued)	Db Dederang	Rolling to hilly residual hills and fan relics; undulating to rolling fans and terraces on Ordovician gneiss and schist, colluvium, and Quaternary alluvium	600--1,050
	Tc Twist's Creek	Undulating fans on valley floors; some low hills and narrow terraces, mainly on colluvium derived from Ordovician sediments	875--1,000
	BR Berringama	Rolling to steep hills with undulating to rolling dissected terraces and fans on Ordovician gneiss, Devonian granite, and Quaternary alluvium	750--1,200
Alluvial flood-plains and terraces	Mu Murray	Alluvial flats along the Murray, Kiewa, and Ovens Rivers with gently sloping dissected fans and terraces, flanked by rolling hills, on various Quaternary alluvial parent materials	625--1,025
	B Benalla (alluvial)	Plain and broad valleys along the Broken River and major tributaries, on Quaternary alluvium	625--1,150

Soils	Native vegetation	Land stability and erosion hazard
Red and yellow duplex soils; weakly bleached red and yellow gradational soils	Woodland II of Blakely's red gum with white box; open forest II of Blakely's red gum with red box, but but, and red stringybark; open forest III and II of narrow-leaf and broad-leaf peppermint in the south	Moderate sheet and gully erosion hazard
Friable red gradational soils; weakly bleached red and yellow-brown gradational soils; red duplex soils	Open forest II of broad-leaf peppermint and long-leaf box, merging to open forest III of narrow-leaf peppermint	Moderate sheet and gully erosion hazard; roading and burning on slopes lead to increased peak flows
Weakly bleached massive gradational soils on hills with some friable brown gradational soils in locally moister sites and red duplex soils on the terraces and fans	Broad-leaf peppermint open forest II and narrow-leaf peppermint open forest III; some red stringybark--long-leaf box open forest II and swamp gum open forest II	Moderate sheet and gully erosion hazard; low sheet and gully erosion hazard on terraces and fans
Yellow-brown gradational soils; alluvial brown loams and weakly bleached gradational soils; red duplex soils on fans and higher terraces; undifferentiated sandy loams on flood-plains, weakly bleached gradational soils on flanking steeper slopes	Mainly woodland II and open forest II of red gum; open forest II of long-leaf box and red stringybark on drier terraces	Moderate sheet and gully erosion hazard on hills and terrace edges; streambank erosion
Red gradational soils and weakly bleached gradational soils over yellow or red clays; yellow duplex soils (some with gilgai); brown and grey alluvial loams	Red gum open forest II; woodland II of grey box and red gum	Low erosion hazard generally on plains; gully erosion hazard on gentle slopes; streambank erosion

The area includes parts of four published Soil Conservation Authority land studies, some provisionally mapped areas that have had limited field checking, and a small area mapped from aerial photographs only.

References

Rowe, R.K. (1967). A study of the land in the Victorian catchment of Lake Hume. *Soil Conservation Authority Technical Communication* No.5.

Rowe, R.K. (1972). A study of the land in the catchment of the Kiewa River. *Soil Conservation Authority Technical Communication* No.8.

Rowe, R.K. (1984 in press). A study of the land in the catchments of the Upper Ovens and King Rivers. *Soil Conservation Authority Technical Communication* No.16.

Rundle, A.S., and Rowe, R.K. (1974). A study of the land in the catchment of the Broken River. *Soil Conservation Authority Technical Communication* No.9.

PART III
CURRENT LAND USE

12. ALBURY--WODONGA DEVELOPMENT CORPORATION LAND

Current land use

The Wodonga area is one of the most productive grazing areas in the State, and virtually all of the land purchased by the Corporation that is included in this investigation has supported agriculture for many years. Since the land has been purchased, the Corporation has retained as much of it as possible in commercial farming units until it is required for other purposes. This has been achieved by leasing back the purchased land as single holdings - in many cases to the former owners. This policy also has the advantage of minimizing the disruption the acquisition caused to the former owners.

Beef production is the main agricultural use of the more productive agricultural land - for both vealer production and cattle fattening. Sheep grazing is the most common use of the steeper hilly country on properties with little or no access to the flood-plain or river flats. Small portions of the land are used for dairying, mainly along the river flats adjacent to the Murray and Kiewa Rivers.

The larger blocks of land (to the west of the existing residential areas of Wodonga; on the edge of Lake Hume, south of Ebden; and south of Wodonga near the Castle Creek Road and adjoining the Wodonga--Beechworth Road) consist almost entirely of hilly to steep country best suited for sheep grazing. Other areas such as the land adjoining the Baranduda Range Regional Park and adjoining Mount Murramurrangbong consist of sheep country with shallow soils that either support native forest or are semi-cleared. These areas have only limited value for grazing.

The alluvial deposits making up the flood-plain of the Murray River are a major source of gravel and aggregate for the construction industry in the area. Large quantities of gravel are currently being extracted from this source on freehold land for the Hume Freeway. Two extractive industry licences are current on land purchased by the Corporation.

Conservation values

As the land has supported agriculture for many years, most of the native vegetation has either been removed or substantially modified. In many cases it has been reduced to isolated trees and a narrow discontinuous belt of trees along creek and water frontages. However, a number of areas support significant stands of native vegetation that have considerable conservation significance.

The flood-plains of the Murray form the major local wetland for the region and support a rich and diverse population of

79552/84—4

Huon Hill, behind Wodonga

bird species. The woodlands of river red gums here - with the associated river lagoons, some of which have well-developed reed beds - are important for native conservation.

Along the River Murray there are a number of important breeding areas for native birds. Ryan's Island - which is a small area of land on an anabranch of the river - supports a breeding rookery of white ibis, nankeen night herons, and egrets. This rookery is significant because the nearest alternative substantial white ibis rookery is near Echuca.

Intensive grazing and the altered food regime associated with the construction of Lake Hume have significantly reduced regeneration of the river red gum species. Without re-establishment of river red gum on the flood-plains, the existing woodlands would eventually disappear as the present old trees died out. This would have consequences for the native fauna that use these trees, many of which depend on the river red gums for hollows for breeding and shelter, and would also reduce the landscape values of the region.

Numerous sites currently vested in the Corporation have high landscape values. The distinctive characteristics of the River Murray flood-plain with its river red gums and natural billabongs and anabranches are of considerable landscape significance. In addition, the block of land that includes Huon Hill has long frontages to both the Murray and Kiewa Rivers and its distinctive twin peaks form a backdrop to the City of Wodonga. A study commissioned by the Corporation identified this block as an important example of land-form contrast and diversity. Portions of several blocks adjoining the Baranduda Range Regional Park are either forested or only semi-cleared, and make a substantial contribution to the landscape of the area.

Recreation

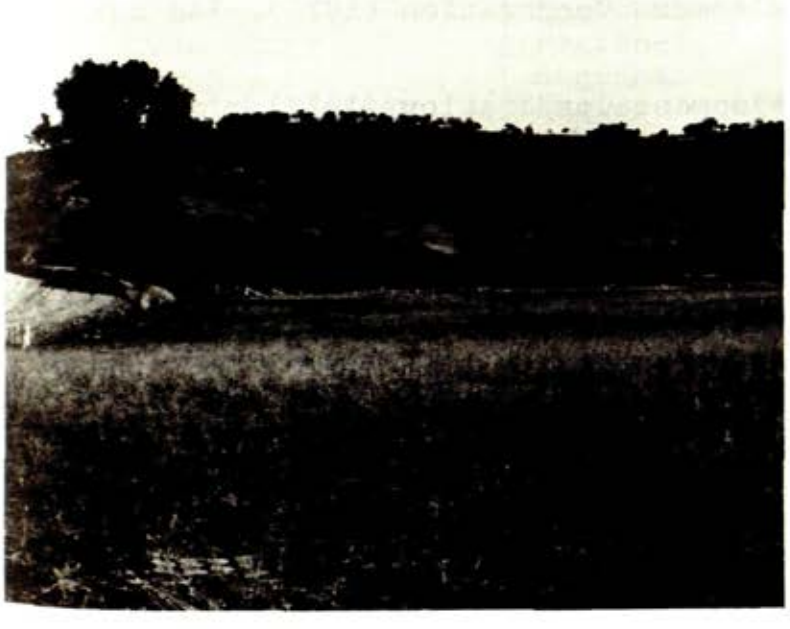
Numerous sites along the River Murray are currently used for outdoor recreation such as fishing and picknicking. Others

have the potential to be developed for passive and active recreation, and proposals involving the area east of Lincoln Causeway and the Huon Hill block have been put forward.

The block of land on the Murray just east of Lincoln Causeway has an extensive river frontage and is centrally located between Albury and Wodonga. It supports significant stands of river red gum on the river banks, including some areas where regeneration is evident, and has potential to be developed for both active and passive recreation. Some gravel pits here are in need of reclamation; others are still in use. The lower-lying parts of the area are subject to periodic flooding.

With frontages to the Murray and Kiewa Rivers, the block of land that includes Huon Hill also has potential to be developed for recreation. A study commissioned by the Corporation suggested that the area could be developed with trails - for activities such as running and walking, picnicking, fishing, and other activiites - and that its close proximity to Wodonga made it highly suited for recreational development.

Albury--Wodonga Field and Game Association currently leases a 10-ha site as a shooting range on land vested in the Corporation near Fell Timber Creek, west of Wodonga.



Albury--Wodonga Corporation land

Other potential uses

The land does not appear to be very suitable for commercial pine plantations. Rainfall is insufficient to promote rapid growth of radiata pine, and the soils on the hilly areas are generally too shallow and infertile to be economically attractive for softwood plantations. Some of the flood-plains and river flats could be suitable for irrigated softwood plantations.

Regeneration of suitable areas with river red gum for commercial forest production may be possible, as well as irri-

gation of various tree species for commercial timber production, using treated sewage effluent.

Such use of tree plantations for tertiary treatment of sewage has been discussed in several reports. At present the Corporation has a trial plantation under irrigation adjacent to the Wodonga sewerage works. The river-flat country to the north-west of Wodonga includes areas that are suitable and well located for an expansion of this use, which would limit the level of nutrient discharge to the river.

The Corporation has carried out amenity plantings with native species on some of the land under its control, mainly in the vicinity of future residential sites. There is potential for these plantings to be extended in other areas of landscape significance and also in steep country that has a high risk of soil erosion.

Parts of the flood-plain have high potential to meet part of the aggregate, sand, and gravel requirements of the Albury--Wodonga area.

References

Albury--Wodonga Development Corporation (1974). 'Development of Albury--Wodonga: Initial Proposals.'

Albury--Wodonga Development Corporation (1975). 'An Environmental Assessment.'

Albury--Wodonga Development Corporation (1977). 'An Environmental Assessment: a Supplement to the October 1975 Report.'

Allan Grant and Associates (1982). 'Waterfront Reservations Study.'

Kinnaird Hill deRohan and Young Pty Ltd and Llewelyn-Davies Associates (1974). 'Albury--Wodonga Structure Plan.' Volume 2.

McColl Partners Pty Ltd (1977). 'The Rural Development Plan: a Study of Land Management in the Albury--Wodonga Designated Area.'

13. NATURE CONSERVATION

Existing Conservation Reserves

As a result of the previous recommendations of the Land Conservation Council, the study area contains 11 parks, which cover some 70,000 ha of public land. Their location is shown on Map 3 (Public Land Use). They fall into four categories - national, State, regional, and multi-purpose parks (see Table 13).

Table 13

EXISTING PARKS[1]

Name	Category	Area (ha)
Burrowa--Pine Mountain	National	15,970
Mount Samaria	State[2]	7,200
Chiltern	State	4,250
Mount Granya	State	6,180
Reef Hills	Regional	2,035
Baranduda Range	Regional	3,100
Beechworth	Regional[3]	1,130
Jarvis Creek Plateau	Regional	2,510
Mount Elliot	Regional	1,280
Mount Pilot	Multi-purpose	13,100
Mount Lawson	Multi-purpose	12,270
Total		69,025

Notes:

1. Some of these parks have not yet been reserved under the *Crown Land (Reserves) Act* 1978.

2. Although recommended as a regional park, this park has been designated as a State park by the National Parks Service.

3. The National Parks Service have named this the Beechworth Historic Park.

National park

A national park is an 'extensive area of public land, of nation-wide significance because of its outstanding natural features and diverse land types, set aside primarily to provide public enjoyment, education, and inspiration in natural environments'. The only national park in the study area - Burrowa--Pine Mountain - is located north of Cudgewa. It has a particularly diverse vegetation with a very high conservation significance. The overstorey vegetation includes

snow gum woodlands and small patches of alpine ash in high sheltered areas near Mount Burrowa, open forests of candle-bark, blue gum, and peppermint, and woodlands of black cypress pine developed on the dry rocky slope of Pine Mountain. The numerous rare plant species present include green grevillea (*Grevillea jephcottii*), which is endemic to the area, and the rare phantom wattle (*Acacia phasmoides*), whose distribution in Victoria is confined to Pine Mountain. Another 28 species occurring in the park have been recognized as being endemic to this area, rare, localied, or at the limits of their distribution. These are listed in Table 14.

The wide range of vegetation types found here would support a diverse fauna.

Table 14

PLANT SPECIES IN THE BURROWA--PINE MOUNTAIN NATIONAL PARK

Significance	Botanical name	Common name
Endemic to the area	*Dodonaea rhombifolia*	Broad-leaf hop-bush
	Grevillea ramosissima	Fan grevillea
	Phebalium lamprophyllum	Shiny phebalium
	Phebalium sp. nov., aff. *P. diosmeum*	Phebalium
Recognized as being rare, localized, or at the limits of their distributon	*Brachycome ptychocarpa*	Daisy
	Dodonaea boroniifolia	Hairy hop-bush
	Festuca eriopoda	Lanky fescue
	Olearia adenophora	Scented daisy-bush
	Pimelea treyvaudii	Grey rice-flower
	Pterostylis sp., aff. *P. gibbosa* ssp. *mitchellii*	Greenhood
	Tripogon loliiformis	Rye beetle-grass
	Anogramma leptophylla	Annual fern
	Banksia canei	Mountain banksia
	Brachychiton populneus	Kurrajong
	Dampiera purpurea	Mountain dampiera
	Echinopogon cheelii	Long-flower hedgehog-grass
	Eucalyptus chapmaniana	Bogong gum
	Haeckeria ozothamnoides	Cottony haeckeria
	Leptospermum micromyrtus	Button tea-tree
	Micrantheum hexandrum	Box micrantheum
	Mirbelia oxylobioides	Mountain mirbelia
	Patersonia sericea	Silky purple-flag
	Pultenaea cunninghamii	Grey bush-pea
	Pultenaea platyphylla	Bush-pea
	Pultenaea vrolandii	Bush-pea
	Tetratheca labillardieri var. *orbifolia*	Glandular pink-bells
	Westringia eremicola	Slender westringia
	Lomandra multiflora	Many-flower mat rush

Two of the many orchids species in the Chiltern State Park - Caladenia dilatata *(the spider orchid on the left) and* Diuris maculata.

State parks

A State park is 'an area of public land containing one or more land types, set aside primarily to provide public enjoyment, education, and inspiration in natural environments'. It is intended that such parks would include samples of land types not represented in national parks and would complement the latter, so that together the two types form a State-wide system. The three in the study area are Mount Samaria State Park north of Mansfield, Chiltern State Park, and Mount Granya State Park north of Tallangatta.

Mount Samaria State Park has vegetation of a high diversity, ranging from low open forests of red stringybark and long-leaf box with a grassy understorey to tall open forests of candlebark with a shrubby understorey. It also contains the rare scale-rush, and significant stands of a narrow-leaf peppermint--blue gum alliance. In the sheltered gullies the understorey may also include austral king-fern, soft tree-fern, rough tree-fern, musk daisy-bush, and blackwood. Small stands of messmate occur on sheltered sites and mountain swamp gum grows in swampy areas. These diverse vegetation types provide habitat for many birds and mammals, including the wonga pigeon, brush cuckoo, and satin bower-bird.

In the Chiltern State Park, the predominant vegetation types are open forests of red ironbark and grey box developed on shallow soils derived from sedimentary rocks. The rare and localized broom bitter-pea and large duck-orchid (and 27

other orchids) occur here. The park also supports a particularly diverse fauna, as it is located at the junction of the dry habitats of the interior and the habitats associated with the wetter mountainous country to the south. Significant species present include the squirrel glider, regent honeyeater, Latham's snipe, peregrine falcon, brown goshawk, and one of the largest breeding populations in Victoria of the rare turquoise parrot.

The vegetation of the Mount Granya State Park consists of an open forest of red stringybark and long-leaf box with either a grassy or low shrubby understorey. Small areas of black cypress pine occur on the slopes overlooking the River Murray, and broad-leaf peppermint forests occur on the plateau and on some southerly aspects. Significant species that have been recorded here include indigo (*Indigofera signata*), bush-pea (*Pultenaea polifolia*), and cliff cudweed (*Gnaphalium umbricola*).

Regional parks

A regional park is 'an area of public land, readily accessible from urban centres or a major tourist route, set aside primarily to provide recreation for large numbers of people in natural or semi-natural surroundings'.

Of the five such parks in the study area, Baranduda Range and Jarvis Creek Plateau Regional Parks are located close to Albury--Wodonga. Although the former has been identified as having a greater demand for development for outdoor recreation, both parks have considerable recreational potential and will be developed as the population of the Albury--Wodonga growth centre increases. Similarly the Mount Elliott Regional Park is located in close proximity to Corryong as well as to a popular tourist route leading to the Snowy Mountains in New South Wales and offers considerable potential to be developed for outdoor recreation.

The Reef Hills Regional park supports the only extensive tract of river red gum forest occurring on public land in the study area, and stands of grey box, and as such is important for conservation. The park provides habitat for a range of birds and mammals, including a breeding population of the brush-tailed phascogale (a species considered to be uncommon in Victoria), the yellow-footed antechinus, and the eastern grey kangaroo.

The Beechworth Regional (Historic) Park includes many natural and historical features, many of which are associated with the township of Beechworth and early gold-mining in the area. Overstorey vegetation types present include long-leaf box, brittle gum, blue gum, black cypress pine, and the only occurrence of mealy stringybark north of the Great Divide. Understorey vegetation here is noted for its diversity and wildflowers, especially orchids. The extremely rare silver tea-tree and the rare scaly greenhood orchid are found here.

Although its size limits its fauna habitat value, Beechworth Park provides corridors between larger forested areas.

A multi-purpose park is 'an area of public land set aside to provide recreation and education in natural surroundings in which other activies such as water production, hardwood timber production, stone extraction, hunting, or grazing are permitted where these form a part of, do not substantially conflict with, or supplement the primary object'.

The study area contains two multi-purpose parks - Mount Lawson north of Koetong and Mount Pilot north of Beechworth. The Mount Pilot Park has high conservation, recreation, and scenic values as well as a number of important historical relics. It includes the most westerly occurrence of black cypress pine. The Mount Lawson Park has been identified as having a lower demand for recreation facilities, but it is also important for recreation and conservation, and includes a number of Aboriginal rock shelters at Mount Porcupine and on the Conic Range.

Reference areas

Finding a solution to problems arising from use of a particular land type is often helped by reference to an undisturbed example of the land type. Here the soils, vegetation, and fauna can be studied under natural conditions and the knowledge gained about the basic relations operating between these components can help solve land use problems.

Reference areas therefore act as standards against which the progress and effect of human alteration and utilization of the land can be measured. They also provide a valuable gene pool of some plant and animal species.

The Council's previous recommendations set aside 13 parcels totalling 10,720 ha, as reference areas. They contain representatives of the major land types found in the study area. As far as possible natural processes should be allowed to continue undisturbed within them: access is restricted and experimental manipulation is not permitted.

Wildlife reserves

Conservation of fauna depends on conservation of habitat, and by far the largest remaining area of natural habitat is on public land. Although many forms of land use do not have marked detrimental effects on habitat, some sites have been set aside specifically for wildlife conservation and for developing wildlife conservation techniques.

Clarke lagoon provides a good breeding and feeding area for water birds, and has been set aside as a wildlife reserve.

Seven Creeks above Galls Gap road has been set aside as a wildlife reserve for the conservation of trout cod and other native fish. The trout cod was once widespread in the Murray--Darling River system but is now only rarely found in these waters. Seven Creeks contains the only viable trout cod population in Victoria, which was derived from introductions in the Goulburn River in 1921 and 1922, and is thus very important for the conservation of this species of native fish as well as for Macquarie perch.

A number of other rivers and streams in the study area are also important for the conservation of native fish species. Table 15 lists sections of watercourses that have been identified as important for this purpose.

Table 15

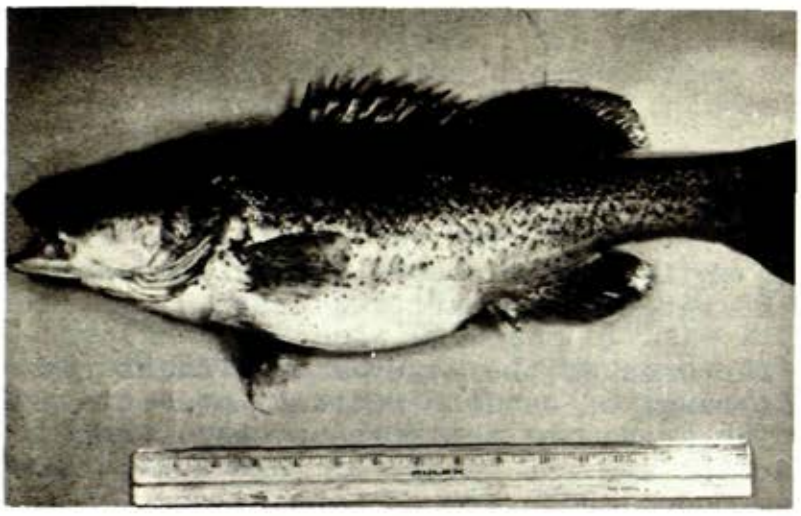
WATERCOURSES AND NATIVE FISH CONSERVATION

Watercourses	Species
Black Dog Creek	Various native fish
Broken River:	
- above Lake Nillahcootie	Australian smelt
- below Lake Nillahcootie	Potential Murray cod
Corryong Creek	Murray cod
Cudgewa Creek	Murray cod; trout cod
Holland Creek	Potential trout cod
Hughes Creek	Potential Macquarie perch; trout cod
Kiewa River (Gundowring-Murray)	Murray cod (spawning conditions); checkered gudgeon
Lake Nillahcootie	Potential Murray cod
Mitta Mitta River below Lake Dartmouth	Macquarie perch; Murray cod (below Mitta Mitta)
Ovens River (Myrtleford-Wangaratta)	Potential Macquarie perch; trout cod
Scrubby Creek	Blackfish
Yackandandah Creek: upper	Ornate mountain galaxias
: lower	Potential Murray cod

Other conservation reserves

The study area also contains two flora reserves (total 120 ha), two flora and fauna reserves (total 2,160 ha), and 38 bushland reserves. Flora reserves are managed to preserve plant species that may be rare or endangered and associations of native species that are poorly represented on public land. Flora and fauna reserves are significant because they provide valuable habitat for populations of native fauna and contain examples of native vegetation with considerable floristic value in a natural or semi-natural state. Bushland reserves are small areas of public land in predominantly cleared agricultural regions that support remnants of the original vegetation. Their major use is to provide diversity in the landscape and to maintain the distinctive Australian character of the countryside.

Education is an important use of land in a natural or near-natural state. Forests, rivers, and other natural landscapes have many applications in education - from primary to post-graduate levels - giving students opportunities to see natural land forms, to observe, interpret, and monitor bio-



This trout cod measured about 55 cm in length

logical processes, and collect specimens. In some cases this may involve long-term studies or alterations to the environment for experimental purposes. The Council's previous recommendations set aside four parcels of land, covering 2,350 ha, as education areas to be developed specifically for outdoor educational purposes.

Other public land

Substantial areas of uncommitted land remain in the study area, which - with the Mount Strathbogie, Toombullup, and Mount Big Ben hardwood production areas - are also important for the conservation of native plants and animals. The wide-ranging vegetation types support a rich assemblage of flora and fauna, and particular values identified by recent vegetation and fauna studies are included in the descriptive block chapters later in this report.

The Council's original recommendations for these areas require land managers to conserve native plants and animals and maintain natural ecosystems.

Further small areas of public land include road reserves, river and stream frontages, and small isolated blocks. These are particularly important for nature conservation in those parts of the study area that have been extensively developed for agriculture, as in many cases they support the only remnants of the original vegetation.

The conservation value of small tracts of native vegetation increases greatly if they are inter-connected. Such connections allow native animals to move from one block of native vegetation to another and also assist migratory and nomadic birds. This is particularly important in the planning of pine plantations, as the conservation of native fauna is greatly assisted by retaining inter-connected areas of native vegetation within the plantation complex.

14. RECREATION

Outdoor recreation is an important use of public land and is a major reason for the retention of natural areas.

The diverse natural features of the study area provide opportunities for a wide range of outdoor recreational activities. The most popular areas are the forests near the historic town of Beechworth, and the waters of Lake Hume, Lake Nillahcootie, and the Bonnie Doon arm of Lake Eildon. Many of the parks here are at an early stage of development of facilities, as reflected in the present low levels of usage. They are, however, close to the main centres of population and major tourist roads and will doubtless receive increased usage as facilities are provided.

Table 16 lists the estimated number of visitors to parks in the study area.

Table 16

ESTIMATED VISITOR USE OF PARKS (1982--83)

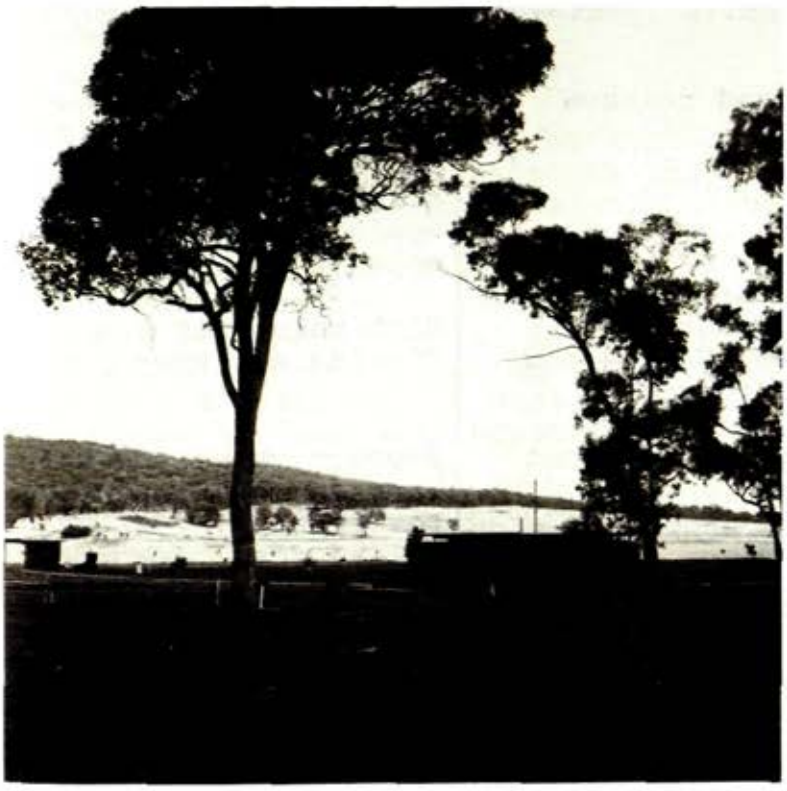
Park	Total Visitor Days
Mount Pilot	27,000
Beechworth	19,000
Mount Samaria	8,300
Reef Hills	6,100
Burrowa - Pine Mountain	5,400
Chiltern	3,000
Baranduda Range	2,500
Mount Granya	1,500
Jarvis Creek Plateau	500
Mount Elliott	300
Mount Lawson	200

Source: Department of Conservation, Forests and Lands

Level of usage of some of these parks has a marked seasonal character, which is not discernible from the table. For example, the Beechworth Regional Park receives about one-third of its annual visits during the spring months and Burrowa--Pine Mountain National Park about the same proportion in autumn, whereas visits to Mount Samaria State Park occur evenly throughout the year. Likewise, some parks receive extensive use, with bushwalking and scenic driving being the

principal activities, while in others particular features provide the main attraction for visitors - most of the recreational activity in the Burrowa--Pine Mountain National Park is focused on the Cudgewa Falls area.

Water-based recreation is well provided for within the study area. Lake Hume presently carries an estimated 500--600 power and ski boats and some 1,500 fishing boats per day over the school holidays, weekends, and public holidays during the summer. Facilities are also provided at Lake Nillahcootie and the Bonnie Doon arm of Lake Eildon. Recreational usage of public-land water frontages - both extensively to obtain access to streams for fishing and intensively for camping and picnicking at a number of localities - is also important.



Picnic facilities on the shore of Lake Nillahcootie

Recreational Activities

Fishing

Fishing is one of the most popular outdoor recreational activities in the study area. Redfin and brown trout are the two species most often caught; however, varying numbers of rainbow trout, common carp, goldfish, blackfish, and Macquarie perch are also taken. A few Murray cod, trout cod and golden perch are caught by experienced anglers. Freshwater crayfish are also present in many of the streams.

Table 17 lists the main inland angling waters of the study area and the main species caught there.

Streams in the study area but not listed in the table contain essentially the same angling species as those found in the nearest main waters. Many of the smaller streams, however, become very low in summer and fishing is poor.

Table 17

MAIN ANGLING WATERS

Water	Main angling species	Comments
Corryong and Cudgewa Creeks	Brown trout	Average value for trout; value for Murray cod and trout cod could be developed
Lake Hume	Redfin	High value for fishing; also stocked by New South Wales with brown trout and golden perch
Kiewa River	Brown and rainbow trout	Very high value trout water; some Murray cod in the lower reaches of the river, and value could be further developed
Mitta Mitta River	Brown trout upper reaches; Murray cod - lower reaches	High value for sport fishing and Murray cod
Lake Nillahcootie	Redfin; brown trout	Average value for both species, but potential for restocking with native fish
Broken River	Redfin upper reaches; brown trout lower reaches	Redfin abundant but small; average value for trout
Ovens River	Brown trout	Average value for trout but potential in lower reaches for restocking with trout cod and Macquarie perch
Seven Creeks	Macquarie perch	High value for conservation and sport fishing; the section from Polly Mc Quinns Dam to Watchbox Creek junction is completely closed to angling to protect the endangered trout cod
Bonnie Doon arm, Lake Eildon	Redfin; brown and rainbow trout	A heavily fished water of high value for brown trout

Source: Tunbridge, B.R., and Rogan, P.L. (1981)

Although introduced fish predominate in the area and provide most of the angling, several waters also carry remnant popukations of native fish, or have habitat suitable for their reintroduction. A start has been made by stocking the Broken River at Benalla with golden perch, and Lake Eildon with Murray cod.

Apart from the present liberations of native fish, which will be increased in future years, there are occasional liberations of brown trout into Lakes Hume and Nillahcootie and the Kiewa and Ovens Rivers.

Fortunately, most waters in the study area are still free of common carp. Those waters (such as the Broken and Ovens Rivers and Lake Eildon) that do have this species present do not appear to have been adversely affected.

Boating and canoeing

Lake Hume is very popular for boating activities such as fishing, cruising, and water-skiing. The numerous boat ramps and mooring facilities around its perimeter are heavily used, particularly over the summer priod. Lake Nillahcootie and the Bonnie Doon arm of Lake Eildon are also used for these activiites, although the relatively small surface area of Lake Nillahcootie limits its use for water-skiing. Other boating activities on these lakes include canoeing, sailing, and rowing. Houseboats are not permitted on either Lake Hume or Lake Nillahcootie.

The lower reaches of the Ovens, Kiewa, Mitta Mitta, and Broken Rivers are all suitable for canoeing. In addition, the upper reaches of the River Murray provide opportunities for white-water canoeing. Canoeists often use this stretch of river for longer trips involving overnight camping.

Hunting

Ducks are the major species hunted here, with the wetlands along the Murray and Mitta Mitta Rivers being popular areas. Lake Nillahcootie and Lake Hume are also used for duck-hunting, as well as dams and other wetlands on public and private land throughout the study area.

Deer-hunting also takes place in the study area although the number of deer present is not large. A project has been established by the Forests Division in the Koetong pine plantation to investigate the use of softwood plantations as habitat for fallow deer. Wild pigs are hunted, principally in the Tolmie Highlands, although small isolated populations occupy remote areas of public land from Mitta Mitta through to Corryong. Likewise, the Strathbogie Range, Tolmie Highlands, and public land north of Myrtleford are the principal localities where wild goats are hunted, although, again, small scattered populations occur on most large parcels of public land throughout the area.

Training in the use of firearms is provided, and competitive shooting events conducted, at rifle ranges established on public land at a number of locations within the study area.

Recreational driving

Most recreational driving in the study area is done in two-wheel-drive vehicles. For many people pleasure driving and sight-seeing are the major activiites, while for others driving provides access to areas where they engage in some other recreational activity.

Self-guided scenic drives have been developed in the Beechworth Regional Park and through the softwood plantations at Shelley and Beechworth. They are well signposted and provide access to points of scenic interest in these locations.

Pleasure driving is usually associated with picnicking. Picnic areas have been developed in most of the parks, on many other areas of public land, and adjacent to major roads. Many of the sites are close to attractive pieces of forest, fern gullies, river and lake frontages, or features or geological interest. Lawrence's Lookout and the Thomas Mitchell Reserve at Shelley are popular with travellers along the Murray Valley highway, as are the picnic areas on the Lake Hume reserve.

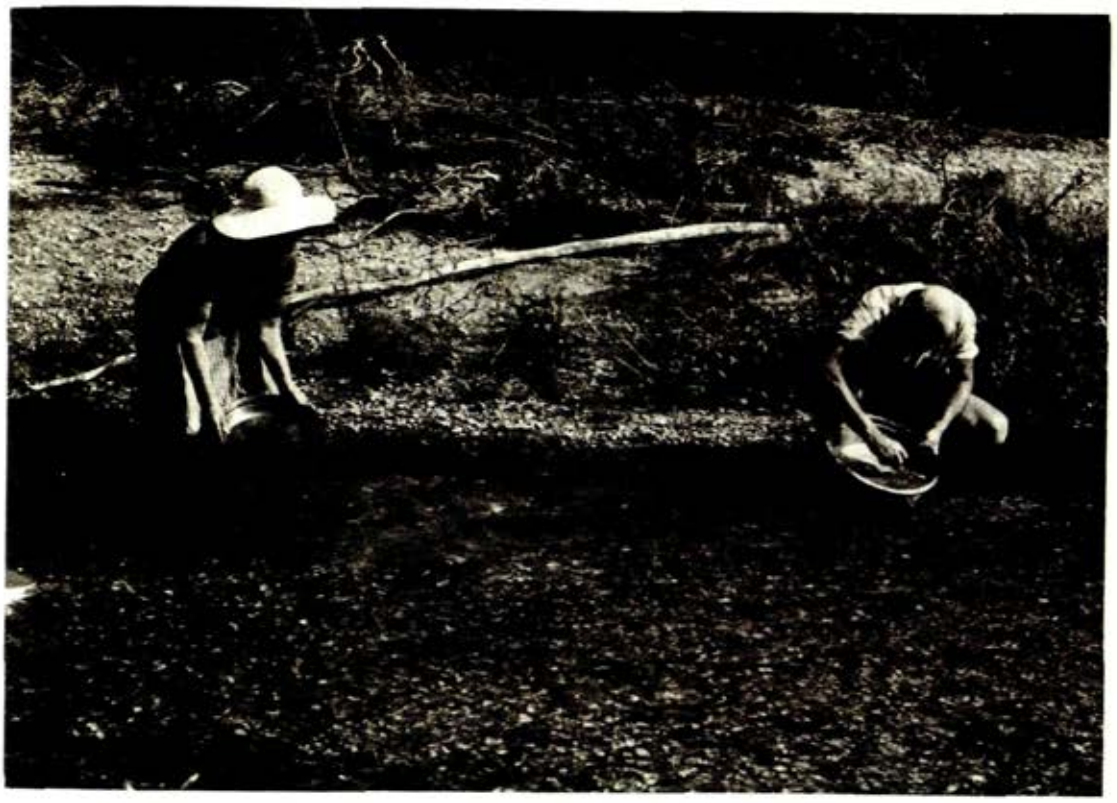
Another form of recreational driving involving four-wheel-drive vehicles takes place on the network of logging and fire-protection roads established throughout the study area. Trailbike riders also make use of these roads.

Camping

Dispersed bush camping is popular on public land throughout the study area and is frequently associated with other activities such as fishing, bushwalking, or canoeing. The most popular sites are usually open areas close to rivers and streams. Extensive use is also made of sites near road crossings, or where roads run adjacent to rivers and streams along public-land water frontages. Facilities for campers are not presently developed in many of the parks, the principal exception being Mount Samaria State Park.

The environs of Lake Hume are popular destinations for campers, and the five caravan parks adjacent to the lake pro-

Camping ground at Mount Wombat



Fossicking for gold

vide about 1,000 sites. There are also caravan parks in many of the towns in the study area.

The Shelley Camp east of Tallangatta, which previously provided accommodation for Forests Commission employees, has been developed as a residential hostel catering for group recreation and education activities. In 1982 the camp was used for approximately 9,500 visitor-days. The majority came from school groups, whose activities are often associated with the use of the adjoining Koetong Education Area.

Gemstones and fossicking

The Mansfield area is well known as a source of gemstones. The Crystal King mine near Tallangalook is a popular site, and other localities south of Benalla and near Tatong yield agates, red jaspers, and black and green cherts. Turquoise is found near Molyullah, and rubies, sapphires, emeralds, topazes, garnets, and red zircons are found in the Tolmie Highlands near the headwaters of Ryans and Middle Creeks.

The region around Beechworth, Bethanga, Chiltern, Yackandandah, and Mitta Mitta contains many relics of the early gold-mining period. Gold and gemstones can still be found in some of these areas and fossicking and prospecting are popular activities here.

Nature study

While many people visit public land specifically to study nature, a far greater number incorporate nature study with other activites such as bushwalking, picnicking, camping and recreational driving.

The study area has much to offer for nature study and bird-watching due to its diverse range of habitats and vegetation types. Sites of particular interest that are easily accessible include: the red ironbark forests in the Chiltern State Park, where the rare turquoise parrot occurs; the forests near Beechworth that include black cypress pine, Blakely's red gum, long-leaf box, and brittle gum; and the diverse range of vegetation types present in the Mount Samaria State Park.

Walking

Two types of activity fall within this category: short walks along prepared sign-posted tracks and extended walks of several days' duration.

Short walking tracks have been developed in a number of parks, in the Shelley softwood plantation, and at other locations in State forest. In addition, fire-access tracks in the parks and State forest provide opportunities for a range of walks.

The study area is not as popular as some parts of the State for extended walks, although the Burrowa--Pine Mountain National Park is increasingly popular with bushwalkers.

Other activities

Small areas of public land throughout the study area are reserved for formal recreation activities such as golf, tennis, cricket, football, motor-racing, and horse-racing.

References

Larkins, J., and Parish, S. (1982). 'Australia's Greatest River.' (Rigby Publishers: Perth.)

Loder and Bayly Planning and Engineering Consultants (1979). 'Lake Hume Recreation Study.' (Lake Hume Recreation Co-ordination Committee: Wodonga.)

Tunbridge, B.R., and Rogan, P.L. (1981). 'A Guide to the Inland Angling Waters of Victoria.' 3rd ed. (Fisheries and Wildlife Division: Melbourne.)

Victorian Amateur Canoe Association (1981). 'Canoeing Guide to Victoria.' (Styleway Printers (Vic) Pty Ltd: Melbourne.)

15. PRIMARY PRODUCTION

Agriculture

Pastoral industries dominate land use on freehold land in north-eastern Victoria, producing livestock, dairy produce, field crops, and wool with a gross value of production in 1981/82 of some $190,000,000. Agricultural enterprises including poultry, hop-growing, tobacco-growing, apple and nut orchards, and small seeds production are also important. As many of the townships in the area supply farm inputs, or are based on service industries that transport, market, and process agricultural products, the agricultural industries have a significant effect on the regional economy.

Present use of developed farmland

Table 18 lists the different agricultural land uses on freehold land in the study area. It shows the dominance of pasture, and therefore of the livestock industries, in local agricultural land use. The sown pastures are largely based upon subterranean clover, with white clover and perennial grasses being sown more frequently in the higher-rainfall zones. Annual forage production from developed pastures in the more favourable situations may reach 10,000 kg per ha, or more than double that from drier areas on poor soils.

Table 18

AGRICULTURAL LAND USE 1981/82 (ha)

Land use	Upper Murray section	Benalla section	Total
Sown pasture	152,476	134,281	286,757
Cropping	7,500	25,987	33,487
Native pasture	112,340	62,970	175,310
Total	272,316	223,238	495,554

Note:
Land not used for production - such as roads, dams, watercourses, rocky outcrops, and land lying idle - is excluded.

Source: Australian Bureau of Statistics

Although beef is still the main industry, cattle numbers have declined some 20% from the peak in 1975 and are now at similar levels to those of the early 1970s. This has been balanced by increases in the sheep and dairy industries, both of which have benefited from improved prices (specifically for wool and milk). Productivity in the beef and sheep

industries has been relatively stable, whereas a steady increase has occurred in dairy cow production due to grain feeding and increased pasture irrigation. Milk production levels, however, remain below State averages.

Table 19 shows the changes in production of crops, livestock for slaughter, and livestock products (including wool and dairy products) between 1979 and 1981. The rise in livestock products at the expense of livestock slaughtered is due to both increased diary and wool production and better prices.

Table 19

AGRICULTURAL COMMODITIES
CONTRIBUTION TO GROSS VALUE OF PRODUCTION (%)

Commodity	Upper Murray section			Benalla section		
	79/80	80/81	81/82	79/80	80/81	81/82
Crops	13.0	12.8	11.9	32.7	33.0	26.8
Stock slaughtered	64.4	59.8	54.9	45.1	48.9	43.2
Stock products	22.6	27.4	33.2	22.2	18.1	30.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Cereal crops, vegetables, orchards, tobacco, and vineyards are locally important in some areas. Large plantings of Red Delicious apples in the Stanley--Beechworth area will boost estimated apple production there to 10,000 tonnes per annum by 1990. The future of the tobacco industry depends on both control of black root rot and community attitude to smoking.

While the proportional contribution of agriculture to the economy of the region as a whole is declining, due to the development of industries in the larger centres and of tourism, it still has an important influence on a large section of the population. Agriculture also contributes to the tourist industry through farm holidays and horse-riding tours, as well as through such ventures as commercial trout fisheries, production and sale at cellar door of strawberry wine at Allens Flat, and roadside sales of vegetables and fruit.

A further feature of the study area is the number of small (or hobby) farms that have been established, most of which are family farms. While providing an alternative to living in towns and cities, they constitute uneconomic agricultural production units. To date, this trend has not had any marked effect on production for the study area, partly because of controls on subdivision administered by local government through Interim Development Orders or Planning Schemes.

Public land

At present public land is used for agriculture, principally grazing, to a very limited extent. Following the Land Conservation Council's examination of land use here in the

Spray irrigation of pastures, Broken River

1970s, a number of conservation reserves were recommended in which grazing was not a permitted use.

Currently, some 40 grazing licences are held over 34,000 ha of public land in the study area. Permitted stock levels, as Dry Sheep Equivalents (D.S.E.), the season and duration of the grazing period are determined for each area. A total of some 8,600 D.S.E. may be grazed on public land under the current licences - about 860 dry cattle. Most of the grazing takes place at lower elevations, under forests. In these areas stock can be grazed for 6 months or more on a given parcel of public land, but at lower stocking rates than for the alpine herb fields in the adjoining Alpine area. Some 30 families with properties in the study area send stock up to the high plains over summer, thus conserving summer pasture growth on the home property, which the cattle can then graze when they return in autumn.

The major areas of public land of importance for agriculture, however, comprise some 5,000 ha of Crown stream frontages and 5,400 ha of unused roads (totalling more than 3,000 parcels of land), which are managed by adjoining land-owners under licence. It is the responsibility of the licensee to control noxious weeds and vermin on such land. The Department of Conservation, Forests and Lands is currently reviewing Crown land rentals.

In general the uncommitted land has a low potential for agriculture, as clearing and development costs on the steep, highly erodible slopes that comprise most of the area would be high. Some small isolated areas have a higher potential, although many also have value for other uses such as conservation of flora and fauna, gravel extraction, and recreation.

Future development

No substantial changes in land use in the major agricultural industries are likely in the next decade, although the effect of the introduction of new technology will continue. Current indications suggest that the production of wool from the area may increase while beef cattle numbers may continue to show a slight decline. Field crop areas are stable, but any slight price improvements could lead to an expansion in

the area sown to crops. The continued development of new cultivation systems and superior plant varieties from agricultural research could allow cropping on currently marginal land, thus bringing more land into production. Even though milk production levels are below the State average, a recent downturn in milk prices is unlikely to cause a dramatic decline in land allocated to dairy production.

A reduction in the area of land used for agriculture could result if land for softwood plantation establishment is obtained entirely from this source in future. While much of the land acquired for softwoods to date was either underdeveloped or marginal for agriculture, the entry of private firms into the field may see higher-quality land close to wood-processing centres being acquired for this purpose. The change in land use from agriculture to low-density residential development within the study area is controlled by either Planning Schemes or Interim Development Orders administered by local government. Similar controls may apply where a change to plantation forestry is proposed by a private-sector land-owner. Consequently, such controls may be a greater determinant of the rate of change than market forces.

Apiculture

Apiculture is a small primary industry producing honey and beeswax. Honey is used for table consumption, confectionary manufacture, and stock feeds, and in the preparation of meat, vinegar, some types of tobacco, and some pharmaceutical and cosmetic products. Beeswax has many uses, including candle, cosmetic, and polish manufacture. Pollen is sought after as a protein health food.

Beehives in grey box forest

Other primary industries also benefit directly from apiculture through the pollincation of flowers. Affected crops include apples, cherries, plums, pears, pumpkins, clovers, cabbages, and rape, sunflower, and lucerne seeds. Bee colonies used for this purpose, however, must be strong in population and have a heavy concentration of brood to be acceptable. Pollen and nectar sources to build up the hive are therefore of importance if this valuable role is to be maintained.

Level of production

In 1982, Victoria produced 5,388 tonnes of honey - 22% of Australian production, as much as two-thirds of which is exported. It also produced 99.2 tonnes of beeswax - 21% of Australian production. Beeswax too is exported, Japan and the United Kingdom being the main buyers.

The level of production of honey can fluctuate considerably from year to year because of climatic variation. High production was achieved in 1979/80 (4,065 tonnes) and 1980/81 (5,160 tonnes), compared with only 1,713 tonnes in the drought 1976/77 season. The reduction in the amount of honey produced in the drought was due entirely to decreased production per hive - 19.5 kg per hive in 1976/77, compared with a high figure of 67.8 kg in 1980/81. In 1982, the number of registered apiarists in Victoria with 40 or more hives was 444.

The principal supply of nectar in this State comes from eucalypts and a few other native trees and shrubs. The native ground flora, although important in other countries, has relatively little importance as a source of nectar in most parts of Victoria. Introduced ground species such as cape weed and Paterson's curse contribute to honey yields from agricultural land. For maximum production of honey, hives are moved from district to district, following the flowering of the eucalypts.

Outlook

World demand for honey has increased noticeably in recent times. One reason for this is that people in many countries now regard honey as a health food. It is expected that this trend in consumption will continue.

The trend to larger transport vehicles and mechanical means of loading and unloading hives has lead to a heavier concentration of hives per apiary that is likely to continue.

Beekeeping in the region.

The study area is mainly used by apiarists who live in or close to it, although a large influx from outside the area - especially from New South Wales - occurs when red stringybark yields a heavy crop. Most colonies utilizing the area on a regular basis would be wintered in the locality and use nectar and pollen from ground flora, white box, and broadleaf peppermint to build up the strength of the hive for honey flows in summer.

Figures collated from apiarists' records indicate that the district provides a livelihood for the equivalent of eight full-time apiarists and returns average some $30,000 gross a year, based on an average wholesale price of 26 cents a kg. In a normal year up to 50 sites utilize the flora of forest areas, 20 sites utilize stream frontages, and 12 sites utilize roadside reserves, while only 24 utilize private property. This indicates the relative importance of the flora on public land to the region's beekeepers.

Table 20 lists the plant species found in the study area and valued by apiarists, in order of importance for total honey yield. Flowering period and pollen yields are also indicated. Pollen is the protein food of the honey bee, and hive population is proportional to the amount and quality of pollen available. It should be noted that, while average honey yields are quoted, flowering intensity will vary from year to year. As a general rule, however, the majority of eucalypts flower heavily every second or third year.

Table 20

IMPORTANT HONEY- AND POLLEN-PRODUCING PLANTS OF THE DISTRICT

Species	Flowering periods	Average honey yield (per hive per year)	Pollen yield
Red stringybark	Feb-Apr	Good, 14-30 kg	Good
River red gum	Dec-Jan	Good, 14-27 kg	Good
Grey box	Feb/Mar-Apr	Good, 14 kg	Good
Blakely's red gum	Oct-Nov	Good, 9-14 kg	Good
Long-leaf box	Mar-Apr	Good, 10-14 kg	Good
Messmate	Feb-Mar	Good, 9-14 kg	Good
Blue gum	Dec-Feb	Good, 4.5-14 kg	Good
Red box	Sept-Oct/Nov	Fair, 4.5-14 kg	Poor
Red ironbark	Mar-Sep	Good, 20 kg	Poor
Mountain swamp gum	Apr-May	Poor, 2-4 kg	Good
White box	Apr-Aug	Fair, 6-10 kg	Poor
But but	Feb-Apr	Fair, 2-4 kg	Good
Broad-leaf peppermint	Sep-Oct	Poor, 2.5-4 kg	Good
Narrow-leaf peppermint	Dec-Jan	Fair, 2.5-7 kg	Good
Candlebark and manna gum	Feb/Mar-May	Fair, 2.5-9 kg	Good
Yellow box	Dec	Good, 14 kg	Poor
Capeweed	Sep-Oct	Fair/poor, 4-10 kg	Good
Patersons Curse	Oct-Nov	Fair, 9 kg	Good

Accessibility plays a significant role in the level of usage of the study area by apiarists. At present the heaviest usage occurs in the north-western and south-western sectors, where beekeepers, both local and those from further west, gain closest and easiest access. Potential for expansion exists in the Mount Lawson--Koetong plateaux areas and, to a lesser extent, in the Dorchap Range.

Extensive clearing of land for agriculture has greatly reduced the value of the study area for beekeeping. Most of the river red gum and Blakely's red gum of the flats and plains have been removed, yet even today river red gum ranks second in importance only to red stringybark. The remaining mature trees on road, lake, and stream frontages, and on private property are of vital importance to the apiarists of the area. The stringybark forests of the hillocks and slopes have been cleared for agriculture in many instances; those remaining on public land provide the main source of honey and thus have great importance.

The establishment of pine plantations has chiefly involved narrow-leaf peppermint and broad-leaf peppermint sites, and these species are not important for honey production in this district.

As private property is progressively cleared and as insecticides, especially those applied by aerial spraying, become more widely used in agriculture, large areas of public land are becoming increasingly important to apiarists.

References

Anon. (1972). The honey industry. *Victorian Year Book* No. 86, 353--4.

Australian Bureau of Statistics (1981). 'Rural Industries, Season 1979/80.' (A.G.P.S.: Melbourne.)

Australian Bureau of Statistics (1982). 'Rural Industries, Season 1980/81.' (A.G.P.S.: Melbourne.)

Australian Bureau of Statistics (1983). 'Rural Industries, Season 1981/82.' (A.G.P.S.: Melbourne.)

16. SOFTWOOD PRODUCTION

To meet a requirement for softwood sawn timber and long-fibre pulpwood, and to supplement the wood supply from native hardwood forests, the planting of softwoods in Victoria commenced late last century. Initially establishment took place at a number of locations - especially near the coast - with varying degrees of success. Based on the experience gained from the early plantings, further plantations were established as funds became available. This phase, which lasted until the early 1960s, provided a basis for the establishment of softwood sawmills at a number of centres. It was not until funds became available on an assured basis from the Commonwealth government in the 1960's, however, that a sustained planting program could be established.

The Forests Commission designated eight development zones for Victoria, (in areas suitable for the growth of pines) in which planting was to take place. The aim in setting up these zones was to provide sufficient softwood resources to support the establishment of a range of permanent wood-using industries at suitable decentralized sites. This policy had its basis in the dual aims of providing employment in rural areas and supplying an essential industrial raw material that would otherwise have to be imported

The study area includes all or part of three of the eight softwood development zones, comprising the whole of the Upper Murray Zone, virtually all of the Benalla--Mansfield Zone, and a small portion of the Ovens. The Upper Murray Zone is centred on plantations in the Shelley--Koetong area, the Benalla--Mansfield Zone on plantations in the northern part of the Strathbogie Ranges and in the Wrightley--Tolmie area, and the portion of the Ovens Softwood Development Zone in the study area includes the Beechworth and Stanley plantations.

Management goals for these plantations are to grow sawlogs, veneer logs, and pulpwood, using a forest management strategy that will optimize sawlog and veneer log production.

The establishment of softwood plantations in the study area commenced in 1931 at Stanley on land that was left seriously eroded following the gold-mining era. The initial aims were to provide unemployment relief, and to supply timber to make fruit cases for the surrounding apple orchards. Planting continued at a moderate rate throughout the next 30 years, and industries became established to utilize the steadily expanding sawlog resource. In the 1960s the rate of plantation establishment increased, with the commencement of planting in the Shelley-Koetong area in 1961 and expanded planting at Beechworth. Plantings in the Benalla--Mansfield portion of the study area did not commence until 1964, with initial plantings being established near Warrenbayne.

Existing plantations

Table 21 gives the net area of softwood plantations that have been established on public and freehold land in the study area. It shows that the majority of softwood plantations are publicly owned.

Table 21

LAND FOR SOFTWOOD PRODUCTION[1,2] BENALLA--UPPER MURRAY AREA

Zone	Public ownership (ha)	Private ownership(ha) Farm Forestry Agreement	Other private	Total (ha)
Upper Murray	9,747	995	425	11,167
Benalla--Mansfield(part)	8,875	820	715	10,410
Ovens (part)	4,505	65	20	4,590
Total	23,127[3]	1,880	1,160	26,167

Notes:

1. Source of Information:
   - Public ownership (Forests Commission) - Plantation area statement, March 1984
   - Farm Forestry Agreements - Extension Branch, Forests Commission, February 1984
   - Other private plantations - Assessment Section, Forests Commission, March 1979 Census

2. The Forests Commission has purchased about 15,600 ha (gross) of former freehold land in this area - on which, to date, an estimated 10,000 hectares of the existing softwood plantations have been established.

3. A further 327 ha (233 ha Education Department and 94 ha Beechworth Prison) have also been established on public land.

Source: Forests Division, Department of Conservation, Forests and Lands

The wood-based industry

Plantation softwoods produce the raw material for a variety of end uses, including light construction, flooring, weatherboards, joinery, furniture, veneers and plywood, particle-board, paper, and fencing material. The timber is suitable for pressure treatment with preservatives, enabling it to be used in situations where it is exposed to insect and fungal attack.

Table 22 shows the various industries processing softwood material from State forest in the study area. Of these, Australian Newsprint Mills and Australian Forest Industries are by far the largest users. These complexes represent significant capital investments - about $200 million by ANM and about $17 million in the sawmill--pulpmill--veneer-mill complex by AFI. This investment is recognized by long-term legislated pulpwood supply agreements, which ensure the supply of raw material. It should be noted that at present Australian Forest Industries draws its supplies from the Ovens Softwood Plantation Development Zone, of which only a small proportion is included in the study area. Together, the softwood processing industries shown in Table 22 provide employment for about 920 men - the proportion attributable to raw material supplied from the study area cannot, however, be established.

Table 22

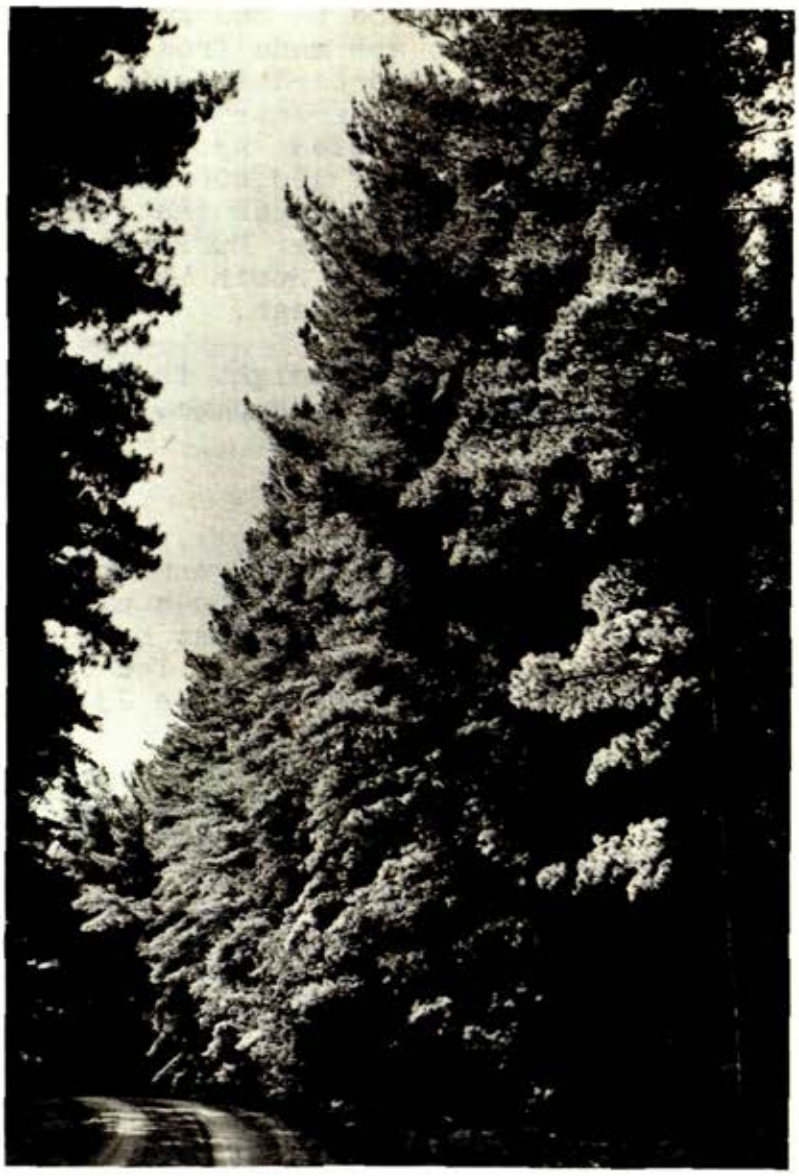
SOFTWOOD PROCESSING INDUSTRIES USING MATERIAL FROM STATE FOREST

Company	Mill type	Supply zone*	Location
Australian Newsprint Mills Ltd	Pulp (refiner groundwood) and newsprint	1, 2, 3	Albury
Bowater-Scott	Pulp (refiner groundwood)	3	Myrtleford
Australian Forest Industries Pty Ltd	Sawmill, veneer mill and preservation plant	3	Myrtleford
A. Dunstan & Sons Pty Ltd	Sawmill, preservation plant	1, 3	Wodonga
Savaco Pty Ltd	Veneer mill	3	Benalla
Carlton Jones Pty Ltd	Preservation plant	3	Eurobin
Buckley Sawmills Pty Ltd	Sawmill, preservation plant	2	Euroa Euroa--Mansfield
Marbut-Gunnersen Ind. Pty Ltd	Sawmills, preservation plant	2	Mansfield--Benalla Benalla
A.D., D.G., & J.F. Barker	Sawmills (2), preservation plants (2)	2	Violet Town

* Supply zones 1 Upper Murray
2 Benalla--Mansfield
3 Ovens

Source: Forests Division, Department of Conservation, Forests and Lands

Radiata pine plantation, at Stanley



Softwood supply commitments

The annual sawlog and veneer log commitments for the Ovens and Upper Murray Softwood Development Zones are 154,000 cu.m and 30,000 cu.m respectively. Plantings in the Benalla --Mansfield portion of the study area began in 1964, and are now reaching a size where commercial volumes of sawlogs could be made available. No sawlog commitments have as yet been made for this resource. The sawmills and associated wood-processing plants established at nearby centres do, however, represent significant investments that have been undertaken in the expectation (based on past practice) that additional quantities of raw material will be made available as the plantations mature.

The government has entered into two legislated agreements to supply pulpwood from the study area:

1. The *Forests (Bowater-Scott) Agreement Act* 1971 provides for supply of 47,200 cu.m per annum at present, rising to 63,720 cu.m by the year 1992. This material is to be supplied exclusively from the Ovens Softwood Development Zone.

2. Supplies of pulpwood to the Australian Newsprint Mills Ltd Albury plant are made from both Victoria and New South Wales under separate legislated agreements. Those from Victoria are guaranteed by the *Forests (Australian Newsprint Mills Limited) Act* 1980, to be maintained at the present level of 120,000 tonnes per annum until the year 2010. It is expected that this wood will be primarily drawn from the Upper Murray and Ovens Zones. A similar agreement for New South Wales provides for 300,000 tonnes of pulpwood a year.

   Note: 1 tonne green weight is approximately 1 cubic metre for radiata pine.

Future development

Some of the areas that the government has approved for softwood production have not yet been planted. In addition, some areas of freehold land that have recently been purchased have not yet been planted. The areas of land in these two categories are shown in Table 23.

Table 23

LAND NOT YET PLANTED (NET PLANTABLE AREA) [1,2]
AS AT JANUARY 1984

Zone	Areas of public land approved by government (ha)	Areas of recently purchased freehold land (ha)	Total (ha)
Upper Murray	1,081	447	1,528
Benalla--Mansfield (part)	1,976	72	2,048
Ovens (part)	140	100	240
Total	3,197[3]	619	3,816

1. These areas will be reduced as a result of 1984 plantings
2. Estimates, net plantable areas
3. Includes approximately 570 ha of purchased private property included as public land in the original LCC studies

Source: Forests Division, Department of Conservation, Forests and Lands

The strategy being followed at present is to expand the plantations in the Ovens, Upper Murray, and Benalla--Mansfield Zones at a rate of up to 1,750 ha a year. Annual plantings within the study area, as part of this total, are expected to be about 600 ha in 1984. The land to be used is that allocated by government decision following previous Council studies or obtained by subsequent purchase. It is government policy that the clearing of intact native forest

for softwood planting be phased out. On present rates, sufficient land remains in stock for 6 years' planting, based on a policy of using land already allocated and purchased to date. This would need to be supplemented by further land purchases in order to maintain the projected planting rate beyond that period. Constraints on the availability of funds and other factors may limit the extent of additional purchases, however, and thus the area of new plantation that may be established.

References

Bureau of Agricultural Economics (1977). 'The Australian Softwood Products Industry.' (Australian Government Publishing Service: Canberra.)

Forests Commission Victoria (1979). 'Submission to Inquiry by Senate Standing Committee on Trade and Commerce into all Aspects of Australia's Forestry and Forest Products Industries.' (Forests Commission, Victoria: Melbourne.)

17. HARDWOOD PRODUCTION

Hardwood forests cover a substantial proportion of the public land within the study area and have been used as a source of wood since early settlement. In these mostly mixed species forests, the occurrence of the various species is controlled by environmental factors such as temperature, soil type, and soil moisture status, which in turn largely depend on aspect and elevation.

Logging in the State forest is carried out in accordance with prescriptions approved by the Forests Commission. These prescriptions set down operating procedures aimed at reducing the impact of logging on water quality and catchment values. They also protect flora and fauna, landscape, recreation, and historical features. The prescriptions cover matters such as retention of strips of undisturbed vegetation along streams, log snigging, location of landings, road and track standards and maintenance, regeneration standards, and the responsibilities of supervisors. Their application results in 20--30% of any logging area, on average, being left undisturbed.

Silvicultural systems

Logs are taken from the forests of the study area under the silvicultural method known as group selection. This method is applied to forests containing trees of widely varying age and size. Trees are felled as they become mature, which means that harvesters take single trees or small groups of trees; the cutting cycle extends over 10--20 years.

Burning of the heads of the felled trees and disturbance of the ground with logging machines both foster regeneration. Saplings and pole-sized regrowth are protected during harvesting. Retained trees usually produce adequate seed, but seed is sown by hand if necessary.

Logging by the selection system has less impact than clearfelling, as it disturbs relatively small areas in each harvesting cycle, and does not dramatically change the structure of the forest.

Forest types

The forest types discussed below correspond generally with the units used in preparing the vegetation map; those types of little significance for timber production, however, have not been considered.

Peppermint--stringybark

These forests occur extensively throughout the study area, generally at elevations between 300 m and 1,100 m. Species

present include narrow-leaf peppermint, blue gum, candlebark, and manna gum on the more sheltered sites and broad-leaf peppermint, brittle gum, and red stringybark on the drier sites.

Forests containing narrow-leaf peppermint and its associated species reach their best development on the deep soils of the plateaux such as the Stanley Plateau, the Koetong Plateau, the Tomie Highlands, and the Strathbogie Ranges. These areas are important for the supply of sawlogs, as they are capable of rapid growth rates and well-stocked stands can be managed for intensive sawlog production. Narrow-leaf peppermint, which is regarded as an inferior sawlog species in other parts of the State, produces good-quality timber in this region.

The bulk of the peppermint--stringybark forests, however, occur on the drier, steep foothills, where sawlog production is only intermittent and usually on a single-tree selection basis.

Messmate

This species occurs either in pure stands or in mixture with narrow-leaf peppermint or candlebark on sheltered sites where soils are deep and annual rainfall exceeds 1,020 mm.

A messmate forest, near Toorour

79652/84—5

River anabranch fringed with red gums - Albury--Wodonga Corporation land

Messmate forests are best developed on the Tolmie Highlands and the Strathbogie Ranges. These stands are highly productive and are suited to management for intensive timber production.

Alpine ash

Small alpine ash stands are scattered across the high elevations of the study area. They occur on sheltered aspects at high elevations in such areas as the Evans Creek catchment, Tolmie Highlands near Archerton, Mount Big Ben, the Eskdale Spur in the vicinity of Mounts Emu and Tawonga, and near Cravensville. Although these forests are very productive, most of the mature stands have been logged and no further production will be possible until the regrowth stands reach merchantable size.

River red gum

Although confined to the plains region, and areas of impeded drainage or subject to periodic flooding, river red gum forests have been used as a source of durable timber for sawmilling, sleepers, and posts for many years. Their occurrence on public land is now virtually confined to the frontages of the Murray, Ovens, Kiewa, and Mitta Mitta Rivers and to the Reef Hills area near Benalla, where river red gum

occurs in conjunction with grey box. Trees are, however, widely scattered throughout the agricultural land and are used extensively as a source of farm timbers.

Box--ironbark

Red ironbark, red box, and red stringybark mixed forests grow on shallow sedimentary soils surrounding Chiltern. Grey box and a small amount of yellow box also occur here on the deeper soils of the lower slopes. They provide a source of durable timbers that are used to supply the local demand for fence posts and poles. These forests have slow growth rates (especially on the poorer soils).

Box--stringybark

These forests are widely represented on dry northern aspects throughout the area and have long-leaf box and red stringybark as the principal species. Red box, yellow box, broadleaf peppermint, and brittle gum are associated species. Blakely's red gum occurs on areas of impeded drainage. These forests generally grow to about 25 m tall and, despite slow growth rates, yield a small supply of sawlogs.

Production

Sawlogs

The hardwood forests of the study area supply up to 44,000 cu.m of sawlogs annually, which is about 3--4% of Victoria's annual production from State forests. Most of the timber produced is peppermint, gum, or messmate and is sold locally for general construction purposes. The present level of cutting is at or slightly above the sustainable yield determined for public land for which production of hardwood is a permitted use.

Individual sawmills are located at Granite Flat, Mitta Mitta, Stanley, Mount Beauty, Chiltern, Yackandandah, and Alexandra, and the Euroa--Mansfield area contains a total of eight mills. Together these mills provide employment for about 120 men, making them an important source of employment in these centres. It should be noted that the mills at Mansfield, Granite Flat, Mitta Mitta, Mount Beauty and Alexandra also draw supplies from outside the study area and, in addition, mills at Corryong and Wodonga currently receive supply entirely from the Alpine area.

Pulpwood

The mixed eucalypt stands that have been utilized for sawlogs in the past have potential to supply pulpwood. Currently, however, the study area has no market for pulpwood and there are no plans to commence pulpwood harvesting there.

Other wood products

Minor forest products such as fencing materials, poles, and firewood are also obtained from the hardwood forests and service the local demand for these products.

18. MINERALS AND STONE

Mineral data used in the original Land Conservation Council reports for north-eastern Victoria were compiled over the years 1971--73.

The relevant chapters discussed all mineral occurrences that were known at the time in the area. It is intended that this chapter will summarize and update that original material where required as well as providing a summary of mineral exploration activity over the last 10 years.

Tenements under the *Mines Act* (1983)

Table 24 lists those tenements that have been issued or are the subject of applications under the *Mines Act* 1983. Of the variety of tenement types available, as at May 1984, 49 had been issued and 46 were under application.

Mining

Gold-mining on public land in the area is currently being conducted under Miner's Right claims. These small tenements are normally limited to 1 hectare, but with the consent of the Minister for Minerals and Energy may range up to 5 ha, and have minimal expenditure and work requirements. Production returns are not required for these tenements and therefore no record exists of how much gold is being produced from the 19 Miner's Right claims current in the area.

No mining activity under the more substantial mining leases is current in the area. One lease is current and applications for three others, all on public land, are pending. The last recorded cases of production from mining leases in the area were tin at Eldorado in 1979, fluorite from public land at Pine Mountain in 1974, and tin at Walwa in 1971.

Development leases are tenements mid-way between an exploration licence and an actual mining lease, and are issued for the purpose of detailed investigations to determine the feasibility of putting a mineral deposit into production. Nine applications are pending for development leases, all of which contain some public land, at Walwa, Bethanga, and near Beechworth.

Tailings licences are only issued for mine dumps on public land, for either treatment on site or removal. As at May 1984, 21 tailings licences were current, of which one was associated with gold-mining while the rest were used as sources of gravel for road construction and maintenance.

Mineral exploration

Such activity undergoes constant and often rapid evolution and change. New ideas and concepts on ore genesis develop

Table 24

TENEMENTS UNDER THE *MINES ACT* (1983) ON PUBLIC LAND - as at May 1984

Type and number (a) application (r) renewal	Lessee	Locality name	Parish	L.C.C. Recommendations (see Map 3)
Mining leases				
443	Dunstall	Carawalbi Mine	Everton	A10
1038(a)	Nardok Pty Ltd	Chappells Gully	Eldorado	A10
1105(a)	ACI Resources		Beechworth	R3
1153(a)	Brown and Cuffley	Upper Yackandandah Ck Mine	Yackandandah	T1
Development leases				
1(a)2(a)	Union Corporation (Aust) P/L	Mt. Alwa/Redbank Creek	Walwa & Burrowye	P1 and private
32(a)	Newton	Davitts Swamp	Eldorado	-
39(a)	Brown and Cuffley	Homeward Bound Mine	Stanley	G1
40(a)	Brown and Cuffley	Kerry Eagle Mine	Stanley	G1
55(a)	ACI Resources		Beechworth	R3
61(a)79(a)80(a)	Webb	Bethanga	Berringa & Township of Bethanga	S1and private
Prospecting area licences				
4	Brown and Cuffley	Upper Yackandandah Ck Mine	Yackandandah	T1
Miners Right claims				
4	Douglas		Chiltern	A3
26	McGrath		Tangambalanga	S1
39	Bartel		Tangambalanga	S1
40	Dryden		Yackandandah	G1
78	Balfour and Stone		Woorragee	G1
82,83	Balfour and Wilcox		Stanley	G1
84	Murphy		Noorongong	S1
167	Sutherland		Gundowring	S1

Table 24 (continued)

Type and number (a) applications (r) renewal	Lessee	Locality name	Parish	L.C.C. recommendations (seeMap 3)
Mining Right (contd.)				
178	Thomas		Tallangallook	-
360(a)	Strauss		Yackandandah	G1
361(a)	Blanche		Yackandandah	G1
384	Strauss		Stanley	F1
460	Barton		Everton	A10
484	Driessen		Everton	A10
533(a)	Dryden		Yackandandah	G1
723(a)	Black		Myrtleford	S1
752(a)	Sugars		Everton	A10
753(a)	Sugars		Everton	A10
Search licences				
2841	Garner		Stanley	G1,F1
2842	Jupiter Mining Pty Ltd		Murmungee	G1
2844	Jupiter Mining Pty Ltd		Stanley	G1
Tailings licences (treatment)				
64	Aughterson, Brand, Clough	Stringers Ridge	Stanley	G1
168(a)	Terrestrial Mining Pty Ltd		Chiltern West	-
Tailings licences				
4012	Dunstall	Nieoff Gully	Everton	A10
4330	Webb	North Gift	Berringa	-
4380	Shire of Wangaratta		Byawatha	P1
4667	Shire of Beechworth	Stanley No. 1	Stanley	A7
4668	Shire of Beechworth			G1
4669	Shire of Beechworth		Stanley	G1

4670	Shire of Beechworth		Beechworth	
4731	Forests Division	Homeward Bound I & II	Bruarong	G1
4738	Shire of Yackandandah	Kirbys Pit	Yackandandah	M1
4812	Forests Division	Caledonia	Stanley	G1
4835	Shire of Yackandandah	Rowdy Flat	Yackandandah	M1
4836	Shire of Yackandandah	Emerys Pit	Yackandandah	T1
4837	Shire of Yackandandah	Chattam Gardens	Yackandandah	G1
4838	Shire of Yackandandah	Rowdy Flat South	Yackandandah	M1
4839	Shire of Yackandandah	Gate Pit	Yackandandah	G1
4863	Shire of Tallangatta		Walwa	P1
4864	Webb	Bethanga	Berringa	S1
4896	Forests Division		Woorragee	G1
4917	Shire of Yackandandah		Yackandandah	G1
4918	Shire of Yackandandah	Bon Accord, Homeward Bound, Relay	Bruarong, Township of Hillsborough	G1
4922(a)	Masterson	-	-	-
4923(a)	Masterson	-	-	-
4930(r)	Forests Division	No. 1 Road	Stanley	F1
4964(a)	Worland	Reedy Creek	Eldorado	A10
4965(a)	Brown and Carlassaie	Barwidgee Creek	Myrtleford	S1

Exploration licences

746	Australian Anglo American	)
918	Geosearch and Hardrock	)
1019(r)	CVT Pty Ltd	) Exploration
1058(r)	Webb	) licences cover
1208	BHP Minerals	) broad areas and
1229	Australian Anglo American	) include both
1232	Australian Anglo American	) private and
1248	Golden Eagle	) public lands
1285(r)	Eastern Resources	)
1300	Plagolmin Pty Ltd	)
1310	Brady	)
1339	Australian Anglo American	)
1355	Brady	)

Applications (at 8/5/84) current for a further 19 exploration licences

Bethanga goldfield - site of the old treatment ponds shown above - and the Eldorado field - including the Cocks Pioneer Sluice lease (left) - still attract mining interest

and these, backed by changing technologies, lead to constant re-evaluation of known mineralized areas. Tied in closely with this is a basic tenet of mineral exploration - that mineral deposits currently regarded as uneconomic may become economically viable in the future, and some minerals not used at present may one day become important.

The new concepts and technologies have led naturally to investigations of areas away from known mineralized areas. The search for hitherto unsuspected ore bodies is an important element in many mineral exploration programs.

Mineral exploration is a high-cost and high-risk activity. If a substantial ore body is found the economic return can be great, yet the chance of this occurring is low. Victorian experience shows that since 1965 about 1,500 mineral ex-

ploration licences have been issued in the State and to date only two significant ore deposits have been located under these programs, neither of which has yet come into production due to several interconnected reasons, including economic ones.

In this study area the major work being done by mining companies is of an exploratory nature. As at May 1984, 13 operational exploration licences and three search licences were current, all of which contain some public land. In addition there were applications for a further 19 exploration licences, all of which contain some public land.

Since 1970 about $2,965,000 has been spent on mineral exploration under exporation licences here, with expenditure being about $300,000 in 1983. Both these figures exclude expenditure incurred under a number of mining leases and mineral search licences that have operated from time to time in parts of the area.

This continuing interest in mineral exploration is due to the association of mineral occurrences with many of the rock types and structures found locally and considered favourable for the formation of mineral deposits which could be mined.

The exploration effort over the last decade has ranged from broad-scale activities, often on public land, to detailed exploration of specific prospects, either known (a past mine) or newly discovered, some of which have been on public lands. Exploration techniques have included all the commonly used geochemical and geophysical methods, as well as drilling in places. Map 8 (facing page 132) shows areas prospected since 1970, and those currently being investigated.

The more specific rock types and geological environments that have been actively prospected over the last 10 years are listed below. All of these environments contain some public land. Location of the various rock types is shown on published geological maps, and the block descriptions include comments on specific locations.

Pegmatite, aplite dykes, and porphyrys - These often occur as swarms and sills intruding either granitic areas or the enclosing metamorphics and sediments. In places, the rocks are hydrothermally altered. Mineralization often associated with them includes tin, gold, tungsten, lead, zinc, molybdenum, and tantalum.

Quartz veins - Minerals that have been mined or recorded as associated with quartz veins include gold, fluorite, wolfram, lead, zinc, silver, and copper.

Shallow granitic rocks associated with volcanics - Potential mineralization is of the porphyry copper--molybdenum types. Where greisens are present there is potential for tungsten--tin mineralization in the granitic rocks and the enclosing metamorphic aureoles.

Zones of contact (either between different types of granite, or between granite and metamorphics) - Mineralization assoc-

iated and recorded with this environment includes tin, wolfram, and fluorite, with occurrences of molybdenum, lead, and zinc.

Fault zones - Mineralization recorded includes fluorite and wolfram.

Metamorphic rocks and sediments of Ordovician age - Disseminated tin, wolfram, gold, and sulphide mineralization is now recorded in places, which have thus attracted interest as potential low-grade, high-tonnage prospects.

Alluvial deposits - In places, erosion of some of the above primary sources of mineralization has resulted in the concentration of heavy minerals such as cassiterite (tin mineral) and gold in alluvial deposits, together with scheelite (wolfram mineral) and ilmenite and rutile (both titanium minerals). Searches have covered both shallow lead and eluvial material close to the primary source of the mineralization (mainly gold), and extended to the much deeper leads in the major valleys and feeding off the main hills.

Diamond-bearing pipes - The occurrence of diamonds in the alluvials around Beechworth--Chiltern has led to searches for kimberlite-like bodies, a principal primary source of diamonds. Such rocks have recently been found near Koetong.

Basic volcanic complexes of Cambrian age - These offer potential for copper, gold, nickel, chromium, cobalt, and platinoid mineralization.

Mudstone and sandstones or redbeds of Upper Palaeozoic age - This environment has been actively searched for copper and uranium mineralization, and a number of occurrences of copper and uranium minerals have been recorded (none of economic grade).

In the north-east of the area most of the general mineral exploration effort on public lands in the last 10 years has been conducted on uncommitted Crown lands or reserved forest in the area between Bungil, Cudgewa, and Cravensville (see Map 8). A number of zones generally anomalous in tin and tungsten have been identified. Some recent mineral exploration activity has been conducted in the Mount Lawson Multipurpose Park and includes activity in Lukins Wolfram Reef near Mount Porcupine.

Elswhere, the gold potential of the alluvials along the Mitta Mitta River has aroused considerable exploration interest. The hills adjacent to that river, particularly to the west from Sandy Creek Upper to Mitta Mitta fall within a known gold--tin province and a number of tenements on public land are current there.

Large parts of the known mineralized areas at Chiltern - and in the region bordered by Yackandandah, Beechworth, Eldorado, and Myrtleford - lie on public land. These are regularly prospected for gold, diamonds, tin, and molybdenum and Map 8 shows that they contain the greatest number of current tenements under the *Mines Act* (1983) in the study area.

The use of geophysics has greatly assisted in the search for buried river channels. Such channels (deep leads) are potentially gold-bearing, and most current interest is being concentrated on extensions to the known lead systems, north and south of Chiltern on both private and public lands.

The Cambrian rocks on public land south of Tatong are currently being investigated for base metals, with encouraging results, and the redbed sequences east and north-east of Mansfield have been prospected for copper and uranium. The goldfield, mostly on public land, that lies to the west of Mount Strathbogie has regularly been searched in the past.

Exploration in the study area in the last 10 years has also been characterized by detailed work on specific prospects. The old Bethanga goldfield, which consists of private and public lands, has had continuous exploratory investigation until very recently under mining leases and is now the subject of application for development leases. Previous production of gold from the Bethanga field came from steeply dipping quartz sulphide reefs within gneiss. The narrow reefs occupy faults and can be traced on the surface for up to 2 km. The ore contained up to 60% sulphides in a matrix of quartz and calcite. A typical assay was 30 g of gold and 60 g of silver per tonne, with 3% copper and 6% arsenic. Despite the high copper content, little copper was produced. In the oxidized zone, free gold was readily extractable, but below this zone the gold became less free-milling and more difficult to extract from the complex sulphides. Recent activity on the Bethanga field has been directed towards exploration for wide disseminated sulphide zones with low gold values, and broad zones anomalous in silver, lead and zinc.

The Walwa tin-field lying on both public and private land has also recently been prospected in more detail. Mining at Walwa is recorded as taking place in 1882--83, 1911--13, 1919, 1927--28, 1967--68, and 1970. At Walwa, where cassiterite occurs with tantalite--columbite (ores of tantalum and niobium), total recorded production of tin concentrate is only 175 tonnes. Exploration since 1970 has established a resource in excess of 520,000 tonnes on public land in the Mount Alwa--Red Bank Creek area at less than 0.2% tin, together with low values of tantalite. The ore grades are currently below the cut-off grades that the Bureau of Mineral Resources considers economic. Investigations are current under exploration licence and there are applications for three development leases over this public land block.

Fluorite has previously been mined at Pine Mountain. Exploratory work at Pine Mountain from 1970 to 1974, under mining leases, established 75,000 tonnes of 100% fluorite (calcium fluoride) in a quartz--fluoride--galena vein. At the time this tonnage was insufficient to justify mining.

Part of the prospect is now within the Burrowa--Pine Mountain National Park. A recently expired mining lease, somewhat smaller than previous leases due to the park declaration, was located partly on uncommitted land and partly on private land abutting the park.

Stone

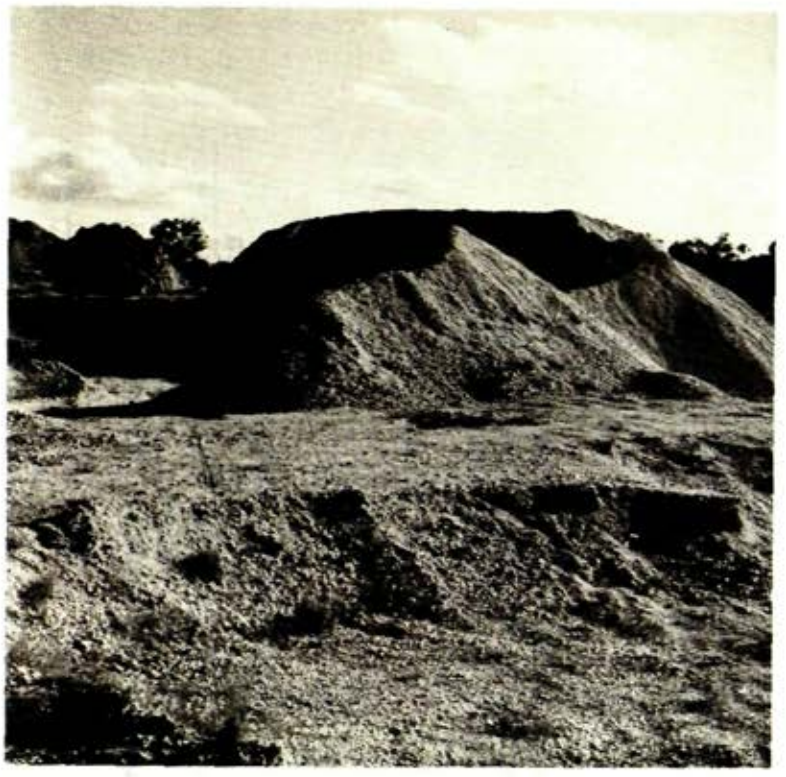
The study area contains a variety of rock types suitable for use in the construction industry. Most extraction sites are located close to construction areas due to the low unit price combined with the high transport cost, and hence all the large population centres have one or a number of commercial quarries nearby. Construction of the Hume Freeway has also resulted in a number of hard-rock quarries being established relatively close by to service this construction program, which has required large quantities of stone. Indeed, the biggest use of stone in the area is in the construction and maintenance of roads. Other uses of stone here include that for concrete, mortar, general construction, buildings, etc.

By far the bulk of stone being extracted in the area comes from private land. The only commercial quarry operating on public land is at Skeleton Hill near Chiltern (see Table 25).

Each of the local municipalities has a continuing demand for stone, and collectively they extracted about 188,000 cu.m for the year ending June 1983. Only four of the 13 shires extract stone from public land, utilizing five public land sites in that year. The quantity extracted from these five sites was 26,000 cu.m, representing 14% of total shire requirements.

State authorities also maintain roads in some areas of public land. The Forests Division operates the Walwa Road Quarry in the Koetong Plantation. In 1981, 12,700 cu.m of gravel was extracted, of which the Shire of Tallangatta purchased 2,600 cu.m. The current road maintenance and construction program by the Division will extract in excess of 4,000 cu.m from this quarry in the current year. The Forests

Sand deposits used for extraction, Reedy Creek, Eldorado



Mine dumps are used for road-making materials

Division at Mansfield operates two pits on public land for its *roading requirements.*

A large road program is current in the Stanley Plantation, with the Forests Division at Beechworth utilizing some 20,000 cu.m of gravel per annum from tailings licences, as shown in Table 25.

Tailings licences are a common source of gravel for road construction. As can be seen from Table 24, 18 tailings licences are current in the study area, 17 of these being held by local government or a State authority for road purposes. Local government holds 13 tailings licences, but used only two sites for extractions in the 12 months ended June 1983, taking 2,000 cu.m from tailings at Eldorado and 1,000 cu.m from tailings at Rowdy Flat South.

Table 25 lists all current extraction sites on public land in the study area, and these are also indicated on Map 8.

References

Bureau of Mineral Resources, Geology and Geophysics (1982). 'Australian Mineral Industry Annual Review, 1980.' (A.G.P.S.: Canberra.)

Chenoweth, L.M. (1973). 'Terminal Report to Victorian Mines Department for M.E.L. 434 at Bethanga, for Western Mining Corporation.' (Victorian Department of Minerals and Energy: Melbourne.)

Hill, M. (1976). Tin. In 'Geology of Victoria', *Geological Society of Australia Special Publication* No. 5, 453.

Nott, R.J. (1982). Geochemical Index Series, 1982. *Geological Survey of Victoria Unpublished Report* No. 1982/15.

Table 25

STONE EXTRACTION FROM PUBLIC LAND, BENALLA--UPPER MURRAY
JULY 1982--JUNE 1983

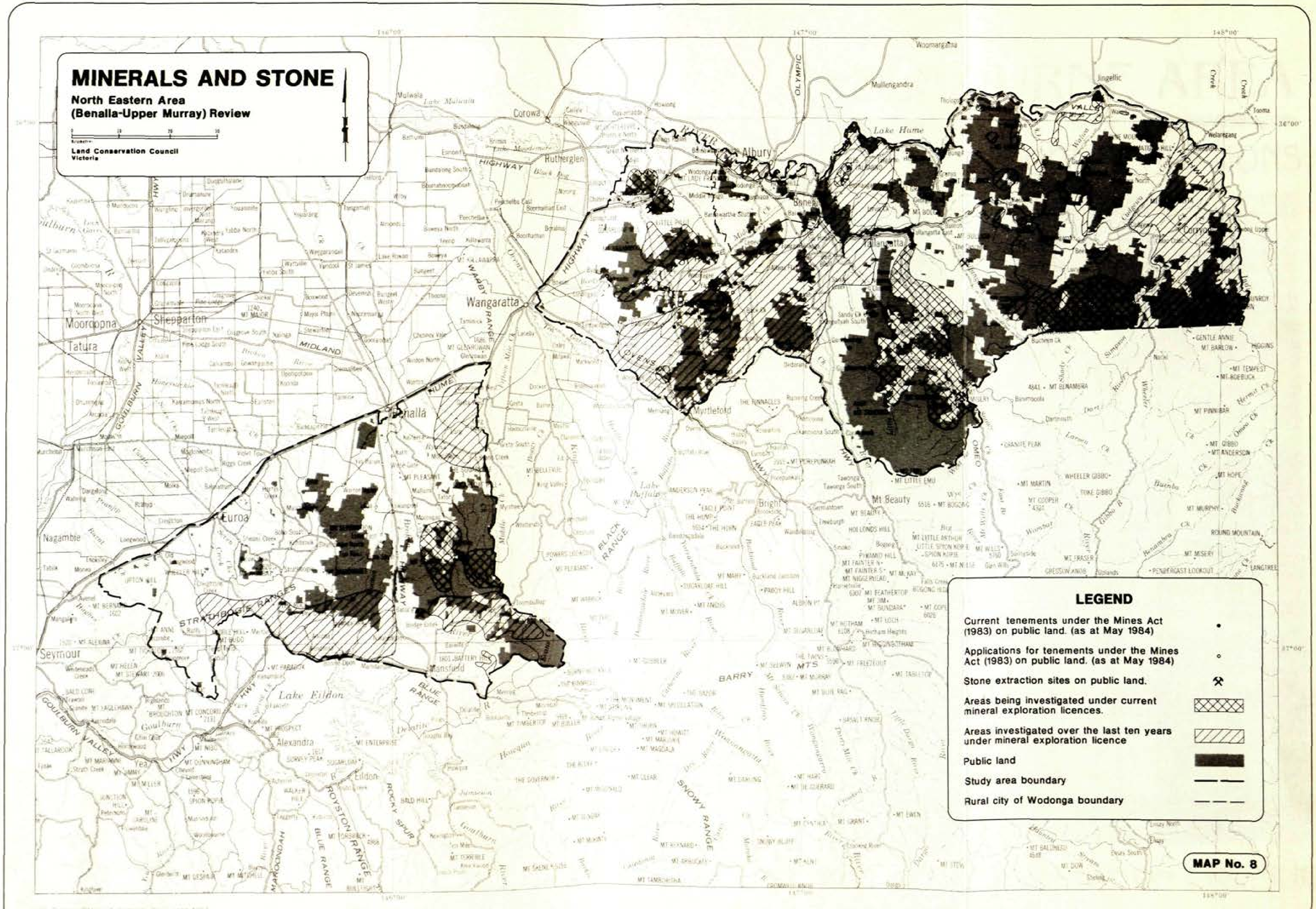
Operator	Total (cu.m)	Percentage from Public land	Comments on public land extraction
Municipality			
Beechworth	33,500	0	Three tailings licences are current; last extraction was in 1981
Benalla	15,000	0	
Bright	0	0	
Chiltern	15,100	60	Granite sand taken from one pit on uncommitted public land, Barambogie
Euroa	15,000	0	
Goulburn	6,000	0	
Mansfield	0	0	
Myrtleford	0	0	
Tallangatta	15,800	60	Mainly from Walwa Road Quarry; in addition, 3,000 cu.m from Tallangatta Creek in early 1984 and intermittent use of tailings at Walwa: current application to extend in Mitta Mitta River
Violet Town	6,000	0	
Wangaratta	2,400	83	From Tailings Licence 4380, Eldorado

Table 25 (continued)

Operator	Total (cu.m)	Percentage from public land	Comments on public land extraction
Municipality (continued)			
Wodonga (City)	28,500	5	Small amounts from anabranch of Kiewa River near Whyte Hill
Yackandandah	24,000	25	Two sites in 1983: along Kiewa Road south of Keegan's Bridge: tailings from Rowdy Flat South; application to extract from Kiewa River at Gundowring
Upper Murray	26,500	0	
State authority			
Forests Division			
Beechworth	20,000	100	Principally from Tailings Licence 4930 and used for Stanley Plantation road
Mansfield	2,500	100	Two pits: Contis pit adjacent to the Tatong--Tolmie Road, and Samaria Pit
Tallangatta	3,200	100	Walwa Road Quarry: current annual extraction rate exceeds 40,000 cu.m
Private industry			
Extractive Industry Lease 286	6,556 (1981/82)	100	Operating hard-rock (hornfels) quarry at Chiltern State Park

Smith, A. (1974). 'Final Report on Mineral Lease 9048, Pine Mountain, North-eastern Victoria.' (Victorian Department of Minerals and Energy: Melbourne.)

Whiting, R.G., and Bowen, K.G. (1976). Gold. In 'Geology of Victoria', *Geological Society of Australia Special Publication* No. 5, 448.



© Crown (State of Victoria) Copyright 1984

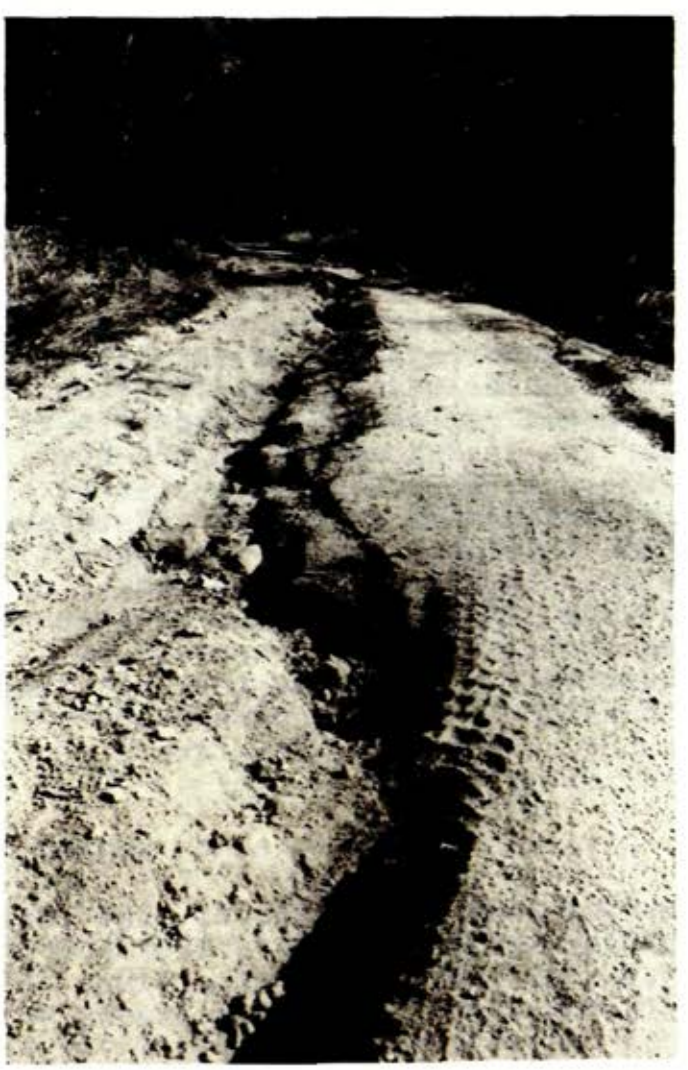
19. HAZARDS

Hazards are here defined as biological and physical processes that threaten the integrity of land and lower its productivity. To retain the productivity of land it is important that actual and potential sources of environmental degradation are identified and controlled.

Soil Deterioration

Soil formation, movement, and redeposition occur naturally and form part of the continuing geological process. If the land is not used properly, however, soil loss may be speeded up, and/or fertility reduced.

Appendix VII gives a system for rating the erosion risk of land, which involves its classification into five classes based on the soil and site properties of recognized land units. The proportions of public land in the study area in each class are shown at the end of each block description.



Track erosion, Lightning Ridge, Lima east

Most public land falls in the higher-risk categories, indicating the extent to which the less-erodible land on the plains and along the river valleys has been alienated for agriculture, while that on the steeper slopes has been left unalienated. The soils vary in their resistance to erosion, governed by the constituents of the soil and their cohesion, the existence of a vegatative covering, and the condition of the surrounding terrain. Land management is also important: flat land along streams may have a low erosion risk, but if it is poorly managed and over-cultivated, it may deteriorate severely, as has occurred with many streams in the study area.

Soil deterioration involves the community in long-term losses, such as a permanent reduction in productivity and versatility of the land. In addition, correction of such deterioration involves a direct cost for restoration.

Part of the eroded soil is carried into streams. The resultant silting can increase the occurrence of flooding and the cost of water storages, and reduce the fertility of floodplains. Increased turbidity, colour, and total dissolved solids can increase the cost of using water for domestic and industrial purposes.

In natural forest the main period of high erosion hazard is the summer and autumn. Loss of vegetation cover increases it. Soil loss from severely burnt land can be considerable, especially if a vegetative cover does not become re-established relatively quickly.

Most forms of soil erosion are present in the study area, but erosion on public land is serious in only a few localities.

Wildfire

The area has a high risk of wildfire during summer, due to a combination of hot dry weather and the highly flammable nature of the vegetation. Although man starts most fires here, lightning is also a major cause. Of fires attended by Forests Division personnel over the last 10 years in the part of the study area east of Wodonga, about 40% were started by lightning compared with the State average of 25%. Elsewhere in the study area, the figure is closer to the average.

In an endeavour to minimize the damage and extent of wildfires, the responsible fire-fighting authorities rely on reducing the hazard by low-intensity burning under safe conditions, ready detection of wildfire outbreaks, and up-to-date suppression methods using skilled fire-fighting forces and efficient equipment.

Rivers

The hydraulic and environmental characteristics of most Victorian rivers have changed dramatically since settlement. Moreover the present condition of many of the rivers and their frontages is unsatisfactory and is becoming steadily worse with every flood.

Settlement of the catchments and their development as stable productive units is a necessity. But the loss of environmental and social values, the silting of river courses, estuaries, and water storages, and the destruction of the river frontage lands that have all resulted run contrary to the interests of the State as a whole.

In proposing solutions to the problems of rivers, we need to compromise between the community's wishes:

- to use rivers for the strictly hydraulic purposes of water supply, flood control, and drainage
- to use them for their environmental, landscape, and recreation values
- to use the land of the catchments, flood-plains, and frontages for agriculture

These different uses for rivers compete with one another, but each has its part to play when arriving at a formula for a balanced, long-term, stable, and productive system.

Flooding

Floods in the study area seldom present a problem in moderately graded to steep mountain streams with little or no flood-plain adjacent to the main course, as high flows are generally contained within the banks and cause little or no damage. The Murray, Mitta Mitta, Kiewa, Ovens, and Broken Rivers and downstream sections of their main tributaries are not so steeply graded, however, and in most years flows overtop the banks.

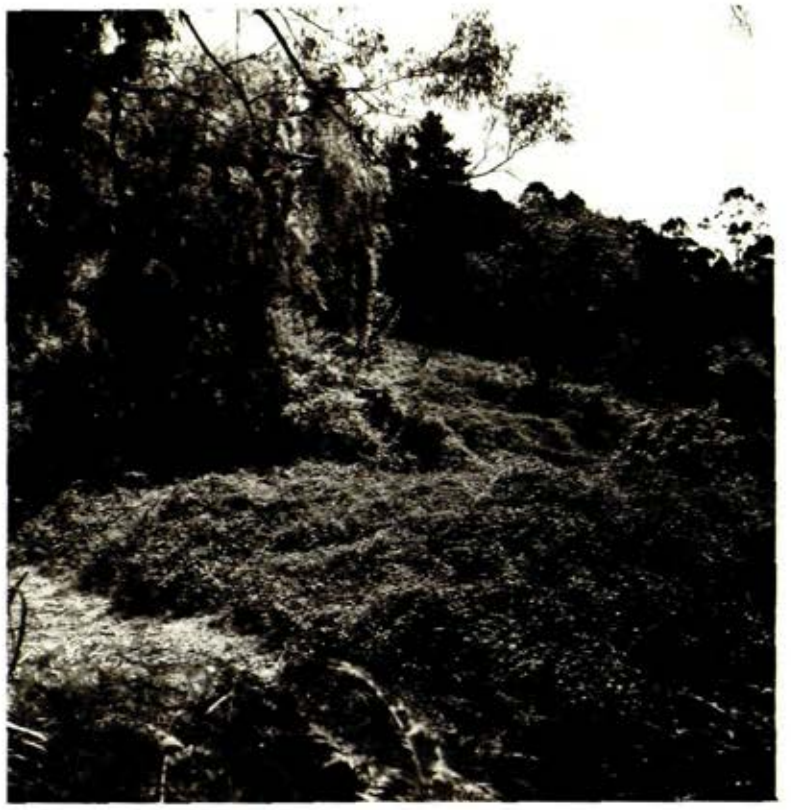
Usually these peak flows last only a short time, submersion causes little damage to pasture, and existing bank-protection works limit erosion damage to minor proportions. The spread of urban development onto flood-plains, however - for example, at Myrtleford, Wangaratta, and Benalla - increases the likelihood that buildings will be inundated in years of peak flooding. Likewise, roads constructed across the flood-plains may be cut.

While the frequency and intensity of rainfall determine when flooding can occur, it is the condition of the catchment itself that determines the rate at which this precipitation runs off into streams. Removal of the vegetative cover over large areas of a catchment through intense fire, or extensive clearing, increases the frequency and severity of flooding of streams.

Biological Hazards

Noxious weeds

In Victoria, 103 plants have been proclaimed as noxious weeds under the provisions of the *Vermin and Noxious Weeds Act* 1958, and 44 of these are found within the study area. In general, their distribution is limited to semi-improved agricultural land, undeveloped land, or land that has been



Severe blackberry infestation - at Bunston Hill

disturbed. Many of them are found only in isolated patches or have very limited distribution - African lovegrass (*Eragrostis curvula*) has so far only been found here along the Hume Highway, and efforts are being made to eradicate it.

Priority is also being given to the eradication of four other noxious weeds that are not extensively established in the study areas. A fifth weed, prairie ground cherry (*Physalis viscosa*), is firmly established, however, and its eradication is not likely to be possible, although control measures are enforced where the plant is a threat to adjoining clear areas.

Other noxious weeds causing localized problems with different degrees of significance include blackberry (*Rubus fruticosus*), St John's wort (*Hypericum perforatum*), Paterson's curse (*Echium plantagineum*), boxthorn (*Lycium ferocissimum*), hawthorn (*Crataegus* spp.), and sweet briar (*Rosa rubiginosa*). In general, control measures are preventing further spread of these and other noxious weeds.

Pest animals

The rabbit population throughout is reasonably low, but numbers can rapidly increase under favourable breeding conditions. In such years rabbits are still a significant problem - particularly in the granitic areas around Beechworth, Eldorado, and Barambogie. While poisoning has been favoured in the past as the most efficient means of achieving a rapid reduction in rabbit numbers, other control methods also have an important role. Fumigation and warren-ripping can be very effective means, while myxomatosis continues to be a very significant disease of rabbits - using rabbit flea and mosquito vectors to spread the disease. Destruction of har-

Litter and car bodies on uncommitted land near Tolmie

bour such as blackberry, boxthorn, bracken fern, and fallen timber is, however, an essential part of any successful long-term control program.

Foxes and feral cats are common, although population levels fluctuate widely. Dingoes (*Canis familiaris dingo*), feral dogs, and their hybrids are declared vermin throughout the State and cause problems to some land-owners in the more remote parts of the study area. Dog numbers are sufficient to preclude the Tallangatta Creek, Mitta Mitta River, and upper Murray River valleys from sheep production.

Feral pigs occur principally in the west of the study area, although small scattered populations are found in the larger blocks of public land elsewhere. They can cause problems in town water-supply catchments by disturbing earth in riparian areas. Wild goats have restricted occurrences here and are not generally a problem.

Direct alteration to streams and other changes in the environment since European settlement have adversely affected the survival of native fish in the streams. Many of the changes have been acceptable to introduced fish species, which have moved into areas previously occupied by native fish.

The European carp - although present in some waters (such as the Broken and Ovens Rivers and Lake Eildon) - does not seem to have significantly affected the native fish populations in the study area.

Insects

The local forests are principally of mixed eucalypt species. The areas of pure stands are not extensive. This diversity of vegetation on public land helps to keep the pathogen--host--predator relations in balance, so plagues of insects seldom occur.

The introduced sirex wood-wasp (*Sirex noctilio*) is present in the pine plantations. The population level is low, however, and biological control using nematodes that cause sterility in sirex is being adopted.

Tree Decline on Rural Land

Tree decline on farmland is increasing in the study area. This problem afflicts many parts of the country and results from a combination of causes - including insect attack, root damage due to stock, isolation of trees, altered fertilizer regimes, and fungal attack. Assistance is available to landowners through the Department of Conservation, Forests and Lands by way of advice, and direct financial assistance through the Tree Growing Assistance Scheme.

PART IV

BLOCK DESCRIPTIONS

DESCRIPTIVE BLOCKS

North Eastern Area
(Benalla-Upper Murray) Review

Kilometres

Land Conservation Council
Victoria

WOMBAT
1
RUFFY
DRY CREEK
WEEP HILLS
4
LURG
STRINGYBARK
WANDILIGONG
5
INDIGO
KIEWA (WEST)
KIEWA (EAST)
BULLHEAD
WALWA
ELLIOT
BUNSTON

LEGEND

Public land (NOTE: Many small areas of public land not shown)

Descriptive block boundary

Study area boundary

Rural city of Wodonga boundary

MAP No. 9

© Crown (State of Victoria) Copyright 1984

BLOCK DESCRIPTIONS

The original descriptive reports by the Land Conservation Council covering the North-eastern area divided the three districts into 31 blocks to facilitate a detailed description and assessment of natural resources. In this review the 31 blocks have been amalgamated into ten groups that have broadly similar climate, soils, topography, and vegetation. The block names used in the original report have been retained for continuity.

Map 9 shows the location of the 31 descriptive blocks and the boundaries of the ten groups into which they have been amalgamated.

The present tenure, nature of the land, capability for various uses, and likely land use hazards are described for each group. A consistent format of headings and subheadings has been used to enable the reader to compare specific data for various blocks. The information on land uses in this section of the report refers to the public land except where explicit reference is made to the private land. Within each block the discussion is concentrated on the resources and potential uses of the uncommitted land.

Capability

This term refers to the value of the land for the particular use to which it may be put. Present levels of use are described, where possible, to give some indication of capability. Capability for some uses, such as nature conservation, is based primarily on the land's inherent characteristics. For others it also depends on inputs (such as fertilizer application) that raise the productivity.

Capabilities are assessed in general terms only, because the amount of information available varies from block to block and because some values are difficult to quantify. In assessing capabilities, comparisons have been made with other blocks and with other parts of the State.

1. RUFFY--WOMBAT

A. Tenure and Nature of the Land

1. Present tenure

The public land totals approximately 3,300 ha, made up of a number of small parcels. The largest parcel, Mount Wombat--Garden Range Flora and Fauna Reserve, covers 1,400 ha. Other conservation reserves include the Seven Creeks Wildlife Reserve (250 ha), the Big Hill Flora Reserve (60 ha), Tenneriffe Flora Reserve (60 ha), and three bushland reserves (totalling 240 ha). The Euroa Hill Bushland Reserve recommendation, however, has not yet been accepted by government, pending a decision on the route of the Hume Freeway Euroa by-pass. There are 131 ha of softwood plantation at Mount Barranhet. Uncommitted land totals 500 ha.

2. Climate

Average annual rainfall ranges from about 510 mm in the north to 1,020 mm in the south. The rainfall on the plateau has a definite winter maximum. Summers are relatively hot and dry at the lower elevations and warm on the massif. Winters are cold, with occasional snowfalls on the higher country.

3. Geology and geomorphology

The Strathbogie massif, a granite intrusion of Devonian age, dominates the block. Lowlands extend up the main streams - Seven Creeks, Castle Creek, Creightons Creek, and Sheans Creek. The lowlands are replaced by steep, dissected slopes that rise to an undulating plateau surface with Mounts

Seven Creeks - Euroa

Barrenhet and Wombat, at elevations of 823 m and 799 m respectively, being the tallest features. A scarp to the east of Seven Creeks and south of Sheans Creek is underlain by granite with minor aplite. This continues east for about 10 km, where it forms the boundary between granitic and acid volcanic rocks and also the approximate watershed boundary between Seven Creeks and north-westerly flowing streams such as Faithful Creek.

4. Soils

Soils of the public land on granitic parent material include red duplex soils and weakly bleached gradational soils on the plateau, undifferentiated stony loams and coarse sandy loams on steep slopes, and friable red and brown gradational soils on less-steep slopes. On hillslopes where parent materials are acid volcanics, red and yellow duplex soils and coarse sandy loams predominate.

5. Vegetation

The Mount Wombat--Garden Range area supports a variety of vegetation types, including messmate open forest (usually with bracken and silver wattle understorey), narrow-leaf peppermint open forest with a grassy or bracken understorey, and open heaths and open forests of red stringybark and long-leaf box on the drier sites along the scarp. Considerable areas of bare rock occur near the summit of Mount Wombat and forest red gum open forest with a heathy understorey is present on the rocky hillsides near Kelvin View.

The Euroa Hill bushland reserve east of Euroa supports white and grey box with a grassy understorey. Hickory wattle *(Acacia penninervis)* - a species of restricted occurrence in Victoria - grows in the Big Hill and Tenneriffe Flora Reserves. The other parcels of public land generally support open forests of narrow-leaf peppermint, or messmate and in some cases (in the drier northern section) stands of long-leaf box.

6. Fauna

Although much of the land in this block has been alienated, it still possesses a moderately diverse mammal fauna, with 23 native species present, including the rare tiger quoll. Long-nosed bandicoots have been recorded in wetter vegetation in this block. A roadside verge of mature narrow-leaf peppermint, blue gum, and candlebark along Old Coach Road south of Strathbogie supports a population of the rare brush-tailed phascogale, illustrating the importance of these remnant vegetation patches to some species. The rufous bettong, which is now extinct in Victoria, was last recorded in the study area at Violet Town in 1874.

Mount Wombat is an outlier of the cool-temperate Bassian environment and supports many of the bird species typical of these habitats, such as brown thornbill, white-browed scrubwren, red-browed treecreeper, eastern yellow robin, and crimson rosella. Raptors are also well represented, with both the powerful owl and peregrine falcon breeding here.

The bush thick-knee is present in some of the open areas in this block, and remnant vegetation and roadside verges provide potential habitat for the grey-crowned babbler.

B. Present Use and Capabilities

1. Nature conservation

Because of the isolated nature of public land in the block, capability for flora and fauna conservation is moderate. The major reservation for fauna has been the stream frontage of Seven Creeks above Galls Gap road for the conservation of the trout cod and other native fish. Mount Wombat has been reserved for the protection of flora and fauna (Mount Wombat --Garden Range flora and fauna reserve), while areas at Upton Hill and Bald Hill are bushland reserves. (Euroa Hill is subject to a decision on the route of the Hume Freeway Euroa by-pass and has not yet been accepted by government).

In addition, flora reserves have been created at Tenneriffe and Big Hill to preserve the occurrences of hickory wattle.

2. Recreation

Capability for recreational usage is subordinate to nature conservation considerations on most of the public land. The Mount Wombat area has values for sightseeing, picnicking, nature walks, camping, and rock-climbing. Features include a scenic lookout point, a waterfall, and outstanding wildflower displays. Seven Creeks Run, a tourist complex highlighting our country's associations with wool-production, adjoins the proposed Euroa Hill Bushland Reserve.

3. Water supply catchments

Parts of the Seven Creeks (Euroa) and Honeysuckle Creek water supply catchments are located in this block.

4. Agriculture and apiculture

Final Recommendations for North-eastern Area, District 2, published in 1974, recommended three areas of this land (totalling some 260 ha) for alienation for agriculture. The balance of the public land either is unavailable or has a low capability for agriculture.

Capability for apiculture is moderate to low. However, the block serves as a valuable build-up area in spring because of capeweed, Blakely's red gum, river red gum, and white box flows.

5. Softwood production

It is government policy that the clearing of intact native forest for softwood planting be phased out.

6. Hardwood production

Public land in the block is not used for hardwood production because of either reservation or unsuitability.

Church Camp, Mount Wombat

7. Mining and Quarrying

Mineral production capability of public land is low; a minor occurrence of molybdenum near Euroa and a basalt quarry on private property near Seven Creeks are the only such deposits in the block.

8. Hazards and conflicts

The sheet erosion hazard is high on steep northern slopes in the north of the block and moderate on steep slopes and foothills in the western section. Light-textured soils formed on granite are very prone to gully erosion. On less-steep slopes the erosion hazard is low.

Erosion risk ratings for public land in this block are as follows:

Class	Public Land (%)
1	-
2	2
3	7
4	16
5(a)	72
5(b)	4

The fire hazard is moderately high. Fishing in the Seven Creeks could conflict with conservation of the trout cod.

2. WARRENBAYNE--TOOROUR--DRY CREEK

A. Tenure and Nature of the Land

1. Present tenure

Public land totals approximately 33,000 ha, virtually all located in one large consolidated parcel centred on the Strathbogie Ranges. In the northern part extensive softwood plantations have been established: softwoods already established total 5,766 ha net, and a further 540 ha of land have previously been recommended for softwood production but not yet planted. A further 6,500 ha of public land adjoining these plantations are maintained under native vegetation as forest area.

Conservation reserves include two reference areas - Toorour (470 ha) and Glen Creek (390 ha) - and 380 ha of land at Lima South set aside as an education area. A large tract in the southern portion of this parcel of public land is managed for hardwood production (6,900 ha) and contains some of the most productive hardwood forest in the Strathbogie Ranges.

Uncommitted land covers 8,000 ha and is located in two blocks: one west of Lake Nillahcootie and the other near Gerars Creek.

2. Climate

Average annual rainfall ranges from 630 mm in the north to as high as 1,270 mm on the plateaux, with a definite winter maximum. Winters are cold, with occasional snowfalls on the higher country, while summers are relatively hot and dry at the lower elevations and warm on the plateaux.

3. Geology and geomorphology

The Strathbogie massif is again the principal feature of the block. Consisting of Devonian granite and, north of a line between Boho South and Lima, Devonian rhyodacite, the massif is moderately to strongly dissected, with a few plateaux. It falls to the alluvial Benalla Plain in the north and the Mid Goulburn terrain in the south. Much of the massif is above 600 m, the highest point being Mount Strathbogie with an elevation of 1,007 m. Most of the Mid Goulburn terrain overlies Devonian--Silurian mudstones, siltstones, and sandstones, which form a much-dissected landscape. Streams flowing south into Lake Eildon include Merton, Hayfield, Gerar, Brankeet, Dry, Tallangalook, and Glen Creeks. Those flowing north include Lima, Five Mile, Warrenbayne, and Honeysuckle Creeks, while streams flowing north-east into the Broken River or Lake Nillahcootie include Moonee Moonee, Rocky Ned, Parlors, and Sandy Creeks.

4. Soils

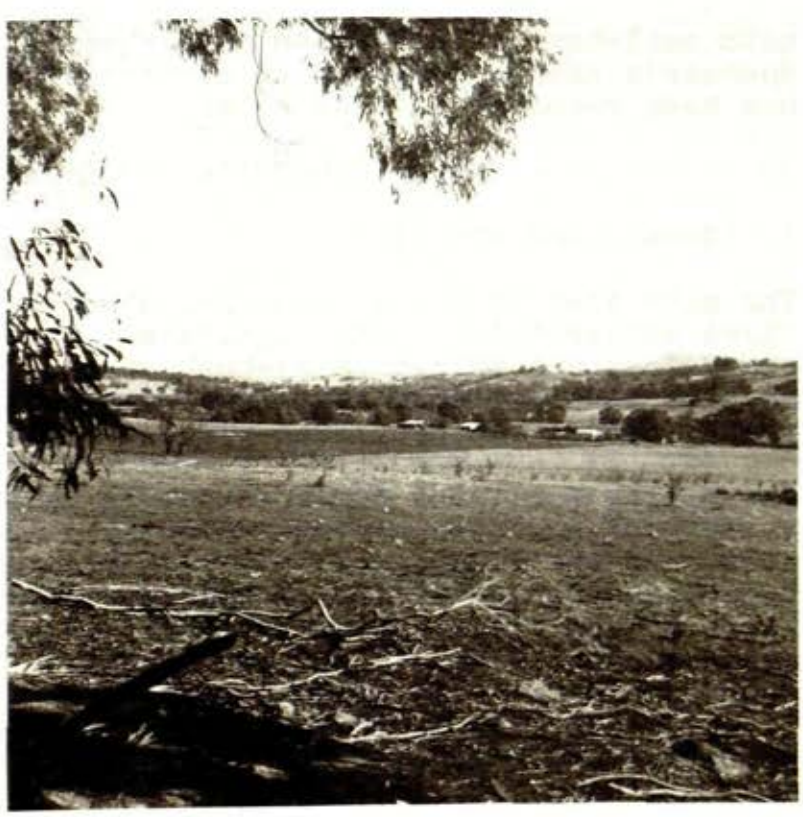
Where granite is the parent material on the plateaux, red duplex soils predominate. The steep slopes have undifferentiated stony loams, the rolling ridge-tops and major valleys have friable brown or red gradational soils, and the foothills at lower elevations have red or yellow duplex soils. The rhyodacite plateaux and broad ridges carry friable brown gradational soils and friable red gradational soils (with weakly structured subsoils). Yellow duplex soils predominate on the adjacent slopes and foothills.

5. Vegetation

Scattered stands of messmate open forest III and IV grow at the higher elevations on the plateaux or on sheltered sites. The understorey on the plateaux is typically a dense layer of bracken over-topped by silver wattle; an understorey of low ferns, musk daisy-bush, and scattered blackwoods may be present on sheltered sites.

Narrow-leaf peppermint open forest III predominates in the higher-rainfall areas, with an understorey of bracken, common cassinia, and silver wattle or grasses. Some gullies have a dense understorey of musk daisy-bush, hazel pomaderris, and blackwood. On the dry montane slopes and foothills broad-leaf peppermint--red stringybark open forest II predominates, with a typically grassy understorey. Red stringybark--long-leaf box open forest II, with red box as an associated species, also occurs on the drier sites, usually with either a heathy or grassy understorey.

Mount Strathbogie and an adjacent high point carry candlebark--snow gum open forest I with a grassy or mossy under-



Strathbogie massif near Boho South

storey. Blakely's red gum has restricted occurrences at low elevations in areas of poor drainage.

6. Fauna

The fauna of this block is representative of many of the mountain forest areas in the north-east of Victoria. It includes one of the most diverse mammal populations for the study area, with 30 native species recorded. The eastern pygmy-possum, an uncommon and infrequently recorded species, is present. Feathertail gliders and yellow-bellied gliders have been detected by recent predator scat analyses, while roadside verges in the Warrenbayne area support the uncommon squirrel glider, which appears to have decreased in numbers over recent years. The long-nosed bandicoot has been recorded at several localities in the Strathbogie Ranges and the greater glider and koala are found in higher densities here than in other blocks of the study area. Two uncommon bat species, the common bent-wing bat and great pipistrelle, have been recorded in low numbers in tall open-forest habitats. Brush-tailed phascogales have been located in the drier edges of the native forest blocks, and the eastern quoll, now extinct on the mainland, was recorded around the turn of the century in the Warrenbayne region.

Most of the birds typical of mountain forest areas of Victoria have been recorded in this block, as well as species usually found in more open, drier habitats, such as budgerigars and bush thick-knee. The square-tailed kite has been recorded in the Lima East area, and peregrine falcons nest near Mount Strathbogie. Bird distributions in the drier areas of this block appear to be changing in response to gradual habitat changes; for example, the grey-crowned babbler has disappeared from the area in the last 15 years, while turquoise parrots appear to be increasing here. Reptiles and amphibians are well represented in the block, with both cool-temperate Bassian and Eyrean species present. Spencer's skink, an arboreal species found in wet forest, has been recorded in this block.

B. Present Uses and Capabilities

1. Nature conservation

The main area of public land has a moderate capability for flora conservation. The significant species *Tetratheca glandulosa* and twiggy daisy-bush *Olearia ramulosa* var. *rigida* have been recorded near Lima. Interesting species in the south include the grey bush-pea and box-leaf wattle.

Capability for fauna conservation is moderate. A large variety of ground-dwelling and aboreal mammals inhabit the area, and the tiger quoll has been recorded here. The wonga pigeon and peregrine falcon frequent the forests in the north of the block, where the white-browed babbler and grey-crowned babbler have also been recorded. The rare turquoise parrot appears to be present in increasing numbers. Reptiles are well represented and amphibians less so. Spencer's skink, recorded at only two localities in the study area, is found here.

2. Recreation

For many forms of outdoor recreation, capability is moderate to high. The greatest attraction to visitors is Lake Eildon, the Bonnie Doon arm of which falls within the study area. The Lake provides opportunities for a variety of water sports - including angling for trout and redfin. A number of people also visit the old gold-mining areas of Tallangalook, Dry Creek, and Glen Creek, and the crystal mine near Barjarg road. The forest environment and scenic viewpoints from Golden Mountain and Wild Dog Bluff offer attractions to hikers and campers, as do the Moonee Moonee Creek Valley and Lightning Ridge. Other features include fishing along Lima, Moonee Moonee, and Sandy Creeks, a waterfall on Sandy Creek, and a scenic viewpoint and rockface at Mount Sugarloaf.

3. Water supply catchments

Parts of the Honeysuckle Creek, Seven Creeks (Euroa), Lake Nillahcootie, and Lake Eildon water supply catchments are located in this block.

4. Agriculture and apiculture

Most of the public land has a moderate to low capability for agriculture due to steep slopes and/or summer droughts, with the exception of some creek valleys. Most river flats and valleys have already been alienated for agriculture.

Capability for honey production and pollen build-up is high, but wintering capability is low. All available sites are fully utilized. Red stringybark forests provide the main honey crop in the north, while blue gum, manna gum, candlebark, red stringybark, and river red gum, and messmate (in descending order of importance) are the principal species in the centre and south.

5. Softwood production

Narrow-leaf peppermint open forest III and purchased farmland have provided the principal source of land for softwood establishment in the north. It is government policy that clearing of intact native forest for softwood planting be phased out. Freehold land recently purchased totals 72 ha.

6. Hardwood production

The capability for hardwood production is low in the dry open forests in the north of the block, but very good in the areas of blue gum and messmate on the plateaux. Narrow-leaf peppermint is also utilized, although it is not as suitable for timber production. The value of the southern plateaux portion for timber production was recognized by the designation of 6,900 ha for hardwood production.

7. Mining and quarrying

In general the capability for mineral production is low, with the exception of the central portion. Here, minor deposits of felspar and occurrences of tin, antimony, and rock

79652/84—6

crystals are found. The Tallangalook gold-field lies in the southern part and this has been regularly prospected for gold under search licence, exploration licence, and Miner's Right claim. Because of the patchy to low-grade return of the deposits in this field, the area is generally only prospected by individuals or small groups. One Miner's Right claim is current. In the south of the block, investigations for fluorite have taken place near Sandy Creek, under a mineral-search licence.

8. Hazards and conflicts

A high gully and sheet erosion hazard applies on steep northern montane slopes and a moderate hazard on the foothills. Tunnel erosion occurs along the northern slopes of the plateaux, and these colluvial slopes are a major intake area exacerbating the dry-land salting that is apparent on adjacent freehold land. Erosion hazard is generally low on the plateaux and the less-steep slopes.

Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	-
2	2
3	8
4	19
5(a)	66
5(b)	5

The fire hazard is high to moderate.

Sirex wood wasp is a hazard to softwood production, but is kept in check by silvicultural practices and the use of biological control agents.

Recreation on Lake Eildon could affect water quality unless controlled.

3. STOCKYARD--RYANS--SAMARIA--HAT HILL--BUNSTON

A. Tenure and Nature of the Land

1. Present tenure

This block covers land in the Toombullups and Mount Samaria as well as land in the headwaters of the Broken River and of Evans Creek. It contains a total of 46,700 ha, the bulk of which is located in large, consolidated blocks.

The largest conservation reserve is the Mount Samaria State Park, which covers 7,200 ha. Other conservation reserves include the Hat Hill flora and fauna reserve (760 ha), the Toombullup Historic Area (270 ha), and two reference areas (total 720 ha). Two water supply reservoirs - the Loombah Weir and Lake McCall Say - supply water to Benalla; and Lake Nillahcootie, an irrigation storage on the Broken River, adjoins the Midland Highway to the west of Mount Samaria State Park.

A total of 3,500 ha north of Tolmie have been reserved on the plateau for hardwood production and a total of 2,978 ha net of softwood plantations have been established on public land. A further 1,436 ha of public land were allocated for softwood production under the Council's previous recommendations but have not yet been planted, and 3,050 ha of public land adjoining the softwood plantations are maintained under native vegetation as forest area.

Uncommitted land comprises a large parcel in the headwaters of Evans Creek and the Broken River, a large parcel in the Northern Toombullups, and smaller parcels adjoining the Hat Hill flora and fauna reserve, north of Mount Samaria State Park, and along Hollands Creek. There are several scattered parcels of uncommitted land north of Tatong.

2. Climate

Average annual rainfall ranges from 760 mm to more than 1,270 mm at higher elevations. Light snow may fall several times during winter at higher elevations. Frosts are common and often severe on the highlands, and occur from autumn through to spring. Temperatures in summer are generally lower in the highlands than in the adjacent valleys.

3. Geology and geomorphology

The Tolmie Highlands are the dominant feature of the block. They consist predominantly of broad ridges and plateaux bounded by montane slopes - except in the south around Mount Battery and Bunston Hill, where they consist of long gentle slopes descending to the Mansfield Plain in a south-westerly direction, and in the headwaters of the Broken River and Evans Creek, where they are deeply dissected.

The highlands reach elevations in excess of 900 m, with Mount Samaria reaching 953 m, and fall away to elevations of more than 300 m on the Mansfield Plain in the south and less than 300 m on the Benalla Plain in the north.

The uplands are of various geological origin. They consist principally of Devonian volcanics, with outcrops of Ordovician sedimentary rocks, Tertiary basalts, Devonian granite, and Cambrian greenstones being relatively minor in extent in the north. Lower Carboniferous sandstones and conglomerates and Tertiary basalts outcrop in the centre and south, while the geology of the Mount Samaria area is the most complex - consisting of Devonian granite, Devonian acid volcanics. Devonian--Silurian sedimentary rocks, Cambrian greenstone and chert, and Ordovician sedimentary rocks. Lower Carboniferous sedimentary rocks form an undulating landscape in the south of the block. Mansfield and Benalla Plains are composed of Quarternary alluvial deposits.

The Broken River flows westwards along the southern edge of the highlands. It then continues north from Nillahcootie to Benalla between the highlands and the Strathbogie massif. The other principal northwards-flowing streams are Evans Creek (headwaters), Ryans Creek, Holland Creek, and Samaria Creek. Black and Ford Creeks flow to the south into Lake Eildon.

4. Soils

Soils are diverse. On the granitic plateau, red duplex soils and weakly bleached gradational soils are found. On the granitic slopes the predominant soils are undifferentiated stony loams, which together with yellow duplex soils also occur on acid volcanic slopes. The foothills of acid volcanics have stony loams, yellow duplex soils, and weakly bleached gradational soils, while the foothills of Devonian --Silurian sedimentary rocks have mainly weakly bleached gradational soils and red duplex soils.

On Tertiary basalt and Cambrian parent materials, the rolling plateaux and upper valleys carry friable red gradational soils (with well-structured subsoils); the steep slopes on the older material have undifferentiated stony loams and weakly bleached gradational soils.

The major soils on the Tolmie plateau are red and yellow duplex soils, while those of the slopes descending to the Mansfield Plain vary from yellow duplex soils and weakly bleached gradational soils to undifferentiated stony loams. On Upper Devonian volcanics in the Holland and Ryans Creeks upper catchments, friable brown gradational soils predominate.

5. Vegetation

This block has a particularly diverse vegetation, ranging from open forests of snow gum with a grassy understorey to red stringybark--red box open forest with a sparse understorey on the drier aspects. The following other units are present.

Alpine ash open forest IV (mainly regrowth) has a grassy or wet forest understorey.

Messmate open forest III has a bracken and silver wattle to wet forest understorey, while narrow-leaf peppermint open forest III occupies upper elevations, with a range of dry to wet forest understoreys.

Broad-leaf peppermint open forest II (mixed with candlebark in wetter areas) has a grassy understorey with scattered mountain grevilleas; and sparse grasses also grow under the red stringybark--broad-leaf peppermint open forest II. Mountain swamp gum open forest II associated with the drainage lines at higher elevations may have a grassy or shrubby understorey.

Some small stands of Blakely's red gum are found in the driest situations in the north, while small pockets of river red gum grow in a few drainage basins at low elevations in the Mount Samaria State Park and more extensively on private land on the Mansfield Plain.

Narrow-leaf peppermint on Toombullup Plateau

6. Fauna

This area supports a diverse mammal fauna, including 30 native species. The only record of the eastern horseshoe bat for the north-east came from within this block, in a disused mine shaft east of Fords Bridge. Nine other bat species were detected in the block, all of which use trees rather than caves for roosting. Yellow-bellied gliders were found at several localities throughout the block, and the eastern pygmy-possum and feathertail glider have been recorded.

The brown antechinus, an inhabitant of many of the wetter forest types, is widespread and common, while the yellow-footed antechinus is restricted to the drier country in the extreme north.

Some of the more interesting birds in this block include the peregrine falcon, square-tailed kite, and bush thick-knee, while the wetlands associated with Lake Nillahcootie provide habitat for a wide variety of waterfowl.

View - Mount Samaria State Park

The range of habitats from dry forest to sub-alpine woodland provides for a large number of reptile and amphibian species (including Spencer's skink, the blind snake, and the mountain dragon).

B. Present Uses and Capabilities

1. Nature conservation

Capability for flora conservation is moderate with the exception of Mount Samaria, where the capability is high due to the diversity of vegetation types - from low open forests of red stringybark and long-leaf box with grassy understorey to tall open forests of candlebark with a shrubby understorey, with messmate and mountain swamp gum also found. This vegetation has established on soils developed *in situ* on rocks of complex geological origin - consisting of Lower Devonian granite, Upper Devonian acid volcanics, Devonian--Silurian sedimentary rocks, Cambrian greenstone and chert, and Ordovician sedimentary rocks.

Capability for fauna conservation on public land around Mount Samaria is high, as this large, consolidated and relatively undisturbed area contains a range of habitats. Mammals include the yellow-bellied glider, brown antechinus, and bobuck. Birds noted include the wonga pigeon, brush cuckoo, satin bower-bird, leaden fly-catcher, and red-browed tree-creeper, while significant reptiles include the lace lizard, Spencer's skink, and stone gekko. Hat Hill is interesting, particularly for reptiles, because of the range

in altitude and amount of rock outcrops; it is a flora and fauna reserve.

Conservation values are also noted in parts of the uncommitted areas. The Evans Creek catchment in particular contains a range of vegetation - from low-country to high-altitude types.

The Wabonga Plateau State Park, adjacent to the block in the east, contains a range of vegetation types complementary to those in the Mount Samaria State Park.

2. Recreation

Lake Nillahcootie is the main focus for recreation in the block. It is used extensively by both groups, and individuals for a range of activities including yachting, canoeing, power-boating, and recreational fishing. The lake has been zoned for the various user groups and as many as 20--30 power boats, 30--40 yachts, canoeists, and windsurfers, and a variable number of people fishing from boats use the area, particularly over the summer--autumn period.

Mount Samaria State Park has low-intensity development, and provides opportunities for picnicking, walking, and camping. Scenic viewpoints are available on Hat Hill, Mount Samaria, and the highlands to the east.

Fishing takes place in the west of the block along the Broken River and also on Lake Nillahcootie, where redfin, brown trout, river blackfish, and Macquarie perch are caught. Ryans Creek and adjacent streams in the east provide angling for brown trout, river blackfish, and Macquarie perch.

In the south-east of the block sambar deer range in from the adjacent highlands, providing sport for shooters.

3. Water supply catchments

The Ryans Creek (Benalla) catchment, and parts of the Fifteen Mile Creek (Glenrowan), Lake Nillahcootie, and Lake Eildon water supply catchments are located in this block.

4. Agriculture and apiculture

Steep slopes and a moderately high erosion hazard, or access considerations, render most of the public land unsuitable for agriculture. Gentle slopes near Tolmie and to the south of Bunston Hill would be suitable for pasture establishment.

The drier foothill forests have a high capability for honey production and a moderate one for pollen build-up and wintering. The principal species harvested are red stringybark and long-leaf box. On the highlands the capability for honey production and pollen build-up is low to moderate, but the potential for commercial queen-bee breeding and pollen production is considerable. Narrow-leaf peppermint, candlebark, manna gum, and blue gum are the principal nectar-producing species. River red gums on the Mansfield Plain provide a valuable honey source, particularly as these trees

flower at variance with other red gum flowering cycles. Most trees are, however, on private property.

5. Softwood production

Narrow-leaf peppermint open forest III and purchased farmland have provided the principal source of land for softwood establishment. It is government policy that the clearing of intact native forest for softwood planting be phased out.

6. Hardwood production

The capability for hardwood production is low in the dry open forests in the block, but very good in the area of blue gum and messmate on the plateaux. Narrow-leaf peppermint and manna gum are also utilized, although these are not as suitable for timber production. The value of the Toombullup area as a source of hardwood timber was recognized in the recommendation that 3,500 ha be available for hardwood production.

7. Mining and quarrying

The capability ranges from moderate to unknown. The Toombullup and Archerton gold-fields have been worked in the past for their alluvial gold and tin. No lode mining for gold took place on these fields, and activity under current exploration licences is directed towards assessing the potential of part of the Toombullup field for primary sources of gold.

Deposits of antimony occur near Tatong and Wrightley, and there are indications of fluorite along Holland Creek and near the Broken River. The Cambrian rocks running from Moorngag to the Blue Range are regarded as having the most potential for minerals in the block, with current base-metal investigations including drilling under exploration licence.

8. Hazards and conflicts

The potential for sheet erosion is high on steep northern aspects and moderate on the foothills and other dry steep slopes. Mass movement has occurred near Stockyard on sloping land. Sheet erosion hazard is generally low on gentler slopes and on the plateaux. Dryland salting is evident around Samaria, Tatong, and Molyullah.

Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	-
2	5
3	18
4	16
5(a)	58
5(b)	3

The fire hazard is high to moderate. Sirex wood wasp, an insect that attacks softwoods, is controlled by the use of biological control agents. Strips of native vegetation have been retained within softwood plantations along streams to maintain visual diversity and also to maintain faunal habitat and facilitate movement between larger areas of native vegetation. Blackberries are a hazard in disturbed areas, while feral pigs in the Ryans Creek catchment disturb the soil around swampy areas and near streams - constituting a hazard to water quality.

4. REEF HILLS--LURG

A. Tenure and Nature of the Land

1. Present tenure

Public land totals approximately 2,300 ha, the bulk of which is located in one large parcel (2,035 ha) at Reef Hills near Benalla. Other areas of public land include recreation reserves at Benalla, Glenrowan, and Winton (total 110 ha), and the balance consists of small isolated blocks and river and stream frontages.

Land in the Reef Hills Regional Park has been set aside for the Hume Freeway Benalla by-pass.

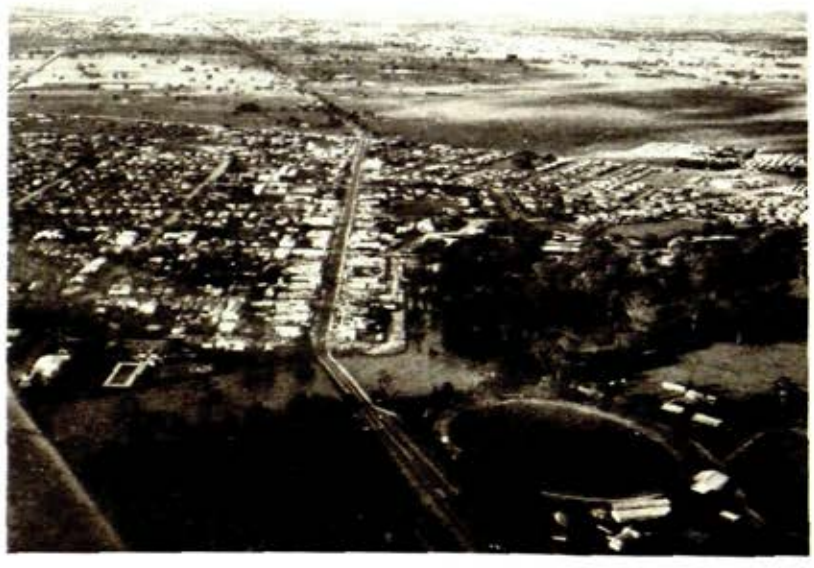
2. Climate

Average annual rainfall ranges from 630 mm near Benalla to 760 mm in the north-east and south of the block. The seasonal patterns show a marked winter incidence, with June the wettest month at most stations. The driest month is usually February, but rainfall generally increases fairly sharply in the autumn.

Summers are warm to hot. Temperatures above 38°C may occur from October to the end of March, but can exceed 44°C for several days together. Winters are cool to mild, with severe frosts only likely from mid June to early August.

3. Geology and geomorphology

The Benalla Plain is the principal feature of the block. It comprises Quaternary alluvial deposits and has an elevation



Flooding of the Broken River at Benalla

of less than 300 m. In the north, the maturely dissected Lurg hills rise above 300 m. They are mostly of Ordovician sedimentary origin, with some of the higher ones being of Silurian granite. In the south of the block, the low hills are of Ordovician sedimentary and Devonian granite origin.

The Reef Hills near Benalla comprise low hills of Devonian--Silurian sedimentary rock origin. Like the surrounding plain, they do not exceed 300 m. in elevation. Streams include the Broken River, Eight Mile Creek, Holland Creek, Ryans Creek, and Four Mile Creek.

4. Soils

The predominant soils of the low hills are undifferentiated stony loams and red duplex soils. Gently sloping areas have red gradational and weakly bleached gradational soils, and gilgaied yellow duplex soils are found on the plains.

5. Vegetation

The vegetation of the Reef Hills region differs entirely from that found on public land elsewhere in the study area. Three major floristic associations are present: red stringybark--long-leaf box--red box open forest I on the ridges; grey box open forest II on the lower slopes and better-drained sites on the plain; and river red gum open forest in the low-lying areas and along the watercourses. The river red gums occur both as pure stands and in mixture with other eucalypts. The understorey under the box--stringybark forests usually comprises grasses (tussock, wallaby, and spear grasses) and some scattered shrubs such as golden wattle and woolly wattle. Scattered hedge wattle over silvertop wallaby grass is found under the river red gum.

Most of the remaining blocks of public land have been cleared, although forest red gum occurs on the recreation reserve at Glenrowan and scattered river red gums grow along some stream frontages.

Most of the native vegetation has been removed in the north of the block. Blakely's red gum open forest I predominates on the uncleared freehold land. Some remnants of red ironbark forest and grey box forest remain on some roadside reserves.

6. Fauna

Most of the public land in this block is contained within Reef Hills Regional Park. The drier habitats found here support some inland species - including two bats, the little mastiff-bat and the broad-nosed bat. The yellow-footed antechinus is present in moderately large numbers.

Reef Hills block is a significant part of Victoria for the brush-tailed phascogale. In the past this species has been found here in relatively high densities, but numbers seem to have declined over the last few years, possibly due to the recent drought. The squirrel glider, although apparently suitable habitat for it occurs, has not been detected rec-

ently within the Reef Hills Regional Park; it has, however, been found on an adjacent roadside verge of mature red box, red stringybark, and river red gum just south of the forest. Echidnas are also relatively common.

Reef Hills contains a great diversity of bird species, with many of the drier country species present, including Gilbert's whistler, hooded robin, speckled warbler, white-backed swallow, diamond firetail, and white-browed babbler. Turquoise parrots are resident as a breeding population, and the rare regent and painted honeyeaters also utilize the area.

Reptiles include the sand goanna, rainbow skink, and blind snake, all apparently associated with the rocky outcrops present in the Lurg area. The spotted burrowing frog occurs in red gum areas at Reef Hills.

B. Present Uses and Capabilities

1. Nature conservation

The Reef Hills area has a high capability for flora conservation. As well as being a viable remnant of the original vegetation on the northern plains, it contains a number of significant species: large duck-orchid, bent-leaf wattle (*Acacia flexifolia*), and another wattle, *A. difformis*. In addition, 18 orchids and many wildflowers - including blue pincushion, bluebell, guinea flowers, swamp isotome, tall lobelia, pink-bells, chocolate lily, creamy stackhousia, diggers speedwell, and trigger plant - occur here. Flora capability in the north of the block is low.

Although little public land remains in the northern part, the conservation of an endangered amphibian, *Hyla maculata*, and five endangered or significant reptile species is desirable. The frog is found associated with streams near Glenrowan, while the reptiles are found mainly on rocky hills on private property.

The Reef Hills area has a high capability for fauna conservation, as many species of the northern forests are found here. Significant birds include the turquoise parrot, regent and painted honeyeaters, little and noisy friar-birds, dollar-bird, brush cuckoo, southern stone-curlew, black-eared cuckoo, king quail, spotted harrier, and barking owl. The brush-tailed phascogale and squirrel glider occur in the area, as does the lace lizard. Native fish in the Broken River include Macquarie perch and river blackfish.

2. Recreation

Its proximity to Benalla gives the Reef Hills area high capability for recreation related to enjoying the native environment. Reef Hills Park contains rifle, pistol, shotgun, and small-bore ranges. Capability for recreation in the north of the block is low. The main features are the Winton racetrack on public land, and the fire tower at Lurg and remains of the Kelly homestead at Glenrowan West, both on private property.

Grey box forest, Reef Hills

3. Water supply catchment

Part of the Fifteen Mile Creek (Glenrowan) water supply catchment is located in this block.

4. Agriculture and apiculture

Reef Hills no longer provides supplementary grazing. Elsewhere the public land in the block has generally low capability for agriculture.

The capability for honey production at Reef Hills is high and gives apiarists the highest financial return per ha in the district. Grey box, river red gum, and Blakely's red gum provide the principal sources of nectar. Capability for pollen build up and wintering is moderate. The main species for honey production in the north of the block are red ironbark and grey box, but capability is low due to the restricted occurrences of these species.

5. Softwood production

There are no softwood plantations on public land in this block.

6. Hardwood production

Reef Hills, particularly the grey box forest, is an important source of naturally durable round timbers and firewood for Benalla.

7. Mining and quarrying

Gravel extraction from Reef Hills has been phased out. The area was worked for reef and alluvial gold in the past. An

area of public land near Mount Pleasant contains reserves of gravel. Otherwise, capability for this block is low.

8. Hazards and conflicts

The erosion hazard on public land generally is low.

Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	24
2	50
3	20
4	6
5(a)	-
5(b)	-

The potential fire hazard becomes high in summer, when the grasslands surrounding Reef Hills dry off. No serious fires have been through this area in recent years, however. Uncontrolled shooting and rubbish-dumping pose threats to nature conservation and recreation values and to the natural beauty, respectively, of the Reef Hills area. Stream-bank clearing and channel works in the Broken River, if not properly planned and conducted, could affect the conservation of native fish. Clearing of vegetation along streams near Glenrowan could conflict with the preservation of the endangered amphibian *Hyla maculata*.

5. INDIGO--PILOT--STANLEY--KIEWA (WEST)

A. Tenure and Nature of the Land

1. Present tenure

This block, with the Kiewa River as its eastern boundary, includes public land between Wodonga and Myrtleford and in the Chiltern area. Public land is principally located in several large parcels and includes most of the land currently vested in the Albury--Wodonga (Victoria) Development Corporation.

Conservation reserves include the Chiltern State Park (4,250 ha), Mount Pilot Multi-purpose Park (13,100 ha), Beechworth Regional Park (1,130 ha), Baranduda Range Regional Park (3,100 ha), and the Pilot Range Reference Area (1,130 ha). In addition, an education area of 700 ha at Mount Barambogie, scenic reserves at Barnawartha (130 ha), Murmungee (5 ha), and Mount Stanley (2,700 ha), and a number of bushland and streamside reserves have been recommended.

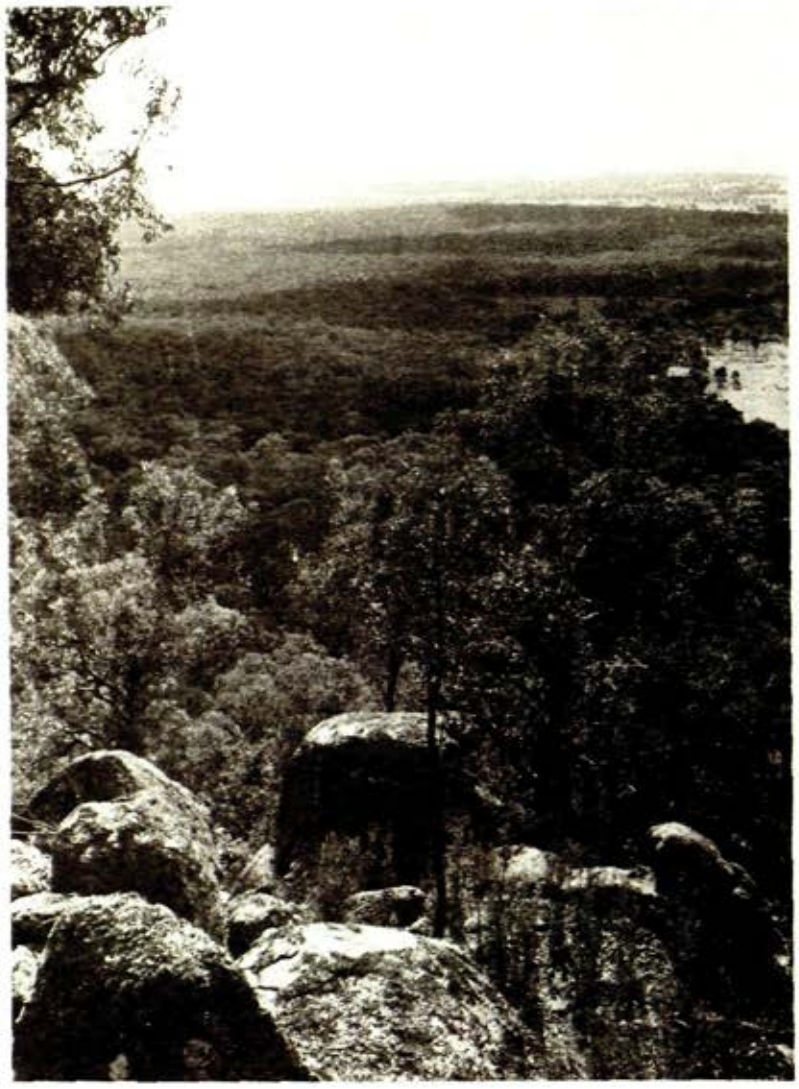
Hardwood production values at Mount Big Ben have been recognized by the designation of 8,600 ha for hardwood production. Extensive softwood plantations established near Beechworth and Stanley occupy some 4,505 ha. A further 9,850 ha of public land adjoining the plantations are maintained under native vegetation as forest area. There is also a small softwood plantation near Mount Barambogie.

Department of Community Welfare Services facilities occupied by the Mental Health Authority (150 ha) and for prison purposes (435 ha) are located at Beechworth, while Albury--Wodonga (Victoria) Corporation land totalling 7,650 ha comprises a number of blocks in the vicinity of the Baranduda Range and Wodonga.

There are four large parcels of uncommitted land: 2,935 ha near Mount Barambogie, 2,400 ha north of Gapstead, and two parcels that cover approximately 400 ha and 1,350 ha respectively north of Mount Big Ben.

2. Climate

Average annual rainfall ranges from 625 mm in the dry northwestern portion of the block, increasing with elevation, to 1,230 mm at Stanley and 1,250 mm at Mount Big Ben. Likewise, elevation and topography play important roles in the effects of frost, so Wodonga has an annual average of 240 frost-free days while Beechworth averages only 148. On the high country around Stanley the period is probably even shorter, with small variations in the local topography also having some influence. Summers are warm to hot. Temperatures at the lower elevations may exceed 35°C between October and the end of March.



Granite tors and forest - north of Mount Pilot

3. Geology and geomorphology

In the north, the River Murray flood-plain and Browns Plain, composed of Quaternary sediments, form one edge of the Riverina, while the Kiewa River and Ovens River flood-plains bound the block to the east and south. The hills at Chiltern are the northernmost portion of the central physiographic region of Ordovician sedimentary rocks, succeeded to the south by Devonian granite extending south to Everton but also outcropping at Mount Stanley. The hilly country between Barnawartha and Wodonga consists of regionally metamorphosed gneiss and schist of Ordovician age. Indigo Creek follows the fault that separates the Ordovician sedimentary rocks from the metamorphics to the north-east.

Faulting has contributed to the valley and range topography in the Kiewa River vicinity. The Baranduda Range of gneiss and granite has been uplifted relative to the surrounding country, and is separated from the Mount Big Ben area by the wide and hilly Yackandandah Valley. This valley has developed on Devonian granite, which is exposed on some of the creek-beds.

The rocks around Mount Big Ben are a complex of faulted schists, gneiss, and granite, often outcropping at small waterfalls and cascades in creeks. The Stanley area forms

a hilly plateau of Ordovician sediments intruded by Devonian granite at Mount Stanley, with a high contact metamorphic aureole forming a ridge to the east and less-pronounced aureole ridge to the west. The Beechworth granites to the north-west are at a slightly lower elevation, but the rest of the surrounding country is much lower, often as much as 400 m lower than the Stanley plateau. In the south-west, granite occurs but is buried below the alluvium of the Murmungee basin. The metamorphosed sediments originally surrounding the granites have proved more resistent to erosion and form a crescent-shaped range surrounding the basin.

Granite outcrops are common throughout the area west of Beechworth and often occur as granite tors. The most spectacular localities are at Mount Pilot and the Woolshed Gorge. Permian glacial deposits of sandstone, tillite, clay, and conglomerate occur at Woorragee, at Byawatha, and on the Hume Highway south of Springhurst.

4. Soils

The soils in the flood-plains include alluvial brown loams, brown gradational soils, and sandy loams. Yellow duplex soils occur on fans and terraces and on poorly drained areas. Red duplex soils also occur on fans and terraces, and on upper slopes. Weakly bleached gradational soils are widespread, occurring on steep slopes, mid slopes, and lower slopes, particularly in the north. The higher mountainous areas and the Big Ben plateaux have friable brown and red gradational soils and some stony loams.

In the granite areas such as the Pilot Range, coarse sandy loams and pale massive gradational soils occur on the steep slopes, with weakly bleached gradational and some red duplex soils on other slopes and yellow duplex soils in areas with poorer drainage.

5. Vegetation

This block supports a diverse range of vegetation communities that include the following.

Open forest I and II of red ironbark and grey box with a sparse grassy understorey may be found in the Chiltern State Park. Drier aspects in uncommitted land north of Gapstead, and on the Baranduda and Pilot Ranges, support open forest I and II of long-leaf box.

Open forests of narrow-leaf peppermint and broad-leaf peppermint occur extensively in this block, with a range of associated tree species and understorey types. Areas subject to periodic waterlogging carry open forests and woodlands of Blakely's red gum.

Black cypress pine open forest II grows in pure or mixed stands throughout the southern portion of the Pilot Range.

Open forest IV of alpine ash near the summit of Mount Big Ben gives way to candlebark--snow gum open forest on the summit itself.

River red gum woodlands with grassy understoreys occur on the Murray and Kiewa River flood-plains in the north of the block and along the Ovens River near Wangaratta. The land currently vested in the Albury--Wodonga (Victoria) Development Corporation is predominantly cleared for agriculture, but carries a few shade trees and woodlands of river red gum along the frontages to the River Murray and its tributaries.

The box--ironbark forests around Chiltern are important for orchids. Significant species include purplish beard-orchid (*Calochilus robertsonii*), slender onion-orchid (*Microtis parviflora*), and sun orchid (*Thelymitra* sp.). Also of importance is an occurrence of Deanes wattle (*Acacia deanei*), which is extremely rare in Victoria.

Pilot Range contains a range of dry open forests - including black cypress pine (*Callitris endlicheri*) and Blakely's red gum (*Eucalyptus blakelyi*) as well as red stringybark, long-leaf box, and brittle gum (*E. mannifera*), with broad-leaf peppermint occurring in the northern end of the Range near Woorragee where the soil is deeper and the conditions moister. While the forests in this block are important for wildflowers, especially orchids, they suffer from heavy infestations of noxious weeds, mainly St John's wort.

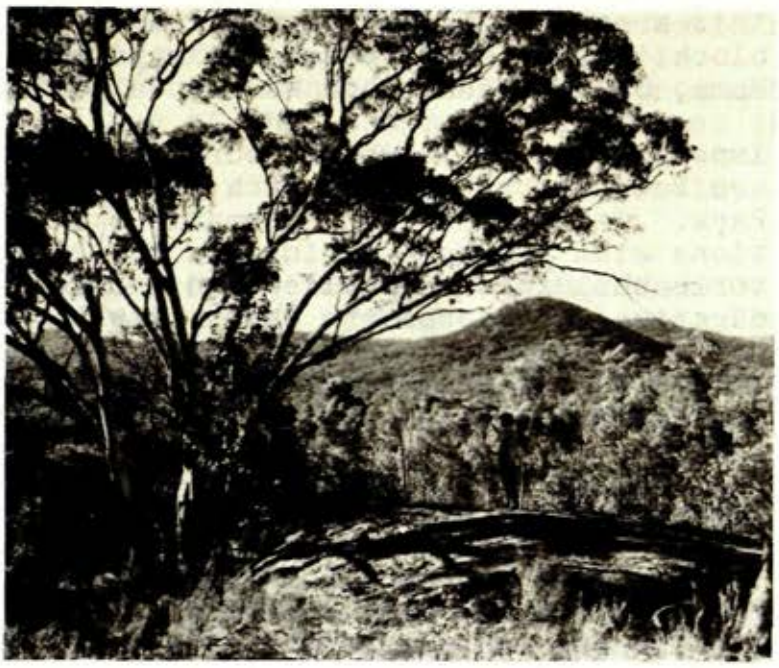
6. Fauna

The boundary of the Bassian zoogeographical region crosses this block, which has its south-eastern portion within the region and its north-western portion in the transition zone between Bassian and Eyrean. Hence it contains a wide range of habitats and diversity of species. The 29 species of native mammals detected here include 11 species of bats (the highest number of any block in the study area) including the more Eyrean little mastiff-bat and broad-nosed bat.

The distribution of antechinus illustrates the zoogeographic regions: the brown antechinus occurs in the Bassian region and the yellow-footed antechinus in the transition zone. Squirrel glider records here are concentrated around Chiltern, where this species may be relatively common. The brush-tailed phascogale is present in the Chiltern, Barandud a Range, and Beechworth areas. Tiger quolls have been caught infrequently by rabbit-trappers around the Mount Pilot Range and the hills behind Springhurst.

Of particular interest in this block is the remarkably diverse honeyeater fauna: at least 16 species are present, including regent, painted, and blue-faced honeyeaters. Other notable birds include the barking owl, chestnut-rumped hylacola, crested bellbird, bush thick-knee, zebra finch, and peregrine falcon. One of the two major strongholds of the turquoise parrot in Victoria is in this block. The grey-crowned babbler appears to be nearly extinct, however, with only one small group known to remain north-west of Chiltern. The riverine forests of the River Murray support yellow rosellas and numerous water birds.

One of Victoria's rarest snakes, the bandy-bandy, survives here. All specimens of this snake found in the past 30



Extensive areas of Blakely's red gum occur on the granite hills near Eldorado

years have come from the Chiltern--Beechworth area, and the species appears to have drastically declined over much of its former range in the rest of the State.

B. Present Uses and Capabilities

1. Nature conservation

Chiltern forest has a high value for nature conservation, which has been recognized by its reservation as a State Park. The public land bordering the River Murray is significant for nature conservation and is especially important for its contribution to the quality of the aquatic habitat.

The Pilot Range also has a high value for nature conservation. The forest types here differ significantly from those in surrounding areas; they include black cypress pine and extensive stands of Blakely's red gum growing in drainage lines and on the drier hillsides. Tiger quolls are found here. Although a number of weed species are present in the ground flora, the area has a varied and interesting indigenous flora. Further, the large stretches of rock and woodland make it especially important for reptiles. Adjoining stands of box and peppermint forest are particularly important for maintaining the larger mammal species here.

The only Victorian occurrence of the argyle apple (*Eucalyptus cinerea*) north of the divide is found near Beechworth. The rare bandy-bandy snake has only been found in recent years in the Chiltern--Beechworth area.

Beechworth Regional Park provides important links between larger areas of public land and also contains the orchid *Pterostylis hamata*.

2. Recreation

Its proximity to the Albury--Wodonga growth centre and to the snow-fields of north-eastern Victoria greatly increases

this area's significance for recreation. In addition, the block is traversed by several major highways - including the Hume, Ovens, Kiewa, and Murray Valley Highways.

Important areas in which recreation activity is concentrated are Beechworth Regional Park and Mount Pilot Multi-purpose Park. Interesting land formations and historical associations with the gold-mining era occur close to the town. Historic buildings on public land include the Beechworth powder magazine and Beechworth cemetery with its Chinese burning towers. Nearby, at Eldorado, the last of the dredges once active in the Ovens Valley lies in its own pondage. Fossicking for gold and gemstones is a popular activity in the area.

Further to the west, granite tors and shelving rock are important elements in the landscape, and views of the surrounding country are obtained from many points, especially from Mount Pilot and other granitic outcrops. The open nature of the forests and woodlands in the Pilot Range allow easy walking, and wildflower displays are an attractive element in the vegetation.

The Chiltern forest - being relatively flat terrain with an extensive network of roads - provides opportunities for many forms of recreation (mainly passive, such as picnicking). The wildflowers and birds, including the rare turquoise parrot, add to the area's attractiveness.

The River Murray borders the block to the north and is important for fishing, camping, and aquatic sports. Billabongs

Red ironbark forest, near Chiltern

and riverine vegetation make important contributions to this value - as well as providing faunal habitat - and their maintenance or improvement would contribute to the continued enjoyment of the area. Some of the land currently vested in the Albury--Wodonga (Victoria) Corporation along the River Murray carries significant riverine vegetation and provides important faunal habitat.

The hilly forest environment of the Baranduda Range and Mount Big Ben provides a wide range of vegetation types. The Baranduda Range Regional Park offers opportunities for bush-walking, picnicking, and pleasure-driving. Views from some points are extensive. Corporation land in the vicinity may be considered to complement the values of the park, as well as contributing a scenic backdrop to Wodonga, if maintained under native vegetation.

The Stanley plateau to the south-west of Mount Big Ben offers extensive softwood plantations, providing a suitable environment for a number of active and passive recreational activities. Lake Kerferd and Fletcher Dam provide fishing and sites for picnicking. Mount Stanley is an outstanding lookout point. Many relics from the gold-mining days - such as old workings, disused mines, and occasionally machinery - can still be seen in the bush, providing a link with historical aspects of the neighbouring towns of Beechworth, Yackandandah, and Stanley.

3. Water supply catchments

The Nine Mile Creek (Beechworth and Yackandandah) and Diddah Diddah Creek (Springhurst) water supply catchments are located in this block.

4. Agriculture and apiculture

In the drier western portion of the block, the main enterprises are cereal cropping, fat lamb production, and beef cattle. Potatoes and other vegetables are grown around Barnawartha North and Wodonga. To the east and south dairying and beef production predominate, while the agricultural land near Stanley carries extensive apple orchards. Some tobacco is grown on the Ovens River and Kiewa River flats. Much of the land currently vested in the Albury--Wodonga (Victoria) Corporation has a moderate to high capability for agriculture. The bulk has been leased to maintain it in agricultural production until it is required for other purposes; it is covered by about 40 leases.

The remaining public land has a low capability for agriculture. Some parts of the forests that are not within conservation reserves are grazed, but stocking rates are low.

The box and ironbark forests at Chiltern and Blakely's red gum woodlands in the Pilot Range are especially important for apiculture, as are the river red gum of the Ovens, Kiewa, and Murray River valleys. Mount Big Ben, the Baranduda Range, and the Stanley Plateau are of lesser importance for apiculture. Red stringybark--long-leaf box open forests (where these occur) are important for apiculture.

5. Softwood production

Narrow-leaf peppermint open forest III and reclaimed mine-workings have provided the principal source of land for softwood production in the centre and south of the block. It is government policy that the clearing of intact native forest for softwood planting be phased out.

6. Hardwood production

The alpine ash forest on Mount Big Ben is the most productive hardwood area in the block. Low-intensity sawlog production is possible from the remaining forests on Mount Big Ben, except for the drier parts towards the north and west, which are unproductive. The importance of Mount Big Ben for timber production has been recognized by its designation for hardwood production.

Capability of the remainder of the block is low to moderate. Within conservation reserves, the cutting of posts, poles, and sawlogs is either prohibited or at least closely regulated. Small and intermittent yields of sawlogs are possible from some of the long-leaf box and broad-leaf peppermint forests under low-intensity logging management.

7. Mining and quarrying

Capabilities for the production of minerals are moderate to unknown, depending on the rock association. The Chiltern gold-field, which falls within this block, was worked extensively last century. Explorers are showing renewed interest in the areas, employing geophysical methods to locate the full extent of the deep lead systems. Gold has also been found in the vicinity of House Creek.

The occurrence of diamonds in the alluvials of the Chiltern --Beechworth district led to a number of so-far unsuccessful attempts to locate the primary source of diamonds there.

The Yackandandah gold-field has been worked extensively in the past. A number of small-scale operations are current under Miner's Right claims, and search licences and applications for Miner's Right claims and development leases are current.

The Eldorado--Beechworth gold- and tin-fields were the richest in the block. Both reef and alluvial deposits have been worked, and a dredge still exists at Eldorado. Mineral exploration interest in this field over the last decade has continued under both exploration licence and mineral search licence. A number of Miner's Right claims, mining leases, and tailings licences are current on public land, particularly near Eldorado.

The Stanley--Myrtleford gold-fields in the south have been extensively worked for reef and alluvial gold, and mineral search licences are current in the area.

Other minerals found within the block include molybdenum north of Everton, small quantities of bismuthite south of

Stanley, and small amounts of tungsten around Barnawartha. Felspar deposits are located near Wodonga and Barnawartha.

The area contains large quantities of road-making materials, including river gravel and sand along the Murray and Kiewa River flood-plains and dredge- and mine-tailings. Metamorphic rocks (hornfels) occurring at Skeleton Hill and near Barnawartha are important sources of road-making material. Small quantities of hill gravel occur north of Gapstead, while granitic sand deposits occur near the granite oucrops - especially on the northern slopes near Springhurst.

8. Hazards and conflicts

Noxious weeds, expecially St John's wort, pose a major problem in the Pilot Range and the Chiltern State Park. Fossicking for minerals on the banks and more recently the use of dredge pumps in the streams can accelerate erosion and reduce the aesthetics of areas.

Extraction of river gravels, principally for road-making purposes, could reduce the quality of the river environs.

The soils in the granitic area are highly erodible, and rabbits are still troublesome in these areas. Soils on the Ordovician sedimentary rocks have a moderate sheet and gully erosion hazard, while those on the plains have a low erosion hazard.

Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	-
2	3
3	28
4	20
5(a)	44
5(b)	5

The fire hazard is moderate to high.

Sirex wood wasp, an insect that attacks softwood, is controlled by use of biological agents. Strips of native vegetation have been retained within softwood plantations along streams to maintain visual diversity and also faunal habitat and to facilitate movement between larger areas of native vegetation. Blackberries are a hazard in disturbed areas.

Revegetation of disused sand and gravel pits on the granite country is a continuing problem.

6. KIEWA (EAST)--DORCHAP--BULLHEAD

A. Tenure and Nature of the Land

1. Present tenure

Nearly all the public land in this block is uncommitted land, in two large parcels continuous with other public land in the south. Lake Hume and its fringe of reserve forms the northern boundary of the block, which is bounded on the west by the Kiewa River and in the east by Tallangatta Creek.

Conservation reserves include the Mitta Mitta Reference Area (630 ha), the Lockhart Creek Education Area (500 ha), and a number of bushland and streamside reserves. Several parcels of land totalling 1,480 ha and currently vested in the Albury--Wodonga (Victoria) Development Corporation are situated in the vicinity of Ebden. Uncommitted land in the block totals 77,100 ha.

2. Climate

In this block topography greatly influences rainfall. The annual average increases from 750 mm in the north to more than 1,000 mm in the south. It is highest on the Mount Emu --Mount Tawonga ridge, where it probably exceeds 1,500 mm.

The frost-free period decreases from about 200 days in the north to about 130 days in the south. Light snow may fall several times during the winter at higher elevations. Temperatures in summer are generally lower in the highlands than in the adjacent valleys.

3. Geology and geomorphology

The block falls mainly within the eastern physiographic region of metamorphic and granitic rock. Movement along faults within the area has contributed to the valley and range topography. Sandy, Lockhart, and Little Scrubby Creeks follow faults. In the east of the block, Ordovician sedimentary rocks outcrop - Scrubby and Little Snowy Creeks follow probable fault lines - while metamorphic rocks in the west form a prominent ridge running from Mount Emu northward through Mount Tawonga. The ground here slopes up gradually from the Mitta Mitta River to the ridge, but falls steeply down to the Kiewa River on the western side.

The Mitta Mitta River and its tributaries to the west (Trappers, Rodda, Lords, Scrubby, Little Snowy, and Little Scrubby Creeks) and east (Bullhead and Watchingorra Creeks) constitute the major drainage system. In the north, Sandy and Lockhart Creeks drain directly into Lake Hume, while the block is bounded on the east by Tallangatta Creek and the west by the Kiewa River. Alluvial sediments of Quaternary origin are present in mature creek and river valleys.

4. Soils

The valleys contain alluvial brown loams, brown gradational soils, and sandy loams. Red and yellow duplex soils occur on higher river terraces and fans.

Weakly bleached gradational soils occupy the slopes, especially in the north, and grade into friable brown gradational soils in the wetter localities. Friable brown and red gradational soils occur in the more mountainous country, with shallow organic loams on the higher parts of the mountains.

5. Vegetation

The common forest types over much of the block are narrow-leaf and broad-leaf peppermint. Typically, the narrow-leaf peppermint open forest III occurs in the wetter gullies, while broad-leaf peppermint open forest II occupies drier slopes. In addition the driest sites, usually in the north-west of the block, carry extensive areas of long-leaf box open forest II or I - which also occurs on the steep, drier parts of the metamorphic rock that surrounds the granite.

Moist soils at higher elevations along the ridge running from Mount Emu northwards to Mount Tawonga carry scattered stands of alpine ash, as does land in the headwaters of Trappers Creek. The highest land has areas of candlebark--snow gum open forest I.

Mountain swamp gum (*Eucalyptus camphora*) grows in narrow strips along creek valleys at higher elevations.

The understorey types associated with the long-leaf box open forest are undisturbed by grazing in some areas and comprise a diverse array, including kangaroo grass grassland, austral grass-tree (*Xanthorrhoea australis*) tussock grassland, and heathland of small-leaf parrot-pea (*Dillwynia retorta*) and ploughshare wattle (*Acacia gunnii*). The understoreys associated with the other overstorey types resemble those extensively represented to the south, in the Bogong National Park and proposed additions to the alpine park system.

6. Fauna

The fauna is typical for the moister, cooler climates. Many records of the rare tiger quoll come from this block, mostly of individuals caught in dog or rabbit traps. As tiger quolls are rarely encountered, the number of recent records indicates that population densities may be higher here than in other regions - giving the block some significance for this species. The eastern pygmy possum has been seen in two sections of the block: at Trappers Gap in tall open forest of blue gum, broad-leaf peppermint, and alpine ash with a moderately dense understorey; and further north near Lockhart Gap, in peppermint open forest with no understorey and a very sparse ground cover. Usually this possum occupies areas with denser understorey cover and especially favours banksias and myrtaceous shrubs, so its presence here may make this block particularly valuable in further determining the species' habitat requirements.

The platypus has been seen in Sandy Creek reservoir

The only yellow-bellied glider records in the locality have come from near the southern boundary of this block - in mature open forest of manna gum along Trappers and Lords Creeks. The common and mountain brush-tail possums, usually found in different habitats and at different altitudes, co-exist along Little Snowy Creek. The platypus and eastern water-rat have been observed in the Sandy Creek reservoir. In March 1976 a colony of approximately 3,000 little red flying foxes nested on an island below the dam wall of Lake Hume. This species is nomadic, only occasionally visiting Victoria.

Extensive wetlands associated with Lake Hume, the Kiewa and Mitta Mitta Rivers provide habitat for many species of water birds, and the yellow rosella reaches the eastern limit of its distribution along the River Murray in this block. Many forest birds are found here, including the superb lyrebird, red-browed treecreeper, wonga pigeon, and satin bowerbird. The uncommon chestnut-rumped hylacola occurs in heathy areas.

Reptiles present in the wet forests include the mountain dragon, grass skink, and highland copperhead snake. The Mitta Mitta River flats and associated foothills support many species of frogs, with the red-groined toadlet (a species extremely restricted in Victoria) present at the southern and western limits of its distribution.

B. Present Uses and Capabilities

1. Nature conservation

The block has moderate to high capabilities for nature conservation. Many of the forest types in the study area occur in it, resulting in a diverse flora. A rare beard-orchid (*Calochilus grandiflorus*) has only recently been rediscovered near Mitta Mitta, while the poverty or mitta wattle (*Acacia dawsonii*) is known in Victoria only from a few isolated occurrences on rocky hillsides near the town.

Austral toad-flax (*Thesium australe*), a very rare plant of grasslands and herb-fields, has been reported from the Mitta

Mitta River, as has *Hypsela tridens*. Silver tea-tree (*Leptospermum multicaule*) is confined in Victoria to the Mitta Mitta River and Beechworth Regional Park.

The dainty bird-orchid (*Chiloglottis trapeziformis*) has occurrences near Tallangatta and Mitta Mitta, while the purple diuris (*Diuris punctata*) has been recorded near Tallangatta. The narrow-leaf peppermint open forest III and broad-leaf peppermint open forest II vegetation types are represented in the Mitta Mitta Reference Area and in the alpine park system.

The public land in this block is important for fauna conservation because it is continuous with extensive areas of public land to the south. The range of habitat types is extensive. The rare tiger quoll and the eastern pygmy possum are found here, and the rocky outcrops and dry long-leaf box open forests are important for reptiles; while the lower Mitta Mitta River provides valuable waterfowl habitat. The endangered trout cod has been reported from the Mitta Mitta River.

2. Recreation

The capabilities of the public land for recreation are moderate. Opportunities are provided for bush-walking and nature study within varied forest environments. Access - by forest tracks - is generally unsuitable for two-wheel drive vehicles but is suitable for four-wheel drive touring. Access is provided between the Kiewa and Mitta Mitta River valleys in the south of the block by a road through Trappers Gap, but considerable expenditure would be necessary to upgrade it for use by conventional vehicles. The location of Mount Bogong immediately to the south causes this block to have landscape significance.

The Mitta Mitta River is attractive and popular for passive recreation such as driving for pleasure. The river supports canoeing and fishing. Below Tallandoon, the river and associated wetlands are important for ducks.

In the north of the block, the shoreline of Lake Hume is used extensively for picnicking, and boat-launching facilities are provided. A section of the closed Wodonga--Cudgewa narrow-gauge railway, where it fringes Lake Hume, is under consideration for development as a tourist railway.

3. Water supply catchment

Most of this block is located in the Lake Hume water supply catchment.

4. Agriculture and apiculture

Public land in this block generally has a low capability for agriculture due to its steepness and inaccessibility. A number of grazing licences have been issued, the largest of which covers land south of Tallangatta adjoining Lockhart Creek and in the catchments of Watchingorra and Trappers Creeks. Albury--Wodonga (Victoria) Development Corporation

land adjoining Lake Hume, near Ebden, is substantially cleared and has been maintained in agricultural use.

The area is not of major importance for apiculture due to its inaccessibility.

5. Softwood production

There are no softwood plantations on public land in this block.

6. Hardwood production

The ground sloping gently up from the Mitta Mitta River valley to the Mount Emu--Mount Tawonga ridge is of moderate importance for low-intensity mixed-species timber production - notably narrow-leaf peppermint. With the exception of stands in the headwaters of Trappers Creek, the scattered occurrences of alpine ash are of limited importance for timber production. The long-leaf box open forest yields some fencing timbers and firewood.

7. Mining and quarrying

Part of the Mitta Mitta (reef and alluvial) gold and tin field lies within the block. The lode has been inadequately prospected and much of the field lies within a current exploration licence. Miner's Right claims are current around Sandy Creek Upper and Gundowring. The mineral potential of the surface alluvial and deep lead deposits is being investigated under current exploration licences. Antimony has been found near Tallandoon and there are felspar deposits near Tallangatta. The southern portion of the Kiewa valley forms part of the Tawonga goldfield, where small amounts of copper were found in the gold-bearing ore.

Gravels from the Kiewa and Mitta Mitta valleys are quarried for road-making purposes, and these sources have the capability to yield significant amounts of such material.

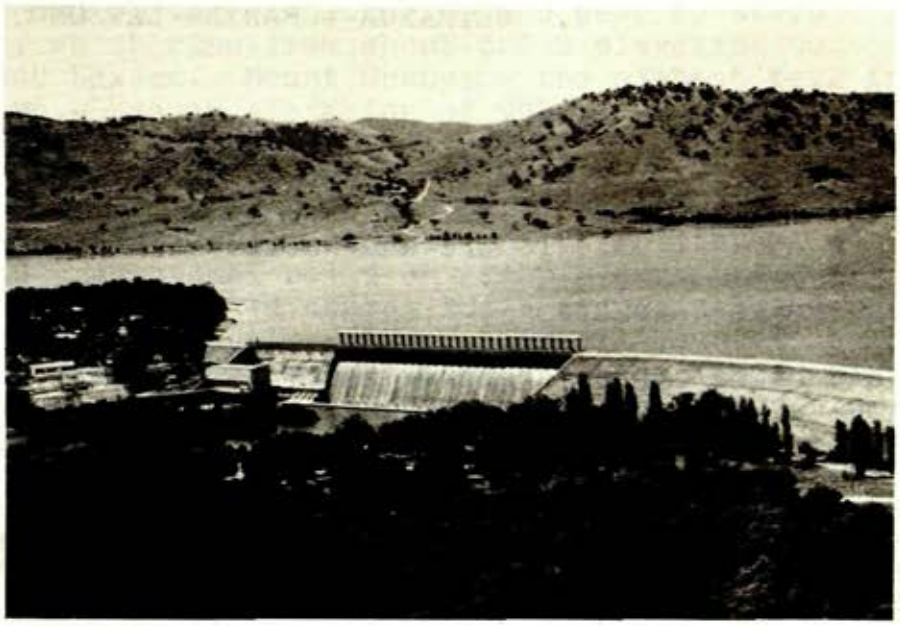
8. Hazards and conflicts

Soil erosion is a significant hazard on the steeper slopes, especially on the pale massive gradational soils of the granitic areas. Sheet erosion occurs on sloping ground after loss of ground cover.

Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	2
2	-
3	4
4	9
5(a)	79
5(b)	6

Lake Hume, looking towards Bethanga Gap



Completion of Lake Dartmouth has altered the flow regime of the Mitta Mitta River. Extraction of river gravels, principally for road-making purposes, could reduce the quality of the river environs. Wildfire is a danger during the summer. Any upgrading of the road between the Kiewa and Mitta Mitta River valleys via Trappers Gap would have to be conducted sensitively because of its proximity to Mount Bogong.

7. BETHANGA--GRANYA--LAWSON

A. Tenure and Nature of the Land

1. Present tenure

This block includes approximately 38,000 ha of public land, the bulk of which is located in three large parcels. It includes three parks: Mount Granya State Park (6,180 ha); Jarvis Creek Regional Park (2,510 ha); and Mount Lawson Multi-purpose Park (12,270 ha). The Mount Lawson Park excludes the Bungil Reference Area, which coveres 1,750 ha. The largest parcels of uncommitted land consist of 780 ha on the eastern edge of Mount Granya State Park, 3,350 ha south of the Mount Lawson Multi-purpose Park (which adjoins other uncommitted land south of the Tallangatta--Corryong Road) and 300 ha of cleared public land near Bethanga.

The block also includes 541 ha of existing softwood plantations and two parcels (12 ha and 490 ha respectively) of public land currently vested in the Albury--Wodonga (Victoria) Development Corporation, adjoining the Tallangatta arm of Lake Hume. Other public land includes the frontage to Lake Hume, Wise Creek Bushland Reserve, various stream frontages, and a number of small scattered parcels. Freehold land adjoining the Mount Lawson Park, totalling 214.4 ha, was obtained in an exchange authorized by the *Granya (Land Exchange) Act* 1978.

2. Climate

Average annual rainfall varies from 660 mm in the west to 900 mm in the east, with a winter maximum. Summers are relatively hot and dry at lower elevations and warm on the plateaux and higher country. Winters are cold, with occasional snowfalls on the higher country - several light falls may be expected in most winters. Severe frosts affect the plateau where cold air is pooled. Cold air drainage causes a higher frost incidence in valley tracts. Higher temperatures generally apply to northern aspects and at lower elevations.

3. Geology and geomorphology

Ordovician gneiss and schists are the predominant rock formation underlying these blocks, with the northern extension of the Koetong Uplands in the Lawson block comprising an intrusion of Devonian grey granite. Minor deposits of gravels are of Tertiary age.

Montane slopes rise from the valley floors at elevations of 240--400 m, forming broad ridges and plateaux at elevations ranging predominantly from 460 m to 610 m. The Koetong Uplands in the east consist of a weakly to strongly dissected

surface surrounded on the east, north, and west by steep montane slopes, which rise from about 600 m elevation to 1,020 m at Mount Lawson. Mount Granya - the highest peak in the western part - has an elevation of 905 m.

4. Soils

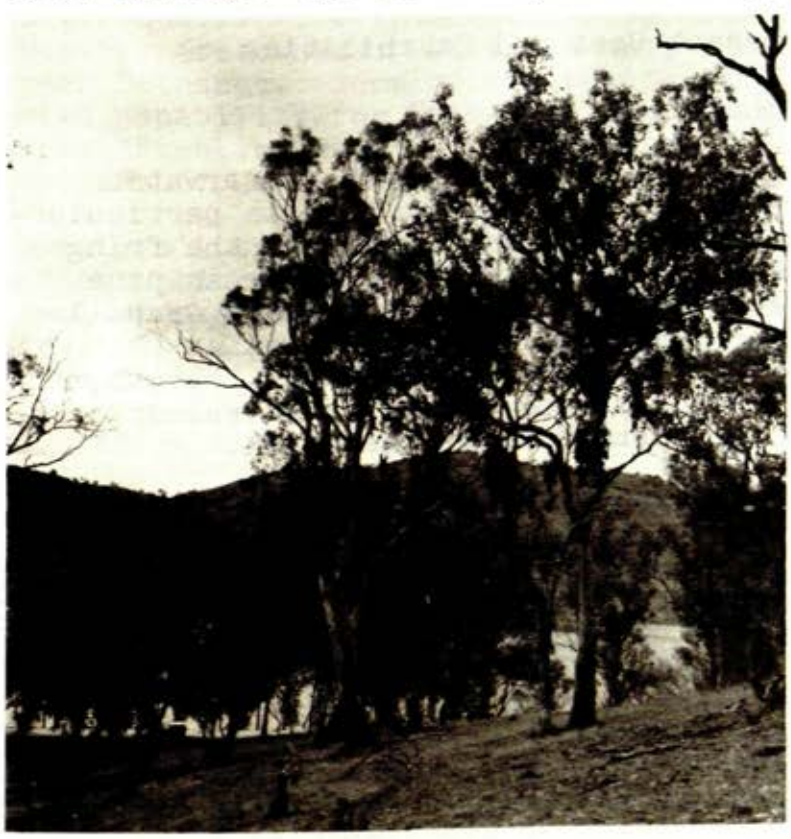
Friable red gradational soils dominate on the plateaux, with weakly bleached gradational soils on steep slopes and in shallow drainage lines. Red duplex soils predominate on the gentler slopes and the flatter, lower-rainfall country in the valleys. Ridge-tops are often very stony and large rock outcrops are common. Undifferentiated stony loams are prevalent in such areas and on the steepest slopes, particularly on northern aspects. Sandy loams are sometimes found at the bases of very steep slopes.

5. Vegetation

The diverse vegetation of this block includes the following associations.

Open forests of red stringybark and long-leaf box generally grow on the very dry steep northern and north-eastern aspects. The ridges and dry sites carry open forests of broad-leaf peppermint with a grassy or low shrubby understorey. Open forests of narrow-leaf peppermint with an understorey of bracken and silver wattle occur in the drainage lines and moister sites on the plateau country.

An open forest of cypress pine with a sparse ground cover or shrubby understorey occupies the steepest driest slopes on the western and northern edges of the uplands facing the River Murray. The heath may cover large continuous areas or



River red gum and white box fringing Lake Hume

may surround isolated rocky outcrops. On the rocky outcrops themselves, open mosslands of lichens and mosses occur.

Open forest and woodlands of Blakely's red gum occur to a minor extent along some watercourses and on dry hillocks.

6. Fauna

The local peppermint forests particularly suit the arboreal greater glider and ringtail possum, which have been found in higher densitites here than in most of the study area. Echidnas are present throughout the block, but appear to be declining in numbers - possibly due to predation by feral dogs. Several sightings of tiger quoll from Talgarno and around Georges Creek were reported during the 1960s, and it is possible that this species is still present.

The yellow-footed antechinus was recorded near Tallangatta in 1947. As none have been detected since, it is likely that any suitable habitat has been cleared. The bulk of the vegetation that remains supports the brown antechinus, an inhabitant of wetter forests.

One part of this block of particular value for birds is the Wise Creek Bushland Reserve, where flowering Blakely's red gum and white box are used by many species of honeyeater, including the rare regent honeyeater. Other interesting local birds include the emu, dollar bird, bush thick-knee, and southern whiteface.

The giant bullfrog is known at only three localities in Victoria, one of which is in this block near Bethanga. The red-groined toadlet is also present on river flats and foothills.

B. Present Uses and Capabilities

1. Nature conservation

The blocks have a high capability for flora conservation because of the diversity of vegetation. This is particularly so to the north and west of Mount Lawson, at the fringes of public land, where large stands of black cypress pine occur. Associated plant species include the rare *Grevillea polybractea*, as well as such interesting species as the wedge-leaf hop-bush, cane wire-grass, river bottlebrush, guinea flower, and drooping sheoak. *Pomaderris subcapitata* has been recorded in the north-east of the block.

Public land at Granya and Jarvis Creek has medium value for flora conservation, with high values at some localities such as the slopes bordering the Murray Valley Highway at Granya Gap. These are covered with showy plants, including some rare species. Plants include grey bush-pea (*Pultenaea cunninghamii*), *P. polifolia*, *Grevillea polybractea*, and *Pimelea treyvaudii*.

One of the few examples of white box woodland on public land is found on an isolated block at Wise Creek. Most of this type has been cleared for grazing. Other species found there

Rock outcrops carrying black cypress pine open forest I complex with heaths and open mossland

include Blakely's red gum, box-leaf wattle, and nodding blue-lily. The only known occurrence in Victoria of the rare *Eucalyptus dealbata* (tumbledown red gum) has been found on the Georges Creek road between the Granya and Jarvis Creek Parks.

Capability for native fauna conservation is also high. The northern sector, which again warrants special interest, provides habitat for the black-tailed wallaby and perhaps the tiger quoll. The inland bullfrog (*Limnodynastes interioris*) has been recorded in Victoria only on a roadside reserve near Bethanga. Some of the public land around Lake Hume has high capability for waterbird conservation, while the Wise Creek Bushland Reserve has value as a feeding area for many species of honeyeater.

Nearly all the public land in the block has been placed in conservation reserves. At Bethanga, however, it consists of small parcels that have generally been cleared of all but a few trees and presently have low value for conservation, but have potential for revegetation.

2. Recreation

A high capability exists along the River Murray, for camping and fishing and passive recreation such as pleasure-driving, as the area is relatively well roaded. In addition, a number of lookouts offer scenic vistas of Lake Hume and countryside. Mount Lawson has potential for walking.

Lake Hume provides a major focus for recreation. Facilities are provided at intervals around the shoreline, and include provision for camping in some locations.

Proximity to the twin cities of Albury and Wodonga will mean increasing pressure on the areas of public land as the popu-

79652/84—7

lation continues to increase. Bellbridge, on the shores of Lake Hume, is a developing resort, while Tallangatta is both a regional centre and resort.

Other features include:

* a spectacular waterfall and gorge on Flaggy Creek
* remains of mining at Thologolong, on Flaggy Creek, and near Koetong
* Aboriginal rock paintings in the Koetong Creek Valley and near Thologolong
* fishing in Koetong Creek, the River Murray, and Lake Hume
* rock-climbing on steep rocky slopes and rock outcrops

3. Water supply catchment

This entire block is located in the Lake Hume water supply catchment.

4. Agriculture

Generally low capability exists for agriculture and no large areas of public land suitable for alienation for farming remain. The main area suitable for low-intensity grazing lies on areas of moderate slope on the plateaux, and on sheltered aspects.

The drier western and northern sectors of public land have a high capability for honey production. Red stringybark is the main species used, and some capacity exists for further sites to be used if access to public land in the east of the block was improved.

5. Softwood production

Some freehold land in the vicinity of Koetong has been purchased by the Forests Division and planted to softwoods. Most of the public land in the blocks is within conservation reserves. It is government policy that the clearing of intact native forest for softwood planting be phased out.

6. Hardwood production

The capability for hardwood production is generally low. Narrow-leaf peppermint stands with a high proportion of blue gum have the highest capabilities. Such stands occur at Mount Lawson, north of Koetong Creek, and north of Darbyshire Creek. Within the Mount Lawson Multi-purpose Park and Jarvis Creek Plateau Regional Park, low-intensity timber production is a permitted subordinate use.

7. Mining and quarrying

Gold has been won from Mount Granya. The gold--copper bodies at Bethanga could become more important, provided modern techniques for extracting from the thin lodes and separating the gold ores from associated minerals make mining economic. Applications for development leases are current in the Bethanga area. Tin, bismuth, molybdenum, and tungsten have also been mined in the area.

8. Hazards and conflicts

The steep granite montane slopes in the north-east of the block usually have sparse to scrubby protective vegetative cover. The soils there are prone to erosion. Least erosion has occurred on the less-steep slopes in the south of the block, where rainfall is higher and the protective vegetation cover more effective.

Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	-
2	-
3	5
4	14
5(a)	76
5(b)	5

Erosion on public land does not present many serious problems at present, but the potential erosion hazard on the drier northern slopes is generally as high as any in the region and the block's proximity to Lake Hume requires that measures be taken to ensure that soil loss does not occur.

The shores of Lake Hume are prone to erosion due to wave action on the more steeply sloping shores when the Lake is near full-supply level. Because of the variations in water level that occur in the Lake over summer, recreational developments such as boat-launching ramps have to be located in these areas. Planning controls provide for care to be taken when establishing these facilities.

The fire hazard is high in the north, but decreases to the south. Nevertheless, any wildfire in this block would present a hazrd to both nature conservation and the pine plantations in the south. Conflicts are unlikely over most of the public land. Should the price of metals rise sufficiently, however, then mining could conflict with nature conservation and soil conservation values.

8. KOETONG--LUCYVALE--CUDGEWA

A. Tenure and Nature of the Land

1. Present tenure

The public land covers a total of some 51,000 ha, nearly all of which lies in one large unconsolidated block. Of this area, about 27,000 ha remains uncommitted. Forest grazing is a current use.

The block includes three reference areas - Dry Forest Creek (1,350 ha), Lucyvale Creek (500 ha), and Cudgewa Creek (840 ha) - and the Mountain Creek Education Area (770 ha).

Extensive softwood plantations have been established on purchased freehold and public land in the northern portion, and cover approximately 8,925 ha. A further 3,900 ha of public land adjoining these plantations have been designated forest area, to be used for the protection of the adjoining softwood area while being maintained uner native vegetation.

An area of public land west of Koetong was exchanged for an isolated block of freehold land adjoining Mount Lawson Multi-purpose Park, in an exchage authorized by the *Granya (Land Exchange) Act* 1978.

The remaining public land in the block comprises land recommended for agriculture, an existing S.E.C. transmission-line easement, and various small reserves.

2. Climate

Average annual rainfall, except in the rain-shadow area in Tallangatta Creek valley, varies from about 900 mm near Burrowye to more than 1,140 mm on the plateau and 1,270 mm on the highlands east of Cravensville. The rainfall on the plateau has a definite winter maximum; light snow may fall several times during the winter.

Frosts on the plateau are common and often severe, particularly in low-lying areas, and occur from autumn through to spring. Temperatures in summer are generally lower on the plateau than in the adjacent valleys.

3. Geology and geomorphology

The Koetong Uplands, a dissected plateau of rolling to hilly topography at a general elevation of 600--900 m, is the major feature of the block. Most of the landscape has been formed on Devonian grey granite, which also occurs as outcrops at Mount Cudgewa and in the Reedy Creek watershed.

In the north and south of the block some hillocks and montane slopes are formed on Ordovician schists. There are

also minor occurrences of Tertiary gravels and Quaternary colluvial--alluvial deposits in the south.

The Koetong plateau is flanked by steep to very steep montane slopes. These pass into rolling to steep hills at about 300 m to 450 m elevation. The highest elevations are found in the south of the block, forming the divide between the Tallangatta and Cudgewa Creek catchments at a general elevation of about 920 m. It reaches 1,100 m at Mount Cudgewa and just over 1,200 m in the south. For the most part this divide is a narrow ridge, but it broadens out to form a plateau at Mount Cudgewa and again in the far south to form a broad, flat-topped ridge. The main drainage pattern is provided by northward-flowing streams.

4. Soils

Friable red gradational soils occur on the plateaux. Outcrops of granite boulders are common on the tops of low ridges and hills. Granite floaters occur in the soil in many places and decomposing rock is encountered at shallower depths on hills and ridges than elsewhere. Undifferentiated stony loams are found on the ridge-tops.

The predominant soils of the steep montane slopes are weakly bleached gradational soils in the drier situations, and friable brown gradational soils on the moister sites. On the less-steep slopes and valley floors, red duplex soils predominate and friable red gradational soils may occupy gentle slopes where the rainfall is higher. Sandy loams and weakly bleached gradational soils occur on alluvial fans and cones.

5. Vegetation

Extensive areas of softwood plantation have been established in the vicinity of Shelley and Koetong on purchased farmland

Narrow-leaf peppermint, on the Koetong Uplands

and public land. They have mainly replaced narrow-leaf peppermint open forest, which is the predominant vegetation of the remainder of the Koetong plateau land. This vegetation unit also extends down valleys and sheltered gullies in the north and east and is found in moist situations in the south. Its understorey on the plateau usually comprises a dense sward of tussock grass with scattered shrubs (mainly handsome flat-pea), or mainly a bracken fern or hop bitter-pea layer. The understorey in the moist gullies in the south of the block includes bracken fern, fishbone water-fern, hazel pomaderris, and blackwood. On sheltered aspects and in basins in the north of the block, the understorey usually comprises dense bracken fern with scattered small trees of silver wattle and blackwood.

Broad-leaf peppermint open forest commonly occupies drier ridges and slopes on the plateau (except for some red stringybark--long-leaf box open forest on the drier northerly aspects). The broad-leaf peppermint open forest has a grassy to scrubby understorey. Shrubs include handsome flat-pea and purple coral-pea. The grass is mainly tussock grass.

Mountain swamp gum open forest is found in and bordering some perennial streams or in low-lying swampy areas on the plateau. The understorey around Lake Findlay consists of coral heath and sometimes sphagnum moss, but at lower elevations the understorey mainly consists of ferns, including fishbone water-fern and soft treefern. Mountain tea-tree, the common reed, and fishbone water-fern form a dense under-

Coral heath - a component of the understorey in the block

storey under the small areas of the unit found in the headwaters of Pheasant Creek.

A small stand of alpine ash occurs on a flat ridge along Gibb Range Road in the very south of the block.

6. Fauna

The tiger quoll is present here, and relatively high population densities of the long-nosed bandicoot have been recorded along Burrowye Creek and at similar sites. The feathertail glider occupies an area of mature wet open forest of narrow-leaf peppermint, blue gum, and candlebark surrounded by pines along Pheasant Creek. An uncommon bat species, the great pipistrelle, occurs in this block.

A feral animal that has recently become established in this area is the fallow deer, which was first introduced into the pine plantations around Shelley in 1971.

Bird species recorded locally include the cicadabird, olive whistler, brush cuckoo, rufous fantail, and superb lyrebird. The peregrine falcon ranges widely in this block and the emu has also been recorded.

One reptile of note is the red-throated skink, otherwise found in Victoria only in the extreme east of the State, where it is usually associated with rock outcrops.

B. Present Uses and Capabilities

1. Nature conservation

Capability for flora conservation is moderate to high. Perhaps the most interesting flora are contained in sub-alpine wet heaths in swampy drainage lines at Lake Findlay and along such creeks as Lucyvale Creek. Significant species recorded at Cravensville in the south are *Mirbelia oxylobioides* (mountain mirbelia) and *Pimelea treyvaudii*. *Chiloglottis pescottiana* has been recorded near Cravensville, but is now presumed extinct for this locality.

The Koetong plateau supports few rare species. Its main value lies in the fact that this plateau environment and associated flora do not occur elsewhere in Victoria - although similar environments, but with different flora, are found on the Stanley plateau near Beechworth and the Mount Samaria and Strathbogie plateaux near Mansfield.

Capability for fauna conservation also ranges from moderate to high. The plateau country supports a number of species, including the satin bowerbird, Lewin honeyeater, tiger quoll, long-nosed bandicoot, greater glider, wombat, black-tailed wallaby, and eastern grey kangaroo. The feathertail glider and noisy friarbird have also been recorded here.

2. Recreation

Capability for passive recreation in the block has been enhanced by the network of roads that has been developed

throughout the area and provision of picnic facilities and parking area at Lawrence lookout.

The Koetong Deer Management Project has been developed in the softwood plantation and visitors may inspect it. Shelley forest camp, which is available for hire to groups, and the Mountain Creek Education Area are both close to the highway.

The former Tallangatta--Cudgewa narrow-gauge railway line passes through the block. Shelley railway station has the highest elevation of any in the State rail system. Although the line is now closed, it is possible that some sections of it, including the bridges, could be retained. The railway easement, where is passes through public land, would lend itself to development as a major walking track.

Other activities include fishing for brown and rainbow trout in a number of streams in the block, including Burrowye and Koetong Creeks. Tin-mining sites at Dry Forest Creek may also be inspected.

3. Water supply catchment

This entire block is located in the Lake Hume Water Supply Catchment.

4. Agriculture and apiculture

The less-steep upland areas in this block have a moderate to high capability, not only for cattle and sheep production, but also for horticulture, including production of potatoes, apples, and strawberries. Elsewhere the capability is low. The major factor limiting this capability is the cold in winter, which limits pasture growth.

While most of the land suitable for softwood production in this block would also support agriculture, the trend in recent years has been for freehold land to be purchased for planting to softwoods.

As the block carries mainly narrow-leaf peppermint, broad-leaf peppermint, and candlebark gum, it has only a low capability for honey production. There is some limited potential on red stringybark--long-leaf box sites on the drier slopes.

5. Softwood production

The northern half of the block has a moderate to high capability for softwood production. This is reflected in the area of public land and purchased freehold planted to softwoods. It is government policy that the clearing of inact native forest for softwood planting be phased out.

6. Hardwood production

Most of the block has a moderate capability for hardwood production. Scattered areas of blue gum regrowth forest have high growth rates and could be used for pole and sawlog production. Mixed species forest at Rogers Creek and a small

stand of regrowth ash on the Gibb Range Road, in the south of the block, would lend themselves to sawlog production.

7. Mining and quarrying

Much of the area has an unknown capability for production of minerals such as gold, tin, and tungsten. Exploration is current in the southern part of the block. Gold has been recorded at Cravensville, but the area has been worked and reserves are probably low.

The Walwa Road Quarry is the principal source of road gravel for the Forests Division and the Shire of Tallangatta.

8. Hazards and conflicts

The sheet erosion hazard on the steep montane slopes of the lower Tallangatta Creek valley is high. Protection from fire, and management to improve or maintain ground cover, is necessary to minimize or prevent erosion. A lower erosion hazard exists on montane slopes around Mount Cudgewa and Cravensville and on the Koetong plateau.

Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	-
2	6
3	14
4	22
5(a)	54
5(b)	4

The fire hazard is moderate in the northern section of the block and low in the southern section.

In the east of this block, land with deeper soils has a moderate to high landslip risk, not necessarily on only the steepest slopes. On freehold land the clearing of such areas and steep slopes has had a dramatic impact on streambank stability.

9. WABBA--BUNROY--ELLIOTT

A. Tenure and Nature of the Land

1. Present tenure

Public land in the block covers approximately 49,500 ha, nearly all of it in two large consolidated parcels. It is virtually all uncommitted land, apart from Mount Elliott Regional Park (1,280 ha) and the Burbibyong Creek Reference Area (1,300 ha).

The largest block of uncommitted land comprises 25,370 ha to the west of Corryong Creek. To the east of Corryong Creek, a further 20,210 ha form one block and another 970 ha lie north of Nariel Gap. A 32 ha school plantation adjoins the Nariel road.

Other public land includes stream frontages and a number of small, scattered parcels.

2. Climate

Average annual rainfall ranges from 760 mm to more than 1,270 mm. The Corryong Creek Valley is in a slight rain-shadow below Colac Colac and receives the lowest rainfall, while the higher elevations to the west in the head of Log Bridge Creek receive the highest. More rain falls in winter than in the other seasons; some snow falls at the higher elevations during winter. Temperatures are influenced by the increasing elevation from north to south within the block, summers being milder and winters cooler at the higher elevations.

3. Geology and geomorphology

Steep montane slopes occur over most of the southern portion of the block, with hillocks, stream flats, and terrace land forms around the northern and eastern margins of the hills. The highest country in the block, reaching elevations in excess of 900 m, is in the Log Bridge Creek headwaters and the divide between that and Corryong Creek.

An area in the headwaters of Spring Creek forms a diseected plateau.

In the montane country, the valley floors occupy elevations from about 450 m to 750 m and are narrow, but the River Murray (below Biggara) and the Corryong and Thowgla Creeks open into broad, mature valleys with elevations below 300 m. Most of the streams have cut into Ordovician schists, unaltered sandstones, shales, and slates, giving rise to highly dissected topography. A north--south belt of grey granite, however, lying mainly in Wabba Creek watershed, but

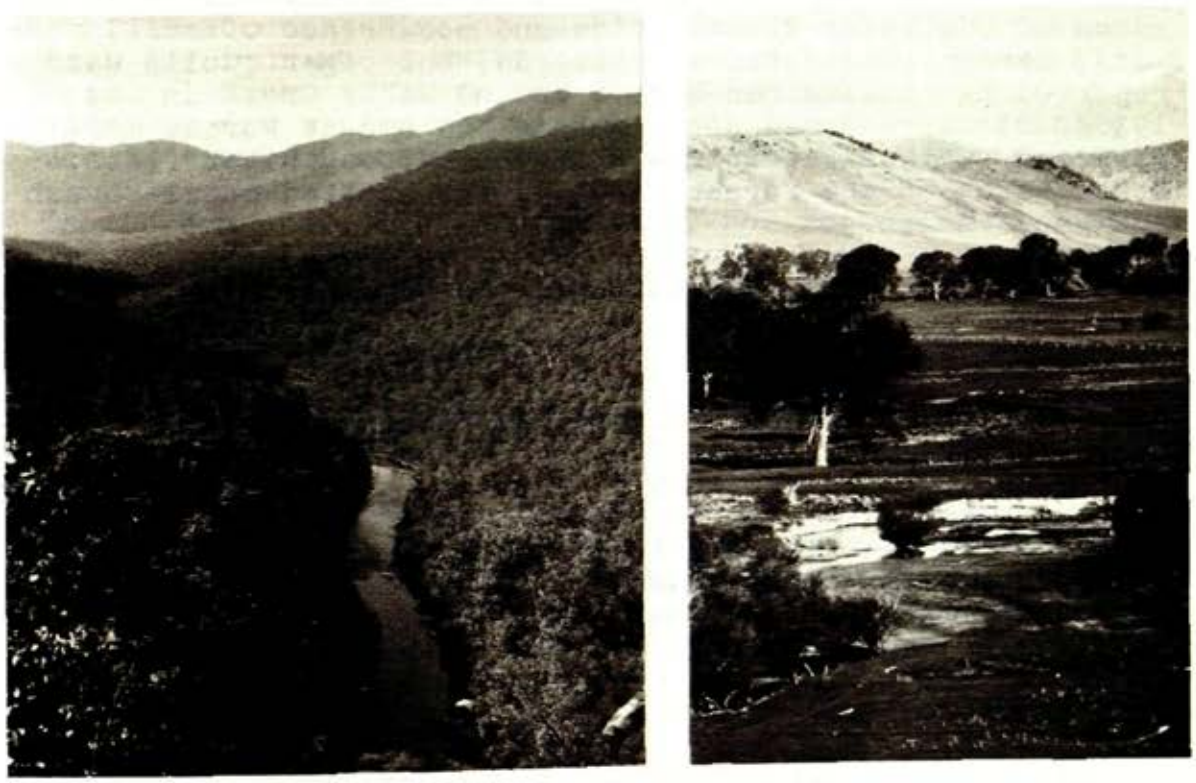
also underlying land north of the Nariel and Towong Gaps, is associated with less-steep slopes and basins.

Quaternary deposits form broad upper terraces in the Corryong Creek valley.

The summit of Mount Unicorn is composed of quartz porphyry rock. Thowgla Creek valley contains a number of gold-bearing quartz reefs.

4. Soils

The soils of the steeper less-stable slopes on granite, and on lower drier slopes and dissected terraces, are commonly weakly bleached gradational soils. These may be associated with sandy loams where a sharp break in slope occurs. Friable brown gradational soils are the most widely distributed type on the montane slopes, and also occur on broad ridge-tops at the highest elevations. Undifferentiated stony loams are common on the narrower ridge-tops and steep slopes with northern aspects. Red duplex soils occur on the less-steep hills and gently sloping upper terraces, while the lower terraces or flats carry alluvial brown loams.



The upper reaches of the River Murray above Biggara (left) contrast with the lower flats carrying alluvial brown loams

5. Vegetation

The upper slopes in the north of the area usually carry an open forest of red stringybark and long-leaf box with either a tussock grass understorey or a sparse one with occasional grasses. In the south of the block the dry montane slopes usually support an open forest of broad-leaf peppermint with an understorey of either tussock grass or bracken.

Narrow-leaf peppermint open forest is found on moister sites such as broad ridge-tops, gullies, and southerly aspects. The understorey is usually shrubby, and consists of bracken, silver wattle, and hop bitter-pea.

Much of the Blakely's red gum woodland and river red gum woodland in the broad open valleys has been alienated for agriculture and now only carries a scattered cover of trees. The Murray River flats originally carried a characteristic wetland vegetation, including a number of rare and extremely localized occurrences of plants. These flats have been alienated to agriculture.

The mountain bertya, a plant recorded in the upper Murray last century and otherwise only known from a localized occurrence in the western Grampians, has limited occurrences in the stream-side environs of Thowgla Creek and the River Murray at Bunroy.

6. Fauna

Mammals recorded in the block include numerous eastern grey kangaroos around Mount Elliott and in other localities, the common wombat, black-tailed wallaby, and dingo. The greater glider has been reported near McCormack Creek. Litle is known of the local distribution and occurrence of small mammals, marsupials, bats, and lizards, but tiger quolls were reported as raiding hen-houses around Wabba Creek in the 1930s. Birds recorded here include the emu at Forest margins and various waterbirds along th Murray River flats. Other birds of the forests include the spotted quail-thrush and grey thrush.

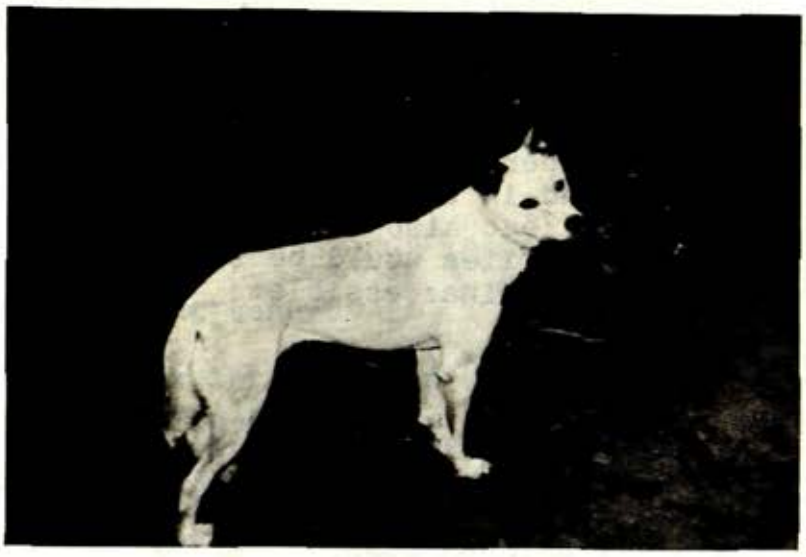
B. Present Uses and Capabilities

1. Nature conservation

Capability for flora conservation is moderate to high, as the extensive areas of native vegetation are contiguous with the alpine area to the south. In terms of botanical diversity the public land on the Elliott ridge contains a number of significant native plants including crimson grevillea, mealy bundy, and cliff cudweed. This area is already protected within a regional park. The rare dwarf milkwort occurs near Bunroy Creek. Mountain mirbelia and box micrantheum are also found near Bunroy. An addition to the alpine park system extends into the study area at Bunroy.

The river flats along the River Murray, although alienated for agriculture, contain a number of significant plant species. These include water-shield, large duckweed, and swamp violet at Biggara, and flat-sedge, large duckweed, river hook-sedge, swamp violet, austral ladies tresses, and sedge near Towong.

The block also has a high capability for fauna conservation, having consolidated areas of relatively undisturbed land. The large herbivores and the gliders, possums, and phascogales would all be well represented. Dingoes are also present. The birds of the southern parts of the block are



Native fauna found in this block include the dingo

typical of the wet open forest elsewhere in the north-east. Reptiles would be well represented and amphibians less so.

2. Recreation

Capability for passive recreation in most of the block is limited by the broken nature of the topography - restricting vehicle access. Fire-protection tracks provide opportunities for four-wheel drive recreation driving. Mount Elliott Regional Park, although not easily accessible by car, provides opportunities for nature study as well as offering scenic views of the Snowy Mountains and Mitta Mitta massif.

The streams have a high capability for recreational fishing for brown and rainbow trout, while the River Murray is popular for white-water canoeing and rafting.

3. Water supply catchment

This entire block is located in the Lake Hume water supply catchment.

4. Agriculture and apiculture

Most of the public land in the block is too steep or too cold for consideration for agriculture. Most of the river flats at higher elevations and the broad valley floors at lower elevations have already been alienated and cleared for agriculture.

Honey production is limited by the availability of suitable tree species and is mainly restricted to river red gum growing along road and stream reserves in the north of the block and some sites using forested land near Nariel Creek.

5. Softwood production

The small size and remote location of the limited areas of narrow-leaf peppermint open forest indicate a low capability for softwood production. It is government policy that the clearing of intact native forest for softwood planting be phased out.

6. Hardwood production

Some narrow-leaf peppermint and candlebark gum stands in Wabba Creek have been logged, but they are small and remote. Other stands of narrow-leaf peppermint in the headwaters of Bullocky and Kangaroo Creeks and in the Bunroy basin are also capable of log production, but also limited in area. Some blue gum stands in moist gullies would be suitable for sawlog production, but relatively inaccessible.

7. Mining and quarrying

The gold-fields around Mount Elliott have apparently been worked out. Gold has also been won in the past from reefs and alluvium along the Thowgla Creen and some of its tributaries. Current mineral exploration is located west of Nariel Creek and in the Mount Unicorn area.

8. Hazards and conflicts

The sheet erosion hzard on the steep montane slopes is low because of the undisturbed nature of the vegetation; however, clearing or a severe fire could present conditions under which such erosion could occur. The plateau area near Mount Elliott has a lower erosion hazard.

Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	-
2	-
3	-
4	6
5(a)	88
5(b)	6

Blackberry presents a serious hazard to some forms of recreation and to nature conservation in some localities. The dingo and wild dog populations in the area are sufficient to cause stock losses on adjoining properties.

10. WALWA--PINE MOUNTAIN--BURROWA--MITTAMATITE

A. Tenure and Nature of the Land

1. Present tenure

This block includes approximately 25,300 ha of public land, most of it (17,600 ha) in the Burrowa--Pine Mountain National Park. The park includes two reference areas: Jemba (1,030 ha) and Pine Mountain (600 ha).

Uncommitted land comprises an isolated area including Mount Mitta Mitta (4,280 ha), two parcels adjoining the Burrowa--Pine Mountain National Park (750 ha and 120 ha), and another east of Walwa (105 ha).

Three wildlife reserves along the Murray River totalling 130 ha - a scenic lookout (75 ha), a small portion of the Shelley softwood plantation (281 ha), and adjoining forest area (500 ha) - and a number of small reserves make up the balance of public land in the block.

2. Climate

Average annual rainfall ranges from 710 mm in the north of the block to more than 1,020 mm on the Burrowa massif, falling mainly in the winter months. The Cudgewa and Corryong Creek and River Murray valleys lie in a slight rain-shadow. Summers are hot and relatively dry and winters cool, with an autumn to spring incidence of frosts. Summer conditions are ameliorated at the higher elevations, where temperatures are lower.

3. Geology and geomorphology

The dominating features of this block are the Burrowa, Pine Mountain, and Mount Mitta Mitta massifs. Although similar in appearance, they are not all of the same origin. Most of the Burrowa massif comprises Jemba rhyolite, an acid volcanic rock of Devonian age; the massif consists of steep montane slopes with occasional perched basins and small high-level plateaux at 1,000--1,200 m.

Mount Burrowa, with an elevation of 1,278 m, forms the highest point. Cliffs around the massif have given rise to the popular name of Cudgewa Bluff. A north--south trending belt of Ordovician schists underlies the Jemba rhyolite, and extends beyond it to the north, east, and south. Limited outcrops of quartz porphyry and quartz felspar porphyry are probably associated with a ring dyke, from which the rhyolites originated. The Pine Mountain and Mitta Mitta massifs are composed of Devonian red and grey granite intruded by dyke swarms of varying composition. The Mitta Mitta massif's perched basins are, however, larger in extent than those of Pine Mountain.

The Mitta Mitta massif - from Mount Mitta Mitta

The remainder of the area consists of Devonian granite and Ordovician schists, mostly at elevations below 700 m. Alluvial fans and terraces of Quaternary origin are found at the bases of the massifs.

In the north-western corner of the block, in the vicinity of Walwa, tin-bearing dykes of various composition intersect Ordovician schists. Most of the public land in this corner lies on the schists, and the associated landscapes have a higher proportion of steep montane slopes than the granite.

The broad mature valley floors range in elevation from about 300 m to 450 m.

4. Soils

Weakly bleached gradational soils predominate on the lower slopes and upper terraces and on steeper, less-stable slopes on the grey granites. Undifferentiated stony loams have been formed in steep, dry situations. In the south of the block, friable brown gradational soils are found, with friable red gradational soils on the flatter and moister areas - mainly on the broader ridge-tops and southern aspects. Around the Corryong Creek valley and on the more gently sloping country elsewhere in the block, red duplex soils are found. Alluvial brown loams predominate on the Murray River flats.

5. Vegetation

This block contains the most diverse vegetation in the study area. Differences in local climate due to the range in elevation from 300 m to more than 1,200 m - and the marked effects of aspect due to a high degree of dissection of the topography - have caused this diversity. Difference in soil

parent materials also play some part. The full range of native vegetation units in the study area is represented.

On the Burrowa massif candlebark gum--snow gum open forest caps the ridges at the highest elevations. Stands of alpine ash occupy some sheltered situations below the highest ridges, and the understorey associated with this species often consists of small trees and tall shrubs. Vegetative cover on the balance of the massif varies according to topography and rainfall.

The Pine Mountain and Mitta Mitta massifs both carry predominantly red stringybark--long-leaf box open forest, but this dominant vegetation is also mixed with vegetation characteristic of moister sites and also with a complex of mossland, heaths, and black cypress pine open forest on some rocky slopes.

While narrow-leaf peppermint open forest may be found on some sheltered aspects, the predominant vegetation on southerly aspects at lower elevations and on the foothills is broad-leaf peppermint--candlebark gum forest.

Most of the river flats have been cleared for agriculture, but scattered remnants of the original river red gum woodland still remain. Blakely's red gum woodland is found above the river red gum.

The block contains a large number of species of conservation significance, found in the understorey vegetation to the open forests and on the river flats.

6. Fauna

Elevation, climatic conditions, and vegetation all vary widely here, combining to provide diverse habitats. Animals recorded include the eastern grey kangaroo, greater glider, and common wombat. The brush-tailed rock-wallaby, a species that now has an extremely restricted range in Victoria, was once common on the top of Pine Mountain, and a photo of two rock wallabies in a tree was taken in 1895 near Tintaldra. They have not been recorded in this area since.

Birds recorded in the block include the wedge-tail eagle, painted honeyeater, crimson rosella, pied currawong, bee-eater, satin fly-catcher, white-browed scrub-wren, grey thrush, red wattle-bird, and superb blue wren. A pair of brolgas has been recorded as nesting at Towong, although recently only one bird has been seen. The Murray River flats provide habitat for water birds such as grebes, herons, egrets, bitterns, spoonbills, Latham's snipe, ibis, cormorants, and ducks. The vegetation along the river also provides food and shelter for migratory species such as the noisy and little friar-birds and dollar-bird. Azure kingfishers have been recorded as nesting in the river bank at Tintaldra.

Reptile species are well represented, as at least 10 of the 25 reptiles recorded for the Upper Murray are found here - including some cool temperate species. The coppertail skink

has been recorded on the lower slopes of the Burrowa massif near Guys Forest.

B. Present Uses and Capabilities

1. Nature conservation

The great diversity in vegetation types in this block and its high capability for flora and fauna conservation have been recognized by the creation of the Burrowa--Pine Mountain National Park, incorporating the Burrowa and Pine Mountain massifs. Plant species endemic to the area and found within the park include the phantom wattle, a round-leaf form of the shining phebalium (*Phebalium* sp. aff. *diosmeum*), bogong gum, and a number of very localized and/or rare species such as the hairy hop-bush, broad-leaf hop-bush, green grevillea, fan grevillea, scented daisy-bush, and lanky fescue.

The vegetation of the Mitta Mitta massif is similar to that of Pine Mountain. An additional species of conservation significance on the massif is the common spleen-wort.

Most of the river flats in the block have been alienated for agriculture, but a number of rare species have been recorded on the river flats near Walwa, including graceful swamp wallaby-grass, umbrella grass, and rat-tail grass. The scaly greenhood, fan grevillea, rye beetle-grass, and brush wire-grass are also found near Walwa.

Extensive areas of stream frontage, held under licence, have some conservation potential. The parcels of uncommitted land adjoining the park have a lower capability for nature conservation than the park itself; however, their presence provides a forested link to the Murray Valley Highway in the south and contributes in both the south and east to the character of the landscape.

The large parcel of public land comprising the Burrowa--Pine Mountain National Park has a high capability for nature conservation. The large herbivores are represented as well as the possums and gliders, and phascogales and native rodents probably occur here also. Similarly, the block contains many and varied bird species and almost half of the reptiles recorded for the Upper Murray area, including the tree dragon, grass skink, garden skink, three-lined skink, eastern water skink, and tiger snake.

While the river red gum forest and associated riverine environment have importance for such birds as the dollar-bird, noisy friar-bird, and little friar-bird and for mammals such as the platypus and eastern water rat, the wildlife reserves at Clarke Lagoon, Jeremal, and Tintaldra suffer because of their small size, linear nature, and limited area of wetlands.

2. Recreation

The Murray Valley Highway effectively bounds this block on three sides. Access to the edges of the public land is

good and a dry-weather road provides access to the summit of the Mitta Mitta massif and Embery's Lookout. Access within the Burrowa--Pine Mountain National Park is more restricted, apart from a road to the south-western section of the Burrowa massif, although a good road has been provided to the Cudgewa Falls.

Recreation driving using the network of roads, together with picnic areas on the Murray Valley Highway near Beetoomba, Colac Colac, Jeremal, and Tintaldra, provides opportunities for leisurely contemplation of the vistas - extending to the Snowy Mountains in New South Wales and the Koetong uplands.

A number of walking tracks have been developed within the National Park - including one linking Mount Burrowa and Pine Mountain - but shortage of drinkable water *en-route* may restrict walking opportunities in summer. There is potential for off-track walking on the Mitta Mitta massif, and the section of the closed Shelley--Cudgewa railway easement from east of Beetoomba as it sweeps parallel with the foothills of the Burrowa massif through farmland could lend itself to development as a feeder walking track to the National Park. Fishing in Cudgewa Creek and the River Murray and rafting and canoeing in the Murray are water-based activities that attract adherents.

The bulk of the public land near Walwa has a low capability for recreation. Tin-mining areas east of Walwa, however, provide historical insights, while land adjoining the River Murray is intensively used for camping and fishing.

3. Water supply catchment

This entire block is within the Lake Hume water supply catchment.

4. Agriculture and apiculture

Agricultural capability is moderate to low on public land in the block except along the River Murray, where capability is moderate to high. Public land near the Murray supports grazing under licence. A small reserve adjacent to the Murray Valley Highway near Pine Mountain is used for holding stock being driven along the road.

While some of the lower-elevation basins, especially those with southerly aspects, could be developed for agriculture, the fertilizer requirements on weakly bleached massive gradational soils and red duplex soils may be high.

Public land in the north of the block has high capability for honey production. The bulk of production comes from Blakely's red gum, river red gum, and red stringybark. Most of the bee sites utilize the vegetation on stream frontages and roadside reserves.

5. Softwood production

A small portion of the south-western corner of the block, in the Keelangie Creek basin, has been converted to softwoods.

The uncommitted land remaining is unsuitable for radiata pine growth. It is government policy that the clearing of intact native forest for softwood be phased out.

6. Hardwood production

Capability on the uncommitted land is very low.

7. Mining and quarrying

Public land near Walwa has high capability for tin production, but activity is strongly influenced by prevailing ore prices. There is exploration interest in this area.

Fluorite, a mineral used in open-hearth steel smelting and a number of other manufacturing processes, has been obtained from a mine at Pine Mountain Creek. Part of the prospect now lies within the Burrowa--Pine Mountain National Park. A recently expired mining lease, somewhat smaller in area than previous leases due to the park declaration, abutted the park, partly on uncommitted public land and partly on private land.

8. Hazards and conflicts

The erosion hazard is high on steep slopes, where weakly bleached massive gradational soils or undifferentiated sandy loams carry sparse vegetation. Land with deeper soils has a moderate to high landslip risk, not necessarily on only the steepest slopes. Erosion risk ratings for public land in this block are as follows:

Class	Public land (%)
1	-
2	-
3	7
4	13
5(a)	72
5(b)	8

A high fire hazard at Pine Mountain results from the combination of scrubby vegetation, steep northerly slopes, and dry summers. Mineral production may conflict with flora conservation and maintenance of water quality. Illegal gravel extraction from watercourses conflicts with nature conservation and other streamside values.

APPENDICES

Appendix I

KEY TO PUBLIC LAND RECOMMENDATIONS

Category	Reference no.	Name	Previous recommendations			
			NE1	NE2	NE3, 4 & 5	Alp S.I.
Parks						
- National	A1	Mount Burrowa—Pine Mountain	A4			
- State	A2	Mount Samaria		A1		
	A3	Chiltern			A4	
	A4	Mount Granya	A2			
- Regional	A5	Reef Hills		A2		
	A6	Baranduda Range			A5	
	A7	Beechworth			A6	
	A8	Jarvis Creek Plateau	A1			
	A9	Mount Elliott	A5			
- Multi-purpose	A10	Mount Pilot			A3	
	A11	Mount Lawson	A3			
- Alpine	A12	Mount Barlow addition	J2			A22
Reference areas	B1	Toorour		B1		
	B2	Glen Creek		B2		
	B3	Blue Range		B3		
	B4	Ryans Creek		B4		
	B5	Pilot Range			B5	
	B6	Mitta Mitta			B6	
	B7	Bungil	B1			
	B8	Jemba	B2			
	B9	Pine Mountain	B3			
	B10	Dry Forest Creek	B4			
	B11	Lucyvale Creek	B5			
	B12	Cudgewa Creek	B6			
	B13	Burbibyong Creek	B7			
Wildlife reserves	C1	Seven Creeks		C1		
	C2	Clarke Lagoon	C1			
	C3	Jeremal	C2			
	C4	Tintaldra	C3			
Water production	D1	Mountain Hut Creek		E3		
	D2	Honeysuckle Creek		E4		
	D3	Lake Eildon		E5		
	D4	Lake Nillahcootie		E5		
	D5	Lake McCall Say		E2		
	D6	Loombah Weir		E1		
	D7	Lake Mokoan		E1		
	D8	Diversion Channel Ovens River (Wangaratta)			D5	

Appendix 1 (continued)

Category	Reference no.	Name	Previous recommendations			
			NE1	NE2	NE3, 4 & 5	Alp S.I.
Water production (continued)	D9	Diddah Diddah Creek			D10	
	D10	Barambogie Creek			D11	
	D11	Commissioners Creek			D14	
	D12	Nine Mile Creek (Yackandandah)			D15	
	D13	Nine Mile Creek (Beechworth)			D12	
	D14	Wodonga Creek			D13	
	D15	Lake Hume	E1		D16	
Hardwood production	E1	Mount Strathbogie		F1		
	E2	Toombullup		F2		
	E3	Mount Big Ben			E2	
Softwood production	F1	Various existing plantations	F1-F3	G1-G3	F1-F10	
Forest areas	G1	Various	G1	H1	G1	
Flora/Flora and fauna	H1	Tenneriffe		L5		
	H2	Big Hill		L6		
	H3	Mount Wombat		L7		
	H4	Hat Hill		L8		
Bushland reserves	I1	Upton Hill		L2		
	I2	Euroa Hill		L3		
	I3	Bald Hill		L4		
	I4				H4	
	I5				H5	
	I6				H6	
	I7				H7	
	I8				H8	
	I9				H9	
	I10				H10	
	I11				H11	
	I12				H12	
	I13				H13	
	I14				H14	
	I15				H15	
	I16				H16	
	I17				H17	
	I18				H18	
	I19				H19	
	I20				H20	
	I21				H21	
	I22				H22	
	I23				H23	
	I24				H24	
	I25				H25	
	I26				H26	
	I27				H27	

Appendix 1 (continued)

Category	Reference no.	Name	Previous recommendations			
			NE1	NE2	NE3, 4 & 5	Alp S.I.
Bushland reserves (continued)	I28				H28	
	I29				H29	
	I30				H30	
	I31				H31	
	I32				H32	
	I33				H33	
	I34				H34	
	I35				H35	
	I36				H36	
	I37				H38	
	I38				H39	
	I39		K2			
Scenic reserves	J1	Mount Stanley			N2	
	J2	Barnawartha			N3	
	J3	Murmungee			N7	
	J4	Embery Lookout	K1			
Rivers and streams	K1	Frontages	K3	L10	I1	
	K2				J23	
	K3				J6	
	K4				J7	
	K5				J8	
	K6				J9	
	K7				J10	
	K8				J11	
	K9				J12	
	K10				J13	
	K11				J14	
Education areas	L1	Lima South		D1		
	L2	Mount Barambogie			L2	
	L3	Lockhart Creek			L3	
	L4	Mountain Creek	D1			
Recreation	M1	Existing recreation reserves	K5	L11	M4,M6-8, M10	
Historic	N1	Toombullup		L1		
Agriculture	O1	Alienation (various)	H1,H2	I1	O1	
		Parish of Kancobin	J2			K9
Mineral and stone production	P1	Various	I1	J1	P2	
Utilities and survey	R1	Transmission lines	L2	M2	Q1,Q2	
	R2	Beechworth Hospital			Q8	

Appendix 1 (continued)

Category	Reference no.	Name	Previous recommendations			
			NE1	NE2	NE3, 4 & 5	Alp S.I.
Utilities and survey (continued	R3	Beechworth Prison			Q9	
	R4	Other utility areas	L1	M1	Q11	
Uncommitted land	S1	Various	J1	K1	S1	
	S2	Broken River, Evans Creek		K2		
	S3	Wabba, Bunroy, and Biggara	J2			
Other reserves (public land)	T1	Various	K5	L11	T1	
Albury--Wodonga Corporation Land	U1		-	-	-	

Appendix II

GLOSSARY OF SOIL TERMS

available water capacity	:	an estimate of the amount of water stored in the soil that is available for plant growth
bleached horizon	:	a layer in the soil profile that has a paler colour than the overlying horizon
cation exchange capacity	:	a measure of the cations (including calcium, magnesium, ammonium, and hydrogen ions), which are loosely bound to clay particles and are exchangeable with other cations in solution
concretions	:	hard lumps in the soil formed from insoluble iron or calcium oxides, sometimes being fragments of a continuous layer or hardpan
dispersibility	:	the tendency of some types of clay to lose any structure or aggregation on wetting, and to disperse into colloidal-size particles
duplex soils	:	soils with profiles showing marked texture change between the A and B horizons, the subsoil being much more clayey than the topsoil
gilgai	:	a natural formation of some soils where the land has a hummocky surface of small mounds and depressions
gradational soils	:	soils with profiles showing no sharp changes in texture, but gradually becoming more clayey with depth
hard-setting	:	property of some soil A horizons where a compact, hard, and structureless condition occurs periodically on drying-out
horizon	:	a layer in the soil profile that has morphological characteristics and properties different from layers below and/or above it
infiltration	:	the entry of water into the soil surface

permeability	:	the rate of movement of water through the soil profile
porosity	:	The measure of the amount of pore space in a soil sample - that is, the volume occupied by air or water rather than by solid soil particles
profile	:	a soil profile is the face of the soil exposed in a vertical section, from the surface down to the parent material
structure	:	the degree of formation of the soil into individual natural aggregates of the smaller sand, silt and clay particles of which it is composed
texture	:	the texture of a soil horizon reflects the proportions of the sand, fine sand, silt, and clay size particles of which it is composed
uniform soils	:	soils with profiles showing little, if any, texture change from top to bottom

Appendix III

PLANT NAMES IN REPORT

Common name	Scientific name
African lovegrass	*Eragrostis curvula*
Alpine ash	*Eucalyptus delegatensis*
Alpine bottlebrush	*Callistemon sieberi*
Annual fern	*Anogramma leptophylla*
Argyle apple	*Eucalyptus cinerea*
Austral bugle	*Ajuga australis*
Austral grass-tree	*Xanthorrhoea australis*
Austral king-fern	*Todea barbara*
Austral ladies tresses	*Spiranthes sinensis*
Austral toad-flax	*Thesium australe*
Australian indigo	*Indigofera australis*
Barley grass	*Hordeum* spp.
Beard-orchid	*Calochilus grandiflorus*
Bent-leaf wattle	*Acacia flexifolia*
Bidgee-widgee	*Acaena anserinifolia*
Black cypress pine	*Callitris endlicheri*
Black sallee	*Eucalyptus stellulata*
Blackwood	*Acacia melanoxylon*
Blakely's red gum	*Eucalyptus blakelyi*
Blanket-leaf	*Bedfordia salicina*
Bluebell	*Wahlenbergia stricta*
Blue gum	*Eucalyptus bicostata*
Blue pincushion	*Brunonia australis*
Bogong gum	*Eucalyptus chapmaniana*
Box-leaf wattle	*Acacia buxifolia*
Box micrantheum	*Micrantheum hexandrum*
Boxthorn	*Lycium ferocissimum*
Bracken fern or Austral bracken	*Pteridium esculentum*
Brittle gum	*Eucalyptus mannifera*
Broad-leaf hop-bush	*Dodonaea rhombifolia*
Broad-leaf peppermint	*Eucalyptus dives*
Brome	*Bromus* spp.
Bronzy bird-orchid	*Chiloglottis pescottiana*
Broom bitter-pea	*Daviesia genistifolia*
Brush wire-grass	*Cyperus flavidus*
Bush-pea	*Pultenaea platyphylla*
Bush-pea	*Pultenaea polifolia*
Bush-pea	*Pultenaea vrolandii*
But but	*Eucalyptus bridgesiana*
Button tea-tree	*Leptospermum micromyrtus*
Candlebark gum	*Eucalyptus rubida*
Cane wire-grass	*Aristida ramosa*
Chocolate lily	*Dichopogon strictus*
Cliff cudweed	*Gnaphalium umbricola*
Common fringe-myrtle	*Calytrix tetragona*
Common maiden-hair	*Adiantum aethiopicum*
Common reed	*Phragmites communis*
Common spleenwort	*Asplenium trichomanes*
Common woodruff	*Asperula conferta*
Coral heath	*Epacris microphylla*
Cottony haeckeria	*Haeckeria ozothamnoides*

Common name	Scientific name
Creamy stackhousia	*Stackhousia monogyna*
Crimson grevillea	*Grevillea polybractea*
Dainty bird-orchid	*Chiloglottis trapeziformis*
Daisy	*Brachycome ptychocarpa*
Daisy bush	*Olearia* spp.
Deane's wattle	*Acacia deanei*
Digger's speedwell	*Veronica perfoliata*
Dogwood	*Cassinia aculeata*
Drooping she-oak	*Casuarina stricta*
Dwarf cherry	*Exocarpos strictus*
Dwarf milkwort	*Polygala japonica*
Early nancy	*Anguillaria dioica*
Fan grevillea	*Grevillea ramosissima*
Fescue	*Vulpia* spp.
Flat-sedge or mussel leaf-rush	*Cyperus unioloides*
Fishbone water-fern	*Blechnum nudum*
Glandular pink-bells	*Tetratheca glandulosa*
Glandular pink-bells	*Tetratheca labillardieri* var. *orbifolia*
Golden wattle	*Acacia pycnantha*
Gorse bitter-pea	*Daviesia ulicifolia*
Graceful swamp wallaby-grass	*Amphibromus gracilis*
Green grevillea	*Grevillea jephcottii*
Greenhood	*Pterostylis* sp., aff. *P. gibbosa* ssp. *mitchelli*
Grey box	*Eucalyptus microcarpa*
Grey bush-pea	*Pultenaea cunninghamii*
Grey rice-flower	*Pimelea treyvaudii*
Guinea flowers	*Hibbertia* spp.
Handsome flat-pea	*Platylobium formosum*
Hairy hop-bush	*Dodonaea boroniifolia*
Hawthorn	*Crataegus* spp.
Hazel pomaderris	*Pomaderris aspera*
Heath-myrtle	*Micromyrtus ciliata*
Hedge wattle	*Acacia paradoxa* (syn. *armata*
Hickory wattle	*Acacia penninervis*
Hop bitter-pea	*Daviesia latifolia*
Hypsela	*Hypsela tridens*
Kangaroo grass	*Themeda australis*
Kurrajong	*Brachychiton populneus*
Lanky fescue	*Festuca eriopoda*
Large duck-orchid	*Caleana major*
Large duckweed	*Spirodela polyrrhiza* (syn. *Lemna polyrhiza*)
Lightwood	*Acacia implexa*
Long-flower hedgehog-grass	*Echinopogon cheelii*
Long-leaf box	*Eucalyptus goniocalyx*

Common name	Scientific name
Manna gum	*Eucalyptus viminalis*
Many-flower mat-rush	*Lomandra multiflora*
Mealy bundy	*Eucalyptus nortonii*
Messmate	*Eucalyptus obliqua*
Mosquito orchid	*Acianthus reniformis*
Mother shield-fern	*Polystichum proliferum*
Mountain baeckea	*Baeckea utilis*
Mountain banksia	*Banksia canei*
Mountain bertya	*Bertya findlayi*
Mountain dampiera	*Dampiera purpurea*
Mountain grevillea	*Grevillea alpina*
Mountain gum	*Eucalyptus dalrympleana*
Mountain hickory wattle	*Acacia obliquinervia*
Mountain mirbelia	*Mirbelia oxyloboides*
Mountain swamp gum	*Eucalyptus camphora*
Musk daisy-bush	*Olearia argophylla*
Narrow-leaf bitter-pea	*Daviesia virgata*
Narrow-leaf peppermint	*Eucalyptus radiata*
Ovens wattle	*Acacia pravissima*
Paterson's curse	*Echium plantagineum*
Phantom wattle	*Acacia phasmoides*
Pink bells	*Tetratheca* spp.
Ploughshare wattle	*Acacia gunnii*
Pomaderris	*Pomaderris subcapitata*
Poverty or mitta wattle	*Acacia dawsonii*
Prairie ground cherry	*Physalis viscosa*
Prickly tea-tree	*Leptospermum juniperinum*
Prickly woodruff	*Asperula scoparia*
Purple coral-pea	*Hardenbergia violacea*
Purple diuris	*Diuris punctata*
Purplish beard-orchid	*Calochilus robertsonii*
Quaking grass	*Briza* ssp.
Radiata pine	*Pinus radiata*
Rat-tail grass	*Sporobolus creber*
Red box	*Eucalyptus polyanthemos*
Red ironbark	*Eucalyptus sideroxylon*
Red-stemmed wattle	*Acacia rubida*
Red stringybark	*Eucalyptus macrorhyncha*
River bottlebrush	*Callistemon paludosus*
River hook-sedge	*Uncinia riparia*
River lomatia	*Lomatia myricoides*
River red gum	*Eucalyptis camaldulensis*
Rock fern	*Cheilanthes tenuifolia*
Rough tree-fern	*Cyathea australis*
Rye beetle-grass	*Tripogon loliiformis*
Sallow wattle	*Acacia longifolia*
Scaly greenhood	*Pterostylis hamata*
Scented daisy-bush	*Olearia adenophora*
Sedge	*Carex* spp.
Sheep's burr	*Acaena agnipila*
Sheep's burr	*Acaena echinata*

Common name	Scientific name
Shining phebalium	*Phebalium* sp. nov. aff. *diosmeum*
Silky purple-flag	*Patersonia sericea*
Silver tea-tree	*Leptospermum multicaule*
Silvertop wallaby-grass	*Danthonia pallida*
Silver wattle	*Acacia dealbata*
Silvery hair-grass	*Aira caryophyllea*
Slender onion-orchid	*Microtis parviflora*
Slender sun-orchid	*Thelymitra pauciflora*
Slender westringia	*Westringia eremicola*
Small-fruit hakea	*Hakea microcarpa*
Small grass-tree	*Xanthorrhoea minor*
Small-leaf parrot-pea	*Dillwynia retorta*
Snow grass	*Poa sieberana*
Snow gum	*Eucalyptus pauciflora*
Soft tree-fern	*Dicksonia antarctica*
St Johns wort	*Hypericum perforatum*
Swamp isotome	*Isotoma fluviatalis*
Swamp violet	*Viola caleyana*
Sweet briar rose	*Rosa rubiginosa*
Sweet vernal grass	*Anthoxanthum odoratum*
Tall lobelia	*Lobelia gibbosa*
Tall sedge	*Carex appressa*
Trailing groundberry	*Acrotriche prostrata*
Trailing oxylobium	*Oxylobium procumbens*
Trigger plant	*Stylidium graminifolium*
Tumbledown red gum	*Eucalyptus dealbata*
Tussock grass	*Poa labillardieri*
Twiggy daisy-bush	*Olearia ramulosa* var. *rigida*
Umbrella grass	*Digitaria diffusa*
Varnish wattle	*Acacia verniciflua*
Violet kunzea	*Kunzea parvifolia*
Wallaby grass	*Danthonia* spp.
Water-shield	*Brasenia schreberi*
Wedge-leaf hop-bush	*Dodonaea cuneata*
Weeping grass	*Microlaena stipoides*
White box	*Eucalyptus albens*
Woolly wattle	*Acacia lanigera*
Yellow box	*Eucalyptus melliodora*

Appendix IV

DISTRIBUTION OF FAUNA BY HABITAT TYPES

Key:

A Abundant
C Common
U Uncommon
R Rare
V Vagrant
\+ Recorded but abundance not assessed
M Museum of Victoria specimen
L Literature or personal communication

S Detected by Fisheries and Wildlife Division predator scat analysis
I Introduced species
E Extinct in study area with date of last record in brackets
* Old records with no habitat information available

Common name	Wet open forest	Dry open forest	Dry open forest and woodland	River red gum	Softwood	Wetland	Farmland	Urban
Mammals								
Short-beaked echidna	U	U	U	+	+		+	
Platypus						U		
Yellow-footed antechinus		U	C					
Brown antechinus	A	C						
Dusky antechinus	U							
Tiger quoll	R	R					R	
Eastern quoll*								
Brush-tailed phascogale	U	U	U					
Long-nosed bandicoot	U	U					R	
Mountain brushtail possum	C	U						
Common brushtail possum	U	C	C	+			+	+
Feathertail glider	U	U						
Eastern pygmy possum	U							
Yellow-bellied glider	C	C	C					
Sugar glider			U					
Squirrel glider	C	C	C		+			
Common ringtail possum	A	C						
Greater glider	A	C						
Rufous bettong*	C	C	C	+	C		C	
Eastern grey kangaroo	C	C						
Brush-tailed rock-wallaby	C	C	U	U				
Swamp wallaby	C	C	U	R				
Koala	A	A			C		C	
Common wombat	A	A			C		C	
Little red flying-fox*	R	R						
Eastern horseshoe-bat				+				U
Little mastiff bat	C	C	C	+			+	+
White-striped mastiff-bat	U	U	U	+				
Gould's wattled bat	C	U	U	+			+	
Chocolate wattled bat	C	U			+		+	
King River eptesicus	C	U	U	+	+			
Large forest eptesicus	C	C	U	+				
Little forest eptesicus	C	C	U	+				
Common bent-wing bat	R							
Broad-nosed bat		R						
Lesser long-eared bat	C	C	C	+	+		+	+
Gould's long-eared bat	U	U	U		+			
Great pipistrelle	U	U						
Water-rat						U		
Bush rat (I)	A	U						
Black rat (I)	C	U						
Feral dog, dingo (I)	C	C						
Fox (I)	C	C	C		+		+	
Feral cat (I)	C	C	U				+	
Goat (I)	U	U						
Fallow deer (I)					U			
Feral pig (I)	U	U						
Brown hare (I)			U				+	
European rabbit (I)	A	A	C		A		A	
Birds - non-passerines								
Emu	R	R					R	
Great crested grebe						R		
Hoary-headed grebe						U	R	
Australasian grebe						U	U	

Common name	Wet open forest	Dry open forest	Dry open forest and woodland	River red gum	Softwood	Wetland	Farmland	Urban
Australian pelican						U		
Darter						R		
Great cormorant						U		
Pied cormorant (L)								
Little black cormorant						R		
Little pied cormorant						U	U	
Pacific heron						U	U	
White-faced heron						C	C	
Cattle egret (L)								
Great egret						U	R	
Little egret						R		
Intermediate egret(L)								
Rufous night heron						R		
Little bittern (L)								
Australasian bittern (L)								
Black-necked stork (L)								
Glossy ibis (L)								
Sacred ibis (L)						C	U	
Straw-necked ibis						C	U	
Royal spoonbill						R		
Yellow-billed spoonbill						U	R	
Plumed whistling-duck							R	
Black swan						C		
Freckled duck						R		
Australian shelduck						U	R	
Pacific black duck						C	C	
Grey teal						U	U	
Chestnut teal						R		
Australasian shoveler						R		
Pink-eared duck						R		
Hardhead						R		
Maned duck						C	C	
Blue-billed duck (L)								
Musk duck						R		
Black-shouldered kite							R	
Square-tailed kite	R	R						
Whistling kite			R	U		C	U	
Brown goshawk	U	U	U	R		U	U	R
Collared sparrowhawk	R	U	R				R	
Grey goshawk		L	L					
White-bellied sea-eagle (L)								
Wedge-tailed eagle	U	U	U				U	
Little eagle		U	U	R		R	U	
Spotted harrier		R					R	
Marsh harrier						R		
Black falcon (L)								
Peregrine falcon	R	R	R	R		R	R	
Australian hobby	R	R	R	R			R	R
Brown falcon		U	U	U		C	C	U
Australian kestrel			U	U		U	U	U
Stubble quail			+			+	+	
Brown quail (L)								
King quail (L)								
Painted button-quail		R	U					
Little button-quail (L)								
Buff-banded rail (L)								
Baillon's crake (L)								
Australian crake (L)								
Black-tailed native-hen (L)								

Appendix IV (continued)

Common name	Wet open forest	Dry open forest	Dry open forest and woodland	River red gum	Softwood	Wetland	Farmland	Urban
Birds - non-passerines (continued)								
Dusky moorhen						U	U	
Purple swamphen						U	U	
Eurasian coot						C	R	
Brolga						R		
Bush thick-knee			R	R			R	R
Masked lapwing						C	C	U
Banded lapwing (L)								
Red-kneed dotterel						R		
Double-banded plover						R		
Black-fronted plover						U	R	
Black-winged stilt (L)								
Greenshank						+		
Marsh sandpiper (L)								
Latham's snipe						+		
Sharp-tailed sandpiper (L)								
Red-necked stint (L)								
Silver gull						U		
Whiskered tern								
Feral pigeon (I)							R	U
Peaceful dove		R	U	U				
Common bronzewing	U	U	U	U			U	
Brush bronzewing	R							
Crested pigeon			R	U			U	U
Wonga pigeon	U							
Yellow-tailed black-cockatoo	U	R					R	
Gang-gang cockatoo	C	C	R				R	R
Galah	R	R	U	C		U	C	U
Sulphur-crested cockatoo	C	C	C	C		U	C	U
Musk lorikeet			R					
Purple-crowned lorikeet (L)								
Little lorikeet		R	U				R	
Australian king-parrot	U	U	R				R	U
Cockatiel (L)								
Budgerigar			V				V	
Swift parrot (L)								
Crimson rosella	A	A	U	U	+		U	U
Yellow rosella				U				
Eastern rosella		R	U	C		U	C	C
Red-rumped parrot		R	U	C		U	C	U
Blue-winged parrot								
Turquoise parrot		R	U	R			U	
Pallid cuckoo			U	U		+	U	+
Brush cuckoo	U	R						
Fan-tailed cuckoo	U	U	U	U		+	U	+
Black-eared cuckoo (L)								
Horsfield's bronze-cuckoo	U	U		+			+	
Shining bronze-cuckoo	U	U	+	+			+	
Channel-billed cuckoo (L)								
Powerful owl	R							
Southern boobook	U	U	U	+		+	U	+
Barking owl		R						
Barn owl						R	R	
Tawny frogmouth	U	U	U	+		+	U	+
Australian owlet-nightjar			U					
White-throated nightjar	R							
White-throated needletail	+	+	+	+		+	+	+
Fork-tailed swift (L)								
Azure kingfisher (L)								
Laughing kookaburra	C	C	C	C		C	C	U
Red-backed kingfisher							V	
Sacred kingfisher	C	C	+	+		+	+	+
Rainbow bee-eater	+	+	+	+		+	+	+
Dollarbird			+	+			U	
Birds - Passerines								
Superb lyrebird	U	U						
Singing bushlark (L)								
Skylark							+	
White-backed swallow			R				R	
Welcome swallow	R	R	U	C	+	C	C	C
Tree martin			R	U		U	U	R
Fairy martin			R	U		U	C	R

Common name	Wet dry forest	Dry open forest	Dry open forest and woodland	River red gum	Softwood	Wetland	Farmland	Urban
Richard's pipit						R	C	R
Black-faced cuckoo-shrike	U	U	U	U	+	U	U	U
White-bellied cuckoo-shrike			R					
Cicadabird	U	U						
White-winged triller		R	R				R	
White's thrush	U	R					R	U
Blackbird (I)	R							
Rose robin	U	R						
Pink robin	R							
Flame robin	U	U	U	U	+	U	C	U
Scarlet robin	U	U	U		+		C	U
Red-capped robin		R	R				R	
Hooded robin		R	U				R	
Eastern yellow robin	C	C	U	+	+	R		
Jacky winter		R	U	U			U	
Crested shrike-tit	U	U	U	+				
Olive whistler	R							
Gilbert's whistler			R					
Golden whistler	C	C	U					
Rufous whistler	C	C	C	+				
Grey shrike-thrush	C	C	C	+	+		U	
Crested bellbird			R					
Leaden flycatcher	U	U	R					
Satin flycatcher	R	R						
Restless flycatcher		R	U	+		U	U	R
Rufous fantail	R							
Grey fantail	C	C	C	+	+		R	U
Willie wagtail		R	U	C	+	+	C	C
Eastern whipbird	U	R						
Spotted quail-thrush	U	U						
Grey-crowned babbler			R				R	
White-browed babbler			U	R				
Clamorous reed-warbler						U		
Little grassbird						R		
Golden-headed cisticola						R	R	
Rufous songlark		U	U	+			R	
Brown songlark							R	
Superb fairy-wren	C	C	C	C	+	U	C	
Pilotbird	U	R						
Large-billed scrubwren (L)								
White-browed scrubwren	C	C	U		+			R
Chestnut-rumped hylacola		R	R					
Speckled warbler		R	U					
Weebill		R	U					
Western gerygone		U	U					
White-throated gerygone	U	U	R					
Brown thornbill	A	A	U		+		R	R
Buff-rumped thornbill	R	U	C		+		U	
Yellow-rumped thornbill	R	R	U	+	+	U	C	U
Yellow thornbill		R	U					R
Striated thornbill	A	A	C	+	+			U
Southern whiteface							R	
Varied sittella	U	U	U					
White-throated tree-creeper	A	A	C	U			U	
Red-browed treecreeper	U	U						
Brown treecreeper		R	C	C			U	
Red wattlebird	C	C	U	U			U	U
Little wattlebird (L)								
Noisy friarbird	C	C	C	+			U	R
Regent honeyeater							R	
Noisy miner		R	U	U			C	
Lewin's honeyeater (L)								
Yellow-faced honeyeater	A	A	C	U			U	
Singing honeyeater (L)								
White-eared honeyeater	U	U	R					
Yellow-tufted honeyeater		R	U					
Fuscous honeyeater	R	U	C	R			R	
White-plumed honeyeater	R	R	C	A			C	
Black-chinned honeyeater			U					
Brown-headed honeyeater	U	U	U					
White-naped honeyeater	C	U	U					
Painted honeyeater			R					
Crescent honeyeater	U	R						
New Holland honeyeater		R						
Eastern spinebill	U	U	U				U	
White-fronted chat						R	R	

Appendix IV (continued)

Common name	Dry open forest	Dry open forest	Dry open forest and woodland	River red gum	Softwood	Wetland	Farmland	Urban
Birds - Passerines (continued)								
Mistletoebird	R	U	U					
Spotted pardalote	A	A	C	U		U		
Striated pardalote	A	A	A	C		C		
Silvereye	C	C	U				U	U
European goldfinch (I)			R			R	U	U
House sparrow							C	C
Tree sparrow							R	U
Red-browed firetail	U	U	R		+	+	U	R
Diamond firetail		R	U				R	
Zebra finch							R	
Double-barred finch (L)								
Common starling			U	U		C	C	C
OLive-backed oriole	U	U	U					
Satin bowerbird	U	R					R	R
White-winged chough	R	U	U	+			U	
Australian magpie-lark				U		C	A	C
White-breasted wood-swallow							R	
Masked woodswallow			R					
White-browed woodswallow			R				R	
Dusky woodswallow	U	C	C	+		U	U	
Grey butcherbird	R	U					R	
Pied butcherbird (L)								
Australian magpie	R	R	U	C	+	C	A	C
Pied currawong	C	U	U	+	+		U	U
Grey currawong	U	U	R		+		R	
Australian raven	U	U	U	+	+	U	U	
Little raven			R	+		R	U	
Reptiles and amphibians								
Tree goanna	+	+	+					
Sand goanna			+					
Bearded dragon			+					
Mountain dragon	+						+	
Tree dragon		+	+					
Wood gecko		+	+					
Marbled gecko		+	+					
Legless lizard		+					+	
McCoy's skink	+							
Rainbow skink			+					
Snake-eyed skink			+					
Large-striped skink		+	+				+	
Copper-tailed skink		+	+					
Cunningham's skink		+	+				+	
Black rock skink	+	+						
Tree skink			+	+				
White's skink	+	+						
Three-toed skink	+	+	+				+	

Common name	Wet open forest	Dry open forest	Dry open forest and woodland	River red gum	Softwood	Wetland	Farmland	Urban
Delicate skink		+					+	+
Garden skink	+	+	+	+			+	+
Weasel skink	+							
Coventry's skink	+							
Grass skink[1]						+		
Grass skink[2]	+							
Red-throated skink		+	+					
Three-lined skink	+		+			+		
Bougainville's skink		+	+					
Boulenger's skink	+		+	+			+	+
Spencer's skink	+							
Water skink[3]	+							
Water skink[4]	+	+						
Blotched blue-tongue lizard	+	+						
Commom blue-tongue lizard			+				+	
Copperhead snake[5]	+	+						
Copperhead snake[6]						+		
Small-eyed snake	+	+	+					
White-lipped snake	+	+						
Tiger snake				+		+	+	
Red-bellied black snake		+	+	+		+	+	
Common brown snake		+	+					
Dwyer's snake		+	+					
Little whip snake			+				+	
Bandy bandy			+					
Blind snake[7]		+	+					
Blind snake[8]								
Eastern long-necked tortoise						+		
Brown tree frog[9]	+	+		+	+	+	+	
Brown tree frog[10]	+	+		+	+	+	+	
Lesueur's tree frog	+	+						
Spotted tree frog (L)								
Peron's tree frog		+	+	+		+	+	
Green and gold bell frog					+	+	+	
Froglet[11]	+	+						
Southern bullfrog		+	+	+		+	+	+
Barking frog						+		
Giant bullfrog							+	
Striped marsh frog						+		
Spotted grass frog						+	+	+
Spotted burrowing frog			+	+		+	+	+
Brown toadlet		+	+				+	
Southern toadlet	+	+						
Froglet[12]				+		+	+	
Eastern froglet	+	+	+	+	+	+	+	+
Sloan's froglet				+		+	+	
Red-groined toadlet			+	+		+		

Footnotes:

1. *Leiolopisma entrecasteauxii* form A
2. *Leiolopisma entrecasteauxii* form B
3. *Sphenomorphus tympanum* C.T.F.
4. *Sphenomorphus tympanum* W.T.F.
5. *Austrelaps superba* highland
6. *Australaps superba* lowland
7. *Ramphotyphlops nigrescens*
8. *Ramphotyphlops proxima*
9. *Litoria ewingii*
10. *Litoria paraewingii*
11. *Geocrinia victoriana*
12. *Ranidella parinsignifera*

Appendix V

DISTRIBUTION OF FAUNA BY DESCRIPTIVE BLOCKS

Scientific name	Common name	1	2	3	4	5	6	7	8	9	10
Mammals											
Tachyglossus aculeatus	Short-beaked echidna	R	C	U	C	C	S	U	U	L	U
Ornithorhynchus anatinus	Platypus			S			U	M	U	M	M
Antechinus flavipes	Yellow-footed antechinus	M	L	R	C	C		M			M
Antechinus stuartii	Brown antechinus	U	C	C		C	C	C	C	C	C
Antechinus swainsonii	Dusky antechinus		U	U			U		U		U
Dasyurus maculatus	Tiger quoll	R				L	S	M	L	L	M
Dasyurus viverrinus	Eastern quoll		L								
Phascogale tapoatafa	Brush-tailed phascogale	U	U	M	U	U		M			
Perameles nasuta	Long-nosed bandicoot	U	U	S		U	L		C		
Trichosurus caninus	Mountain brushtail possum	R	C	U			C		U		
Trichosurus vulpecula	Common brushtail possum	C	C	C	C	C	C	C	C	C	C
Acrobates pygmaeus	Feathertail glider		S	U	L	M	S		U		
Cercartetus nanus	Eastern pygmy-possum		U	U		M	U				
Petaurus australis	Yellow-bellied glider		S	U			U				
Petaurus breviceps	Sugar glider	U	C	C	C	C	C	U	U		U
Petaurus norfolcensis	Squirrel glider		M		U	U					
Pseudocheirus peregrinus	Common ringtail possum	C	C	C	C	C	C	C	C	C	C
Petauroides volans	Greater glider	U	A	C		C	U	C	A	C	C
Aepyprymnus rufescens	Rufous bettong	M									
Macropus giganteus	Eastern grey kangaroo	U	C	C	C	C	C	C	C	C	C
Petrogale penicillata	Brush-tailed rock-wallaby										L
Wallabia bicolor	Swamp wallaby	C	C	C	U	C	C	C	C	C	C
Phascolarctos cinereus	Koala	C	C		R	U					
Vombatus ursinus	Common wombat	C	A	C		U	U	C	C	C	C
Pteropus scapulatus	Little red flying-fox					M	M	L			
Rhinolophus megaphyllus	Eastern horseshoe-bat		R	R							
Mormopterus planiceps	Little mastiff-bat				U	U					M
Tadarida australis	White-striped mastiff-bat		C	C	C	C	C	C			
Chalinolobus gouldii	Gould's wattled bat	M		U	C	M	U	U			M
Chalinolobus morio	Chocolate wattled bat	U	C	C	C	L	C	U	U	M	
Eptesicus regulus	King River eptesicus	C	C	C		U	C	U	U		
Eptesicus sagittula	Large forest eptesicus	C	C	C	U	U	C	U	U		
Eptesicus vulturnus	Little forest eptesicus		C	C	U	C		U	U	U	M
Miniopterus schreibersii	Common bent-wing bat		R								
Nyctinomus sp.	Broad-nosed Bat				U	L					
Nyctophilus geoffroyi	Lesser long-eared bat	C	C	C	U	C	C	U	U	U	U
Nyctophilus gouldi	Gould's long-eared bat	C	C	C		L	C	U	U		
Pipistrellus tasmaniensis	Great pipistrelle		U	U			U		U		
Hydromys chrysogaster	Water-rat	L	S	M			U	U		L	
Mus musculus (I)	House Mouse		M	M	C	C	C	U	U		
Rattus fuscipes	Bush rat	M	A	A		C	C	C	C	C	
Rattus rattus (I)	Black rat	U	U	S		C	U	U	U	U	U
Canis familiaris (I)	Feral dog, dingo	C	C	C	C	C	C	C	C	C	C
Vulpes vulpes (I)	Fox		C	C	C	C	C	C	C	C	C
Felis catus (I)	Feral cat	L	C	C	L	U	C	C	C		
Capra hircus (I)	Goat		U								
Dama dama (I)	Fallow deer					L			L		
Sus scrofa (I)	Feral pig		U	U							
Lepus capensis (I)	Brown hare		U	U	U	U		U			
Oryctolagus cuniculus (I)	European rabbit	C	A	A	U	A	A	C	A	C	C
Birds - non-passerines											
Dromaius novaehollandiae	Emu						+	+	+	+	
Podiceps cristatus	Great crested grebe		+	+							
Poliocephalus poliocephalus	Hoary-headed grebe			+	+	+		+		+	+
Tachybaptus novaehollandiae	Australasian grebe		+	+		+	+	+			+
Pelecanus conspicillatus	Australian pelican			+				+			
Anhinga melanogaster	Darter		+	+			+	+			
Phalacrocorax carbo	Great cormorant	+	+	+	+	+	+	+			+
Phalacrocorax varius (L)	Pied cormorant										
Phalacrocorax sulcirostris	Little black cormorant					+	+	+			
Phalacrocorax melanoleucos	Little pied cormorant			+	+	+	+	+	+		+
Ardea pacifica	Pacific heron			+	+	+	+	+	+		+
Ardea novaehollandiae	White-faced heron	+	+	+	+	+	+	+	+	+	+
Ardeola ibis (L)	Cattle egret										
Egretta alba	Great egret					+	+	+			
Egretta garzetta	Little egret							+			
Egretta intermedia (L)	Intermediate egret										
Nycticorax caledonicus	Rufous night heron		+	+							
Ixobrychus minutus (L)	Little bittern										
Botaurus poiciloptilus (L)	Australasian bittern										
Xenorhynchus asiaticus (L)	Black-necked stork										
Plegadis falcinellis (L)	Glossy ibis										
Threskiornis aethiopica	Sacred ibis		+	+	+	+	+	+	+	+	+
Threskiornis spinicollis	Straw-necked ibis		+	+	+	+	+	+	+	+	+
Platalea regia	Royal spoonbill					+	+				
Platalea flavipes	Yellow-billed spoonbill		+	+	+	+	+	+			+
Dendrocygna eytoni	Plumed whistling-duck		+	+							
Cygnus atratus	Black swan		+	+		+	+	+			+
Stictonetta naevosa	Freckled duck					+	L	L			

Scientific name	Common name	1	2	3	4	5	6	7	8	9	10
Tadorna tadornoides	Australian shelduck		+	+	+	+	+	+			+
Anas superciliosa	Pacific black duck	+	+	+	+	+	+	+	+	+	+
Anas gibberifrons	Grey teal	+	+	+	+	+	+	+	+		+
Anas castanea	Chestnut teal							+			+
Anas rhynchotis	Australasian shoveler			+		+	+				+
Malacorhynchus membranaceus	Pink-eared duck										+
Aythya australis	Hardhead		+	+			+	+			+
Chenonetta jubata	Maned duck	+	+	+	+	+	+	+	+	+	+
Oxyura australis (L)	Blue-billed duck										
Biziura lobata	Musk duck			+		+					
Elanus notatus	Black-shouldered kite						+	+			
Lophoictinia isura	Square-tailed kite		R	R							L
Haliastur sphenurus	Whistling kite		+				+	+	+	+	+
Accipiter fasciatus	Brown goshawk	+	+	+	+	+	+	+	+	+	
Accipiter cirrhocephalus	Collared sparrowhawk		+	+	+	+	+				
Accipiter novaehollandiae	Grey goshawk		L			L					
Haliaeetus leucogaster (L)	White-bellied sea-eagle										
Aquila audax	Wedge-tailed eagle	+	+	+	+	+	+	+	+	+	+
Hieraaetus morphnoides	Little eagle	+	+	+	+	+	+	+	+	+	+
Circus assimilis	Spotted harrier		+				+				
Circus aeruginosus	Marsh harrier	+									
Falco subniger (L)	Black falcon										
Falco peregrinus	Peregrine falcon	L	R	R	R	R	R	R	U		R
Falco longipennis	Australian hobby				+	+	+		+		
Falco berigora	Brown falcon	+	+	+	+	+	+	+	+	+	+
Falco cenchroides	Australian kestrel	+	+	+	+	+	+	+	+	+	
Coturnix novaezelandiae	Stubble quail		+	+	+			+			
Coturnix australis (L)	Brown quail										
Coturnix chinensis (L)	King quail										
Turnix varia	Painted button-quail		+		+				+		
Turnix velox (L)	Little button-quail										
Rallus philippensis (L)	Buff-banded rail										
Porzana pusilla (L)	Baillon's crake										
Porzana fluminea (L)	Australian crake										
Gallinula ventralis (L)	Black-tailed native-hen										
Gallinula tenebrosa	Dusky moorhen		+	+	+	+	+	+			+
Porphyrio porphyrio	Purple swamphen	+	+		+		+	+			+
Fulica atra	Eurasian coot	+	+	+		+	+	+			+
Grus rubicundus	Brolga		V					L			R
Burhinus magnirostris	Bush thick-knee	L	L	R	R	L					
Vanellus miles	Masked lapwing	+	+	+	+	+	+	+	+	+	+
Vanellus tricolor (L)	Banded lapwing										
Erythrogonys cinctus	Red-kneed dotterel						+	+			
Charadrius bicinctus (L)	Double-banded plover										
Charadrius melanops	Black-fronted plover				+	+	+	+			+
Himantopus himantopus (L)	Black-winged stilt										
Tringa nebularia	Greenshank						+				
Gallinago hardwickii	Latham's snipe		L	L	L	L	L	+			
Calidris acuminata (L)	Sharp-tailed sandpiper										
Calidris ruficollis (L)	Red-necked stint										
Larus novaehollandiae	Silver gull				+		+	+			+
Chlidonias hybrida (L)	Whiskered tern										
Columba livia (I)	Feral pigeon			+							
Geopelia placida	Peaceful dove				+	+		+			
Phaps chalcoptera	Common bronzewing		+	+	+	+	+		+		
Phaps elegans	Brush bronzewing		+								
Ocyphaps lophotes	Crested pigeon	+	+	+	+	+	+	+			
Leucosarcia melanoleuca	Wonga pigeon		+	+			+				
Calyptorhynchus funereus	Yellow-tailed black-cockatoo		+	+			+	+	+	+	
Callocephalon fimbriatum	Gang-gang cockatoo	+	+	+	+	+	+	+	+	+	+
Cacatua roseicapilla	Galah	+	+	+	+	+	+	+	+	+	+
Cacatua galerita	Sulphur-crested cockatoo	+	+	+	+	+	+	+	+	+	+
Glossopsitta concinna	Musk lorikeet				+						
Glossopsitta porphyrocephala (L)	Purple-crowned lorikeet										
Glossopsitta pusilla	Little lorikeet				+	+		+			
Alisterus scapularis	Australian king-parrot		+	+		+	+	+	+	+	+
Nymphicus hollandicus (L)	Cockatiel										
Melopsittacus undulatus	Budgerigar	+	+			+					
Lathamus discolor (L)	Swift parrot										
Platycercus elegans elegans	Crimson rosella	+	+	+		+	+	+	+	+	+
Platycercus elegans flaveolus	Yellow rosella					U	R	L			
Platycercus eximius	Eastern rosella	+	+	+	+	+	+	+	+	+	+
Psephotus haematonotus	Red-rumped parrot	+	+	+	+	+	+	+	+	+	+
Neophema chrysostoma (L)	Blue-winged parrot										
Neophema pulchella	Turquoise parrot		L	R	R	U					
Cuculus pallidus	Pallid cuckoo		+	+	+	+		+	+		
Cuculus variolosus	Brush cuckoo		+	+	+			+	+		+
Cuculus pyrrhophanus	Fan-tailed cuckoo		+	+	+	+	+	+	+	+	
Chrysococcyx osculans	Black-eared cuckoo					L					
Chrysococcyx basalis	Horsfield's bronze-cuckoo					+	+	+	+		
Chrysococcyx lucidus	Shining bronze-cuckoo		+	+	+			+	+		

Scientific name	Common name	1	2	3	4	5	6	7	8	9	10
Scythrops novaehollandiae	Channel-billed cuckoo										
Ninox strenua	Powerful owl	R	R		L						
Ninox novaeseelandiae	Southern boobook		+	+		+	+	+	+		+
Ninox connivens	Barking owl				L	+	L	L	L		L
Tyto alba	Barn owl						+				+
Podargus strigoides	Tawny frogmouth		+	+	+	+	+	+	+		
Aegotheles cristatus	Australian owlet-nightjar		+		+		+	+			
Caprimulgus mystacalis	White-throated nightjar			+							
Hirundapus caudacutus	White-throated needletail		+	+	+		+		+		
Apus pacificus (L)	Fork-tailed swift										
Ceyx azurea (L)	Azure kingfisher										
Dacelo novaeguineae	Laughing kookaburra	+	+	+	+	+	+	+	+	+	+
Halcyon pyrrhopygia	Red-backed kingfisher						+	+			
Halcyon sancta	Sacred kingfisher	+	+	+	+				+		
Merops ornatus	Rainbow bee-eater	+	+	+	+			+			
Eurystomus orientalis	Dollarbird		+		+			+	+		
Birds - passerines											
Menura novaehollandiae	Superb lyrebird		+	+			+	+	+	+	+
Mirafra javanica (L)	Singing bushlark										
Alauda arvensis (I)	Skylark							+			
Cheramoeca leucosternum	White-backed swallow				+	+					
Hirundo neoxena	Welcome swallow	+	+	+	+	+	+	+	+	+	+
Cecropis nigricans	Tree martin			+	+		+	+	+		
Cecropis ariel	Fairy martin		+	+				+	+		
Anthus novaeseelandiae	Richard's pipit	+	+	+	+	+	+	+	+	+	+
Coracina novaehollandiae	Black-faced cuckoo-shrike	+	+	+	+	+	+	+	+		
Coracina papuensis	White-bellied cuckoo-shrike				+						
Coracina tenuirostris	Cicadabird		+	+			+	+	+		
Lalage sueurii	White-winged triller		+	+	+			+	+		
Zoothera dauma	White's thrush			+					+		+
Turdus merula (I)	Blackbird		+	+	+	+	+	+	+	+	
Petroica rosea	Rose robin		+	+			+		+	+	
Petroica rodinogaster	Pink robin			+					+		
Petroica phoenicea	Flame robin		+	+	+	+	+	+	+	+	+
Petroica multicolor	Scarlet robin	+	+	+	+	+	+	+	+	+	+
Petroica goodenovii	Red-capped robin				+	+		+	+		
Melanodryas cucullata	Hooded robin				+	+	+	+	+		
Eopsaltria australis	Eastern yellow-robin	+	+	+	+	+	+	+	+	+	+
Microeca leucophaea	Jacky winter	+	+	+	+	+		+	+	+	+
Falcunculus frontatus	Crested shrike-tit		+	+	+	+	+	+	+	+	+
Pachycephala olivacea	Olive whistler			+			+		+		
Pachycephala inornata	Gilbert's whistler				+						
Pachycephala pectoralis	Golden whistler	+	+	+		+	+	+	+	+	+
Pachycephala rufiventris	Rufous whistler	+	+	+	+	+	+	+	+	+	+
Colluricincla harmonica	Grey shrike-thrush	+	+	+	+	+	+	+	+	+	+
Oreoica gutturalis	Crested bellbird					+					
Myiagra rubecula	Leaden flycatcher		+	+	+				+		
Myiagra cyanoleuca	Satin flycatcher	+	+	+					+		
Myiagra inquieta	Restless flycatcher		+	+	+	+	+	+	+	+	+
Rhipidura rufifrons	Rufous fantail		+	+			+		+		
Rhipidura fuliginosa	Grey fantail	+	+	+	+	+	+	+	+	+	+
Rhipidura leucophrys	Willie wagtail		+	+	+	+	+	+	+	+	+
Psophodes olivaceus	Eastern whipbird		+	+			+	+	+		+
Cinclosoma punctatum	Spotted quail-thrush		+	+		+	+	+	+	+	+
Pomatostomus temporalis	Grey-crowned babbler	L	L		L	R	L				
Pomatostomus superciliosus	White-browed babbler		+		+	+					
Acrocephalus stentoreus	Clamorous reed-warbler	+			+		+	+			
Megalurus gramineus	Little grassbird	+									
Cisticola exilis	Golden-headed cisticola						+	+	+		+
Cinclorhamphus mathewsi	Rufous songlark		+	+	+		+	+			+
Cinclorhamphus cruralis	Brown songlark			+				+			
Malurus cyaneus	Superb fairy-wren	+	+	+	+	+	+	+	+	+	+
Pycnoptilus floccosus	Pilotbird			+			+				
Sericornis magnirostris (L)	Large-billed scrubwren										
Sericornis frontalis	White-browed scrubwren	+	+	+	+	+	+	+	+	+	+
Sericornis pyrrhopygius	Chestnut-rumped hylacola					R	R				
Sericornis sagittatus	Speckled warbler		+	+	+	+	+	+			+
Sericornis brevirostris	Weebill			+	+	+		+		+	+
Gerygone fusca	Western gerygone		+	+	+	+	+	+			
Gerygone olivacea	White-throated gerygone		+	+			+		+	+	
Acanthiza pusilla	Brown thornbill	+	+	+	+	+	+	+	+	+	+
Acanthiza reguloides	Buff-rumped thornbill	+	+	+	+	+	+	+	+	+	+
Acanthiza chrysorrhoa	Yellow-rumped thornbill	+	+	+	+	+	+	+	+	+	+
Acanthiza nana	Yellow thornbill				+	+	+				
Acanthiza lineata	Striated thornbill	+	+	+	+	+	+	+	+	+	+
Aphelocephala leucopsis	Southern whiteface		+	+		+	+	+	+		
Daphoenositta chrysoptera	Varied sittella		+	+	+	+	+	+	+	+	+
Climacteris leucophaea	White-throated treecreeper	+	+	+	+	+	+	+	+	+	+
Climacteris erythrops	Red-browed treecreeper	+	+	+			+	+	+	+	+

Scientific name	Common name	1	2	3	4	5	6	7	8	9	10
Climacteris picumnus	Brown treecreeper		+	+	+	+	+	+	+	+	+
Anthochaera carunculata	Red wattlebird		+	+	+	+	+	+	+		
Anthochaera chrysoptera(L)	Little wattlebird										
Philemon corniculatus	Noisy friarbird		+	+	+	+	+	+	+		
Philemon citreogularis	Little friarbird				+	+		+			
Xanthomyza phrygia	Regent honeyeater	L			L	R		R		L	
Entomyzon cyanotis	Blue-faced honeyeater					+					
Manorina melanocephala	Noisy miner		+	+	+	+	+	+			
Meliphaga lewinii (L)	Lewin's honeyeater										
Lichenostomus chrysops	Yellow-faced honeyeater	+	+	+	+	+	+		+	+	+
Lichenostomus virescens(L)	Singing honeyeater										
Lichenostomus leucotis	White-eared honeyeater	+	+	+	+	+	+	+	+	+	+
Lichenostomus melanops	Yellow-tufted honeyeater				+	+				+	
Lichenostomus fuscus	Fuscous honeyeater		+	+	+	+	+	+	+		+
Lichenostomus penicillatus	White-plumed honeyeater		+	+	+	+	+	+	+		+
Melithreptus gularis	Black-chinned honeyeater				+	+		+			
Melithreptus brevirostris	Brown-headed honeyeater	+	+	+	+	+	+	+	+	+	+
Melithreptus lunatus	White-naped honeyeater		+	+	+	+	+	+	+	+	+
Grantiella picta	Painted honeyeater		L	L	R			L			
Phylidonyris pyrrhoptera	Crescent honeyeater			+				+	+		
Phylidonyris novaehollandiae	New Holland honeyeater		+	+							
Acanthorhynchus tenuirostris	Eastern spinebill	+	+	+		+	+	+	+	+	+
Ephthianura albifrons	White-fronted chat		+		+	+		+			+
Dicaeum hirundinaceum	Mistletoebird	+	+	+	+	+	+	+	+	+	
Pardalotus punctatus	Spotted pardalote		+	+		+	+	+	+	+	+
Pardalotus striatus	Striated pardalote	+	+	+	+	+	+	+	+	+	+
Zosterops lateralis	Silvereye		+	+		+	+	+	+	+	+
Carduelis carduelis (I)	European goldfinch	+	+	+		+	+	+	+	+	+
Passer domesticus	House sparrow		+	+	+	+	+	+	+	+	+
Passer montanus	Tree sparrow	+					+	+			
Emblema temporalis	Red-browed firetail	+	+	+	+	+	+	+	+	+	+
Emblema guttata	Diamond firetail				+	+		+	+		+
Poephila guttata	Zebra finch					+					
Poephila bichenovii (L)	Double-barred finch										
Sturnus vulgaris	Common starling		+	+	+	+	+	+	+	+	+
Oriolus sagittatus	Olive-backed oriole		+	+	+	+	+		+	+	
Ptilonorhynchus violaceus	Satin bowerbird		+	+			+	+	+	+	+
Corcorax melanorhamphos	White-winged chough	+	+	+	+	+	+	+	+	+	+
Grallina cyanoleuca	Australian magpie-lark	+	+	+	+	+	+	+	+	+	+
Artamus leucorhynchus	White-breasted wood-swallow							+			
Artamus personatus	Masked woodswallow				+						
Artamus superciliosus	White-browed woodswallow				+		+				
Artamus cyanopterus	Dusky woodswallow	+	+	+	+	+	+	+	+		+
Cracticus torquatus	Grey butcherbird			+	+		+	+	+		+
Cracticus nigrogularis (L)	Pied butcherbird										
Gymnorhina tibicen	Australian magpie	+	+	+	+	+	+	+	+	+	+
Strepera graculina	Pied currawong		+	+		+	+	+	+	+	+
Strepera versicolor	Grey currawong		+	+	+	+	+	+	+	+	+
Corvus coronoides	Australian raven	+	+	+	+	+	+	+	+	+	+
Corvus mellori	Little raven			+	+	+			+	+	
Reptiles and amphibians											
Varanus varius	Tree goanna					+		+			
Varanus gouldii	Sand goanna										
Amphibolurus barbatus	Bearded dragon					+					
Amphibolurus diemensis	Mountain dragon			+							
Amphibolurus muricatus	Tree dragon	+	+	+	+			+	+		+
Diplodactylus vittatus	Wood gecko				+	+		+			+
Phyllodactylus marmoratus	Marbled gecko	+	+	+	+	+					
Delma inornata	Legless lizard		+			+					
Anotis maccoyi	McCoy's skink		+	+					+		
Carlia tetradactyla	Rainbow skink	+				+			+		
Cryptoblepharus carnabyi	Snake-eyed skink					+		+			
Ctenotus robustus	Large striped skink	+	+		+			+	+		+
Ctenotus taeniotatus	Copper-tailed snake		+	+		+		+	+		+
Ctenotus uber orientalis			M								
Egernia cunninghami	Cunningham's skink	+	+					+	+	+	+
Egernia saxatilis	Black rock skink	+	+	+				+	+		+
Egernia striolata	Tree skink						+	+			+
Egernia whitii	White's skink		+	+		+	+		+	+	+
Hemiergis decresiensis	Three-toed skink		+			+	+	+	+	+	+
Lampropholis delicata	Delicate skink								+		+
Lampropholis guichenoti	Garden skink		+	+			+	+	+	+	+
Lampropholis mustelina	Weasel skink								+	+	+
Leiolopisma coventyi	Coventry's skink		+	+		+					+
Leiolopisma entrecasteauxii Form A	Grass skink							+			
Leiolopisma entrecasteauxii Form B	Grass skink		+	+					+		

Scientific name	Common name	1	2	3	4	5	6	7	8	9	10
Leiolopisma platynota	Red-throated skink							+	+		+
Leiolopisma trilineata	Three-lined skink								+		+
Lerista bougainvillii	Bougainville's skink		+	+		+		+			+
Morethia	Boulenger's skink	+		+	+	+		+	+		
Pseudemoia spenceri	Spencer's skink		+	+							
Sphenomorphus tympanum C.T.F.	Water skink		+	+		+					
Sphenomorphus tympanum W.T.F.	Water skink		+	+				+	+	+	+
Tiliqua nigrolutea	Blotched blue-tongue lizard		+	+				+	+	+	+
Tiliqua scincoides	Common blue-tongue lizard			+	+			+			
Austrelaps superba H	Copperhead snake		+	+					+		
Austrelaps superba L	Copperhead snake								+		
Cryptophis nigrescens	Small-eyed snake		+	+					+		+
Dryadaila coronoides	White-lipped snake								+		
Notechis scutatus	Tiger snake		+								+
Pseudechis porphyriacus	Red-bellied black snake		+	+	+			+	+		+
Pseudonaja textilis	Common brown snake		+	+			+	+	+		+
Unechis dwyeri	Dwyer's snake								+		
Unechis flagellum	Little whip snake										
Vermicella annulata	Bandy bandy					+					
Ramphotyphlops nigrescens	Blind snake		+			+	+	+	+		+
Ramphotyphlops proxima	Blind snake				M				M		
Chelodina longicollis	Eastern long-necked tortoise	+	+								
Litoria ewingii	Brown tree frog						+	+	+	+	+
Litoria paraewingii	Brown tree frog	+	+	+	+	+	+	+	+		
Litoria lesueurii	Lesueur's tree frog		+	+				+	+	+	+
Litoria maculata	Spotted tree frog				L						
Litoria peronii	Peron's tree frog			+	+		+	+			+
Litoria raniformis	Green and gold bell frog	+	+				+	+	+	+	+
Geocrinia victoriana	Froglet					+	+		+		
Limnodynastes dumerilii	Southern bullfrog	+	+	+	+	+	+	+	+	+	+
Limnodynastes fletcheri	Barking frog					+	+				
Limnodynastes interiroris	Giant bullfrog							+			
Limnodynastes peronii	Striped marsh frog					+	+	+	+	+	+
Limnodynastes tasmaniensis	Spotted grass frog	+	+	+	+	+	+	+	+	+	+
Neobatrachus sudelli	Spotted burrowing frog	+			+		+				
Pseudophryne bibronii	Brown toadlet	+	+	+			+	+	+	+	+
Pseudophryne dendyi	Southern toadlet						+				
Ranidella parinsignifera	Froglet		+	+	+		+	+	+		+
Ranidella signifera	Eastern froglet	+	+	+	+	+	+	+	+	+	+
Ranidella sloanei	Sloan's froglet					+	+	+	+		
Uperoleia rugosa	Red-groined toadlet							+			+

KEY:

A Abundant
C Common
U Uncommon
R Rare
V Vagrant
\+ Recorded but abundance *not* assessed
M Museum of Victoria specimen
L Literature or personal communication
S Detected by Fisheries and Wildlife Division predator scat analysis
I Introduced species
E Extinct in study area with date of last record in brackets.
* Old records with no habitat information available

Appendix VI

STATUS OF SIGNIFICANT AND NOTABLE SPECIES

Species	Status		Distribution		Population trend	
	Aust	Vic.	Aust	Vic.	Aust	Vic.
Significant species:						
Mammals						
Squirrel glider	R	R	M	R	D	D
Tiger quoll	U	R	M	M	D	D
Birds						
Brolga	U	R	W	R	S	D
Bush thick-knee	U	R	W	M	S	D
Turquoise parrot	R	R	R	R	S	I
Grey-crowned babbler	C	R	W	M	S	D
Regent honey-eater	VR	VR	M	M	D	D
Reptiles and amphibians						
Bandy bandy snake	U	VR	W	R	?	?
Red-groined toadlet	U	C	M	R	?	?
Giant bullfrog	U	VR	M	R	?	?
Notable species:						
Mammals						
Brush-tailed phascogale	C	U	M	M	D	D
Yellow-bellied glider	R	U	U	W	?	?
Eastern pygmy-possum	C	C	M	W	?	?
Eastern horse-shoe bat	C	U	M	M	?	?
Little mastiff-bat	?	?	?	?	?	?
Broad-nosed bat	?	?	?	?	?	?
Brush-tailed rock-wallaby	C	VR	M	R	D	D
Birds						
Freckled duck	R	R	M	M	S	S
Square-tailed kite	R	VR	W	W	S	S
Grey goshawk	U	R	M	M	S	S

Appendix VI (continued)

Species	Status		Distribution		Population trend	
	Aust	Vic.	Aust	Vic.	Aust	Vic.
Peregrine falcon	U	U	W	W	S	S
Latham's snipe	U	U	M	W	D	D
Crimson (yellow) rosella	U	U	R	R	S	S
Barking owl	U	R	W	W	S	S
Powerful owl	U	R	M	M	S	S
Black-eared cuckoo	U	R	W	M	S	S
Chestnut-rumped hylacola	U	U	M	M	S	S
Painted honey-eater	U	R	M	M	S	S
Reptiles and amphibians						
Mountain dragon	U	U	M	M	?	D
Sand goanna	C	U	W	M	?	D
Rainbow skink	U	U	M	R	?	S
Copper-tailed skink	C	U	M	R	S	S
Red-throated skink	U	U	M	R	?	?
Dwyer's snake	U	U	M	R	?	?
Blind snake	C	R	M	R	?	D

LEGEND

Status:

VR: Very rare
R: Rare
U: Uncommon
C: Common
A: Abundant

Distribution:

R: Restricted
M: Moderate
W: Widespread

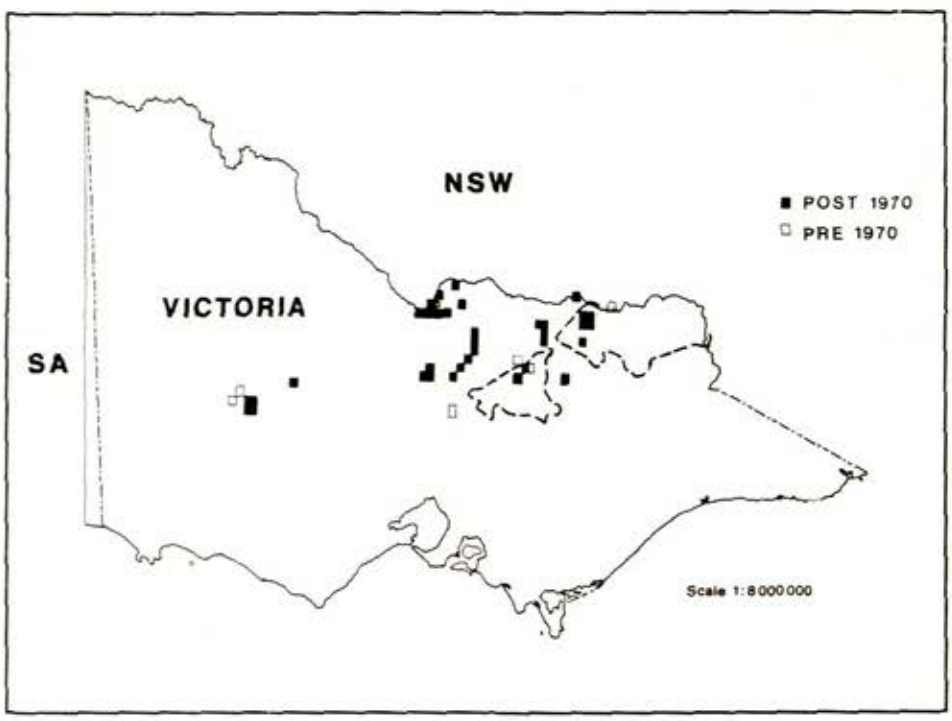
Population trend:

D: Decreasing
S: Stable
I: Increasing

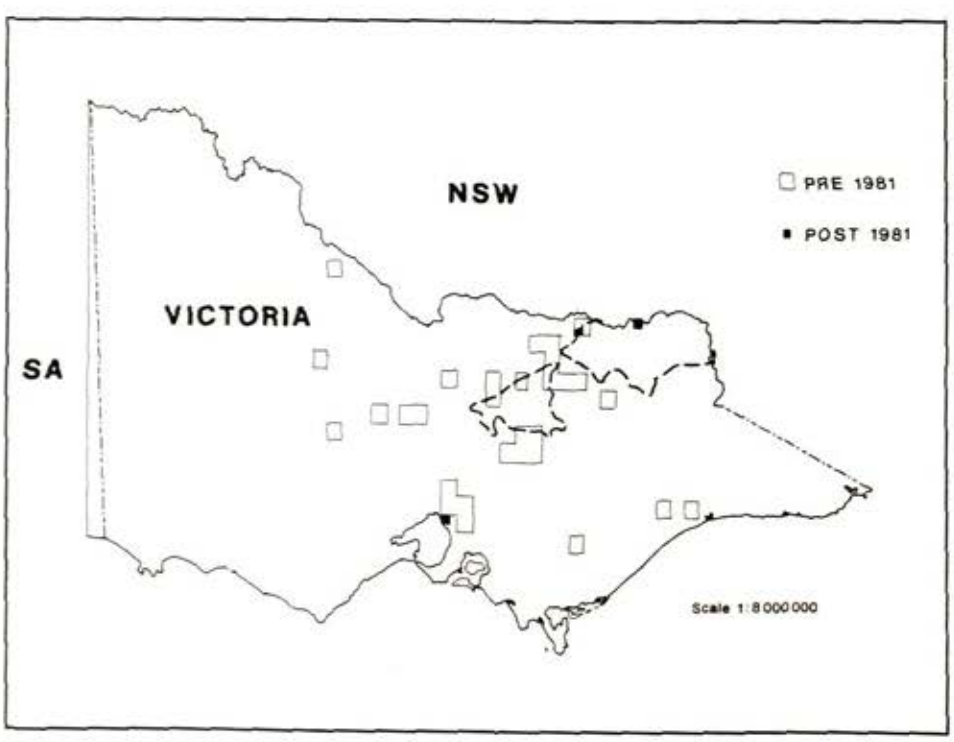
SELECTED SIGNIFICANT FAUNA

Distribution records

Squirrel glider *Petaurus norfolcensis*



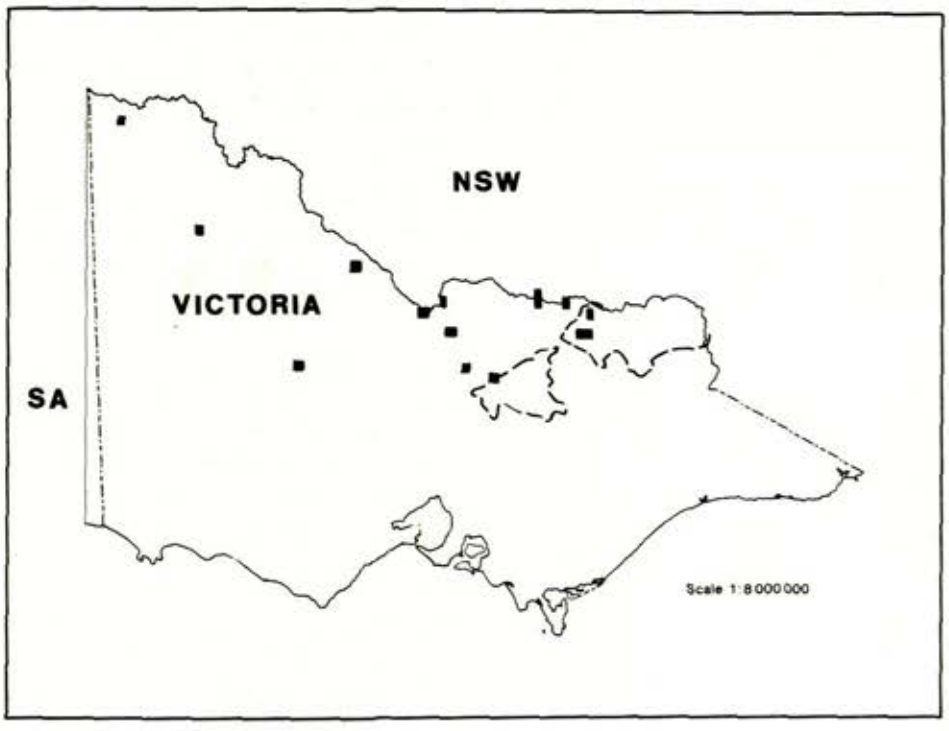
Regent honeyeater *Xanthomyza phrygia*



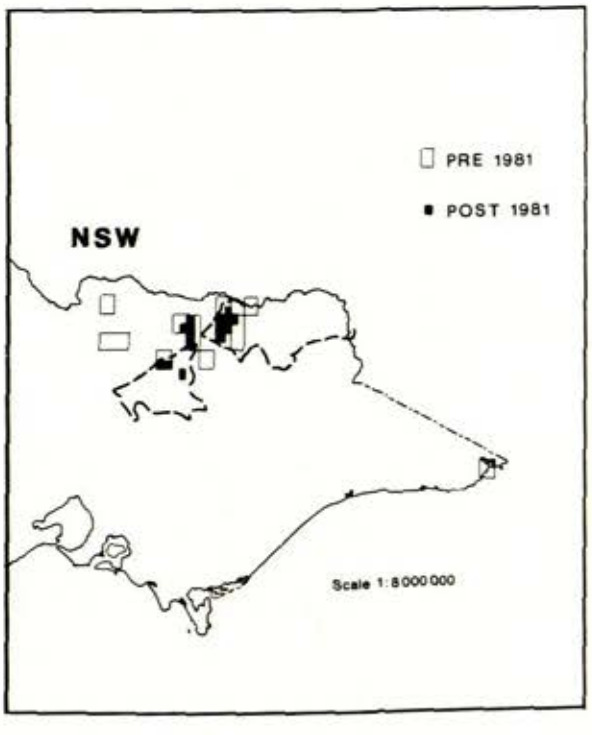
SELECTED SIGNIFICANT FAUNA

Distribution records

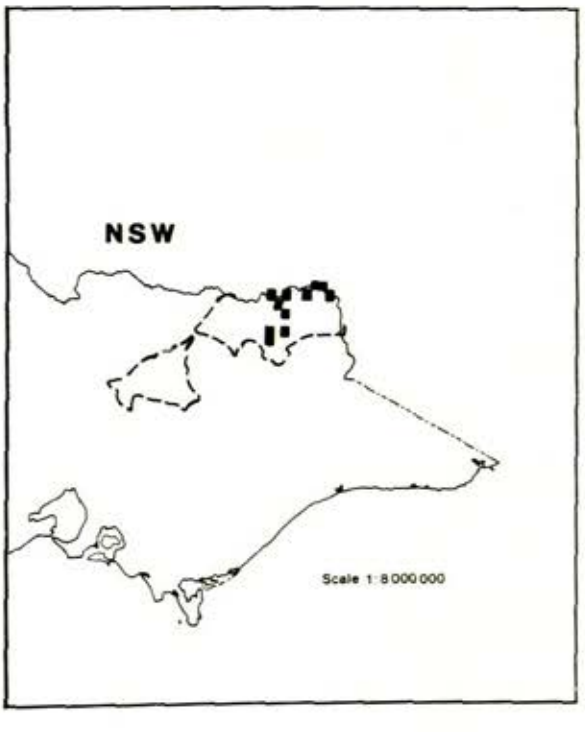
Bandy bandy snake *Vermicella annulata*



Turquoise parrot
Neophema pulchella



Red-groined toadlet
Uperoleia rugosa



Appendix VII

EROSION-RISK RATINGS

Erosion-risk classing is the assessment of the capability of land to withstand the erosive elements when that land is disturbed in any way.

The Land Protection Service has developed a five-class system for intensive use and development of freehold land, and for this study the system has been extended to cover public land also (see Table A).

Class 5 is a broad category (of two subclasses) encompassing a range of land: from land that, although it has major limitations, can be used for timber production or recreation, for example, if conditions of use are followed (5a), to land with such severe limitations that its best use is for protective forest cover in conjunction with passive use such as for recreation and water production (5b).

Note that relatively little public land remains in classes 1, 2, and 3. This reflects the fact that the lower-erosion-risk land is also more productive for agriculture, and thus much of it has been alienated, leaving the higher-risk areas in public land.

The assessment of erosion-risk is based on a study of the various characteristics within each land system and takes into account steepness of the land, erodibility of the soil (estimated from soil permeability, structure, and soil depth), and the effect of increased soil-water accumulation if plant cover is decreased.

Climatic conditions vary considerably throughout the study area and this variation has been taken into account when assessing similar land types within the area.

The management guidelines (shown in Table B) outline the kind and levels of management considered necessary to guard against unacceptable land deterioration within each erosion-risk class.

The considerable variations occurring in standards of local management can substantially effect stability - particularly in areas of high erosion-risk. Similarly, techniques of earthwork construction and follow-up treatment can vary considerably, and these may have significant or drastic effects upon stability where they are inadequate or inappropriate for the conditions.

Reference

Soil Conservation Authority (1980). 'Land Capability Study in the Shire of Benalla.' (Government Printer: Melbourne.)

Table A

EROSION-RISK RATINGS ASSOCIATED WITH LAND DISTURBANCE
North-eastern Victoria

Rating class	Erosion risk	General limitations
1	None to very slight	Disturbance of this land, using standard earthwork techniques and average management, should be possible without erosion.
2	Slight	Drainage lines and steeper slopes should be avoided. Careful planning and use of standard prescriptions for clearing, roading, and other earthworks, along with careful follow-up management, should minimize erosion.
3	Moderate	Erosion may lead to difficulties during and after clearing or other earthworks. Careful planning, standard prescriptions, selected alignments for access, and specific follow-up management may be necessary to overcome these difficulties and minimize erosion.
4	High	Avoidance of erosion during and after clearing operations and other earthworks is difficult, and long-term problems could occur. Adverse effects may spread to adjoining land. Site-specific planning, design, and construction techniques are required, followed by special management to minimize erosion. Localized areas of very high or severe risk should not be disturbed.
5a	Very high	Disturbance is likely to increase instability, leading to erosion and/or risk of mass soil movement. These problems cannot be practically overcome without reforestation. High levels of site-specific planning, design, and construction techniques are required, followed by special management and maintenance, to minimize erosion. Rocky areas are included within this class.
5b	Severe	Any disturbance will increase instability, leading to severe erosion and/or risk of mass soil movement. These cannot be practically overcome. Rocky areas are included within this class.

Table B

MANAGEMENT GUIDELINES FOR EROSION-RISK CLASSES
North-eastern Victoria

Rating class	Management guidelines
1	Generally no specific erosion control management practices are required in this unit except along drainage lines, where gully or stream-bank erosion may occur. To minimize this danger, avoid disturbance and maintain a protective vegetative cover. Design drainage-line crossings where high flows are likely with adequate culvert capacity or low-profile floodway fords. Locate crossings, as nearly as practicable, at right angles to the flow, to minimize cost and erosion potential.
2	Generally only limited special management inputs are required to prevent soil erosion, except along drainage lines, where erosion is likely to occur. To minimize this danger, avoid disturbance and maintain a protective vegetative cover. Design roads that cross drainage lines where high flows are likely as for unit 1 above. In addition, preferably align roads close to contour, with adequate surface and/or subsurface drainage, or align them directly up and down slope with drainage water dispersed laterally.
3	Specialized land management techniques may be required to minimize soil erosion. Moreover, localized areas of severe risk occur in this class and should remain undisturbed. Leave drainage lines indisturbed. Implement any broad-scale disturbance, such as permanent clearing, with special erosion-control techniques to avoid the concentration of overland flow. After clearing, contour-deep-rip the soil surface and promote revegetation. Locate roads and tracks on contours, along ridge lines, or directly up and down slopes. Disperse water from tracks at frequent intervals by surface or subsurface drainage. Observe guidelines as for unit 1 above.

Take care to minimize disturbed areas during any operations and undertake adequate soil conservation measures. Conserve topsoil before any major earthworks and respread after construction. Revegetation of disturbed areas may require special treatment as well as sowing and adequate maintenance.

Generally a vigorous vegetative cover should be maintained throughout this unit. Expert advice on the need for specialized design and construction techniques, and follow-up management, should be obtained prior to commencing works.

---

4 Inputs of specialized planning, construction, and land management techniques are required to minimize soil erosion and/or mass movement.

Plan any necessary land disturbance in such a way as to minimize the length of slope left in an unprotected state at any time. This may require a rotational approach.

Confine all operations to the summer period, planning adequate time to allow protective works to be implemented before the onset of winter. Employ contour ripping of broad disturbed areas, and avoid watercourses and other lines of concentrated flow.

Permanent clearing of any of this land would require very high levels of erosion-control input and thus should be avoided. Where such areas are already cleared reforestation is recommended.

For all earthworks - including roading, logging, or other construction works - employ soil conservation specifications suitable for each site, including topsoil saving, rapid regeneration and other soil-stabilization measures and maintenance.

Grazing should be strictly controlled.

All proposals for land disturbance should be referred for expert advice at the early planning stages.

5a Any land disturbance will require high levels of specialized management input to minimize soil erosion or mass soil movement.

In general logging of these areas should be possible, provided access tracks and other earthworks are located and maintained so as to minimize erosion. Employ site-specific soil conservation practices.

Table B (continued)

Rating class	Management guidelines
5a (cont)	Establishment of softwood plantations would require excessive levels of erosion-control input and thus should be avoided. Confine all operations involving land disturbance to the summer period. Avoid watercourses. Site-specific soil conservation plans should be developed and followed where considered necessary. Grazing of this land should be strictly controlled. In general, the areas should be regarded as being best used for hardwood forestry, protective forestry, water production, and passive recreation. All proposals for land disturbance should be referred for expert advice at the early planning stages.
5b	Avoid disturbance of land in this unit. Plan the limited earthworks necessary for fire protection and access only and implement these under strict erosion-control guidelines, employing site-specific soil conservation to limit the extent of erosion resulting. Confine such operations to the summer period. Avoid watercourses. In general, the areas should be regarded as being best used for protective forestry, water production, and passive recreation. All proposals for land disturbance should be referred for expert advice at the early planning stages.

F D Atkinson Government Printer Melbourne