

GIPPSLAND

**COMPREHENSIVE REGIONAL
ASSESSMENT REPORT**

September 1999

Prepared by officials to support the Gippsland Regional Forest Agreement Process

Published by the joint Commonwealth and Victorian Regional Forest Agreement (RFA) Steering Committee.

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FOREWORD

This report describes the Comprehensive Regional Assessment (CRA) that has been undertaken in Victoria's Gippsland Regional Forest Agreement (RFA) region.

The CRA has examined the natural, cultural, social, resource and economic values in the forests of the Gippsland region. This involved detailed assessments of:

- forest resources;
- forest based industries;
- social values;
- ecologically sustainable forest management;
- biodiversity;
- old-growth forest;
- national estate;
- world heritage; and
- wilderness.

A separate report will be published later in 1999 on National Estate.

Following the release of this CRA report, meetings with local communities and interest groups will be held to discuss its contents and its implications, and to consider issues that will need to be addressed in the RFA. Following consultation with the local community and interested groups, this assessment will provide a basis for the Victorian and Commonwealth Governments to develop proposals to be presented in a Directions Report. There will be further consultation following the release of the Directions Report.

The RFA for the Gippsland region will be developed from the assessments reported herein, proposals in the Directions Report and consultations with the local communities and interest groups.

The RFA will define the commitments made by both Governments to forest conservation, forest use and development, and the development of those industries based on the forest resources of the region. The RFA is intended to operate for 20 years.

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1. BACKGROUND TO THE RFA PROCESS

1.1 INTRODUCTION

For over two decades the competing demands of conservation and industry on our forests have been an area of debate and controversy. The National Forest Policy Statement (NFPS), agreed by the Commonwealth, State and Territory Governments, provides the framework for the resolution of this issue.

The NFPS sets out how the Commonwealth and States will jointly aim to achieve ecologically sustainable management of forests through comprehensive assessments of the natural, cultural, economic, and social values of Australia's forests and negotiated Regional Forest Agreements that will:

- establish and manage forest reserve systems which are comprehensive, adequate and representative (CAR reserve system);
- establish ecologically sustainable management of forests; and
- develop an efficient, internationally competitive timber industry.

A central aim in the RFA process is to take account of the full range of forest values and consider both benefits and costs in making policy or resource use decisions. RFAs also recognise the range of economic and environmental obligations of each tier of government in managing and protecting forest values.

The detailed information required to negotiate each RFA is drawn together through a comprehensive regional assessment (CRA) of forest values for the regions agreed by the Commonwealth and each State. In Victoria, East Gippsland became the first region in Australia for which a CRA was completed followed by an RFA. Subsequently, RFAs have been completed for Tasmania, the Central Highlands and North East regions of Victoria, and the South-West Forest Region of Western Australia. The major steps in the RFA process are shown in Figure 1.1 and are described in more detail in the next section.

RFAs are intended to provide stability through the establishment of a sustainable resource base for industry, while at the same time ensuring the protection of Australia's biodiversity, old growth and wilderness through a CAR reserve system and complementary off-reserve management.

1.2 LEGISLATIVE AND POLICY FRAMEWORK FOR THE RFA PROCESS

The following is a discussion of Commonwealth and State legislation and policies which are the framework for the RFA process.

The National Forest Policy Statement

The NFPS sets out the vision of the Commonwealth and State Governments for Australia's forests and forest industries based on the principles of ecologically sustainable forest management. The elements of that vision are described in the NFPS and comprise:

- forest conservation;
- wood production and industry development;
- integrated decision making and management;
- private native forests;
- plantations;
- water supply and catchment management;
- tourism and other economic and social opportunities;
- employment, workforce education and training;
- public awareness, education and involvement;

- research and development; and
- international responsibilities.

The RFA process implements key elements of the NFPS.

National Reserve Criteria

In accordance with the NFPS, the Joint Australian and New Zealand Environment and Conservation Council (ANZECC) and the Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) NFPS Implementation Sub-committee - known as JANIS - agreed on national criteria for establishing a CAR reserve system (JANIS 1997).

The National Reserve Criteria include provision for the protection of biodiversity, old growth and wilderness, as well as recognising the role of off-reserve management in meeting conservation objectives. Further details of the criteria are provided in the biodiversity, old growth and wilderness chapters of this report.

Commonwealth Legislation

The Commonwealth's principal involvement in forest issues derives from the *Export Control Act 1982* which regulates the export of woodchips and unprocessed wood. In assessing applications for export under this Act, the relevant Minister is required to ensure that a range of Commonwealth obligations are met. The major legislation includes:

- *Australian Heritage Commission Act 1975*
- *Endangered Species Protection Act 1992*
- *Environment Protection (Impact of Proposals) Act 1974*
- *World Heritage Properties Conservation Act 1983.*

Victorian Legislation

The States and Territories have enacted legislation to fulfil their responsibilities for the protection and management of values and resources in public and private forests. The major Victorian legislation includes:

- *Archaeological and Aboriginal Relics Preservation Act 1972*
- *Catchment and Land Protection Act 1994*
- *Conservation, Forests and Lands Act 1987*
- *Crown Land (Reserves) Act 1978*
- *Country Fire Authority Act 1958*
- *Environment Conservation Council Act 1997*
- *Environment Effects Act 1978*
- *Environment Protection Act 1970*
- *Extractive Industries Development Act 1995*
- *Fisheries Act 1995*
- *Flora and Fauna Guarantee Act 1988*
- *Forests Act 1958*
- *Heritage Act 1995*
- *Heritage Rivers Act 1992*
- *Land Act 1958*
- *Land Conservation (Vehicle Control) Act 1972*
- *Mineral Resources Development Act 1990*
- *National Parks Act 1975*
- *Planning and Environment Act 1987*
- *Reference Areas Act 1978*
- *Victorian Conservation Trust Act 1972*
- *Victorian Plantations Corporation Act 1993*

- *Water Act 1989*
- *Wildlife Act 1975*.

Further details on the scope and operation of the legislation in relation to the RFA process is provided in Appendix 1.

Indigenous Issues

The RFA process addresses indigenous issues in two distinct ways: consultation on the outcomes and process in general (as part of the wider consultation process); and cultural heritage, through the National Estate assessment.

As with all communities and stakeholder groups with an interest in the Gippsland RFA, Aboriginal communities in the region and appropriate representative bodies are already involved and will continue to be consulted throughout the RFA process.

The *Native Title Act 1993* recognises and protects native title rights and interests. In recognition of this Act:

- where any Government action to implement an RFA could affect native title, the action will be taken in accordance with the Native Title Act; and
- an RFA is not intended to influence in any way native title claims that may arise.

Accreditation

To the maximum extent possible Governments will accredit existing data sets and processes used in the RFA process under the provisions of the Intergovernmental Agreement on the Environment (IGAE) (Commonwealth of Australia 1992a). Under these provisions, the Commonwealth or Victoria will endorse the processes used by the other's jurisdiction as having accommodated part or all of the interests of the other government.

The data sets and processes used in the assessments described in this report have been accredited for the Gippsland RFA.

1.3 THE RFA PROCESS IN VICTORIA

Background

During 1995 the Commonwealth and the States of Victoria, Tasmania, New South Wales and Western Australia identified interim (or deferred) forest areas which may be required for a CAR reserve system and should be protected pending the completion of RFAs. In January 1996 the Commonwealth and Victoria signed an Interim Forest Agreement (IFA) which makes provision for the protection of such areas. In June 1998 the term of the agreement was extended to the end 1999 to coincide with the completion of the RFA process.

The Prime Minister and Premier also signed a Scoping Agreement committing Governments to arrangements and timetables for the completion of the RFAs.

The RFA process is managed by a Joint Commonwealth-Victoria Steering Committee, supported by a Technical Committee. The membership of these committees is listed in Appendix 2.

Victorian RFA Regions

Victoria has a land area of 22.7 million ha, of which some 40 per cent is publicly owned. Of the public land, 43 per cent (3.9 million ha) is set aside for conservation purposes, including 2.6 million ha of forests. A further 3.47 million ha of public land is also forested, of which about 1.2 million ha is available for timber harvesting.

Victoria has five RFA regions:

- East Gippsland;
- Central Highlands;
- North East;
- Gippsland; and
- West.

On 3 February 1997, the Prime Minister and the Premier of Victoria signed the RFA for the East Gippsland region and the Central Highlands region RFA was signed on 27 March 1998. The signing of the North East region RFA was announced on 23 August 1999. Gippsland is the fourth region in Victoria in which an RFA is to be developed.

Stages in the RFA Process

The major stages in the RFA process are depicted in Figure 1.1 and outlined below.

Comprehensive Regional Assessment (CRA)

The CRA that has been undertaken for the Gippsland region is described in this report. It consists of the following assessments:

- biodiversity;
- world heritage;
- old-growth forest;
- social;
- wilderness;
- resource; and
- economic.

National Estate assessment is continuing and will be the subject of a separate report. Separate reports for the biodiversity, old-growth forest, wilderness, social, minerals and ecologically sustainable forest management assessments are summarised in this report.

The CRA draws on a wide range of studies conducted in recent years. Relevant technical papers are referenced in the report.

The CRA provides a synthesis of the information on which the RFA can be developed and agreed between the Victorian and Commonwealth Governments. It makes no judgments or interpretations of information where this might pre-empt the development of the RFA. Furthermore, both Governments are committed to consultation with the community and other interested stakeholder groups, within the context of the NFPS.

RFA Directions Report

The Directions Report builds upon information contained in the CRA report and the results of consultations with the community. The Directions Report will address:

- how the proposed CAR reserve system addresses the national forest reserve criteria;
- the elements of ecologically sustainable forest management (ESFM) which are part of the RFA;
- industry development opportunities; and
- the links between the RFA process and other statutory processes, particularly environmental impact assessment, World Heritage, National Estate and endangered species.

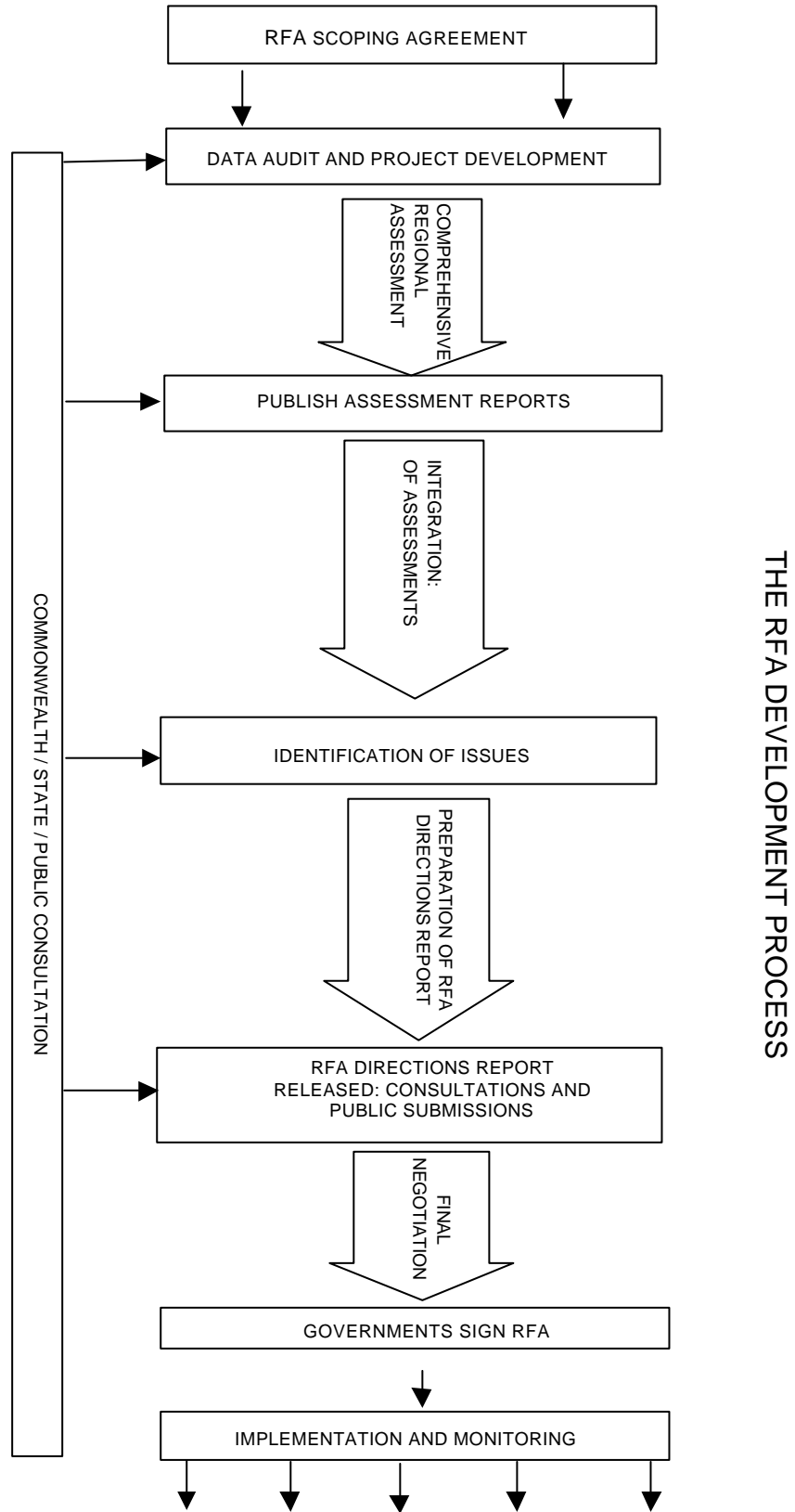
The Gippsland RFA Directions Report will be released later in 1999.

The community and stakeholder groups will be consulted both during the development of the Directions Report and following its release through a series of meetings held in the Gippsland region and in Melbourne over the next few months. These consultations will focus on the issues that need to be addressed in the RFA. The first workshops will be held shortly after the release of this CRA report and will familiarise stakeholders with the information which it contains. Any deficiencies in the data or methods identified at that stage can be taken into account in the development of the Directions Report.

RFA Finalisation

Following the release and consultation on the Directions Report, the Commonwealth and State Governments will negotiate the RFA. The RFA is scheduled to be completed in 1999.

Figure 1.1: Major Stages in the RFA Process



2. GIPPSLAND REGION

2.1 LOCATION

The Gippsland region covers over 2.6 million hectares of Victoria. Its boundaries include the Great Dividing Range to the north, the Timbarra River to the east and Bass Strait to the south. The region covers the Shires of East Gippsland, South Gippsland, La Trobe and Wellington, and the Yallourn Works Area. Sections of the Shires of Towong, Alpine, Baw Baw, Bass Coast and Delatite are also included in the Gippsland region.

The Mid-Gippsland Forest Management Plan, currently in preparation, will have the same boundaries as the RFA region.

2.2 LANDSCAPE AND CLIMATE

The climate in Gippsland is temperate, with patterns of precipitation and temperature influenced by geography, topography, altitude and proximity to the coast.

The Great Dividing Range is the dominant landform feature to the north of the region. It has a significant influence on weather patterns and this in turn, affects vegetation distribution and fire risk conditions. Dry 'rainshadow' valleys contrast with adjacent mountains that are characterised by wet montane forests and, at higher elevations, sub-alpine woodlands and alpine herbfields. Southern highlands of the Strzelecki Ranges and Wilsons Promontory, which both have peaks of over 700 m, also receive high rainfall between 900 mm and 1500 mm.

Rainshadows caused by the ranges occur in the Mitchell and Tambo River valleys, and on the Gippsland plains. Rainshadow effects are evident when comparing average annual rainfall of 659 mm at Tabberabbera in the Mitchell River valley with Bullumwaal in the bordering high country which receives 1080 mm of rain.

Precipitation mainly falls as rain, except at high altitudes, where areas over 1500 m elevation remain snow-covered throughout winter. Maximum rainfall occurs in winter and spring, and high-intensity rains at any time of the year can cause floods in the lower reaches of most major rivers in the region. On the coastal plains, rainfall is fairly evenly distributed throughout the year.

Temperature varies according to proximity to the coast and altitude. The plains and coastal areas are subject to mild winters. Low-lying, inland towns such as Sale and Maffra experience the highest temperatures during summer. Mild winters are experienced on the plains and in coastal areas. Higher winter temperatures compared with other parts of the region are a result of winds becoming warmer when descending from the mountains (Föhn effect) (LCC 1982c).

2.3 SIZE AND TENURE

The Gippsland region covers approximately 2.6 million ha. Private land comprises 1.2 million ha, or 46 per cent of the region, and is mostly cleared and used for a range of agricultural and industrial pursuits. In general, private land is located in the south and west of the region and along the valleys of the major rivers, including the Macalister, Dargo and Tambo Rivers. Extensive areas of plantations exist in the Strzelecki Ranges.

Public land comprises 1.4 million ha, or 54 per cent of the area, and is covered mostly by native forest. The region is known for its mountain landscapes, diverse range of flora and fauna, timber resources, tourism and recreational opportunities, and the high quality of water in its rivers and streams.

Table 2.1: Land Tenure in Gippsland

Land Tenure	Area (ha)	Proportion of all land (%)	Proportion of public land (%)
State Forest	806 000	30	56
Conservation reserves	514 700	19	35
Other public land	35 600	1	2
Other parks and reserves	24 100	1	2
Commonwealth land	900	<1	0
Water bodies ¹	68 300	3	5
Public land total	1 449 600	54	100
Private Land²	1 226 700	46	

Source: NRE unpublished data (1999). ¹Includes some coastal waters. ²Includes freehold land and lands leased or licensed for plantation purposes.

State forest occupies 806 000 ha, more than half of the total public land. Conservation reserves, including National Parks, State Parks and Flora and Fauna Reserves, occupy 35 per cent of the public land, or about 514 000 ha. The remaining public land in the Gippsland region, as shown in Table 2.1, includes other public land, other parks and reserves, and water bodies.

2.4 POPULATION

In 1996, the total population of the Gippsland region was 174 073. Much of the population is located in the Latrobe Valley. Traralgon is the largest town in Gippsland, with a population of 18 993 (ABS 1996). Moe (15 512), Morwell (13 823), Sale (13 366) and Bairnsdale (10 890) are also large population centres in the region (ABS 1996). Numerous small towns exist across the region including Omeo (298), Swifts Creek (228) and Dargo district (147) (ABS 1996). In general, larger population centres are located on the Princes Highway, the major travel route through the region.

More detailed demographic information is provided in Chapter 11, Social Assessment.

2.5 REGIONAL ECONOMY OF THE GIPPSLAND REGION

Victoria's gross state product (GSP) by industry is shown in Table 2.2. Access to native forest resources provides at least part of the base for the following industry groups: agriculture, forestry and fishing; mining; accommodation, cafes and restaurants; and cultural and recreational services. These industries accounted for about 10 per cent of GSP in Victoria in 1996. However, only a small proportion of the GSP associated with these broad industry groupings can be attributed to forest based industries. Other sectors rely, in part, on native forest resources, e.g. the manufacturing category includes output from the wood processing industries.

The Gippsland RFA region accounts for a relatively small proportion of total Victorian GSP, having accounted for only 5.4 per cent of Victoria's employment in 1996 (Table 2.3).

Table 2.2: Industry Contribution to Victorian Gross State Product (in 1996 dollars)

	1990-91 \$m	1995-96 \$m	Share % ^a
Agriculture, forestry and fishing	2 472	3 725	3.3

Mining	3 600	3 150	2.8
Manufacturing	16 460	19 880	18.0
Electricity, gas and water	3 550	3 642	3.3
Construction	6 152	6 149	5.5
Wholesale trade	6 100	7 135	6.4
Retail trade	6 388	8 085	7.3
Accommodation, cafes and restaurants	1 454	2 111	1.9
Transport and storage	4 034	5 011	4.5
Communication	2 537	3 738	3.3
Finance and insurance	2 715	4 684	4.2
Property and business services	8 397	10 890	9.8
Government administration and defence	3 012	3 216	2.9
Education	4 560	5 643	5.1
Health and community services	5 606	7 137	6.4
Cultural and recreational services	1 215	2 105	1.9
Personal and other services	1 650	2 354	2.1
Ownership of dwellings	8 586	9 761	8.8
General government	1 620	1 816	1.6
Total	90 108	110 232	100
Share of Victorian GSP (%)	100	100	100

^a Estimates from ABS statistics based on statistical local areas (SLAs). Share of Victorian GSP in 1996.

Industry classifications that provided a relatively high share of employment for residents of the Gippsland region in 1996 included: wholesale and retail trade (18.5 per cent); health and community services (16.9 per cent); agriculture, forestry and fishing (14.5 per cent); manufacturing (10.2 per cent); and finance, insurance, property and business services (8.5 per cent). Between 1991 and 1996 employment in the forestry and logging sector, and the wood and paper products sector decreased by 13 per cent, from 3891 to 3394 people.

It is estimated that the Victorian timber industry (defined as the forestry and logging sector, and the wood and paper products manufacturing sector) directly employed around 29 865 people in 1996 (Table 2.3). Within the Gippsland region, it is estimated that the timber industry directly employed 3394 people in 1996, accounting for 3.4 per cent of total employment in the Gippsland region and 11.4 per cent of employment in the Victorian timber industry in that year. The forestry and logging industry directly accounted for 0.7 per cent of employment in the Gippsland region in 1996, and the wood and paper products industry accounted for 2.7 per cent of regional employment.

Table 2.3: Employment in the Gippsland RFA Region and Victoria, by Industry^{ab}

	Gippsland			Victoria		
	1991	1996	Share ^c	1991 ^d	1996 ^d	Share ^e
	No.	No.	%	No.	No.	%
Agriculture, forestry and fishing	10 577	14 395	14.5	71 759	74 178	3.9
Forestry and logging ^f	1 109	741	0.7	1 409	1 833	0.1
Mining	1 618	1 242	1.3	5 697	5 626	0.3
Manufacturing	11 319	10 147	10.2	298 007	308 677	16.3
Wood and paper products ^f	2 782	2 653	2.7	25 832	28 032	1.5
Electricity, gas and water supply	7 675	3 082	3.1	25 882	13 497	0.7
Construction	6 192	6 849	6.9	97 526	111 471	5.9
Wholesale and retail trade	17 685	18 321	18.5	348 676	381 489	20.0
Transport and storage	1 721	2 805	2.8	76 430	74 857	3.9
Communication	1 566	1 362	1.4	34 508	43 119	2.3
Finance, insurance, property and business services	8 132	8 450	8.5	200 300	244 789	12.9
Government administration and Defence	6 384	4 171	4.2	94 386	71 416	3.8
Health and community services	8 863	16 810	16.9	323 280	365 381	19.3
Cultural, recreational, personal and other services	1 677	10 269	10.4	112 253	142 905	7.5
Not stated or classifiable	6 830	1 296	1.3	6 852	60 554	3.2
Total	90 239	99 199	100	1 688 704	1 837 405	100
Share of Victorian employment (%)	5.3	5.4				

a Estimates from 1991 and 1996 census data based on statistical local areas (SLAs). Parts of some SLAs included here do not lie completely within the Gippsland RFA region. b The employment data presented in this table are not comparable with employment data presented in the Gippsland CRA Social Assessment Report, as these do not include overseas workers for industry categories in 1991 and 1996. c Share of Gippsland employment in 1996. d As at May 1991 and 1996 respectively. e Share of Victorian employment in 1996. f Subcategory of major category above (major category estimate includes subcategory).

Source: ABS(1997a:b).

Forest related industries directly employ people living in the Gippsland region and indirectly support employment in other sectors of the economy. Employment attributable to the wood resources of the Gippsland region extends beyond the Gippsland RFA boundary, but is not included in these statistics, e.g. timber processors located outside the region that source wood from the Gippsland RFA region. These industry linkages are discussed in more detail in Chapter 5.

2.6 HISTORY OF THE GIPPSLAND FORESTS

The original inhabitants of the Gippsland region were the Kurnai (Gunai) nation which consisted of five tribes (Morgan 1997) — the Brataulung, Tatungolong, Braiakolung, Brabrolung and Kroatungolung (mostly in East Gippsland). These communities lived mainly around lakes, river systems, beaches and estuaries that were rich sources of food, moving up the rivers into the forests during the winter months. In the north, the Kandagora-mittung or Karndtarrngkorramitung clan (part of the Jaitmathang or Ya-idthmidung tribe) lived on the Lake Omeo plains, Limestone Creek, Livingstone Creek and the Tambo headwaters. Mountainous areas were generally avoided because of their harsh climates, however journeys were made to the Alps during warmer months in search of the Bogong Moth.

The culture of Kurnai communities was based on an intimate and dynamic relationship with forest ecosystems. Timber and bark were the primary materials for creating tools, fire, shelter and transport, as well as featuring as a spiritual symbol in the dreaming and rituals of the Kurnai. The forest provided a nutritious and varied diet to the Kurnai, who were dependent upon a wide range of animals and plants as a food source. The Kurnai also used forest products for medicinal purposes and for weapons. Possum skins were used to make clothing, rugs, water containers, musical instruments and balls for sport. Possum and kangaroo bones were used in making tools and weapons (Nelson 1999). The Kurnai shaped the environment through their activities. Fire was used to encourage regeneration, particularly of edible plant foods, and to expose edible roots.

In January 1798, George Bass led the first European expedition into Gippsland, discovering Wilsons Promontory and naming Sealers Cove. By 1805, a sealing industry had developed along the coast. However, by 1830, seals were so rare the industry collapsed. Whaling industries were also significant during this time however inland settlement was hindered by densely forested coastal ranges.

To the north of Gippsland, pressure for new grazing areas came as settlement extended on the Monaro plains in New South Wales. Extensive areas of grazing land on the Omeo plains were reached in 1835 by George McKillop, Livingstone and McFarlane, while Buckley had explored the Bindi and Tongio area by 1837 (LCC 1977). Angus MacMillan, in his search for new grazing land, formed a station at Ensay in 1839. He then followed the Tambo River to the plains, reaching the coast in 1841 at Port Albert near Corner Inlet (LCC 1982c). Later, Count Paul Strzelecki followed MacMillan's path but continued through south Gippsland to Westernport Bay, crossing the Strzelecki Ranges and opening a route to Melbourne.

By the late 1840s, access to Gippsland was achieved by two means. Many settlers entered via the overland route from New South Wales, while others arrived at Port Albert by sea, generally from Melbourne (Abbott *et al.* 1993). Port Albert became the first centre of trade and flourished until inland routes to Melbourne were established in the 1860s. The amount of shipping in the waters near Port Albert resulted in the construction at Wilsons Promontory of a lighthouse that was completed in 1859 (Wescott 1995).

Plains to the west of the Gippsland Lakes were occupied by graziers, and major cattle stations were established at Heyfield, Glenmaggie and Holey Plains (Abbott *et al.* 1993). The mountainous country to the north and north west of the region remained relatively unexplored although, four cattle runs between Dargo and Tabberabbera were taken up between 1845 and

1847 (LCC 1982c). Areas favoured by the new settlers often coincided with traditional Aboriginal hunting grounds, which inevitably led to conflict.

Prior to 1840, the Kurnai had had intermittent contact with Europeans, including escaped convicts, shipwreck survivors and sealers. MacMillan and Strzelecki used Aboriginal trackers. However, settlement during the 1840s soon led to violence, with attacks by the Kurnai provoking reprisals, including numerous massacres. Until 1844 there was no European law or authority in Gippsland, and a climate of mutual distrust and hostility prevailed (Morgan 1997).

By 1850, the Kurnai population had been decimated. This was the result of massacres, diseases and a declining birth rate. Many Kurnai retreated into the swamps and forests (Morgan 1997). A Central Board for the Protection of Aborigines was appointed in 1860 to oversee the interests of the Aborigines in the Colony of Victoria. This Board established a number of missions, including Ramahyuck on the Avon River near Lake Wellington, and Lake Tyers. Legislation that forced many off the missions led to separation of families and a further disruption of Kurnai culture. Ramahyuck was closed in 1908 and the remaining residents were moved to Lake Tyers, along with other Kooris from across Victoria. While this was a sad occasion for many, it had the benefit of fostering a Victorian Aboriginal culture that has survived to this day (Morgan 1997).

Despite the devastating impact of colonisation on the Kurnai nation, Kurnai people — now known as Gunnai (Kurnai) people — and Aboriginal people from other groups remained in the area working on farming properties and in forest related industries such as timber mills. Gunnai (Kurnai) people currently live in Gippsland maintaining their cultural identity and sense of community. The Gunnai (Kurnai) people indicate that the forests contain places of Aboriginal significance and that they are used for cultural and educational purposes.

The development of the timber industry in Gippsland commenced around the 1840s with the Turnbull Company of Port Albert trading split timbers from foothill forests on Wilsons Promontory. A sawmill was established at Sealers Cove in 1853 and operated for five years, supplying timber to sealers and for ship construction. Milling recommenced in 1903 and continued until 1906, when the township was destroyed by fire.

By the early 1860s sawmilling had spread along the south coast between Wilsons Promontory and Port Albert. The extensive river systems emptying into the Gippsland Lakes provided an opportunity for sawmilling to spread inland, to near Bruthen by 1859.

Gold discoveries in the 1850s at Omeo, Swifts Creek and Cassilis caused rapid population increases while trading associated with discoveries at Walhalla and Grant saw the development of towns such as Sale, Maffra, Stratford and Heyfield (Abbott *et al.* 1993). Over the next 30 years, gold was found at Crooked River, Mt Wills, Upper Buckwong River and Buenba Flat, initially concentrating on alluvial fields. Reef mining began in the 1860s, which led to the growth of towns including Tabberabbera, Bullumwaal, Deptford and Dargo (LCC 1982c). Miners from Gippsland also used the track cut by stockmen to reach the Buckland and Harrierville goldfields in the North East.

By the late 1880s, large reef mines were being worked at Cassilis and Glen Wills, and large-scale alluvial mining, including dredging, was occurring in Livingstone Creek, and the Dargo and Crooked Rivers (LCC 1977). At Oriental Claims, the use of hydraulic sluicing required the construction of a dam and water races (Slattery 1998).

Other metals were mined in the region. Tin was mined at Mt Wills from 1888, prompting the development of a township, Glen Wills. Tin was also mined in the Mt Singapore area on

Wilsons Promontory between 1920 and 1936 (Westcott 1995). Copper was mined at Benambra.

Mining methods included sluicing, dredging and quartz reefing. These resulted in significant and widespread disturbance to forests and streams. Forests were cleared to supply the timber that lined the shafts and fuelled steam boilers, while prospectors burned the heavily timbered spurs to make visible surface quartz deposits.

Government assistance for track construction was a significant stimulus for mining activity in the region, particularly in the mountainous regions of the Great Dividing Range. Construction of mining tracks, throughout the region, took place during the 1880s and 1890s. Improved access encouraged prospecting and a network of rough tracks serviced isolated mining areas. However, limited construction of tracks took place after 1909 although clearing and maintenance of tracks by the Mines Department continued until 1925.

Coal mining commenced in 1826 (Morgan 1997) and since then it has been a significant industry in the Gippsland region. Brown coal finds in the Haunted Hills in 1873 led to the discovery of the vast coal resources below the Latrobe Valley. Development commenced in the 1920s, with the State Electricity Commission constructing a brown coal-fired electricity generation station at Yallourn. Other power stations were established at Hazelwood, Yallourn and Loy Yang (Abbott *et al.* 1993).

During the 1860s, four major Land Acts transformed the region from a grazing to an agricultural economy. These 'free selection' acts encouraged new settlers and reduced the squatters' runs. The *Land Act 1869* provided for selection of land, including some of the pastoral estates across the region. Much of the flat country was quickly selected and this is reflected in the current population distribution (LCC 1977). Initially, sheep and cattle were the basis of the agricultural industry. However, production also included a range of produce such as wheat, barley, hops, tobacco, maize and potatoes. The construction of Lake Glenmaggie in 1926 led to the establishment of the Macalister irrigation district (LCC 1982c).

The late 1870s to 1880s was a time of development for the region. Construction of the Main Gippsland Railway in the 1870s connecting Melbourne to Sale gave settlers access to the formerly inaccessible forests of the western and southern parts of Gippsland. A means of land transport was essential to trade. The Great Southern Railway was completed in 1892, extending from Dandenong to Port Albert. Construction of the line used timbers cut from the Mullungdung State Forest. A road linking Melbourne and Sale had been constructed by 1879 and a rail link to Bairnsdale was opened in 1888. With demand for construction timbers and fuel from the railway and mining industries, the timber industry expanded rapidly in the late 1800s.

With the completion of the railway through Gippsland in the boom years of the 1880s, the region was able to provide timber for the rapid commercial and industrial expansion of Victoria. The railway provided a means of internal communication within Gippsland that enabled sawmillers to find wider local markets for their products. The forest areas utilised grew in extent as branch lines were extended out from the main line and included forests in the Strzelecki Ranges and at Mullungdung and Briagolong. The Red Gum forests on the plains around Traralgon, Maffra, Sale and Providence Ponds supplied railway sleepers, bridge construction timbers and street paving blocks.

During this period there was only minimal access to forests in the Great Dividing Range, to the north of the main railway system. A railway line was built from Traralgon, which reached Heyfield in November 1883, Maffra in 1887 and re-joined the main line at Stratford in 1888. This was essentially an agricultural line but carried some timber. This railway connection was

vital for the later establishment of Heyfield as Victoria's pre-eminent timber conversion centre (Evans 1998).

By 1900, parts of the Strzelecki Ranges had been cleared and settled for agriculture. The ranges were cleared by ringbarking, felling and burning, with some timber used for fencing and construction. Wildfires in 1898 destroyed much of the forest on the Strzeleckis, in some ways aiding the clearing attempts (FCV 1976). However, many blocks on the rugged eastern side of range had been abandoned by 1905. Some areas were taken up as soldier settlements at the end of the First World War, but the depression in the 1930s saw farmers again forced off the 'Heartbreak Hills' (Abbott *et al.* 1993). The Crown reclaimed many abandoned selections.

Wildfire occurred frequently in Gippsland due in part to the settlers' use of fire. The first notorious and perhaps most devastating fire documented was the 'Black Thursday' fires of 1851. In 1939, fires burnt much of the Great Dividing Range of eastern Victoria, including significant areas at the head of the Wongungarra and Dargo Rivers and on the Dargo High Plains; Mt Hotham and Omeo were also damaged (Slattery 1998). Other major wildfires in the region occurred in 1875, 1898, 1900, 1908, 1926, 1944, 1951-52, 1965 and 1998.

In the aftermath of the bushfires of 'Black Thursday' 1851, alpine grazing commenced. Fires had denuded the countryside of grass, forcing many squatters to search for forage for their cattle. By the 1860s, a regular pattern of high country grazing had developed on the Bennison, Dargo and Nunniong plateaux (LCC 1977). Stockmen also opened a route from Omeo to the Ovens Valley via Mt Hotham. Graziers introduced new fire regimes to the high plains to encourage a 'green pick' and for protection from wildfire. Regular use of fire and grazing led to changes in the composition of indigenous flora.

Grazing on Wilsons Promontory also commenced at this time but by 1908 it had been significantly restricted in area. It was not until 1992 that grazing was completely phased out on Wilsons Promontory (Westcott 1995).

Graziers, miners and selectors felled large quantities of bush timber. Government authorities used hardwood species for railway sleepers, piles for piers and docks, and electricity poles, and timber companies processed a range of forest products. Selective logging occurred extensively in the Mullungdung and Alberton West forests. Timber close to railways was milled and railed to Melbourne to meet the requirements of a growing population.

During the gold rushes, the number of sawmills operating in Victoria increased dramatically. Timber cutting in the north of the region intensified during the gold rushes. Forests surrounding towns such as Walhalla were intensively cut for mine supports, heavy construction and fuel that left many hillsides denuded (Abbott *et al.* 1993). The timber was felled by axe and crosscut saw, then sawn into manageable sections for transportation to the mill by horse and bullock teams or timber tramway. The first sawmills were located close to their log supply. Power was supplied by steam, using stationary engines and water-powered mills.

The first legislation enabling the government to reserve forested areas for the protection of timber resources was granted under the Land Act of 1862. This legislation, however, brought no effective measures for the conservation of forests. A series of reports from the 1870s recorded details of huge waste in the timber industry, and irresponsible and ineffective management of the forest resource. Forestry Bills were introduced to Parliament between 1879 and 1892 but none were enacted.

A Royal Commission on Forests that sat from 1897 to 1901 led to the *Forests Act 1907* which established the Department of Forests. This legislation was strengthened by the *Forests Act*

1918, which established the Forests Commission of Victoria. The 1918 Act gave the Commission the revenue to protect, conserve and develop the indigenous forest, and maintain an adequate area of softwood plantations.

In 1930, a mill was established at Mt Baldhead near Swifts Creek and, five years later, logging commenced in the Mt Wills area (LCC 1977). Alpine Ash (*Eucalyptus delegatensis*) was regarded as a good substitute for the preferred Mountain Ash (*Eucalyptus regnans*). The need to salvage fire-killed ash timber after the bushfires of 1939 served to concentrate milling activity in the Eastern and Central Highlands. However, with salvage operations completed, timber companies turned their attention to the Alpine Ash forests for high quality building and joinery timber. Significant demands for timber resulted from post-war migration, the housing boom and restrictions on the importation of timber. In 1946, mills were constructed at Swifts Creek and Omeo and, by 1949 Heyfield was established as an important sawmilling centre with log allocations being granted in the Connors Plain area, north west of Licola. By 1956, ten mills were located in Heyfield, drawing on this ash resource, and taking advantage of a climate that was beneficial for air-drying (LCC 1982c).

The Forests Commission was able to directly influence the location of timber extraction and sawmilling through its log allocation system. Annual licences were granted to remove specified volumes of timber from defined areas of State forest. The Commission's roading program also assisted the expansion of the timber industry. For example, the Tamboritha Road was constructed to give access to areas north and east of Licola and, by 1964, logging had extended through Bennison Plains, Arbuckle and Moroka (Abbott *et al.* 1993).

The Royal Commission, following the 1939 bushfires, directed that sawmills should no longer be sited in the forest. This required the improvement of the road system for hauling logs to urban centres. Licensees became responsible for the construction of the roads in their area. The improvement in roads and an advance in technology after the Second World War encouraged the increased mechanisation of logging operations.

Changes in cutting and sawmilling technology led to a dramatic increase in the volume of timber harvested in Victoria. Tractors for snigging, and motor vehicles for hauling logs and sawn timber replaced bullock teams and timber tramways. Diesel and electric power replaced steam at the mills. Crawler tractors fitted with dozer blades facilitated road making, which gave access to previously inaccessible areas, and bulldozers with winches snigged logs from deep gullies. Chainsaws also revolutionised cutting practices in the forests.

In 1936, the Government signed an agreement with APM Forests Pty Ltd to supply pulpwood for a chemical pulpmill at Maryvale. This pulp mill became operational in 1939 and contributed to the development of a number of towns including Morwell.

APM Forests also entered into the reforestation of the Strzelecki Ranges in 1960 and had begun purchasing land for plantation establishment a decade earlier. The Forest Commission of Victoria had begun purchasing freehold land in the early 1930s for the same purpose. All purchases were the result of voluntary sale and large-scale plantings began in 1946 at Childers and Allambee (FCV 1976). Extensive plantations of Radiata Pine (*Pinus radiata*) and Mountain Ash now exist in the Strzelecki Ranges.

Residents of the Gippsland region also used the forests for recreation. Organised bushwalking tours, which began in the late 1890s, had become well established by the 1920s and boomed in the 1930s. During this time, the Victorian Railways organised many bushwalking tours, visiting remote areas such as Dargo, Mt Howitt and Crooked River (Siseman 1985).

Alpine recreation on an organised basis began in the late 1920s. Mt Hotham snowfields were skied from around 1925 and accommodation was available at Hotham Heights and

Mt St Bernard (LCC 1977). An alpine resort was formally established in 1958 at Mt Hotham and it continues to be a popular destination, with around 97 000 people visiting the resort each year.

Wilson's Promontory National Park was temporarily reserved in 1898, and permanently reserved in 1905, making the Promontory Victoria's oldest national park. Bulga and Tarra Valley National Parks were reserved in 1904 and 1909 respectively, protecting vegetation communities which were characteristic of the Strzelecki Ranges prior to European settlement. These, and other parks, reserves and State forest, have a history of recreational use including picnicking, bushwalking, horse riding and nature observation. Across the region, the popularity of these activities and others such as four-wheel driving, trail bike and mountain bike riding has steadily increased.

The Land Conservation Council (LCC) conducted a number of land use reviews during the 1970s and 1980s and, through these, shaped Gippsland's character. The reviews led to the creation of new and enlarged National, State and Regional Parks and reserves, and identified forests that would be available for timber production and other land uses. In some instances, land for plantation extension was identified. Through the creation of the Alpine National Park, a link was formed between Victoria's alpine area and the Kosciusko National Park in New South Wales. Similarly, LCC recommendations recognised that the Gippsland Lakes system has many distinctive features that have high recreation and conservation values.

2.7 LAND CLASSIFICATION

Conservation Reserves

The Gippsland region has an extensive system of National Parks and other conservation reserves. The system has been established to protect a range of significant natural and cultural values and to provide opportunities for recreation, tourism and education.

The reserve system occupies about 514 000 ha, or 35 per cent of public land in the region. It includes part of the Alpine National Park, Mitchell River National Park and Wilson's Promontory National Park. The biodiversity, old-growth and national estate assessments provide information on the reserve system and the values it contains. Map 1 shows the location of the reserve system.

State Forest

State forests are managed for both conservation and sustainable resource utilisation. Within State forest provision is made for:

- water supply;
- catchment and stream protection;
- hardwood timber production;
- conservation of natural and cultural values;
- recreation and tourism;
- mineral exploration and mining; and
- other forest uses, such as honey production and grazing.

State forest also has an important role in complementing the management of parks and reserves for conservation, recreation and eco-tourism. Forest management plans direct the management of State forest for the protection of environmental values while providing for the sustainable management of the natural resources.

A management plan for State forest in Gippsland is currently in preparation. The management plan will provide a strategic land use framework in State forest and be based on three

‘management zones’ which set priorities and specify permitted activities for different parts of the forest. The three management zones are:

- The **Special Protection Zone (SPZ)** — managed for conservation with no timber harvesting permitted. This zone is designed to link and complement established conservation reserves.
- The **Special Management Zone (SMZ)** — managed to conserve specific features where timber harvesting is still permitted under certain conditions.
- The **General Management Zone (GMZ)** — managed for a number of uses where timber production is the main priority.

2.8 MANAGEMENT ARRANGEMENTS

Land management arrangements, central to the achievement of Ecologically Sustainable Forest Management, vary according to tenure and the objectives of management on each tenure. Legislation and policies define the broad management arrangements applicable to different lands. Implementation of such arrangements is achieved through planning processes, management plans, codes of practice, guidelines and environmental prescriptions that are applied at a strategic and operational level.

3. FOREST MANAGEMENT AND RESOURCE UTILISATION

Forest management on public land aims for the conservation of natural and cultural values while providing resources for the community's economic benefit.

This chapter outlines the processes of State forest planning and management in the Gippsland region. Further information about the forest management planning process is provided in the Ecologically Sustainable Forest Management (ESFM) reports (VicRFASC 1996b and VicRFASC 1997a).

3.1 STATE FOREST MANAGEMENT

The principles for State forest management in Victoria are set down in the Timber Industry Strategy (Victorian Government 1986). This document states that forest management will be:

- economically viable;
- environmentally sensitive;
- sustainable for all forest values; and
- assisted by public participation in planning.

A number of acts of Parliament, such as the *Forests Act 1958*, the *Conservation, Forests and Lands Act 1987* and the *Flora and Fauna Guarantee Act 1988*, as well as Government and Departmental policies, guide forest management planning in Victoria.

Implementation of many principles in the Timber Industry Strategy is provided through the development of the Code of Forest Practices for Timber Production, Forest Management Plans, wood utilisation plans, coupe plans and forest operator licensing provisions.

Code of Forest Practices for Timber Production

The Victorian Parliament ratified the Code of Forest Practices for Timber Production (the Code) in May 1989 in accordance with Section 55 of the *Conservation, Forests and Lands Act 1987*.

Since its implementation in 1989, several reviews of aspects of the Code have been undertaken (Victoria Auditor-General 1993; CNR 1995a; CNR 1995b; CNR 1995c; O'Shaughnessy 1995). Revision No. 2 (NRE 1996a) of the Code was developed by NRE involving scientific review and community consultation. This included a review of the Code by CSIRO based on scientific evidence, experience and observation of its effectiveness in achieving environmental care. The revised Code was ratified by Parliament in December 1996.

The Code's purpose is to ensure that commercial timber growing and harvesting activities are carried out in such a way that an internationally competitive timber industry is promoted while being compatible with the conservation of a wide range of environmental values, and promoting ESFM.

To this end, the Code provides Statewide goals, guidelines and some minimum standards to be applied to timber production operations both by NRE, as forest managers, and by forest operators. These goals and guidelines apply to timber harvesting, timber extraction roading, regeneration and reforestation, and are to be used during the formulation of detailed plans and prescriptions that include:

- Forest Management Plans that address the management of environmental, cultural and resource values in Forest Management Areas;
- Forest Management Area prescriptions for the control of timber harvesting in native forests;

- Wood Utilisation Plans (WUP) that detail the type and quality of wood to be produced over the duration of the plan, together with a plan for the allocation of wood to processors. Plans are generally produced to cover a three year period and are updated annually; and
- Forest Coupe Plans which identify the areas to be harvested and a schedule that incorporates the specifications and conditions under which each operation is to be administered and controlled.

The Code will be reviewed at least every ten years to take account of new research information and field experience.

In general, the Code is implemented at a local level through a set of regional prescriptions. These detailed prescriptions take account of local conditions such as climate, forest type, topography, elevation, soil type, and various management activities. They must be consistent with the Code, based on relevant scientific input, and reviewed periodically. Regional prescriptions for the Forest Management Areas in the Gippsland region were reviewed in 1997-98 to incorporate the requirements of the revised Code (NRE 1996a).

Compliance with the Code on public land is required under the conditions of licences issued in accordance with the provisions of the *Conservation, Forests and Lands Act 1987* and the *Forests Act 1958*. The Timber Harvesting Regulations 1989 require all forest operators to be licensed to carry out timber harvesting operations. Breaches of particular terms or conditions of Forest Operator Licences can result in the accumulation of penalty points that may lead to the suspension or cancellation of a licence.

Local government authorities are responsible for monitoring the application of the Code on private land. Amendment S13 under the *Planning and Environment Act 1987* extended the application of the Code in 1993 to provide a sound environmental basis for timber production on private land. A pilot program in municipalities in the Gippsland region recently trialed the accreditation of forestry professionals relating to planning for forest operations on private land.

Forest Management Plans

The Timber Industry Strategy divided Victoria into 15 Forest Management Areas (FMAs) for the purpose of preparing and implementing Forest Management Plans. These plans direct the use and care of forests for planning periods of ten years, with provision for more frequent review if circumstances warrant. The planning process provides opportunities for public consultation and participation in resource use and protection. Advisory Committees, made up of people with a range of interests from communities across the region, advise on the preparation of Forest Management Plans.

These plans must be in accord with requirements of relevant Victorian Government Acts and policies, including the *Flora and Fauna Guarantee Act 1988*, the *Catchment and Land Protection Act 1994* and the *Forests Act 1958*, the Code and the National Forest Policy Statement 1992. Accordingly, plans are required to consider:

- ecologically sustainable management, including the maintenance of environmental values and the sustainable use of natural resources;
- the contribution of conservation reserves to, and the impact of private land activities on, the determination of appropriate protection levels for environmental values in State forest;
- Catchment Management Strategies, and requirements of Special Area Plans made under the *Catchment and Land Protection Act 1994*;
- protection of all flora and fauna listed as threatened under the *Flora and Fauna Guarantee Act 1988*;

- the requirement for sustainable yield under the *Forests Act 1958*;
- protection of regional biodiversity;
- continuing opportunities for recreation, scientific study and education;
- public participation in plan development; and
- monitoring and review of management performance.

To meet these requirements, the planning process sub-divides the State forest into zones, as discussed in Section 2.7, which identify where environmental, cultural and timber resource values are to be given priority. Combined with land scheduled under the *National Parks Act 1975* and other conservation reserves, these forest management zones provide for an integrated reserve network and a framework for sustainable forest use.

A Forest Management Plan covering State forests in the Gippsland RFA region is currently in preparation. The region covers three Forest Management Areas, including the Tambo FMA, and parts of both the Central Gippsland and Wodonga FMAs. State forest outside the Gippsland RFA region, but within the Central Gippsland and Wodonga FMAs, is covered by the Central Highlands and North East RFAs respectively. A Forest Management Plan has been prepared for the Central Highlands region and a Proposed Forest Management Plan has been completed for the North East region.

The Mid-Gippsland Forest Management Plan will apply to 806 000 ha of State forest, representing 31 per cent of the Gippsland RFA region. This area of State forest has been determined from detailed land use studies by the former Land Conservation Council (LCC). The South Gippsland 1 (LCC 1975) and 2 (LCC 1982b), Alpine (LCC 1979a) and Gippsland Lakes Hinterland (LCC 1984a) study areas cover the Gippsland region. Special investigations of public land use have also been undertaken and include the Stradbroke (LCC 1979b), Gellions Run (LCC 1982a), Hill End (LCC 1984b), Alpine (LCC 1985) and Latrobe Valley (LCC 1987) Special Investigations. Other LCC reviews that cover Gippsland include Special Investigations of Rivers and Streams (LCC 1991a) and Wilderness (LCC 1991b).

Wood Utilisation and Coupe Planning

Forest Management Areas are subdivided into a hierarchy of blocks, compartments and coupes for recording and management purposes. Of these, compartments are the smallest permanent forest planning unit.

Coupes, or harvesting areas, are selected for harvesting to supply the required quantities and mix of wood products to meet annual wood supply commitments. A three-year schedule of coupes, and associated access roading, forms part of a Wood Utilisation Plan, which is prepared for each FMA annually. Its preparation involves specialist expertise as required, including flora, fauna, soils and cultural heritage, uses sound silvicultural practices and ensures environmental care. These plans are made available for a public comment for a period of 30 days prior to finalisation. Special plans may also be prepared and approved to carry out salvage of timber or regeneration of stands following fire, storm or other events, e.g. salvage of Alpine Ash regrowth from Carey State Forest in the region.

Timber harvesting operations are conducted according to a Forest Coupe Plan prepared with reference to the Wood Utilisation Plan and other regional plans. Each plan provides a detailed description of the coupe, including a map identifying the area to be harvested and conditions to apply to all operations. Prior to harvesting, coupe boundaries must be marked in the field. Boundaries may be determined by natural features, such as ridges, or other prominent features. Requirements for coupe planning and harvesting are detailed in the Code of Forest Practice for Timber Production (NRE 1996a). Regional prescriptions, as discussed earlier, provide operational guidelines for coupe marking and harvesting.

3.2 SILVICULTURE

Silviculture is the theory and practice for managing forest establishment, species composition and growth to achieve specific forest management objectives (NRE 1996a). Silvicultural treatments can include harvesting, site preparation, seeding, planting and tending operations such as thinning and fertilising. A review of the theory and practice of silviculture was provided in the East Gippsland Resource and Economics Report (VicRFASC 1996c) and is also relevant to the Gippsland region. Further details on eucalypt silviculture are available in Florence (1996). A summary of silvicultural techniques used in Gippsland, including an outline of current NRE policy, management practices and research in silviculture, is provided in the following section.

State forest in the Gippsland region is dominated by ash-type and mixed species eucalypt forests. These forest types differ in their ecological responses to disturbance, particularly its effects on regeneration. For example, ash-type eucalypt stands are killed by all but low intensity fires, whereas the mixed species stands can withstand fires of higher intensity. As a result, a range of silvicultural techniques may be appropriate, depending on the ecological characteristics of each forest type, plus environmental, economic and social factors.

Ash Forests

Ash forests in Gippsland include Alpine Ash (*Eucalyptus delegatensis*) and Mountain Ash (*E. regnans*). These species are normally found in pure, even-aged stands at altitudes ranging between 300 and 1000 m for *E. regnans*, and 900 m to 1500 m for *E. delegatensis*.

Mountain Ash can be found in association with Alpine Ash at higher elevations. Other species which may be present at the limits of the ash species range include Messmate (*E. obliqua*), Mountain Grey Gum (*E. cypellocarpa*), Manna Gum (*E. viminalis*) and Snow Gum (*E. pauciflora*). Occasional trees or stands of Shining Gum (*E. nitens*) may also occur throughout the ash forests (Campbell *et al.* 1984).

Regeneration Systems

Alpine Ash seeds have inherent dormancy (Grose 1963), which can only be broken by cool, moist conditions such as under snow during winter. This knowledge has led to the current practice of sowing seeds in autumn following seedbed preparation. Germination occurs in the following spring after the snow has melted and the dormancy has been broken.

In contrast, Mountain Ash seeds have no general dormancy (Cunningham 1960), and therefore germinate when soil moisture and temperature conditions are suitable — being either in autumn or spring.

Through operational experience, the clearfelling regeneration system is consistently able to provide for adequate regeneration and optimal growth in Ash forests (Campbell *et al.* 1984; Campbell 1997a). Debris remaining after harvest is burnt and the site is artificially sown with seed collected from the coupe or nearby areas. Burning produces a high quality seedbed, which assists in early germination of seed. Where burning is not appropriate, or conditions have resulted in burning at lower intensities (which are not as effective), mechanical disturbance of the soil is required for adequate regeneration. It is common practice to regenerate by sowing seed; however, when seed availability is restricted or seed has failed to germinate, seedlings are planted to achieve prescribed stocking levels. The seed tree system is occasionally used where seed crops on standing trees are considered sufficient to meet specified seedfall targets. Seed trees may be removed two to three years later, or retained as habitat.

Regeneration success rates in both Alpine Ash and Mountain Ash forests in Gippsland have been satisfactory, with generally 85 per cent of coupe area being adequately or well-stocked

after the first attempt at regeneration in the period July 1989 to June 1993 (Murphy and Fagg 1996).

Regrowth Management

Clearfelling and high intensity wildfire often result in dense regeneration leading to competition for light and nutrients between individual stems. As a result, some stems become dominant and grow strongly, while others are suppressed. Although eucalypt forests naturally self-thin as they mature, artificial thinning of *E. regnans* regrowth leads to increased growth in diameter and basal area (and thus, volume) in the retained trees, thereby contributing to increased sawlog production (Webb 1966, in Jeremiah and Roob 1992). Similar responses occur in *E. delegatensis* regrowth. However, physical damage to retained trees during commercial thinning operations can affect wood quality. White and Kile (1991) found that after wounding, longitudinal extension of decay and discolouration continued at a relatively constant rate for up to 23 years. In recognition of this, prescriptions for ash thinning require that damage be limited to a maximum of 15 per cent of retained trees (CNR 1992). To date there has been no commercial thinning of Ash forests in Gippsland.

Mixed Species Forests

Low elevation mixed species forests in Gippsland are characterised by the Silvertop-stringybark forest type. These forests consist of mixed stands of commercial species including Silvertop (*E. sieberi*), Yellow Stringybark (*E. muellerana*), White Stringybark (*E. globoidea*), Red Stringybark (*E. macrorhyncha*), Brown Stringybark (*E. baxteri*) and Yertchuk (*E. considiniana*). At higher elevations, mixed species forests are dominated by Messmate (*E. obliqua*), Mountain Grey Gum (*E. cytellocarpa*) and Manna Gum (*E. viminalis*). In alpine regions, mixed species forests consist of species such as Mountain Gum (*E. dalrympleana*), Broad-leaved Peppermint (*E. dives*), and Snow Gum (*E. pauciflora*). Stands may also include Ash species at the upper edge of the mixed species range. These forest types provide the majority of the region's mixed species timber supply.

Some foothill forests and woodlands below 500 m elevation consist of durable species including Red Ironbark (*E. sideroxylon*), Red Box (*E. polyanthemos*), Gippsland Grey Box (*E. bosistoana*), Forest Red Gum (*E. tereticornis*) and River Red Gum (*E. camaldulensis*) (Abbott, Lamb and Roberts 1993).

Regeneration Systems

Seed-tree and clearfelling systems are the most commonly used silvicultural systems in the mixed species forest of Gippsland as they result in sufficient disturbance for consistent and adequate regeneration and growth. Mixed-age stands, which are more common in the lower foothills areas, lend themselves to group selection harvesting or removal of overwood and poorer quality stems, to reduce competition and stimulate the growth of retained trees.

Slash burning is the most common means of site preparation, although mechanical disturbance is used, particularly when sites are being re-treated after the initial attempt at regeneration has not been successful (NRE 1998b). In practice, the choice of regeneration technique is strongly influenced by the method of harvesting and the species/structure characteristics of the stand. Silvicultural systems that retain a greater basal area after harvest, for example in uneven-aged stands, may need less site preparation and establishment effort compared with even-aged stands.

Seedfall may be induced by burning, although sites can be artificially sown by air or hand. Coppice from cut stumps often provides a useful contribution to coupe stocking, particularly in box and ironbark forests. Where seed supply is limited, seedlings may be raised and planted, although this technique is considerably more expensive than natural or artificial

sowing methods. In the Swifts Creek district, for example, Manna Gum often needs to be re-established by planting.

Regeneration success rates in the mixed species forests where even-aged silviculture has been practised have been variable in the period 1989 to 1993. There have been some technical and operational problems, such as limited seed supply and browsing by native herbivores, associated with the regeneration of high elevation mixed species forests in Tambo FMA and low elevation mixed species in the Yarram district (Central Gippsland FMA). These issues are being addressed through on-going research that aims to improve regeneration success (Murphy and Fagg 1996).

Regrowth Management

Mixed species forest can also be thinned to increase the merchantable wood yield by concentrating growth on a smaller number of retained stems. For example, since the late 1980s small diameter stems in stands of 20 to 40 year old regrowth in the Boola Boola State Forest have been commercially thinned to enhance future sawlog yields while producing a yield of pulpwood. In the early 1990s, similar thinning operations were conducted in the Alberton West State Forest and more recently in the Won Wron State Forest.

Other sites on which the Silvertop-stringybark forests occur in Gippsland have the potential to produce large volumes of sawlog if thinned at an appropriate age (Abbott, Lamb and Roberts 1993). If funds and/or markets are available, suitable stands of mixed species forest will be thinned, where appropriate, to increase stand productivity and quality. Such operations are required to follow the NRE Guideline on Thinning of Mixed Species Regrowth (NRE 1997b).

Silvicultural Policy and Management

While the application of silviculture is usually based on the ecological characteristics of the forest type — such as the need for high site disturbance in Ash type forests — other considerations are also taken into account. The range of ecological, environmental, social and economic considerations for silviculture is contained in the Code of Forest Practices for Timber Production (the Code) (NRE 1996a). These are implemented through Forest Management Plans, regional prescriptions, Wood Utilisation Plans and Forest Coupe Plans.

The Code provides a series of goals and guidelines for the establishment and tending of timber stands on public land which address:

- management of regeneration and reforestation;
- establishment, including tree species and seed sources;
- stocking and early growth;
- tending; and
- maintaining forest health.

In accordance with the Code, harvesting and regeneration systems in Gippsland are managed to:

- provide for adequate regeneration of the original species;
- obtain the desired growth;
- maximise sawlog yield;
- minimise environmental impact;
- incorporate social and economic considerations; and
- protect regeneration from excessive damage.

Silvicultural systems are applied to both ash-type and mixed species forests to maintain a non-declining yield of sawlogs. This is currently achieved through:

- harvesting ash forests using clearfelling systems on a nominal 80 year rotation; and

- harvesting mixed species forests using clearfelling or seed-tree systems on a rotation of between 80 and 120 years.

A range of harvesting and regeneration treatments is available, and used, depending on numerous factors including:

- stand conditions, including age structure, species composition, seed availability and site quality;
- site conditions, such as elevation, aspect and rainfall;
- operational constraints, such as rock and steep slopes;
- markets for residual roundwood or speciality timbers; and
- non-wood values, including flora and fauna, landscape and recreation (Ryan 1997).

Recommended techniques and standards for the major silvicultural operations are documented in NRE's *Native Forest Silviculture Guidelines* series.

Each FMA is required to report annually on its silvicultural performance in terms of site preparation, establishment and regeneration. Where problems are identified, action is taken to improve results in the future.

Silvicultural Research

An intensive program of silvicultural research into Alpine Ash was undertaken by Grose in the late 1950s and early 1960s, largely based in the Mansfield-Connors Plain areas (Grose 1957, 1963); associated field trials also occurred in the Swifts Creek area. Current knowledge of regeneration requirements of Alpine Ash is based on this work in which several harvesting and regeneration systems were trialed, including retaining group, strip and single seed tree sources. However, operational difficulties led to the current clearfelling system, using high intensity burning and artificial sowing.

While clearfelling is an operationally efficient silvicultural system, and was seen to meet the biological requirements for successful regeneration, the appropriateness of the system in terms of its ability to meet other criteria has been questioned. In response, the Victorian Government commenced a long-term research program now known as the Value Adding and Silvicultural Systems Project (VSP). It incorporates the Silvicultural Systems Project (SSP) and the Value Added Utilisation System (VAUS) Trial. The aims of the VSP are:

- to investigate silvicultural alternatives to clearfelling in Mountain Ash and eastern mixed species forests; and
- to determine the response of forest ecosystems to integrated harvesting (Squire 1987).

The SSP compared clearfelling of Mountain Ash and mixed species forest with a variety of alternative systems, including seed tree retention, strip selection, group/gap selection and shelterwood systems. These alternatives were assessed in relation to success of regeneration, operational costs and safety. A second phase of the study will involve an evaluation of the ecological, operational and social aspects of the selected alternatives.

Reports thus far have indicated that systems other than clearfelling and seed tree systems can produce adequate regeneration of *E. regnans* and mixed species. However, height growth of seedlings is markedly reduced by increasing overwood retention and/or reducing harvested gap size. This drawback, together with the severe operational problems such as safety risks in felling, damage to surrounding trees during felling and snagging, and increased soil compaction in the gap selection system, means that generally the clearfelling and seed tree systems will continue to be used to harvest and regenerate *E. regnans* (Campbell 1997a) and mixed species forest (Squire 1992), particularly where timber production is a high priority.

Details of VAUS and SSP trials are summarised in Squire (1992) and Campbell (1997a, 1997b). A full listing of projects relevant to the mixed species trials can be found in the East Gippsland Resource and Economics Report (VicRFASC 1996c).

Departmental and CSIRO research into thinning of ash eucalypts has occurred over many years. Results have indicated that, given suitable machinery and sites with low levels of old log debris, thinning can be commercially viable and can have other benefits in the longer term (Webb 1966, Kerruish and Rawlins 1991).

In the period 1988-1990, a collaborative research and development program between NRE and the CSIRO Division of Forest Products was carried out in the Silvertop-Stringybark regrowth forests of East Gippsland. The findings (Flinn and Mamers 1991), which cover 11 different projects, including thinning trials, encompass impacts on flora and fauna, fuel reduction burning and processing of timber. These apply equally to the mixed species forests in the Gippsland region. Further research has been carried out by NRE's Centre for Forest Tree Technology related to eucalypt seed crop development, the role of seed trees and the effect of time of sowing in the high elevation mixed species forest type (Lutze *et al.* 1998).

Research and Development Action Groups were established to provide an effective mechanism for linking research to field needs. The Eastern Research and Development Action Group (ERDAG) was formed to improve silvicultural management in commercial forests in the Gippsland region (Fagg and Flinn 1997). To date, ERDAG has produced a 'decision tree' which assists in planning for the harvesting and successful regeneration of high elevation mixed species, and several guidelines on local silviculture, such as seed management (ERDAG 1998).

3.3 FIRE PLANNING AND MANAGEMENT

Fire is an integral part of the ecology of forests. It is a disturbance to which most of the native flora and fauna are generally well adapted. The wildfire hazard in Gippsland is potentially as severe as anywhere in Australia.

The Department of Natural Resources and Environment is responsible for the prevention and suppression of fires in State forests, national parks and other protected public lands. The Department also has responsibility for fire prevention on private land within 1.5 km of State forests, national parks and protected public land which has not been excised by legislation. By definition, under the *Forests Act 1958*, these lands are referred to as the 'Fire Protected Area'.

The Country Fire Authority (CFA) is responsible for fire prevention and suppression in the 'Country Area of Victoria', which excludes the metropolitan fire district and most public land.

The Code of Practice for Fire Management on Public Land (CNR 1995d) provides a framework for fire management on public land in Victoria. As a requirement of this Code, regional fire protection plans must be prepared and provide strategies for fire prevention, preparedness, suppression and recovery. The Gippsland Fire Protection Plan (NRE 1999a) applies in the Gippsland RFA region.

Regional fire protection plans are developed after extensive consultation with municipal and regional fire prevention committees and other interested parties, including agency specialists in flora, fauna, parks, forestry, fire management, land and water protection, the Country Fire Authority and the community. They are reviewed every five to seven years.

Fire prevention, based on the general principle of minimising the incidence of preventable wildfire, includes strategies for education, enforcement and operations such as fuel management. In accordance with the Code of Practice for Fire Management on Public Land,

regional fire protection plans include a fuel management strategy for fire prevention and preparedness, which aims to reduce the rate of wildfire spread, and improve the prospects for controlling wildfire close to assets and in strategically located regional corridors.

The fuel management strategy primarily includes fuel management burning based on five zones:

- Zone 1: asset protection (especially adjacent to private property);
- Zone 2: strategic fuel reduced corridors;
- Zone 3: broad area fuel reduced mosaic;
- Zone 4: specific flora and fauna management; and
- Zone 5: exclusion of prescribed burning.

Fuel reduction burns are undertaken in only three of the strategically located zones to maintain fuel to defined levels. Areas containing significant biological, cultural or economic values, which can be damaged by fire, are generally located in Zone 5 where prescribed burning is excluded, or Zone 4 where the ecological requirements of an area are given priority. Before fuel reduction burning is undertaken on public land, the Code of Practice for Fire Management on Public Land and regional fire protection plans require that each burn must be the subject of an approved plan.

The selection of sites and frequency of burning depend on the priority for fuel reduction, the rate of fine fuel accumulation, and biological values in accordance with the priority zones (CNR 1995d). In strategic areas, non-burning methods such as slashing are used to reduce fuel levels.

The fuel management strategy zoning takes into account natural values and principles of environmental care. The development of fire suppression and rehabilitation strategies also includes consideration of values at risk from wildfire or suppression activities. Where necessary, NRE prepares a rehabilitation plan which details activities required to assist the recovery of infrastructure, other assets and environmental values from the impact of wildfire and fire suppression.

3.4 PEST AND DISEASE MANAGEMENT

Pest plants and animals and diseases impact on the environmental, social and economic values associated with public lands and forests. They reduce agricultural and forest productivity, displace native species and contribute to land degradation. The direct cost of weeds to Victorian agriculture is estimated at more than \$360 million per year (NRE 1998f).

Legislation that has a major influence on pest control on public land in Victoria includes:

- the *Catchment and Land Protection Act 1994*, which provides for the categorisation of pest plants and animals, and for their eradication or control. Catchment Management Authorities were also established under the Act with the role of implementing regional catchment strategies; and
- the *Flora and Fauna Guarantee Act 1988*, which lists the predation of native wildlife by the introduced Red Fox (*Vulpes vulpes*) and the spread of gravel infected by Cinnamon Fungus (*Phytophthora cinnamomi*) as potentially threatening processes.

Other legislation is also relevant, including the *National Parks Act 1975*, which requires exotic flora and fauna to be eradicated and controlled.

The National Forest Policy Statement calls for forest management agencies to monitor and appropriately control the threat to publicly owned native forest ecosystems posed by pest plants, and animals and diseases. Consistent with this, the Code of Forest Practices for Timber Production (NRE 1996a) requires that 'care must be taken to prevent the introduction and/or spread of disease or insect and plant pests in timber production forests'. Gippsland forest

management prescriptions (NRE 1998e) provide objectives and guidelines for the management of pest plants and animals, and for maintaining forest health.

A number of pest plants, animals and diseases have been identified on forests in the Gippsland region:

- Plants — blackberry; ragwort, particularly in Mullungdung State Forest and areas north of Briagolong; St Johns Wort, in the drier forests of Briagolong; Gorse (Furze) in areas of South Gippsland; and Cape Broom.
- Animals/Insects — rabbits; foxes; feral dogs; pigs; goats; bees; and European and English Wasps.
- Diseases — Cinnamon Fungus (*Phytophthora cinnamomi*).

Occurrences of pest plants and animals are recorded on NRE's Pest Management Information System (PMIS).

Both the Commonwealth and Victorian Governments have implemented a number of strategies and programs aimed at pest plant and animal control that involve industry, landholders, land managers community groups and government at all levels. Major Commonwealth initiatives for the control of pests are implemented through the National Heritage Trust, including the National Weed Strategy and the National Feral Animal Control Strategy. The Victorian Weeds Strategy (NRE 1998f) builds on the National Weeds Strategy and also takes account of recommendations in the Victorian parliamentary inquiry 'Report on Weeds in Victoria' (ENRC 1998). The Victorian strategy sets out a range of actions that will establish a cost-effective long-term approach to weed management in Victoria.

A number of State-funded programs including the 'Weed Initiative' and the 'Good Neighbour' and 'Rabbit Busters' programs are run in conjunction with the National Heritage Trust. These projects, on public and private land, reflect priorities established in Regional Catchment Strategies. The Good Neighbour Program allocates resources towards weed and pest animal control programs on both private and public land. In 1997-98, expenditure of \$331 000 funded by the Good Neighbour program targeted pest species such as blackberry, ragwort, and feral dogs and foxes on public land in Gippsland.

3.5 FOREST RESEARCH

Much research has been undertaken in the forests of Gippsland and Victoria. The Compendium of Forest Research in Victoria (BRS 1998b) contains an annotated bibliography of research and other scientific literature, and a synopsis of research in progress. The compendium addresses forest research relating to sustainability indicators, silviculture, forest hydrology, fire effects studies, forest flora and fauna, soils and nutrition, plantation establishment and management, pests and plant diseases, forest entomology and tree breeding genetic development and seed supply. The Compendium is available on request.

3.6 MONITORING AND REVIEW

The Department of Natural Resources and Environment has a number of procedures established to monitor and review implementation of the plans and policies described in this chapter. These processes are considered further in the Statewide ESFM report (VicRFASC 1997a). Review of Codes and management plans are required every ten years, public participation is required in planning processes, and procedures are monitored and independently audited. These reviews provide the basis for adaptation of plans, ensuring they remain relevant.

Regular audits of harvesting operations on State forest are also undertaken to review the implementation of the Code of Forest Practices for Timber Production. Independent auditors from within NRE compare operations to the requirements of codes and prescriptions. These

auditors are actively involved in the day-to-day implementation of the Code but generally work outside the FMA being audited.

In the East Gippsland RFA, Victoria committed to publish future reports of internal audits of compliance with the Code of Forest Practices for Timber Production (NRE 1996a). The 1996-97 and 1997-98 (NRE 1997c, NRE 1998c) Statewide Code audit results have been published. In the Gippsland region, Tambo FMA was audited in 1996-97.

4. MANAGING FOR TIMBER PRODUCTION

This chapter describes and evaluates the past, present and future arrangements used by the Department of Natural Resources and Environment (NRE) for inventory, data handling and yield forecasting for sawlogs and residual logs in the Gippsland region.

4.1 FOREST TYPE, EXTENT AND MERCHANTABILITY

The classification and description of forest types for commercial purposes is based on the predominant commercial species, and the quality and quantity that will provide sawlog material. Subject to a number of constraints, including tenure and zoning, forests in Gippsland are considered to be commercial if potential stand height exceeds 28 m.

For timber production purposes, the commercial forests of the Gippsland region have been classified into four forest types:

- Ash;
- Mountain mixed species;
- Foothill mixed species and Coastal mixed species; and
- Alpine mixed species.

Depending on quality, these types are further sub-divided on the basis of average mature height e.g. Mountain mixed species 1 is > 40 m. and Mountain mixed species 2 is 28-40 m.

The Ash forest type consists of Alpine Ash (*Eucalyptus delegatensis*), Mountain Ash (*E. regnans*) and Shining Gum (*E. nitens*). The Mountain mixed species forest that occupies higher elevation slopes is generally regarded as the high quality mixed species forest (high elevation mixed species or HEMS) and includes the species: Messmate (*E. obliqua*), Mountain Grey Gum (*E. cypellocarpa*), Brown Stringybark (*E. baxteri*) and Manna Gum (*E. viminalis*). The Foothill and Coastal mixed species forests are generally of lower quality for sawlog production and generally occur on the lower slopes of the ranges. They can include Messmate, Silvertop (*E. sieberi*), Yellow Stringybark (*E. muellerana*), White Stringybark (*E. globoidea*), Red Stringybark (*E. macrorhyncha*) and Yertchuk (*E. considiniana*) as characteristic species. Alpine mixed species forest is generally of the lowest quality and consists of species such as Mountain Gum (*E. dalrympleana*), Broad-leaved Peppermint (*E. dives*), and Snow Gum (*E. pauciflora*). Durable species are also present (see chapter 7) but are not included in the sustainable sawlog yield.

Forests are also classified by age or maturity:

- Regrowth — 0-60 years of age;
- Advanced regrowth — 61-80 years;
- Mature (M) — greater than 80 years; and
- Overmature (OM) — greater than 120 years, with evidence of senescing crowns.

In accordance with recommendations of the LCC (LCC 1994) no pre-1900 ash type forest is harvested in the Central Gippsland FMA. Harvesting is therefore confined to ash forest regenerated since 1900, and the mixed species forest types.

Map 5 describes the spatial location and extent of the commercial forest types in the Gippsland region.

The net productive area for commercial forest types in the Gippsland region (Table 4.1) is based on information in the NRE Hardwood Area Resource Information System (HARIS) database. The latest updates to HARIS range from the mid 1980s in Tambo FMA to the early

1990s in Central Gippsland FMA. Net productive area will be updated on completion of the Statewide Forest Resource Inventory (SFRI) in the Gippsland region.

HARIS provides a standing volume for sawlog and residual roundwood for the Mature and Overmature (M/OM) forests. Age classes in HARIS for the Gippsland region are:

- Pre-1900 (Mature and Over-Mature, or M/OM); and
- Decades after 1900 to 1991 (Regrowth and Mature).

Table 4.1: Net Productive Area (ha) for Commercial Forest Types in the Gippsland Region

Forest Type	Central Gippsland FMA (in Gippsland RFA)			Tambo FMA			Wodonga FMA (in Gippsland RFA)			TOTAL
	M/OM	Re-growth	Un-stocked	M/OM	Re-growth	Un-stocked	M/O M	Re-growth	Un-stocked	
Alpine Ash	460	21 810		7 380	11 200		6 350	2 210		49 410
Mountain Ash & Shining Gum	460	3 850	2 670	1 290	2 260					10 530
Mountain Mixed Species	3 100	2 490	650	33 120	3 560		220			43 140
Foothill Mixed Species	33 490	23 810		43 000	3 660					103 960
Coastal Mixed Species				17 450	1 270					18 720
Alpine Mixed Species				11 650			16 400			28 050
TOTAL	37 510	51 960	3 320	113 890	21 950		22 970	2 210		253 810

Source: DNRE Hardwood Area Resource Information System as at 1995

Current estimates of net area of M/OM and regrowth forests for all three FMAs have been derived from HARIS. Estimates of standing volumes of M/OM ash and mixed species for Tambo and Wodonga FMAs have also been obtained from HARIS. Estimates of standing volumes in Central Gippsland FMA have been determined using growth and yield information derived from detailed resource assessments, which were carried out in the late 1980s.

The HARIS database has previously been described and appraised by the University of Melbourne, for the East Gippsland CRA Report (VicRFASC 1996c).

SFRI data will update and improve spatial information and estimates of standing volume for forest stands in Gippsland. New inventory design and reporting standards will, however, make direct comparison with HARIS data difficult. In general, previous inventories collected resource data using classical inventory techniques and applied prevailing sawlog and pulpwood standards. This meant that volume estimates could not be readily recalculated when forest product standards changed or new products were developed. The SFRI will provide strategic level forest resource estimates independent of forest product standards. It is discussed in more detail in Sections 4.3 and 4.5.

It should be noted that the Gippsland RFA region does not correspond exactly to the boundaries of the Central Gippsland, Tambo and Wodonga FMAs. The region includes all of the Tambo FMA and parts of the Central Gippsland (76 per cent) and Wodonga (17 per cent) FMAs. However, legislation requires that sustainable yield figures be provided on an FMA basis.

Log Classification

Sawlogs are graded according to their quality, and sometimes by their species. The actual grading is regulated by sawlog grading instructions, and a grade from A (highest quality) to D (lowest quality) is assigned to all sawlogs. When discussing sawlog allocations, it is usual to refer to a minimum allocation grade, such as C+ or D+. The term C+ denotes C grade and better sawlogs, whilst D+ denotes D grade or better - in effect all sawlogs are D+. The basis for licence allocations and yield predictions was changed in 1996 from C+ sawlogs to D+ sawlogs to align the standards used for licensed sawlog allocations with the legislation governing sustainable yield. Logs not meeting the D grade requirements are termed residual logs. Specifications for sawlog and residual logs are given in Appendix 3.

Timber Resource

The most productive forests in Gippsland are the Ash type forests occupying 60 000 ha (24 per cent) of the total net productive area for the FMAs in the region. Due to their relatively young age and small tree size, the regrowth Ash resource in Wodonga and Tambo FMAs does not currently contribute a major percentage of the region's timber supply. In addition, the majority of the Ash resource in Central Gippsland FMA is concentrated in the Central Highlands part of the FMA. As a result, very little harvesting currently occurs in the regrowth Ash resource in the Gippsland RFA region except for fire salvage in Carey State Forest during 1998-99.

The mixed species forests in Gippsland are also important for timber production and occupy 193 900 ha (76 per cent) of the net productive area.

In 1997-98, approximately 111 000 m³ of D+ sawlog net of defect was harvested in the area covered by the Gippsland RFA. Of this, some 56 000 m³/year (51 per cent) was derived from ash type forests while the remaining 55 000 m³/year (49 per cent) was derived from mixed species forests.

Data pertaining to Ash type forests in Gippsland were derived from regional assessments and various Forest Inventory Reports. A number of Ash and plantation assessments were carried out in the Heyfield and Yarram districts of Central Gippsland FMA in the 1950s and 1960s. More recent Ash assessments were carried out in the Gippsland region in the 1980s (FCV 1981; FCV 1984). Data relating to mixed species forests types are not as reliable as data for the ash resource because the mixed species forests has not been surveyed as thoroughly. An assessment of mixed species was carried out in the Mullungdung State Forest in Central Gippsland FMA in 1989.

Growth rates used in the forecast of sustainable yield are usually derived from successive measurements of forest plots in representative forest types. Rates used for the Gippsland RFA region are in Table 4.4.

Potential errors resulting from using these growth rates to forecast sustainable yield should be relatively small, given the low growth rates applied. The Statewide Forest Resource Inventory (SFRI) project, described later in this chapter, will result in a marked improvement in estimates of net productive area and estimates of growth and yield.

Regrowth

Regrowth forest accounts for 41 300 ha (69 per cent) of the net productive area in Ash, and 34 800 ha (18 per cent) of the net productive area of the mixed species forests in the region. The regrowth Ash forests will provide the greater part of the future timber volume due to its higher growth rates and higher proportion of high quality sawlog. Data for regrowth volumes and growth rates are very important, as these will determine the future availability of sawlog for industry. SFRI will provide improved information on these aspects of the regrowth resource.

Residual Log

Victorian Government policy for native forest timber production is geared towards sawlog production and value adding. The Timber Industry Strategy (Victoria Government 1986) sets the context for Departmental policy regarding the production of residual logs. Residual logs are either too small or too defective to meet current sawlog specifications, but may be salvaged mainly for non-sawlog end-uses such as firewood, craftwood or wood-fibre products. Residual logs are produced as a by-product of harvesting for sawlogs, or from silvicultural activities such as thinning or overwood removal which are designed to enhance future sawlog production.

Currently, about 73 000 m³ gross of residual logs generated from harvesting activities in the Gippsland region each year are sold into residual log markets. Residual logs are a by-product of normal sawlog harvesting operations. Improved estimates of residual log availability will be produced when the sustainable yield for sawlog is reviewed using new data from the Statewide Forest Resource Inventory.

4.2 LEGISLATIVE, POLICY AND PLANNING FRAMEWORK FOR SUSTAINABLE YIELD

Sustainable yield, as the term applies in Victoria, is the annual rate of hardwood sawlog production that can be achieved from the forest, taking into account the structure and condition of the forest, without impairing the long-term productivity of the land.

Sustainable yield is forecast on the basis of sawlog production, as timber harvesting in Victoria is sawlog-driven with residual logs produced as a by-product of sawlog operations. The availability of residual logs is therefore determined by the rate of sustainable production of sawlogs. Nevertheless, as part of the management strategy to supply sawlogs, commitments can be made to supply regular levels of residual logs so that silvicultural regimes can be implemented and waste is minimised.

The *Forests Act 1958* (as amended in 1990) defines the legislative requirements for the determination of sustainable yield for sawlogs and the relationship with hardwood supply levels, i.e. the volume of sawlogs made available to industry. The Act specifies that the total hardwood supply level in a Forest Management Area (FMA) must be within a permitted margin (2 per cent) of the sustainable yield rate for that area over a 15 year Timber Supply Period. The short-term (annual) hardwood sawlog supply level is more flexible. In determining the short-term supply level, the factors which are considered include the long-term sawlog supply level; planning and socio-economic factors; bushfire and other natural disasters; and agreements or decisions by the Commonwealth (*Forests Act 1958*, Sections 52A and 52B).

The *Forests Act 1958* also specifies that the sustainable yield rates for the harvesting of hardwood sawlogs are to be reviewed in each five-year period from 1 July 1991 to determine whether they are still appropriate. The Minister is required to review sustainable yield as soon as possible outside the specified five yearly timetable if 'the Minister considers that there has been a significant variation in the hardwood sawlog resources in any State forest available to

be exploited commercially'. The Minister may also review sustainable yield at any time 'if he or she thinks it is appropriate to do so'. On completion of the review, the Minister may 'decide that sustainable yield rates should remain unchanged; or recommend to the Governor in Council new sustainable yield rates for all or any of the forest management areas' (*Forests Act 1958*), given significant changes in the available sawlog resource, for all or any of the State's 15 designated Forest Management Areas.

The major objectives associated with the forecast of sustainable yield are to:

- provide a non-declining supply of grade D+ sawlogs;
- provide the highest yield available (on a sustainable basis) at any given point in time; and
- eventually achieve a balanced age class distribution throughout the forest and approach the maximum potential productivity of the forest (the long-term sustained yield) (NRE 1997e).

For each forest type, the forecast of sustainable yield requires data for:

- net productive area of mature/overmature forest;
- standing volume of grade D+ sawlogs for the mature/overmature forest;
- net productive area of regrowth forest;
- age (year of origin) of the regrowth and an average minimum harvesting age;
- growth rates, or Mean Annual Increment (MAI), of regrowth forest; and
- allowances for known risks (for example wildfire) or other factors.

From the available data, sustainable yield is forecast using an integrated process that considers wood production in the context of other forest values.

4.3 SUSTAINABLE YIELD IN GIPPSLAND

The current legislated sustainable yields for the Central Gippsland, Tambo and Wodonga FMAs are shown in Table 4.2.

Table 4.2: 1996 Legislated Sustainable Yields of Sawlogs (m³/year)

Forest Management Area	Volume (D+ m ³ /year)
Central Gippsland FMA	225 000
Tambo FMA	66 000
Wodonga FMA	28 000
Total	319 000

Source: NRE 1997e (or *Forests Act 1958*, Third Schedule)

As previously noted, 76 per cent of the Central Gippsland FMA and 17 per cent of the Wodonga FMA occurs within the Gippsland region. Legislation requires that sustainable yield figures be provided on an FMA basis.

Historical Development of Sustainable Yield Forecasts

The following discussion outlines the major factors that have influenced the development of the sustainable yield forecasts that apply to the Forest Management Areas (FMAs) within the Gippsland region.

Prior to the sustainable yield forecasting approach, initiated by the Timber Industry Inquiry, the area available for timber harvesting was reduced as a result of Government decisions to expand the area of parks and reserves in Gippsland, including recommendations relating to the establishment of the Alpine National Park.

1984-85 Board of Inquiry into the Timber Industry in Victoria

The Timber Industry Inquiry (Ferguson 1985) established by the Victorian Government, was required to investigate and report on all aspects of the timber industry in Victoria. Sustainable yields were forecast for forest districts and groupings of forest districts. The departmental (Forests Commission) Hardwood Resources Information System (HARIS) database was updated across the state for the Inquiry.

Forecasts were determined using manual spreadsheet techniques and data extracted from the HARIS database. These forecasts were based on conservative assumptions and the prevailing management strategies and included a conservative approach to land use allocations that sought to allow for a number of environmental issues that had not been formally addressed prior to the Inquiry. As a result, a 25 per cent reduction was applied to the forecast figure to account for the unquantified potential loss in available area and volume associated with protection of arboreal mammal habitats, rainforest and sites of high recreation and landscape value. The forecasts were submitted to the Inquiry and the Chairman, Professor Ian Ferguson, concluded at the time that the forecasts were adequate but recommended that more advanced planning methods and forecasting be used in future (Ferguson 1985).

Since the Timber Industry Inquiry, various factors have resulted in changes to timber resource availability in the region. The following account summarises these changes and their implications for sustainable yield forecasts.

1986 Timber Industry Strategy

The Timber Industry Strategy (TIS) (Victoria Government 1986), resulting from the Timber Industry Inquiry, established the basis for the application of regional sustainable yield to the harvesting of sawlogs from State forest in Victoria. The regions established for this purpose are called Forest Management Areas (FMA) and are based on areas of native forest supplying sawlogs, the location of major conversion centres and consolidation of supply commitments to individual sawmills.

In addition to defining FMAs, the Timber Industry Strategy established the processes and methodology for forecasting sustainable yield. Sustainable sawlog yield rates for each FMA were determined from available resource and growth data, management plans and existing sawlog utilisation standards. Forecast estimates in the TIS were made to 2014-15.

On the basis of the available information and the net productive area of State forest, it was expected that as the Ash resource matured in the Central Gippsland FMA, sustainable levels of hardwood supply would increase. Assuming no other changes, such as land tenure, sustainable yields were estimated to increase from the 1985 levels by 14 per cent for the Central Gippsland FMA (Victoria Government 1986). Similarly, as the resource matured in Tambo and Wodonga FMAs, it was expected that sustainable levels of hardwood supply would increase, again assuming no changes to land tenure. Growth rates used to estimate the forecast increase in yields are given below (Table 4.4).

1988 Uniform Log Grading Rules

Statewide sawlog grading standards were introduced in 1988. Four grades of sawlog were established, based on the relative quality of logs for sawmilling. These grades (A, B, C and D) were applied to all native hardwood species except the durable species including Red Gum, Box and Ironbark.

The lowest grade (grade D) sets the minimum standard for sawlogs from non-durable species across the State.

The new grades replaced local sawlog standards, which varied considerably across the State, and between forests of differing age and type. The significance of this change was that, in some parts of the State, more timber was defined as sawlog. In Gippsland, sawlogs equated to grades A, B and C (C+). The new grading effectively represented the formalisation of a classification of sawlog that was previously purchased outside of the C+ allocation arrangements. Given that this was essentially an administrative amendment, this change did not affect the sustainable yield forecast from Gippsland for C+ sawlogs.

1989 Long-term Licences

Long-term (15-year) licences were first issued in 1989 to provide the timber industry with a secure supply of resource, and to encourage investment in value adding. The licences that were subsequently issued generally specified grade D and better (D+) sawlogs. Only a limited number of purchasers who were already adding value to a substantial proportion of their output were issued with licences for grade C and better (C+) sawlogs.

The long-term licences were set in accordance with the sustainable yield forecasts for the Tambo and Wodonga FMAs. Licences for the Central Gippsland FMA however were set at approximately 66 per cent of the estimated sustainable yield forecast in recognition of the level of uncertainty of data for standing timber volumes and growth rates in mixed species forests. This reduction was in addition to the 25 per cent reduction factor applied to the net available area for all FMAs in forecasting the yield estimate in 1985.

A number of licences in the Wodonga FMA were due for renewal in 1996-97. Five three-year licences have been issued based on their current annual licence allocations in the interim until improved resource information from the SFRI is available. In Central Gippsland and Tambo FMAs, negotiations on the renewal of licences will commence from 1998-99.

Code of Forest Practices for Timber Production

The Code which was first produced in 1989 (CFL 1989) based on wide ranging scientific research and forest management experience, integrated a large number of regional harvesting and regeneration prescriptions into a single Statewide document. It was adopted by the Victorian Parliament in 1989, and subsequently reviewed independently by the CSIRO in 1995 (CNR 1995a). A revision of the Code following the CSIRO review in 1996 was adopted by the Victorian Parliament in early 1997. Given that regional prescriptions were already in place, the introduction of the Code had a minimal impact on resource availability in the Gippsland region.

1990 Sustainable Yield Legislation

In 1990, as part of the implementation of the Timber Industry Strategy (TIS), the *Forests Act 1958* was amended to provide for a legislated sustainable yield rate for each FMA.

The 1990 legislation adopted the sustainable yield rates for Central Gippsland, Tambo and Wodonga FMAs shown in Table 4.3. The legislated sustainable yield rates were determined following TIS using updated HARIS databases.

Table 4.3: 1990 Legislated Sustainable Yields of Sawlogs (m³/year)

Forest Management Area	Volume (C+ m³/year)
Central Gippsland FMA	183 000
Tambo FMA	54 000
Wodonga FMA	23 000
Total	260 000

Source: Forests (Timber Harvesting) Act 1990

Sustainable yield rates are specified in the Third Schedule of the *Forests Act 1958* and are periodically reviewed as required by legislation.

The sustainable yield rates for Central Gippsland and Tambo FMAs were reviewed in 1992 when additional resource information became available. Pearson and Featherston (1992) and Pearson and McCormack (1992) describe the data and methodology used to forecast the sustainable yield rate in Central Gippsland and Tambo FMAs respectively. These studies confirmed the rates adopted in 1990 legislation. Table 4.4 shows the growth rates used to determine sustainable yield in the three FMAs.

Table 4.4: C+ net MAI, by Forest Management Area (m³/ha/year)

Forest Type	Central Gippsland FMA	Tambo FMA	Wodonga FMA
Alpine Ash	2.26	2.00	2.5
Mountain Ash and Shining Gum	3.26	2.00	
Mountain Mixed Species	1.41	1.75	1.0
Foothill Mixed Species	1.15	1.20	1.0
Alpine Mixed Species		1.00	
Coastal Mixed Species		0.50	

1991 Land Conservation Council (LCC) Rivers and Streams Special Investigation and LCC Wilderness Special Investigation

Following the final recommendations of the Land Conservation Council (LCC) Statewide investigation of Rivers and Streams, three Heritage Rivers and six Natural Catchments Areas were designated in the Gippsland region. For these areas, the LCC estimated the reduction to the sustainable yield forecast up to the year 2000-1 would be less than 0.1 per cent for the Tambo FMA and negligible in the other FMAs (LCC 1991a).

The final recommendations for the LCC Statewide investigation of wilderness were published in 1991 (LCC 1991b). In the Gippsland region, all of the Wilderness Areas and 'Other Areas with Remote and Natural Attributes' (Remote and Natural Areas) were in existing National Parks with the exception of part of the Wongungarra catchment. The LCC identified that the Remote and Natural Area in the Wongungarra catchment had only a minor impact on timber supplies.

1993 Transfer of Strzelecki Ranges Hardwood Plantations to the Victorian Plantations Corporation

Following the formation of the Victorian Plantations Corporation (VPC) in 1993, some 10 700 ha of hardwood plantations across the State, including 7416 ha in the Strzelecki Ranges (principally 20-30 year old Mountain Ash), were transferred to the Corporation. The Strzelecki hardwood plantations accounted for approximately 10 per cent of the sustainable yield in Central Gippsland FMA and, prior to this decision, were to be available for sawlog harvesting, and contribute to the sustainable yield from about 2020.

Given that the forecast sustainable yield in the Central Gippsland FMA was estimated to increase by approximately 14 per cent, it was considered that the estimated 10 per cent loss could be offset and therefore a change to the legislated sustainable yield rate was not warranted.

1994 Land Conservation Council Melbourne Area District 2 Review

Acceptance by the Victorian Government of the Land Conservation Council (LCC 1994) recommendations for additions to National Parks in the review resulted in a reduction of 87 ha of net productive area in Central Gippsland FMA, and the prohibition of logging in all stands of pre-1900 Ash forest. The impact of the recommendations was estimated to be a reduction of less than 1 per cent in the Central Gippsland FMA. This reduction is well within the estimated increases in sustainable yield in the Timber Industry Strategy (Victoria Government 1986).

The Council recommended that any change to sustainable yield rates should not be made until after 2001, at which time the estimated reduction could be offset by predicted increases associated with the maturing ash resource.

1994-95 Statewide Forest Resources Inventory (SFRI)

The Statewide Forest Resources Inventory (SFRI) commenced in Victoria in 1994-95 (NRE 1997e). The SFRI will map around 3.5 million ha of State forest, with sampling of productive regrowth, mature and over-mature forests to determine the standing volume of D+ sawlog. The program will also provide the necessary base data to enable development of new growth models for a significant number of forest types, thereby enhancing the capacity to forecast future timber yields from both M/OM and regrowth stands. Specifically the new inventory will:

- update the State's timber resource data, replacing data collected primarily in the 1960s, 1970s and 1980s;
- be the State's first complete forest resource inventory based on a single inventory design and standard;
- enable new growth and yield models to be developed for many of the State's native forests;
- enable resource estimates to be made to a uniform standard of utilisation;
- have the capacity to adjust to new utilisation standards; and
- provide a basis for resource estimates, sustainable yield forecasts and management planning well into the next century.

1996 Statewide Review of Sustainable Yield

The *Forests Act 1958* requires the Minister to review all sustainable yield rates every five years. This follows an amendment to the Act in 1990 and the relevant provisions commenced in 1991. The first review was conducted in 1996.

At the time of the Statewide review, the SFRI project had commenced in Gippsland, but data were not available to update existing information. In addition, with a number of planning processes then underway, including the development of the Proposed Central Highlands Forest Management Plan and the Central Highlands RFA about to commence, it was decided that a full reconciliation of the changes for the Central Gippsland FMA would occur prior to the next sustainable yield review, due in 2001. Improved timber resource information derived from the SFRI program will also be available at this time.

Given the conservative nature of the original forecasts and magnitude of the subsequent changes, it was considered that the changes made in Central Gippsland FMA since 1985, including the impact of removing the Strzelecki Ranges hardwood plantations from the available resource, could be accommodated without changing the sustainable yield rate.

As the resource data, growth data and areas defined as suitable and available for timber production for Tambo and Wodonga FMAs were not significantly different from those used

to establish the sustainable yield rates in 1990, it was considered appropriate that reviews be completed when updated information (SFRI) became available.

One change made for all FMAs as part of the 1996 sustainable yield review was the conversion of sustainable yield rates from C+ to D+ log grade, based on the proportion of each sawlog grade sold in the 1995-96 financial year for each FMA. A log grade audit, conducted in 1996, was used to adjust these figures. This was judged to be the most robust and transparent method of conversion, in the absence of new resource information. The 1996 sustainable yield rates for D+ sawlogs are given in Table 4.2.

4.4 APPRAISAL OF SUSTAINABLE YIELD METHODOLOGY

The Timber Industry Inquiry established the need for improved estimates of sustainable yield (Ferguson 1985) and this is being implemented through the Timber Industry Strategy which established Forest Management Areas and an improved process and methodology for forecasting sustainable yield. As a result, the sustainable yield rates in the Gippsland region have been based on the Timber Industry Strategy and subsequent new resource estimates.

As outlined in Section 4.5, the Sustainable Yield Spreadsheet (SYSS) methodology for forecasting sustainable yield has been externally reviewed and accredited through the CRA/RFA process, and the HARIS data collection process was reviewed for the East Gippsland RFA and was considered adequate. The review suggested improvements to the methodology and these have been addressed through the provision of SFRI data and implementation of the Integrated Forest Planning System (VicRFASC 1996c).

The availability of the SFRI data and use of the Integrated Forest Planning System (IFPS) will enable improved forecast estimates to be made in the development of the Mid-Gippsland Forest Management Plan. The IFPS methodology was reviewed and approved by an external consultant.

Confidence in the sustainable yield forecasts can be enhanced through formal documentation of the methodology used to determine resource availability for the preparation of the Forest Management Plans, including stated assumptions, and exposure to risk using sensitivity analysis, as well as formal documentation of actual versus predicted yields.

4.5 STRATEGIC FORECAST OF SUSTAINABLE SAWLOG YIELD

Strategic forecasts of sustainable yield for FMAs in the Gippsland region will be based on forest management plans, Statewide Forest Resource Inventory (SFRI) and Integrated Forest Planning System (IFPS), as outlined below.

Forest Management Planning

The TIS identified the need for a comprehensive forest management planning process to develop plans for each FMA in Victoria. The plans provide for sustainable timber production, plus the protection of environmental values in State forests, and incorporate input from the community. Each plan includes a management strategy and a zoning scheme that defines areas that are to be managed to meet particular objectives, including timber and a range of biodiversity and other forest values. The zoning scheme will therefore allow for the requirements of sustainable yield under the *Forests Act 1958*. The proposed Gippsland Forest Management Plan, covering State forest in the Gippsland RFA region, will be released during 1999.

During development of the zoning scheme in the proposed plan, analysis of the impact of the plan on timber resource availability will be carried out. The analysis will be based on the net productive area as provided by SFRI and availability as defined by the forest management zones. Revised growth and yield estimates derived from SFRI analyses will also be used.

The general reduction factor applied to earlier estimates will not be applied as available areas are quantified as part of the process of developing forest management zones.

Management guidelines developed as part of the Forest Management Plan will determine the availability of the resource, through definition of forest management zones, and establishment of guidelines for the timing of timber harvesting.

The analysis of implications of the proposed plan on sustainable yield will be carried out using the SYSS module of the Integrated Forest Planning System (IFPS). Following publication of the final plan, a formal review of sustainable yield will be made using the full version of the IFPS.

Future forecasts of sustainable yield for the Tambo, Central Gippsland and Wodonga FMAs will incorporate zoning from the Gippsland, Central Highlands and North East Forest Management Plans to allow reporting on an FMA basis.

Statewide Forest Resource Inventory (SFRI)

The forecast of sustainable yield, to be prepared following the release of the Gippsland Forest Management Plan, will be based on new inventory data provided from the Statewide Forest Resource Inventory. The SFRI will update and improve spatial information and estimates of standing volume and revised growth and yield models for ash and mixed species stands. Information will be spatially referenced and stored in a GIS database.

An estimate of net productive area, which is the area of forest capable of producing merchantable timber, will be produced by the SFRI. The net available productive area is the actual area from which sawlogs can be harvested under current management prescriptions as defined by the Code of Forest Practices (NRE 1996a). This area excludes productive forest located in streamside buffers and on steep slopes. Areas which are deemed to be unmerchantable due to accessibility constraints, are also excluded.

Integrated Forest Planning System (IFPS)

The analysis methodology applied to sustainable yield forecasts has progressed from a manual spreadsheet approach through various stages of computerised spreadsheets known as the Sustainable Yield Spreadsheet (SYSS). SYSS is one component of the Integrated Forest Planning System. It is used to test management strategies using aggregated data. Other components of the IFPS include GIS, growth and yield, optimisation and monitoring modules (Lau *et al.* 1996). Specifically, the IFPS interactively links Arc/Info, FORPLAN/SPECTRUM, Lindo, SIR DBMS (Scientific Information Retrieval Data Base Management System), ERMapper, and an array of smaller components.

The concept behind the integration of such a diverse array of tools is to create a link between the forecast of sustainable timber flow and spatially locating the timber contributing to this flow.

The IFPS offers forest planners a structured, well-organised approach to forest management issues. It provides scientifically based estimates of the sustainable yield of forest resources and a means for monitoring change in the forest. It also enables alternatives to be considered and answers 'What if?' questions related to management options. This enables the objectives of ecologically sustainable forest management to be met.

IFPS models are run many times with different constraints to investigate alternative strategies and to determine the impact that forestry activities will have in both the short and long term.

The IFPS attempts to find an optimal solution, within the constraints imposed, which achieves a balance between the social, economic and environmental aspects of forest use.

The ability to visualise results spatially, in context with maps and remotely sensed data, allows feasibility testing to be conducted. This important process may significantly alter the final forecast of the sustainable yield. However, it usually results in a modified set of prescriptions. Testing options continues in an iterative manner until feasible results are achieved.

The Midlands sustainable yield review (CNR 1995e) is an example of the use of the IFPS to incorporate detailed harvesting prescriptions for specific areas.

Monitoring

NRE is currently undertaking a comparison of the area and volume predicted to be harvested, the actual area and volume harvested, and the licensed volumes for each FMA for the period 1991-92 to 1995-96. This will form part of the ongoing reconciliation of sustainable yield with licensed sawlog levels as required in the Forests Act.

Review of SFRI and IFPS

As part of an external review of the SFRI, both inventory and yield data collection and analysis techniques were seen to be effective and useful methodologies that should result in statistically valid and unbiased estimates of volume and yield appropriate for strategic level planning (Brack and Turner 1996). Brack and Turner also identified the need for sensitivity and jackknife analyses to estimate the effects of SFRI sub-models on the overall reliability of the model estimates.

In the absence of growth data from permanent plots, it is proposed to use stem analysis to develop growth and yield models. This process was considered to be sound by the consultants, and will be used to develop appropriate models.

The HARIS data collection process was reviewed in the CRA/RFA for the East Gippsland FMA, and was considered adequate (VicRFASC 1996c). The SYSS methodology has been externally reviewed and accredited through the CRA/RFA process (VicRFASC 1996c).

The IFPS methodology was reviewed and approved by an external consultant, Brian Turner (CNR 1995e) for its application in the Midlands FMA. The use of this methodology in conjunction with high quality GIS-based inventory data was considered to be consistent with best international practices.

5. TIMBER INDUSTRY

5.1 CURRENT POSITION AND OUTLOOK

State Forest Log Production and Value

In 1997-98, the Gippsland region State forests produced 126 575 cubic metres of sawlog, and 73 511 cubic metres of residual log. The region accounted for 14.4 per cent of total State sawlog production and 6.6 per cent of total State residual log production in 1997-98 (Table 5.1).

The Gippsland region contributed around \$4.2 million in log revenue in 1997-98 (including royalties, Timber Promotion Council component and roading charges) or about 10.7 per cent of total State forest log revenue received in that year. In 1997-98, total sawlog revenue received from the region were approximately \$3.8 million, while total residual log royalties were approximately \$0.4 million. In addition to log revenue, sawmill licence fees for the Gippsland region were around \$0.4 million.

Similar to adjacent regions, the native ash forests of the Gippsland region have a high commercial value. This is due to relatively rapid rates of growth and the characteristic long straight bole of ash trees making them highly suitable for milling into appearance grade sawn timber products. Although the ash forests in the Gippsland region (comprising alpine ash and mountain ash species) account for a relatively small proportion of the total productive forest area in the region (24 per cent), they provide the largest proportion of higher grade logs in the region, and include the largest productive area of alpine ash forest in Victoria.

Residual logs sourced from ash forests are also regarded as a cost-effective input into the manufacture of pulp and paper products because of the low quantity of black tannins produced during the paper manufacturing process. This factor makes ash trees less costly to process than other pulpwood species, such as the mixed hardwood species, which contain higher quantities of black tannins. The cost of log transport is an important factor to be taken into account by pulp producers in determining where they source their pulpwood.

The Gippsland region represents a sizeable source of ash logs for the domestic sawmilling and pulp and paper based industries, accounting for approximately nine per cent of total ash type logs produced from Victorian State forests in 1997-98 and approximately half of sawlogs produced in the Gippsland region. The region produced 61 879 cubic metres of ash sawlogs in 1997-98, with a total log revenue of approximately \$2.3 million, and 40 410 cubic metres of ash type residual log in 1997-98, with a total log revenue of around \$260 000.

The Gippsland region produced 64 696 cubic metres of mixed species hardwood sawlog in 1997-98 which had a total log revenue of \$1.5 million. Over the same period, around 33101 cubic metres of mixed species hardwood residual log, with a total log revenue of around \$179 000, was extracted from the region. The Gippsland region accounted for 10.4 per cent of Victoria's total mixed species log production in 1997-98, with 7.6 per cent being lower value residual logs. Around 10.5 per cent of the log revenue received in Victoria for mixed species logs are from the Gippsland region.

Table 5.1: Gross Volume of Logs Harvested from Gippsland Region, 1997-98^a (cubic metres)

Mixed species								
Log grade ^b	A	B	C	D	D+	R	Other	Total
Central Gippsland	0	149	1 128	1 422	2 699	7 560	0	10 259
Tambo	95	4 691	42 159	12 343	59 288	25 539	79	84 906
Wodonga	0	202	1 345	1 162	2 709	2	0	2 711
Gippsland	95	5 042	44 632	14 927	64 696	33 101	79	97 876
Total Victoria	657	34 792	333 312	111 597	480 358	432 117	26 417	938 892
Gippsland ^c (%)	14.5	14.5	13.4	13.4	13.6	7.7	0.3	10.4

Ash species								
Log grade ^b	A	B	C	D	D+	R	Other	Total
Central Gippsland	70	8 985	4 820	363	14 238	37 075	0	51 313
Tambo	1 030	7 702	17 264	5 255	31 251	2 892	0	34 143
Wodonga	245	3 660	10 148	2 337	16 390	443	0	16 833
Gippsland	1 345	20 347	32 232	7 955	61 879	40 410	0	102 289
Total Victoria	3 759	150 319	192 040	53 452	399 570	686 214	0	1 085 784
Gippsland ^c (%)	35.8	13.5	16.8	14.9	15.5	5.9	0	9.4

Total ash and mixed species								
Log grade ^b	A	B	C	D	D+	R	Other	Total
Central Gippsland	70	9 134	5 948	1 785	16 937	44 635	0	61 572
Tambo	1 125	12 393	59 423	17 598	90 539	28 431	79	119 049
Wodonga	245	3 862	11 493	3 499	19 099	445	0	19 544
Gippsland	1 440	25 389	76 864	22 882	126 575	73 511	79	200 165
Total Victoria	4 416	185 111	525 352	165 049	879 928	1 118 331	26 417	2 240 676
Gippsland ^c (%)	32.6	13.7	14.6	13.9	14.4	6.6	0.3	8.9

^a The Gippsland region includes all State forest areas in the Tambo FMA, 76% of the Central Gippsland FMA and 17% of the Wodonga FMA. The totals presented here are the sum of the log volumes for the Tambo FMA and the portions of the Central Gippsland and Wodonga FMAs that lie within the Gippsland region. ^b Log grades A to D represent sawlogs of diminishing log quality respectively. Log grade D+ is the sum of grades A to D. Log grade R represents residual or pulplog. Other grades are ungraded sawlogs. ^c Gippsland share of Victorian total. *Source*: NRE records.

Log Pricing and Allocation Arrangements

Hardwood sawlogs harvested in the Gippsland region are classified according to their size and quality (potential for processing beyond the green sawntimber stage) and sometimes by their species using a system of log grades in diminishing order of sawlog quality from A through to D. Red Gum, Box and Ironbark species are termed durable species and are not graded from A to D. Presently, B and C grade sawlogs account for the bulk of ash species sawlogs produced from the Gippsland region, whereas C and D grade sawlogs account for the bulk of the mixed species sawlogs (Table 5.1). Logs that do not make the D sawlog classification are called residual logs. These are generally logs which are either too small or too defective to meet current sawlog specifications, but which may be utilised to produce other wood products.

Royalty rates are determined using the 'royalty equation system'. In principle, royalty rates are set so that the sum of royalty rates and the transport costs involved in sending a base grade of sawn timber to a defined key market will be the same for all operations accessible to that market. There may be adjustments to account for variations in timber quality from the base grade, provision of access roads, or other factors. Details of the 'royalty equation system' are contained in the Victorian Timber Industry Strategy (Victorian Government 1986).

Fifteen-year sawlog licences were first issued in 1987 and specified the volumes and grades of sawlogs to be supplied. Long-term licences were introduced to provide a greater degree of certainty regarding the supply of wood resources for the timber industry and to promote further investment in value adding. The volume of logs a mill is allocated is often covered by more than one licence.

Sawlog licence allocations may be specified in net or in gross volume terms. Allocations specified in gross terms include the percentage of defective material in the log that is unsuitable for sawmilling, while allocations specified in net terms exclude defective material. Sustainable yield forecast rates are in net volume terms. Sawlogs sourced from State forests in the Central Gippsland FMA and those parts of the Wodonga FMA in the region are currently sold at the stump. Royalties are charged on the sawlog before any processing occurs and licensees incur the costs of harvesting and log haulage. In the Tambo FMA sawlogs are currently sold at the mill gate, whereby royalties include harvesting and log haulage costs to the mill.

Provision has been made in the licence arrangements so that licensees can elect to receive logs above or below their annual allocation by up to 30 per cent in any one year. This allows for fluctuations in market conditions. Allocations to individual licensees must not be exceeded over the licence period, with no more than 110 per cent of the annual allocation being obtained in any five-year period.

The proportions of sawlog grades that are allocated to licensees are negotiated on the basis of the degree of further processing being undertaken. If licensees are engaging in further processing they may be allocated an increased proportion of higher grade logs. However, the total allocation of D+ logs does not vary through this process.

Current sawlog licence allocations in the Tambo FMA and that part of the Central Gippsland FMA within the Gippsland region are provided in Table 5.2. Estimates of sawlog licence allocations are not available for that portion of the Wodonga FMA which lies within the Gippsland region.

Table 5.2: D+ Net Volume Sawlog Licence Allocations for Forest Management Areas Covering the Gippsland Region

Forest Management Area	Current Licensed Allocations m ³ /year
Central Gippsland ^a	180 800
Tambo	67 700

a. License allocations are based on an FMA. These figures are for the whole of the FMA, including the area within and adjacent to the Gippsland region. *Source:* Department of Natural Resources and Environment, unpublished data.

The availability of residual logs is directly tied to and determined by the sustainable production of sawlogs. Currently around 451 000 cubic metres becomes available in the Gippsland region each year as a by-product of normal sawlog harvesting (Table 5.3). In addition supplies of small diameter logs are available from thinning operations of regrowth forests. Residual logs are currently underutilised. In 1997-98, 73 000 cubic metres was harvested (see Table 5.1), most of which was pulpwood harvested under the Forests (Wood Pulp Agreement) Act 1996.

Table 5.3: Current Residual Log Availabilities for the Gippsland Region

Forest Management Area	Current residual log availability m ³ /year
Central Gippsland ^a	201 300
Tambo	250 500
Total	451 800

a. The figure is for that area of the Central Gippsland FMA within the Gippsland region. This area comprises approximately 76 per cent of the Central Gippsland FMA, with the remainder of the FMA lying in the Central Highlands region. These figures do not cover the area of the Central Gippsland FMA within the Central Highlands region. *Source:* Department of Natural Resources and Environment, unpublished data.

Log Harvesting and Transport Arrangements

Three different arrangements are used to undertake the harvest and haulage of logs from the forest to the sawmill in the Gippsland RFA region. In the Central Gippsland FMA a log harvesting and haulage syndicate is used, while a NRE contractor operates in the Tambo FMA. In the Wodonga FMA, within the Gippsland region, contractors or logging syndicates are engaged by sawmill owners/managers to harvest and transport logs from the forest to the sawmill. There are approximately 46 log harvesting and transport contractors operating within the Central Gippsland and Tambo FMAs within the Gippsland region. These contractors employ around 296 persons in total. Logging and hauling employment in the Wodonga FMA is included in the Comprehensive Regional Assessment Report for North East Victoria (VicRFASC1998).

Recipients of logs from State forests in the Gippsland region pay a roading charge to NRE that is used to build and maintain departmental roads required for log extraction. These charges are separate to the royalty payments by mills for logs harvested from State forests in the region.

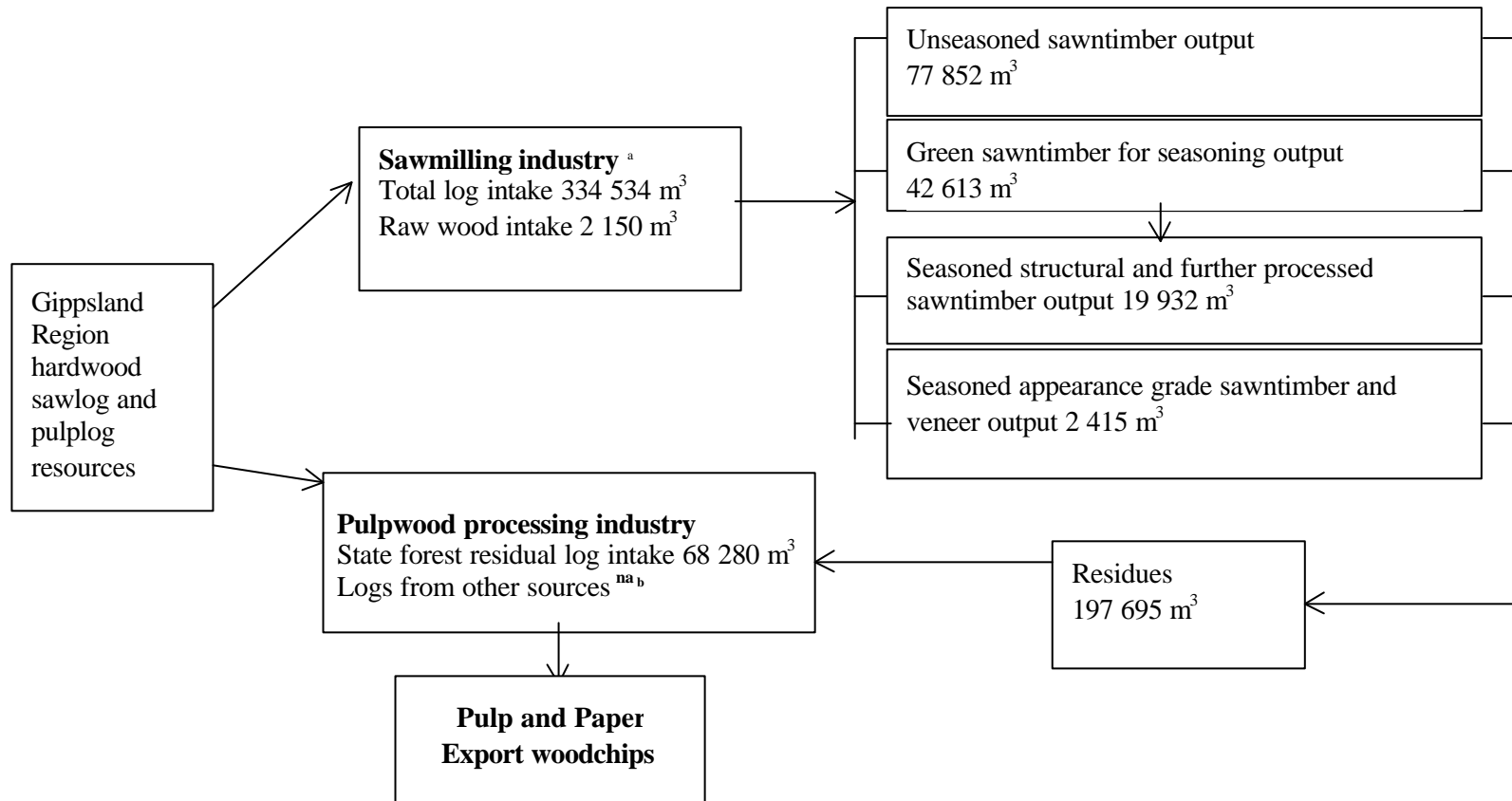
5.2 STRUCTURE AND VALUE OF THE HARDWOOD BASED INDUSTRIES

In 1997-98 there were 17 hardwood sawmills receiving sawlogs from native forests in the region, and a further 3 sawmills receiving residual logs only. In addition, 2 pulpwood processors received residual logs from the region or sawmill residues from sawmills utilising logs from the Gippsland region. The location of State forests and sawmills in the Gippsland is shown in Map 5.1.

The 20 hardwood sawmills are involved in a range of sawntimber processing activities, including a high proportion of further processed products such as kiln dried and appearance grade products for both domestic and export markets. The quality and volume of available sawmill resources, the scale of sawmill operations and further processing capacity largely determine the range of products produced at each mill. The log input capacities of the sawmills processing hardwood sawlog resources from the Gippsland region are shown in Table 5.4.

Products manufactured by the pulpwood processors using hardwood residual logs and sawmill residues sourced from the Gippsland region include export woodchips and woodpulp.

The structure of the hardwood based industry in the Gippsland region in 1997-98 is shown in Figure 5.A.



a Wood intake from both State and private forests in Victoria only. **b**. Includes plantation and private native forest sources; **na** Data not available due to confidentiality reasons.

Figure 5.A: Structure of the hardwood forestry industry in the Gippsland RFA region in 1997-98

Table 5.4: Capacity for sawmills processing sawlogs sourced from the Gippsland region, 1997-98

Log input (cubic metres/year)	Number of sawmills
0 – 10 000	11
10 001 – 20 000	4
20 001 - 30 000	3
30 001 - 50 000	1
50 001 +	1

The commercial forestry, sawmilling and residual log processing industries using wood sourced from the Gippsland region presently account for an estimated 687 direct jobs. The estimated gross value of production of the sawmilling industry in the Gippsland region is \$24.6 million (Table 5.5). For confidentiality reasons it is not possible to provide an estimate of the total value of production for the pulpwood based industry in the region.

Table 5.5: Key economic features of the Gippsland hardwood based industries, 1997-98

Total gross value of wood based industries (product value)	\$ million
Sawmilling industry	24.6
Residual log based industries	na
Total forestry and wood based industry employment	No. persons
Forest management	32 ^a
Sawmilling industry	199 ^b
Residual log based industries	160 ^b
Logging and haulage	296
Total	687
Total log volumes produced ^c	m³
Total sawlogs produced	126 575
Total residual log produced	73 511
Other logs	79
Total	200 165
Total State forest royalties received	\$ million
Total sawlog royalties received	3.8
Total residual log royalties received	0.4
Total sawmill licence fees received	0.4
Total	4.6

^a This figure includes NRE staff directly associated with commercial wood production and does not include permanent or part time forest work crews or NRE staff who spend part of their time on commercial forest activities. ^b Calculated by multiplying the percentage of total intake sourced from the Gippsland region by the relevant total employment, production or gross value of production figures. These facilities are not all located in the Gippsland region. ^c Based on recorded sales from Gippsland region State forests.

The flow-on effects industry to the State economy from the wood based industries using wood sourced from the Gippsland region may be broadly estimated using appropriate input-output and employment multipliers. Drawing on available multipliers for wood based industries in the Victorian economy, it is estimated that the value of turnover from the sawmilling industry drawing hardwood resources from the Gippsland region contributed around \$46 million to State output in 1997-98. This estimate is based on a State output multiplier of 1.87 for the sawmilling sector (National Institute of Economic and Industry Research 1985).

The sawmilling and residual log processing industries receiving logs from the Gippsland region contributed 458 and 496 jobs respectively to the Victorian economy in 1997-98. These estimates are based on a State employment multiplier of 2.3 for the sawmilling sector (with 199 direct jobs) and 3.1 for the paper products sector (with 160 direct jobs). It is also estimated that in the Gippsland region, the commercial forest management sector (with 32 direct jobs) and logging and haulage sectors (with 296 direct jobs) contributed 689 jobs to the Victorian economy in 1997-98, using a State employment multiplier of 2.1 for the forestry sector. The total level of employment attributable to hardwood resources sourced from the Gippsland region from the forestry, logging and haulage, sawmilling and pulpwood processing industries is therefore estimated at 1 643 jobs for the Victorian economy in 1997-98.

The native hardwood resources sourced from the region also contribute to a range of further solid wood manufacturing activities, such as furniture manufacturing, joinery and craft wood industries. In Table 5.6, estimates are provided for employment by major industry category for people working in wood based industries in 1996 and who were resident in the Statistical Local Areas comprising the Gippsland region. Based on these figures, the wood based industries accounted for 3 643 direct jobs in 1996, or around 4 per cent of total regional employment (Australian Bureau of Statistics 1997b). It is important to note, however, that these figures include solid wood based manufacturing activities using both native hardwood and plantation based timbers and possibly imported timber, but do not take account of wood based industry jobs that are linked to hardwood resources sourced from the Gippsland region but are not located within the RFA boundary. An example of such an enterprise would be jobs in the Midway woodchip mill, which sources its eucalypt wood resources from a number of RFA regions. In 1997-98 the company employed 38 persons and utilised both hardwood and softwood, but is located at Geelong outside the RFA boundary.

In 1996 there were 1 150 persons employed in the furniture and joinery based industries who were resident in the Statistical Local Areas comprising the Gippsland region. The industries included: timber resawing and dressing; furniture manufacturing; wooden structural component manufacturing; plywood and veneer manufacturing and fabrication; wood product manufacturing; and wooden furniture, upholstered seat manufacturing and furniture.

Table 5.6: Total Forestry and Wood- based Industry Employment Resident in the Gippsland Region, 1996 ^a

Industry	Employment 1996
Forestry and Logging	
Forestry and Services to forestry	258
Logging	477
Forestry and logging undefined	64
Total	799

Table 5.6: Total Forestry and Wood- based Industry Employment Resident in the Gippsland Region, 1996 ^a (cont.)

Industry	Employment 1996
Wood and paper products manufacturing	
Log sawmilling and timber dressing undefined	285
Log sawmilling	485
Timber resawing and dressing	497
Plywood and veneer manufacturing and fabrication	214
Wooden structural component manufacturing	170
Fabricated wood manufacturing	67
Prefabricated building manufacturing	10
Wood product manufacturing NEC	88
Wood chipping	28
Furniture manufacturing	35
Wooden furniture, upholstered seat manufacturing and furniture	146
Paper and paper products manufacturing undefined	95
Pulp, paper and paperboard manufacturing	680
Paper and sack manufacturing	0
Solid paperboard container manufacturing	0
Corrugated paperboard container manufacturing	3
Paper product manufacturing NEC	32
Other wood product manufacturing undefined	9
Total	2 844
Total forestry and wood based industries	3 643

^a Only Statistical Local Areas that have a minimum of 50 per cent of their area falling within the Gippsland region have been included in these estimates. *Source:* Australian Bureau of Statistics (1998).

5.3 THE HARDWOOD SAWNTIMBER INDUSTRY Sawmilling Industry Survey

In order to provide an accurate assessment of the economic circumstances underlying the competitiveness and value of the hardwood sawmilling industry, an economic survey of sawmills operating in the Gippsland region was conducted in 1998.

The survey contained a series of questions designed to assess the economic conditions underlying the long term competitiveness and value of the industry and was conducted over two weeks in October 1998, with face to face interviews with sawmill owners or managers. All hardwood sawmill owners/managers of mills sourcing logs in the Gippsland region were contacted as part of the economic survey, with questionnaires completed for 100 per cent of the hardwood sawmills receiving State forest hardwood logs from the Gippsland region. In log intake terms, the survey responses accounted for 100 per cent of total State forest logs received by the sawmilling industry in the Gippsland region in 1997-98.

Information derived from the survey has been used in conjunction with other market-based information to estimate the total gross and net economic value of the Gippsland region hardwood sawmilling industry. The method used to derive estimates for the sawmilling industry is outlined in Box 1.

Box 1: Derivation of estimates for the sawmilling industry in the Gippsland region

All of the 20 hardwood sawmills receiving logs from the Gippsland region in 1997-98 responded to the survey.

In some instances, only partial responses to the questionnaires were supplied. For omitted data, estimates calculated from average costs, prices and returns were used. As a number of mills also use logs sourced from outside the Gippsland region, projections for key variables attributable to logs sourced from the Gippsland region are provided. For each mill, the employment, gross value and net value of production attributable to the resources sourced from the Gippsland region are calculated by weighting these key variables according to the percentage of total log intake sourced from the Gippsland region in 1997-98. For example, if a mill employing 40 people were to source 60 per cent of its logs in the Gippsland region and the remainder in other RFA regions, total employment attributable to the Gippsland region would be estimated as 24 people.

Sawmill Industry Analysis

In 1997-98, there were 20 hardwood sawmills receiving logs from State forests located in the Gippsland region. The following information presented on the hardwood sawmilling industry relates to the 1997-98 financial year, the latest year for which complete mill and financial records were available.

For the 20 hardwood sawmills, around 43 per cent of their total log intake came from State forests located within the Gippsland region in 1997-98 (Table 5.7). The remaining sawlogs received were sourced from State forests located in other RFA regions in Victoria and a small amount (two per cent) was sourced from private forests within the region. Furthermore, four of the sawmills receiving logs from the Gippsland region purchased raw wood inputs from other sawmills, from within and outside the Gippsland region. Due to the high proportion of logs sourced from outside the Gippsland region, discussion in the remainder of this chapter will focus mainly on estimates of the physical and financial characteristics of the hardwood sawmilling industry 'attributable to Gippsland region resource' as discussed in Box 1.

The value of turnover (or gross value of production) for the hardwood sawmilling industry in the Gippsland region is estimated at \$24.6 million in 1997-98 (Table 5.8). It is estimated that labour costs for the sawmilling industry totaled \$4.2 million in 1997-98, approximately one-fifth of the estimated total operating costs of \$20.8 million. The net value of production (or net profits earned) for 1997-98 for the hardwood sawmilling industry in the Gippsland region is estimated at around \$3.8 million.

Table 5.7: Wood intake for the Gippsland region hardwood sawmilling industry 1997-98 ^a

	Intake (m ³)	Share of total log intake (%)
Gippsland region State forests	142 616	42.6
Gippsland region private forest	5 904	1.8
Other than Gippsland region ^b	186 014	55.6
Total log intake by sawmills	334 534	100.0
Raw wood material intake ^c	2 150	na

na not applicable ^a Estimates based on sawmill survey that includes information sourced from mills located within and outside Gippsland RFA region. ^b Includes public and private sources ^c Timber purchased from other sawmills within and outside the Gippsland RFA region. Data are not available to separately identify Gippsland region sourced raw wood.

In absolute terms the largest net incomes were associated with mills with the largest mill intakes (greater than 20 000 cubic metres) in 1997-98. In 1997-98 these mills accounted for 61 per cent of total log intake and 61 per cent of total net income for the Gippsland hardwood

industry. However, on average mills with the smallest log intakes and the smallest capital values in 1997-98 had the largest net incomes per cubic metre of logs received.

Table 5.8: Key financial features of the Gippsland region hardwood sawmilling industry, by product, 1997-98^a

	Sawmill production	
	Total \$m	Attributable to Gippsland ^b \$m
Gross receipts from sawntimber and products	52.5	22.7
Gross receipts from sawmill residues (woodchips etc.)	4.6	1.9
Gross value of production	57.1	24.6
Labour costs (wages and salaries paid)	11.4	4.2
Total operating costs ^c	47.6	20.8
Capital investment by sawmills in 1997-98	3.2	1.0
Net value of production (GVP minus total operating costs)	9.5	3.8
Replacement value of fixed capital	24.7	11.3
Logs purchased	334 534 m ³	149 565 m ³
Logs processed ^d	335 507 m ³	145 944 m ³
Sawntimber production	142 812 m ³	63 671 m ³
Timber recovery rate	42.6%	43.6%

^a Estimates based on sawmill survey. Estimates are based on single year data and are not necessarily representative of long term trends. ^b Estimates are totals for the sawmilling industry based on log intake from the Gippsland region. ^c Operating costs include labour costs, wood purchasing and delivery costs, repairs and maintenance, depreciation and interest payments. ^d The volume of logs processed may not equal total output in table 5.9 due to possible inclusion in seasoned sawntimber production numbers of sawntimber not cut in 1997-98 financial year but air and kiln dried in that year.

It is estimated that the level of employment attributable to the Gippsland resource at sawmills was 199 people (out of a total of 438 persons employed by these mills). Approximately 80 per cent of these employees were full time workers. Mill employment at the 20 mills using wood resources from the Gippsland region ranged from around three people in the smallest mill to around 200 people at the largest mill.

Major Sawntimber Products and Markets

Approximately 90 per cent (56 566 cubic metres) of the 63 188 cubic metres of hardwood sawntimber produced from logs sourced from the Gippsland region in 1997-98 was unseasoned sawntimber (Table 5.9). The remaining 10 per cent was mainly sold as seasoned structural or further processed timber. Of the unseasoned sawntimber production, 22 959 cubic metres (41 per cent of total unseasoned sawntimber produced) was sold as an input for seasoned sawntimber production. Unseasoned products such as scantling, pallets and palings accounted for 59 per cent of unseasoned sawntimber production in 1997-98.

Table 5.9: Production of the Gippsland hardwood sawmilling industry, 1997-98^a

	Attributable to Gippsland ^b		Total	
	m ³	%	m ³	%

Seasoned sawntimber^c				
Veneer	31	0.02	31	0.01
Appearance – select	426	0.30	1 340	0.40
Appearance – standard	424	0.30	1 044	0.30
Structural	2 101	1.40	14 515	4.30
Further processed	3 671	2.40	5 417	1.60
Sub total	6 622	4.40	22 347	6.60
Unseasoned sawntimber^d				
Appearance – select	787	0.50	802	0.20
Appearance – standard	100	0.10	167	0.10
Structural	519	0.30	528	0.20
Further processed	21 553	14.40	41 116	12.10
Scantling ^e	20 786	13.90	27 911	8.20
Palings and pallets	9 881	6.60	46 533	13.60
Other sawn	2 940	2.00	3 408	1.00
Sub total	56 566	37.70	120 465	35.40
Total sawntimber	63 188	42.10	142 812	42.00
Woodchips	56 263	37.50	126 796	37.20
Other residues	30 492	20.30	70 899	20.80
Total residues	86 755	57.90	197 695	58.00
Total	149 943	100	340 507	100

a Preliminary estimates for industry based on sawmill survey. b Estimates are totals for the sawmilling industry based on industry estimates of log intake from the Gippsland region. c Kiln dried volumes may include timber from logs not processed in the 1997-98 financial year. d Although not all green sawntimber is sold for further processing, the unseasoned sawntimber category includes green sawntimber that was sold for further processing to become seasoned sawntimber. Categories for which this applies are those from appearance select through to further processed. e Includes small proportion of sawntimber to be sold as unseasoned structural grade sawntimber.

Seasoned sawntimber was produced at 12 of the 20 hardwood sawmills using logs from the Gippsland region (11 of these mills also produced unseasoned sawntimber). The volume of seasoned sawntimber produced at these mills accounted for almost 11 per cent of the total volume of sawntimber attributable to logs sourced from the Gippsland region in 1997-98 but 20 per cent of the total gross value of sawntimber production. The higher prices received for these products reflect the additional processing required. These mills also accounted for over half of the estimated \$1.0 million of capital investment undertaken in 1997-98 (Table 5.8) at mills sourcing logs from the Gippsland region in 1997-98.

Table 5.10 shows the mix of sawntimber products sold by the Gippsland sawmill industry in 1997-98 and the anticipated product mix in 2007-08. It can be seen that sawmillers currently utilising logs from the Gippsland region anticipate that the proportion of output sold as seasoned timber will increase from 10 per cent to around 40 per cent of total output by 2007-08. The increase is based largely on sawmillers expecting to process more of the green sawn timber they currently sell for further processing elsewhere.

Sawmillers indicated that if there were sufficient high quality sawlogs available in the future, they would undertake additional investment to increase their production of (high value) appearance grade products rather than unseasoned sawntimber production.

The major markets for each product were also identified (Table 5.10). The unseasoned timber products were distributed to Melbourne and regional Victoria. The bulk of seasoned timber production was also sold in Victorian markets with a small amount of select appearance grade products exported.

Table 5.10: Current and anticipated Gippsland sawntimber production and major markets, 1997-98 and 2007-08^a

Product	Production share		Major markets in 1997-98 ^b
	1997-98 %	2007-08 %	
Seasoned sawntimber	10.5	39.7	
Appearance grade – select	0.7	4.3	Melbourne, export
Appearance grade – standard	0.7	6.9	Melbourne
Dried structural grade	3.3	8.8	Melbourne, Central Gippsland, regional Victoria
Further processed	5.8	19.7	Melbourne, Central Gippsland
Green sawn timber sold for further processing	36.1	6.8	Melbourne, Central Gippsland
Unseasoned sawntimber	53.4	53.5	
Structural	0.2	0.2	Melbourne, regional Victoria
Scantling	32.9	28.5	Melbourne, regional Victoria
Palings and pallets	15.6	18.4	Melbourne, regional Victoria
Other sawntimber	4.7	6.4	Melbourne, regional Victoria
Total	100	100	

^a Preliminary estimates for industry based on sawmill survey. These estimates exclude specialist recovery mills. ^b Markets recorded in order of importance.

5.4 HARDWOOD RESIDUAL LOG BASED INDUSTRIES

Hardwood residual logs and sawmill residues sourced from the Gippsland region are used in the production of woodchips for export and for the production of pulp that is further processed into paper. For confidentiality reasons it is not possible to report on the physical and financial characteristics of these producers. However, a description of the major downstream processing operations using hardwood pulpwood and sawmill residues from the Gippsland region is provided below.

Australian Paper Pty Ltd

Australian Paper Pty Ltd, a wholly owned subsidiary of Amcor Printing Papers Group Ltd, sources hardwood residual logs from State forests, residues from sawmills and plantation pulplogs (both hardwood and softwood logs) for the production of woodpulp for paper manufacturing at its Maryvale mill. However, plantation logs form the major source of fibre used by the company.

The Maryvale mill is currently the largest pulp and paper manufacturing plant in Australia, employing 930 people to process hardwood and softwood resources in 1997-98. Wood intake (pulplogs and sawmill residues) in 1997-98 was approximately 1.4 million tonnes allowing the production of around 400 000 tonnes of paper products. Of the hardwood resource intake, approximately 290 000 tonnes of residual log and sawmill residues were sourced from the Gippsland region, and made up about 40 per cent of the plant's hardwood intake and 20 per cent of total mill intake. The types of paper produced include high quality copy paper, strong brown paper and cardboard stock. While most of the paper produced at Maryvale is sold on domestic markets a small proportion is exported.

Midway Pty Ltd

Midway operates an export oriented woodchip facility in Geelong. Hardwood residual logs, sawmill residues and softwood logs are chipped at this facility. The mill has a production capacity of around 500 000 tonnes a year. Twenty full time staff are employed at the mill handling the hardwood intake (additional staff are employed in plantation operations and handling the softwood intake). Of the hardwood intake, approximately 6 000 tonnes (21 per cent) of sawmill residues were sourced from the Gippsland region. In 1997-98, these sawmill residues accounted for approximately 1 per cent of Midway's total hardwood intake, while hardwood residual logs from the Gippsland RFA region accounted for around 4 per cent of total hardwood intake.

5.5 PLANTATION BASED INDUSTRIES

The area under plantations in the Gippsland region in 1997-98 was estimated at 85 700 hectares, with the split between hardwoods and softwoods being 62 400 hectares and 23 300 hectares respectively. In comparison, the net available area of commercial native hardwood forests in the Gippsland region is 254 000 ha.

Australian Paper Plantations Pty Ltd, a wholly owned subsidiary of Amcor Printing Papers Group Ltd, was the largest plantation owner in Victoria in 1997-98, managing hardwood and softwood plantations in the Gippsland region that cover approximately 15 200 hectares and 38 800 hectares respectively. The wood from these plantations is mainly used at the Maryvale mill of Australian Paper Pty Ltd.

There are also a number of sawmills established in the region that utilise the available hardwood and softwood plantation sawlog resource of the Gippsland region. A new hardwood sawmill, based on mountain ash plantation resource managed by Hancock Victorian Plantations, has recently been established in Morwell by Planthard Pty Ltd. The mill, which employs 110 people, produces a range of green and dried sawntimber products including structural timber, mouldings and flooring. These products are sold on the domestic and export markets.

Softwood sawntimber and treated poles are also produced using plantation softwood logs grown in the Gippsland region. Two major producers of softwood sawntimber in the region are Brown and Dureau Building Materials Pty Ltd and NF McDonnell and Sons Pty Ltd. The sawmill operated by Brown and Dureau Building Materials Pty Ltd in Morwell is able to process up to 300 000 cubic metres of logs annually and currently employs 160 people. Sawntimber products available include framing and building timbers that are sold domestically. NF McDonnell and Sons Pty Ltd (formerly Sunwood Pty Ltd in Yarram) produces mainly fencing, pergola and packaging timbers from plantation softwood logs sourced within the Gippsland region (although the company also owns a mill and logging operations in South Australia) for sale on the domestic market. The mill located in Yarram is able to process up to 100 000 cubic metres of softwood logs annually and employs 25 people.

The softwood and hardwood plantation based industries are discussed further in Chapter 6.

5.6 OUTLOOK FOR LOGGING AND WOOD PROCESSING INDUSTRIES

The discussion below is a broad overview of the factors influencing the market outlook for Australian hardwood forest product industries. Based on available data, trends in international markets are analysed and related to the outlook for Australian native forest products industries in terms of the major forest product groups — sawntimber, wood based panels and pulp and paper products.

Macroeconomic Assumptions

The following outline of ABARE assumptions on the world economic outlook form the basis for the industry outlook in this section. World economic growth is assumed to improve gradually from an average annual rate of 3.2 per cent in the period 1996 to 2000, to around 3.4 per cent in 2001 to 2005 and 3.6 per cent in 2006 to 2010 before easing to around 3.5 per cent there after until 2020. Despite the recent downturn in South East Asia, Asia is expected to remain the strongest growth region in the world economy, with levels of income per person converging towards OECD country levels over the projection period.

Reflecting a recovery from the recent downturn in economic activity, economic growth in the Asian region is assumed to improve slightly from an average annual rate of 5.5 per cent between 1996 and 2000 to 5.8 per cent between 2001 and 2005 and 6.0 per cent between 2006 and 2010, before easing to 5.0 per cent between 2011 and 2020. The proportionate population growth rate for the Asian region is forecast to be close to the world average, but well above those forecast for OECD countries.

Outlook for Forest Product Markets

North America dominates the production of all forest product categories, accounting for at least 30 per cent of global output. Western Europe and the Asia Pacific region are the principal importing regions, while the Nordic countries and North America are the principal exporting regions.

In recent decades, the rapid industrialisation of countries in Asia such as Japan, South Korea and Taiwan has resulted in an increase in consumption of wood products per person, particularly paper products. Its proximity and potential for significant increases in consumption mean that the Asia Pacific region is likely to be the main market focus for any expansion of Australia's forest product industries. Economic developments over the past decade have resulted in significant changes to trade in wood products in the Asia Pacific region. Most notably, trade in unprocessed logs has declined as a result of the imposition of log export bans in Indonesia (since lifted during 1998) and Malaysia, moves to promote value added domestic processing, and increased domestic demand for wood products in traditional tropical wood supplying countries.

The downturn in economic activity in many of these countries over the past year has caused a decline in consumption of forest products in the region. Exacerbating the problem has been the rapid expansion in production capacity for several products including pulp, paper and medium density fibreboard (MDF). The combination of declining demand and excess capacity has led to a fall in world prices (measured in US dollars) during 1998 for most forest products. These depressed market conditions are expected to continue through 1999 until economic activity gradually picks up in the Asia-Pacific region.

In its recent review of world forest products markets, the Food and Agriculture Organisation of the United Nations (FAO) concluded that product prices will not rise significantly in the period to 2010 (FAO 1999). Many regions have ample or excess wood product manufacturing capacity. It is only for the higher grades of timber products that any upward pressure of prices is foreseen with any price increases restrained by the availability of cheaper wood and non-

wood substitutes. There is expected to be more in-country processing, with less trade in semi-processed and commodity grade timber products and more trade in higher-value products.

Australian trade position for forest products markets

The Australian market for timber products is strongly influenced by the international market because Australia imports or exports most forest products. Australian trade in most forest products is small in comparison with world trade, and domestic prices are largely determined by the landed price of imports.

The Asian economic downturn in 1997-98 had rather diverse short-term trade impacts on the Australian forest products trade. The fall in demand for forest products in the Asian region in 1997-98 has generally led to a decline in world prices denominated in US dollars for forest products. However, relative exchange rate movements meant that prices for imported softwood timbers into Australia rose while prices for tropical hardwood timbers fell. World softwood timber prices tend to be set by North American market conditions, but the weakening Australian dollar, measured against the US dollar, tended to offset any advantage gained by North American suppliers in the Australian market from lower world prices. On the other hand, the appreciation of the Australian dollar against the currencies of Australia's major Asian hardwood suppliers led to a fall in the price of imported tropical timbers within Australia.

The volume and value of imports of forest products into Australia rose in 1997-98. The value of forest products imports in 1997-98 reached \$2.71 billion, up from \$2.55 billion in 1996-97 (ABARE 1999). The rise largely reflects increases in value and volume of softwood sawn timber imports. Australia's strong economy, continued high level of housing activity and lower world prices for sawnwood contributed to the growth in imports. Plywood imports, mostly structural plywood from New Zealand and Indonesia, were another major contributor to the rise in the value of imports. The value and volume of paper product imports also rose, largely through increases in imports of newsprint and paperboard and industrial packaging imports

The value of exports of forest products from Australia rose by 13 per cent, or \$143 million, to \$1.25 billion in 1997-98. The main contributor to the rise was a \$128 million increase in the value of woodchip exports. Shipments of woodchips, which were almost solely directed to Japan, increased 30 per cent in 1997-98. While world woodchip prices, measured in US dollars declined in 1997-98, Australian exporters to some extent were buffered against the decline in world prices. Prices in contracts negotiated by Australian exporters to sell woodchips to Japan are written in Australian dollars, and because the Australian dollar fell markedly against the US dollar in 1997 and 1998, Australian woodchips were priced competitively against those from suppliers selling in US dollars. The yen equivalent of the average Australian woodchip prices in June 1998 was 20 per cent below the US price and 14 per cent below the price from all sources (Ausnewz 1998).

The economic downturn in Asian countries has also had an impact on export of other forest products with falls in the volume and value of Australian roundwood, sawntimber and particleboard exports in 1997-98. Australia's net trade position is not expected to improve during 1998-99.

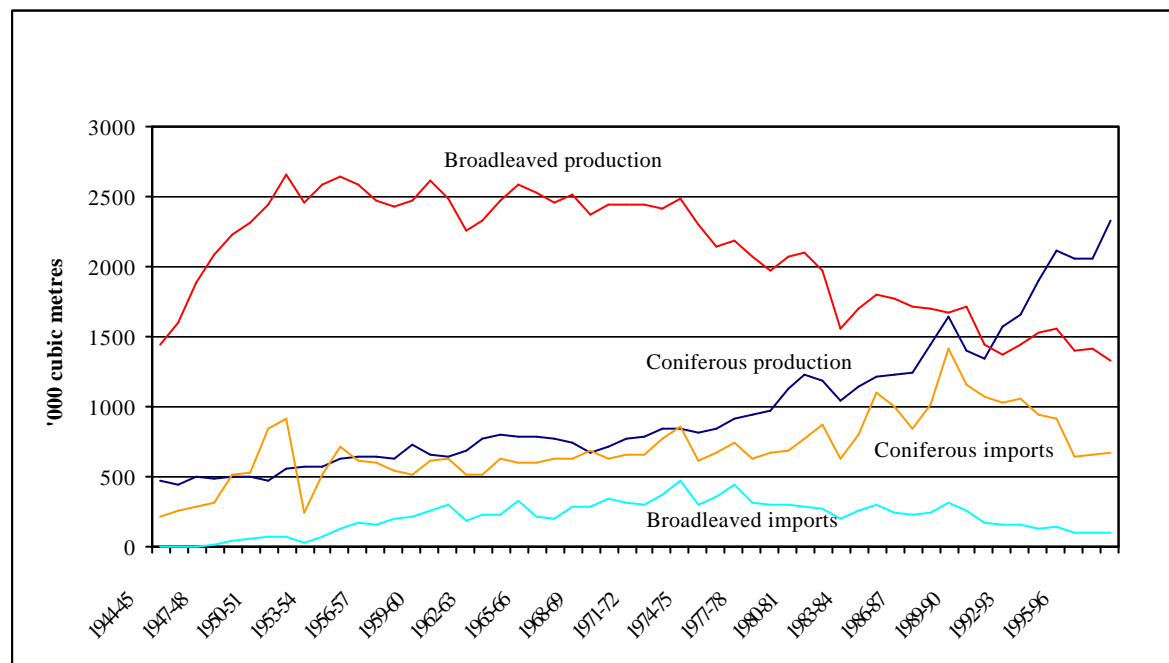
Sawntimber

Global production of sawn hardwood increased from 110 million cubic metres in 1980 to 130 million cubic metres in 1991, but has since declined slightly. The production of sawn hardwood in Asia is expected to continue to decline, given the decreasing availability of tropical hardwood logs. However, the Asia Pacific forest products sector is expected to meet projected consumer demand and, as a result, significant real price increases are not expected.

Demand is expected to be met through a combination of more efficient use of existing Pacific Rim timber resources and the establishment of manufacturing capacity to produce nontraditional products such as MDF, oriented strand board (OSB) and other reconstituted panels (Johnson 1997).

Australian production of sawn hardwood has declined from a peak of 2.6 million cubic metres in 1954-55 to 1.32 million cubic metres in 1997-98 (Figure 5.B), largely as a result of reduced resource availability in native forests and the increased substitution of softwood for traditional hardwood sawntimber. Annual sawn hardwood production is expected to fall from current levels until around 2000, before rising gradually over the next two decades as hardwood regrowth and possibly some hardwood plantation logs become available for harvesting. Softwood sawntimber production is also expected to rise as existing softwood plantations mature. Australia is likely to have a small exportable surplus of softwood sawntimber by 2005-06 (Love, Yainshet and Grist 1999).

Figure 5.B: Australian sawnwood production, consumption and trade



Hardwood sawntimber production in Australia has traditionally been focused on producing timber for building applications and other structural end uses. Historically, the competition between softwoods and hardwoods for internal building applications was influenced by the greater availability and lower price of hardwood sawntimber. Competition from softwoods for external applications and other structural end uses was constrained by the natural advantages of hardwoods, such as strength, durability and resistance to biological degradation.

However, there have been dramatic falls in softwood production costs, which have been reflected in lower softwood timber prices, in recent decades — mainly a result of large automated softwood mills being commissioned and an increasing softwood resource base. The average cost of sawntimber produced by a new softwood mill was previously estimated to be around 10 per cent lower than that for a new hardwood mill producing predominantly unseasoned sawntimber (Jaakko Pöyry 1993). The lower price has enabled softwood sawntimber to increase its market share of internal building applications where softwood sawntimber is directly substitutable with hardwood timber.

More recently, competition from softwood sawntimber has also contributed to a decline in the market share of hardwood in external building applications. This has been possible as a result of the increasing size of the softwood resource and the decline in softwood production costs, combined with improved processing technologies and treatments for the preservation (for external applications) and lamination (for structural uses) of softwoods. These factors have allowed softwoods to be increasingly substituted for hardwoods in numerous external building applications, albeit from a small base.

A range of other minor sawntimber products is produced from forests — for example, posts, stakes, trellising, decking and packing cases. The natural advantages of hardwoods in these applications have also been offset by the improved treatments available for the preservation and lamination of softwoods. Softwoods are increasingly likely to be used as a substitute for hardwoods in many of these applications.

The competitiveness and increased availability of softwood sawntimber is indicated by the declining market share of hardwood sawntimber in total domestic sawntimber consumption. Apparent consumption of hardwood sawntimber was approximately 2.04 million cubic metres in 1984-85 (or 47 per cent of total apparent consumption) but only 1.41 million cubic metres (or 32.0 per cent of total apparent consumption) in 1997-98. Domestic annual production of softwood and hardwood sawntimber is estimated to have been 2.33 million cubic metres and 1.32 million cubic metres respectively in 1997-98.

The growth in the production of softwood plantation timber has also resulted in an almost 50 per cent decline in the volume of timber imports. Other factors contributing to the replacement of imports of sawntimber have been the dramatic increases in prices of imported timbers in the mid 1990s, the declining supplies of tropical hardwood sawntimber from South East Asia and the increasing availability of native hardwood timbers which have been processed beyond the rough sawn stage.

Increased use of softwood sawntimber in building applications and other structural end uses over the medium and longer term is expected to continue — especially in Western Australia and Tasmania where hardwood sawntimber consumption still exceeds that of softwood sawntimber (reflecting the previously small softwood resource base). However, in line with projected increases in the softwood resource base and the consequent rise in the availability of softwood sawlogs, softwood consumption in these States can be expected to increase.

The impact of substitution away from unseasoned hardwoods to lower cost softwoods in housing construction has been partly offset by hardwood sawmillers diversifying into, and expanding, markets for kiln dried timber — for example, furniture, flooring, mouldings and other value added products (Neck, Curtotti and Sar 1996). Many of these applications involve further processing and the replacement of imported products.

The continuing ability of the hardwood sawmilling industry to maintain profitability and compete against domestic softwood and imported timbers will depend on the underlying cost competitiveness of the industry. In addition to the future level of hardwood availability, the perceived dependability of future access to hardwood resources will affect the level of investment in the hardwood-based industry which, in turn, will influence the cost competitiveness of the industry. Increasingly, the focus is likely to be on the production of appearance grades of timber used in furniture and joinery, to capture the potential higher returns from the marketing of specific timber species that have distinct natural attributes. Many of these specific features may be exploited in product markets for furniture, linings, flooring, architraves, skirtings and seasoned beams.

It is unlikely that prices for imported timber will rise in the next few years. Weakening demand in the main consumer markets such as Japan, a continuing high value of the US dollar

relative to East Asian currencies and slow economic activity in many South East Asian countries are likely to lead to declining US dollar prices for meranti and other tropical timbers (Adams and Johnson 1998). Despite the limited potential for price increases, an expected tightening in the supply of hardwood sawntimber in the Pacific Rim could provide continued opportunities for the use of high grade hardwoods for appearance purposes and certain structural applications.

Wood Based Panels

Wood based panels comprise three main product categories — particleboard, MDF and plywood — and are used in a wide range of building, construction and furniture applications. Total world consumption of wood based panels increased by around 400 per cent from the level in 1960 to reach around 148 million cubic metres in 1996. The growth in world production and consumption of composite wood panels and other engineered wood products reflects the growing market acceptance and competitiveness of these products in a diverse range of end use markets. Plywood is the most important panel produced in the Asia Pacific region in volume terms, accounting for over 70 per cent of total panel production of about 30 million cubic metres in 1996. However, in line with decreasing availability of veneer logs, plywood production in the Asia Pacific region is expected to decline and investment in the processing capacity of other panel products is increasing.

Of the wood based panel products currently available, MDF has recorded the strongest market growth over the past decade. Rapid growth in the consumption of this product since the early 1990s in domestic and international markets is attributed to the widespread application and growing consumer acceptance of MDF products in building and furniture making.

Total annual consumption of wood based panels in Australia exceeded 1.5 million cubic metres in 1997-98, up from almost 1 million cubic metres in 1985-86. Australia was a net importer of wood based panel products up to 1994-95, but in 1995-96 and 1996-97 was a small net exporter. The recent downturn in economic activity in Asia and the subsequent availability of surplus panel products on world markets resulted in Australia becoming a net importer again in 1997-98.

In Australia, competition from softwood residues has affected demand for hardwood on two fronts: as an alternative input into wood based panels and the use of these softwood based panels as a substitute for hardwood sawntimbers and other residual hardwood products. Use of residual hardwood roundwood in composite wood based panels has decreased over recent years with the increasing availability of softwood residue. This has occurred as a result of the increasing size of the softwood resource, rising mill throughputs and the consequent increase in the availability of low cost residual softwood roundwood. Users have also been substituting composite wood panels for hardwood sawntimbers in internal building applications such as floors, ceilings and walls.

Future opportunities for Australian producers of hardwoods will be assisted by the forecast reduction in the supply of tropical timbers. An expected tightening in supply of hardwood timber in the Pacific Rim could also provide continued opportunities for the use of high-grade hardwoods in select appearance applications. Australian veneer production for example, which targets the high value decorative veneer market, is likely to continue to be competitive. The main factors influencing the ability of these producers to expand their market base are the future availability and quality of the resource and the price competitiveness of substitute products such as medium density fibreboard. Limited marketing opportunities exist for new panel producers in supplying the Australian market. Any new producer would need to rely mainly on expanding export markets in the Asia Pacific region.

Pulp and Paper

Growth in world paper consumption closely follows changes in economic activity. Consequently, growth in consumption of paper products over the longer term is expected to be particularly strong in the Asian region. World paper and paperboard consumption has been projected to increase from the current level of about 280 million tonnes a year to around 394 million tonnes a year by 2010 (FAO 1999). The projected annual rate of growth in world paper consumption to 2010 (around 2.3 per cent a year) is well above projected world population growth rates (around 1.5 per cent a year). This reflects growing urbanisation and the expected increase in demand for paper as world literacy rates continue to rise. However, growth in paper consumption from 2010 to 2020 is expected to slow slightly, reflecting the slowdown in economic growth rates in developing countries.

A supply and demand analysis carried out by the FAO suggests that the capacity of the forests and other sources of fibre will be sufficient to meet demand in the foreseeable future, although producers in Africa and South Asia will continue to have to use a range of non-forest supply sources to meet their needs (FAO 1999). Furthermore, pulp prices will be under pressure from increased use of recovered/waste paper, particularly in the production of lower quality paper products.

Australia has been a significant importer of paper products and pulp over this period. This means that an expanding domestic industry could replace imports to some degree. By world standards, Australian paper manufacturers already use a high proportion of recycled paper in their fibre furnish and only limited growth in the use of recycled paper can be expected in line with the rate of increase in paper consumption.

Australian hardwood pulplogs and woodchips are either used in domestic pulp production or exported to Japan. In Australia, given the historical shortage of softwood and the abundance of eucalypt, the domestic pulp and paper industry has used eucalypt pulp instead of softwood pulps in higher proportions than used elsewhere in the world. With the availability of softwood pulplog supplies unlikely to increase over the medium term (Love *et al.* 1999), the use of eucalypt pulp in these applications will remain high over time.

Australian hardwood pulpwood is also exported (as woodchips) and is primarily used in the production of bleached hardwood kraft pulp and, consequently, for high quality printing and writing papers. Japan is the only significant market for Australia's woodchip exports, accounting for over 99 per cent of Australia's hardwood and softwood chip exports in 1997-98. There has been little growth in Australia's hardwood woodchip exports in recent years, with shipments averaging 2.74 million tonnes (dry basis) over the five years to 1997-98.

Paper consumption in Asia has declined over the past year but Japan's pulp and paper companies forecast woodchip imports will rise in the medium term once economic activity in the region recovers (Iida 1998). To assure future supplies they have been investing in overseas plantations of eucalyptus in Australia, Chile and other countries in the Pacific Rim regions. Thus over the life of the RFA, woodchip demand is projected to increase although plantation wood is expected to form a greater proportion of the overall export market.

The absence of a suitable softwood substitute in the bleached hardwood kraft pulping process is likely to result in rising demand for Australian hardwood woodchips and/or pulp, to meet the expected increase in Asian demand for printing and writing papers. The major factor influencing the future supply of Australian native hardwood chips appears to be access to suitable forest resources.

5.7 INDUSTRY DEVELOPMENT OPPORTUNITIES

As part of the economic assessment underlying the future development of a Gippsland RFA, an examination of timber industry development opportunities in the Gippsland region was undertaken by Kevin Wareing and Associates Pty Ltd. This assessment included an analysis of the feasibility of future development of the native wood based industries utilising logs from the Gippsland region. This section outlines the main findings of that study, taking into account forest product markets and the availability and quality of hardwood resources. The discussion below is based on the assumption that sustainable yield rates for native forests will be maintained.

Hardwood Availability

Sawlogs

Sustainable yield rates and licensed volumes in the FMAs within the Gippsland region will be reviewed on completion of the State Forest Resources Inventory (SFRI) taking into account the outcomes of the RFA. The availability and quality of hardwood resources from the Gippsland region will have a bearing on development opportunities. It is expected that log size will decrease over the period to 2020 as increasing volumes from regrowth forests come on stream.

The proportion of ash sawlogs in the total Gippsland region sawlog harvest is expected to remain high (in 1996-97 around 70 per cent of the total sawlog harvest was ash sawlogs). The wood characteristics and growth properties of alpine ash make them highly suitable for milling into sawntimber for use in appearance grade products and provide significant potential for further processing.

Residual logs

Residual logs are produced in conjunction with sawlog harvesting operations, with availability being tied directly to the sustainable level of sawlog production. Currently around 450 000 cubic metres of residual logs become available each year as a by-product of normal sawlog harvesting. It is expected that the availability of residual logs will fall slightly over the next 20 years.

In 1997-98 around 73 000 cubic metres of residual logs was harvested from the region, the bulk of which was pulpwood harvested under the *Forests (Wood Pulp Agreement) Act 1996* and supplied to Australian Paper's pulp and paper mill at Maryvale. The remaining logs were used mainly for pallet production and export woodchips.

Residual logs are currently under-utilised compared to their availability due to:

- the resource being dispersed and remote from existing processing facilities, involving long log haulage distances; and
- the low level of availability relative to requirements for the development of competitive fibre-based processing facilities located within the region.

Hardwood Sawmilling Development Opportunities

Development opportunities for the hardwood sawmilling industry in the Gippsland region will be determined in part by the level of sawlog availability. However, in recent years the Victorian hardwood sawmilling industry has:

- increased the proportion of sawntimber that is seasoned;
- recognised that a number of species other than ash can be seasoned and used in applications where their properties provide a competitive advantage;
- refined sawing, drying and further processing techniques to improve the recovery of appearance grade products;

- increased the utilisation of lower grade logs and experienced an increase in the demand for accurately sized timber for pallets;
- developed a greater range of products and a broader customer base; and
- developed a coordinated approach to the development of export markets and introduced quality assurance procedures.

The progressive transition of production from predominantly unseasoned to seasoned products by the Victorian hardwood sawmilling industry is expected to continue (Gooding 1999).

Specific development options that could be considered by the sawn timber industry sourcing hardwood sawlogs and residual logs from the Gippsland region include:

- increasing the proportion of sawn timber that is kiln dried. Most producers processing logs from the Gippsland region have the capacity to increase the proportion of their production that is kiln dried and reprocessed;
- increasing the processing of residual logs through investment in plants specifically designed to process these logs;
- developing networks between timber processors to facilitate investment in the specialised equipment needed to produce highly processed wood products;
- strengthening links with the furniture industry; and
- continuing to identify and expand markets where the properties of the various hardwoods from the Gippsland region (durability, appearance, strength and hardness) provide a competitive advantage.

These development options have been successful for a number of firms and there would appear to be scope for the sawmilling industry processing logs from the Gippsland region to extend their successful application. The industry is expected to remain diverse in terms of varying capacity, the different species processed and the range of sawn products available for a number of different markets.

However if the industry continues to evolve under the influence of market forces, it can be expected that the industry will shrink towards fewer, larger production units focussed on maximising the production of appearance grade timber and capable of taking advantage of export opportunities. The broad types of sawmills that exist today and are expected to exist in the future are set out in table 5.11.

In addition to these opportunities in the sawmilling industry, the alpine ash resource in the Gippsland region has potential for producing sliced veneer for appearance grade applications. Veneer milling appears feasible only at those mills with large sawlog allocations that include high quality logs suitable for veneer production. Based on past experience, mills would need to address a number of issues including scale of operations, choice of equipment, lack of experience in veneer production and inadequate marketing to ensure commercial success in the production of sliced veneer.

Table 5.11 Broad classification of sawn timber producers

Annual log input	Processing facilities	Principal products produced
Up to 6000 m ³	Conventional sawmill	Green structural timber (F8)
6 000 – 20 000 m ³	Conventional sawmill Drying kilns & planer	Seasoned structural timber (F17) Some green structural (F8)
20 000 – 50 000 m ³	Bandsawmill Drying kilns & moulders	Maximum recovery of appearance grades.

	Laminating & finger jointing equipment	Seasoned structural (F17) No unseasoned timber
Over 50 000 m ³	Bandsaw mill Drying kilns & moulders Laminating, finger jointing & other re-processing facilities.	Appearance grade products. Capacity to supply export markets with joinery/furniture components.

Residual Log Processing Development Opportunities

Although it is estimated that the supply of residual logs in the Gippsland region will be at least 420 000 cubic metres a year for at least the next 20 years, the resource is too widely dispersed to support the development of competitive new processing industries, such as panelboard or pulp and paper production, based solely on the native hardwood resource. However, the residual log resource may contribute to the development of new manufacturing industries if it is used in conjunction with resources from adjacent regions or supplemented from private hardwoods.

The major current user of residual logs is Australian Paper, which in 1996-97 utilised nearly 70 000 cubic metres of pulpwood from the Gippsland region. However, in coming years the company is expected to become more reliant on wood from its own hardwood plantations or joint venture plantations with a resultant drop in intake from public native forests.

Development Opportunities in Conjunction with Plantation Resources

Plantations form a significant component of the overall wood resource of the region. Generally, the industries that have been established to process veneer logs, sawlogs and residual logs from the softwood plantations in eastern Victoria and southern New South Wales have been built specifically to process softwood and opportunities for processing hardwood are limited.

Forecasts of future availability of plantation sawlogs and pulplogs were made under the National Plantation Inventory (NPI) in 1997 for the Central Gippsland plantation region (Table 5.12). Although the NPI's Central Gippsland region extends beyond the Gippsland RFA boundaries, all existing plantation areas with the NPI region lie within the RFA boundary. The forecasts indicate that softwood pulplog production will expand rapidly over the next 5 years and then decline slightly over the remainder of the RFA period. Hardwood pulplog forecasts indicate a steady growth in production over the next 15 years. While these forecasts incorporate plantation owners' plans for expansion at the time the NPI study was undertaken in 1996, they do not appear to take into account potential expanded planting rates that could be expected through recent government initiatives such as the Plantation 2020 Vision.

Table 5.12: Woodflow forecasts from plantations in Central Gippsland region (cubic metres per year)

	1995-99	2000-04	2005-09	2010-14	2015-19
<i>Softwood</i>					
Sawlogs	179	503	497	594	585
Pulplogs	498	591	477	458	462
<i>Hardwood</i>					
Pulplogs	237	298	367	539	523
Total	914	1 392	1 341	1 591	1 570

Source Based on National Forestry Inventory (1997).

The production of coated particleboard or MDF for use in cupboards and furniture provides a potential outlet for sliced veneer. In the event of the development of a sliced hardwood veneer industry there could be some benefits associated with having MDF and particleboard industries in close proximity.

The largest user of pulpwood in the Gippsland region is Australian Paper. The company has an annual log intake sourced from a number of RFA regions of around 1.45 million cubic metres with the split between softwood and hardwood logs being around 44 per cent softwood (630 000 cubic metres) and 56 per cent hardwood (around 820 000 cubic metres). The company has a long-term contract for the supply of 500 000 cubic metres from native forests until 2004, when it will progressively reduce to 350 000 cubic metres by 2010. The company has indicated that it intends to become increasingly dependent on plantations for its log supply. Australian Paper has begun importing hardwood based chemical pulp as furnish for its newly commissioned paper mill at Maryvale. At present, there are no plans to expand pulp production at the site.

6. PLANTATIONS

6.1 INTRODUCTION

Plantations can contribute significantly to wood supply, particularly pulpwood and small diameter sawlogs for industry. They can contribute to regional economic development, especially if they are linked to downstream processing industries as they are in the Gippsland region. Plantations on farms can also provide environmental and agricultural production benefits to landholders and the broader community.

Plantations in south-eastern Australia are typically of the exotic Radiata Pine (*Pinus radiata*) referred to as 'softwood', or of native species (predominantly *Eucalyptus* spp.) referred to as 'hardwood'. To date, hardwood plantations have been managed mainly on short rotations to produce pulpwood for paper manufacturing. However, with improved technology and emphasis on value adding, it is anticipated these plantations will increasingly be used for sawlog or veneer production similar to softwoods.

Current Victorian Government policy prohibits the clearing of native forest on public land to establish plantations. Native forest can be cleared on private land for plantation establishment subject to native vegetation retention controls to protect flora and fauna, and also to local government planning requirements. Consequently, opportunities for plantation development are available only on public lands that do not presently contain forest, which are limited in area, and on predominantly cleared areas of private land that satisfy the vegetation retention and planning controls.

Whilst the primary focus of RFAs is on public native forests, and where necessary private native forests, the Scoping Agreement for Victorian RFAs also provides for analysis of a region's potential for plantation expansion as an input to considerations of potential industry development and infrastructure options. However, it is important to note that the use and management of cleared private land is not covered by RFAs.

This chapter outlines the substantial Gippsland region plantation resources and their potential for further development.

6.2 POLICIES, PROGRAMS AND INITIATIVES

Policies and Programs

State and Commonwealth Governments have developed policy and program initiatives to allow for plantation development and management in the context of economic efficiency, social considerations, and environment and heritage issues. It is a policy position of Victoria and the Commonwealth in the National Forest Policy Statement (NFPS) (Commonwealth of Australia 1992b) that:

The wood products industry is drawing and will continue to draw wood from a mix of sustainably managed softwood and hardwood plantations and native forests.

This position was reaffirmed in the Wood and Paper Industry Strategy (WAPIS) (Commonwealth of Australia 1995).

National Forest Policy Statement

The NFPS sets several goals for forest management. For plantations:

... One goal is to expand Australia's commercial plantations of softwoods and hardwoods so as to provide an additional, economically viable, reliable and high-quality wood resource for industry. Other goals are to increase plantings to rehabilitate agricultural land, to improve water quality, and to meet other environmental, economic or aesthetic objectives.

Objectives in the NFPS directed towards achieving these goals for Australia's plantation resource are to:

- increase commercial plantation development on cleared agricultural land and, where possible, to integrate plantation enterprises with other agricultural land use;
- improve the productivity of existing plantation areas by means of improved technology, breeding of genetically improved stock and selection of species; and
- encourage industrial growers, and where appropriate public forestry agencies, to expand their plantation base to satisfy specific requirements.

Governments also agreed through the NFPS:

- Decisions to establish plantations for wood production should rest on their economic viability. The States will adopt commercial approaches for their plantations and will continue to ensure that the public plantation resource is actively managed in order to maximise net returns.
- State and local governments will provide a planning framework that facilitates the development of large-scale industrial plantations by ensuring that impediments to plantation development are minimal in areas such as taxation, planning and access to information.
- Consistent with ecologically sustainable management objectives, the States will not clear public land for plantation establishment where this would compromise regional conservation and catchment management objectives. In particular, Victoria has a policy of not clearing public native forests for plantation development.

The plantation objectives of the NFPS are being implemented through a number of initiatives, including the Wood and Paper Industry Strategy (WAPIS). The WAPIS is a four-year initiative of the Commonwealth Government, which commenced in 1996, to encourage investment, value adding and growth in employment in forest related industries. To this end, it will promote continued development of a diverse, internationally competitive industry based on ecologically sustainable management practices, and assist the integration of industry and conservation objectives for Australia's native forests and plantations.

Notable features of WAPIS include removal of impediments to plantation development in areas such as taxation; improved planning and access to information; review of pricing policies and export controls; and promotion of plantation research and development.

WAPIS acknowledges that plantation industries can contribute to regional economic development by locally value-adding to primary production, resulting in more jobs. When developed on farms, plantations also provide substantial benefits to landholders and the broader community in relation to greenhouse, environment, landcare and agricultural productivity.

The Commonwealth Export Control (Unprocessed Wood) Regulations have been amended under the *Export Control Act 1982* so that an export licence is no longer required for timber sourced from a plantation if the Minister for Primary Industries and Energy has approved a code of plantation practice for the State from which the wood is sourced. On 25 March 1997, following consideration of assessment reports prepared by the CSIRO and other relevant information, the Minister approved the Victorian Code of Forest Practices for Timber Production and associated procedures.

The Victorian Private Forestry Program and the Commonwealth Farm Forestry Program are implementing initiatives addressing the NFPS objectives on plantation resources. In addition, Commonwealth and Victorian legislation pertaining to plantation development has been reviewed. Victorian forestry rights were approved by Parliament in 1996 under the *Victorian Forestry Rights Act 1996*, providing for Forest Property Agreements between landowners and

tree growers that give legal title for trees separate from the land. This allows investors to grow and harvest plantations on land under separate ownership, which promotes the trading of trees through a legal market.

The Victorian *Planning and Environment Act 1987* provides for establishment of forestry plantations up to 40 ha in some areas without a planning permit.

Plantations 2020 Vision

In 1996, the Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA) agreed to a national goal to treble the area of Australia's plantations by the year 2020. The Standing Committee on Forestry (SCF) was required to report on how the target might be accomplished. The SCF and industry have since formulated an implementation plan, *Plantations for Australia: The 2020 Vision*, which was endorsed by the MCFFA in 1997 (MCFFA 1997).

The Vision states that:

By 2020, plantation forestry in Australia will be a sustainable and profitable long rotation crop with significant private sector investment.

The plantation growing and processing industries will:

- *operate in the global marketplace;*
- *be internationally competitive; and*
- *be commercially oriented, market driven and market focused in all their operations.*

Returning trees to the landscape as a profitable crop will also significantly benefit the environment.

To treble the 1996 plantation estate of 1 million ha will require a national average of 80 000 ha per year of new plantations from 1996 to 2020. In 1998, 65 000 ha of new plantation were established nationally. This compares with a national average expansion rate between 1960 and 1994 of around 25 000 ha per year. Governments and industry are collaborating to create an environment that will attract further investment to implement and expand the plantation program, and enhance the growth of forest industries to contribute to the Australian economy, rural communities and regional development.

In 1996, the Victorian Government established a Ministerial Taskforce to develop a strategy for private forestry in Victoria aimed at increasing plantation development in Victoria, in line with the national 2020 Vision. The taskforce's report, *Towards a Victorian Private Forestry Strategy*, was presented to the Victorian Government in May 1997 and resulted in the appointment of a Private Forestry Council by the Minister of Agriculture and Resources. Its membership is taken from key stakeholders in the private and public sectors and members are appointed for three years. The Council's task was to develop a strategy and produce an implementation plan (PFC-VIC 1998). The taskforce report underpinned the preparation of the State strategy, *Private Forestry in Victoria: Strategy Towards 2020*, released in May 1998, aims to guide the expansion of plantations on private lands.

The Strategy has six elements:

- achieving broad public support for private forestry — *embracing community support*;
- providing clear roles for state and regional bodies to facilitate private forestry — *forging better links*;
- identifying suitable land for commercial tree growing — *finding the commercial land base*;

- strengthening local government support for regional private forestry — *developing the partnership with local government*;
- encouraging investment options in private forestry — *recruiting capital into the sector*; and
- increasing the competitiveness of the private forestry sector — *gaining the competitive edge*.

Achievement of the vision will have benefits such as improved investment and infrastructure; regional jobs; increased farm incomes where private forestry is fully integrated with other agricultural enterprises; a surplus in national trade deficit in wood and wood products; and providing catchment protection and other environmental benefits.

Commonwealth Farm Forestry Program

The Commonwealth's Farm Forestry Program commenced in 1993. It aims to promote commercial wood production on cleared agricultural land and, where possible, the integration of plantation enterprises with other agricultural land uses.

Both the NFPS and WAPIS provide the framework for implementing the aims and objectives of the farm forestry program in relation to plantations. The key strategic aims are:

to develop and enhance regional farm forestry strategies, focusing in particular on industry development but also on integrating commercial tree growing activities with other land, water and vegetation management strategies.

Other actions that contribute to the aims of the program include:

- the establishment of Regional Plantation Committees (including Gippsland Farm Plantations Inc.);
- enhancement of communication and cooperation amongst all stakeholders;
- training and education;
- local government planning reform; and
- research into farm-forestry including methods for on farm land suitability assessment, growth projections and inventory.

Through WAPIS, the Commonwealth Government has provided around \$17 million nationally for some 50 projects over the period 1996 to 2000, including nearly \$5 million for 11 projects in Victoria.

The Natural Heritage Trust (NHT), which commenced in 1998, will implement programs with the intention of developing sustainable agriculture and natural resource management while protecting biodiversity. Under the NHT the Commonwealth has provided \$22 million to enhance the Farm Forestry Program during 1997-98 to 2000-01. Nationally, an additional \$14.5 million has been allocated to the Farm Forestry Program from Bushcare: National Vegetation Initiative to develop and promote commercial wood and non-wood products, especially where priority is given to biodiversity and land degradation issues, such as the use of native species in lower rainfall regions. Of this, \$0.65 million was allocated for projects in Victoria in 1997-1998, and \$0.97 million has been allocated for 1998-99.

Gippsland Farm Plantations Inc

Gippsland Farm Plantations Inc (GFP) was established as a WAPIS project in September 1996 under the Commonwealth Farm Forestry Program, with funding of \$1.1 million over four years, to implement the 'Gippsland Farm Forestry Project'. It operates under a Board of Management (the Board) comprising representatives of wood processing, power generation

and agricultural industries, corporate and private plantation growers, regional catchment and economic development agencies, and the Department of Natural Resources and Environment.

The Project's vision is:

Gippsland will have a substantially increased area of commercial wood production on private land, comprising a resource that is strategically located, well managed, and market oriented.

GFP's goal is 'to facilitate the establishment of more than 10 000 ha of commercially viable plantations (principally eucalypt) in the Gippsland region over the next 10 years'. For this purpose, the Board has identified a number of objectives which aim to:

- identify and attract profitable market opportunities for private Gippsland farm forest growers;
- encourage Gippsland landowners to consider plantations as a viable land use on their properties;
- attract investment capital to fund plantation establishment and management in the region;
- improve community attitudes towards plantations as a valuable rural activity; and
- coordinate strategic plantation development initiatives.

The GFP region incorporates six shires, five of which are in the Gippsland RFA region. They cover dryland areas with plantation potential, which are characterised by good growing conditions, proximity to major buyers, relatively low risk factors and a history of plantation management and industry. Two reports from a consultant were provided to the GFP Board in December 1998. The 'Regional Resources and Industry, Future Capacity and Opportunities' report provides information on the region's land, existing plantation and forest resources, forest industries, infrastructure, social factors, plantation risk factors, opportunities for plantation development, environmental values, regional capacity and future opportunities. The second report 'Regional Strategy and Action Plan' looks at the Region, in terms of carbon credits, forest product markets and investment climate, and at the forest, in terms of pulpwood plantations, softwood sawlog plantations, hardwood sawlog plantations, boutique tree farms, low rainfall tree farms and native forests.

Victorian Private Forestry Program

The major role of the Department of Natural Resources and Environment's Private Forestry Program is to facilitate the development of the commercial private forestry sector.

In addition to the \$5 million funding from the Commonwealth Farm Forestry Program over the four years from 1996, Victoria will provide at least \$5 million of State funding over the same period to enhance the uptake of farm forestry. Support includes: extension; demonstration; education and training; information gathering and dissemination; planning and coordination; practical research and development activities including inventory of private forests; land capability assessment; and growth modelling.

Social and Environmental Implications of Plantations

Past experiences with plantation expansion in farming landscapes have revealed both favourable and unfavourable perceptions of their socio-economic and environmental consequences (Spencer & Jellinek 1995). Therefore, plantation expansion under the 2020 Vision will require careful attention to these issues in the planning and implementation phases. Plantations affect different sectors of society in different ways and generate a variety of concerns according to individual and group perspectives. Economically, agriculture and forestry exhibit major differences in cash flows, but these can be evaluated through cost-benefit analysis (Trapnell & Lavery 1989). Environmentally, plantations can confer many

benefits, however, in the past, land purchase by governments and corporations for plantation establishment has led to concern by some landholders and rural communities about:

- population decline, leading to loss of community services and erosion of local government rate bases;
- falls in land value; and
- costs of maintaining road networks.

To address the issues, the Victorian Government initiated a State Plantations Impact Study (SPIS), which resulted in a comprehensive report on impacts to stimulate discussions (Centre for Farm Planning and Land Management 1989), followed by a report (SPIS 1990) with 41 recommendations relating to plantation development and management on cleared agricultural lands, covering:

- current and future wood demand;
- procedures for land purchase;
- relative socio-economic benefits of forestry and agriculture;
- socio-economic impact;
- plantation share-farming;
- fire management;
- environmental impact of plantations; and
- hardwood plantations.

Many of these recommendations have been subsequently addressed, either directly or indirectly, through reforms to administrative and operational procedures stemming from the NFPS. For example, the Victorian Government's Code of Forest Practices for Timber Production (NRE 1996a) directs plantation development and harvesting in a manner consistent with the principles of environmental care and is designed to ensure that appropriate attention is given to environmental aspects.

In agricultural landscapes many socio-economic and environmental benefits can be gained from further plantation development, including:

- protection for soil and water values;
- groundwater management;
- waste water disposal;
- landscape improvement;
- crop and stock protection; and
- diversification of farm income.

Active involvement of farmers in such development can improve their understanding and support of plantations and encourage a sense of local ownership. This in turn can help to achieve expansion targets in ways that maximise community benefits and economic viability.

6.3 CURRENT RESOURCE AND MANAGEMENT

Current Resource

As of 1998, there are some 250 000 ha of plantations in Victoria (PFC-VIC 1998); 220 000 ha principally of Radiata Pine, and 30 000 ha of various Eucalypts. Ownership of plantations in Victoria is fairly evenly divided between the public and private sectors, whereas the national average for private ownership is 27 per cent.

The Gippsland RFA region falls within the Central Gippsland plantation region, which on the basis of area planted is in the middle of Australia's 15 softwood plantation regions identified in the National Plantation Inventory (BRS 1997a). Two of these regions are wholly within Victoria and another three are partly within Victoria. The Central Gippsland region extends from the eastern suburbs of Melbourne along the Princes Highway corridor to Bairnsdale. The

Central Gippsland plantations are generally located within the area bounded by Warragul, Yarram and Sale, with outliers to the west of Bairnsdale. The resource is substantially based on the Strzelecki Ranges and the coastal plain to the east.

The total plantation area in the Gippsland region in 1998 was approximately 85 700 ha. Of this area, some 54 000 ha are owned by Australian Paper Plantation Pty Ltd (APP), 26 000 ha of plantation are owned by Hancock Victorian Plantations Pty Ltd, and some 5 700 ha are in private ownership (GFP 1998). In 1998, the Hancock Timber Resources Group acquired the plantation resource of the Victorian Plantations Corporation (VPC). Current roundwood supplies to industries in the region total approximately 450 000 m³ of sawlogs and 615 000 m³ of pulpwood.

The plantations support major regional industries in Maryvale (Australian Paper Ltd), Morwell (Brown & Dureau Building Materials Pty Ltd), Yarram (McDonnell Industries) and Moe (Planthard Pty Ltd). Collectively, these industries process both softwood and hardwood sawlogs, and residual roundwood for pulp and paper products. At least seven smaller firms preserve pine roundwood, with one of them sawing timber as well. They are located in at Alberton, Darnum, Fish Creek, Maffra, Morwell and Traralgon within the region.

Small sawlog/pulp logs from the region are sourced for the export facility at Geelong through SPE (Management) Pty Ltd and through Midway Pty Ltd.

The former VPC was not expanding its softwood plantation base in the region, but was replanting harvested areas using enhanced silvicultural practices and genetically improved stock. However, there is potential to expand the area of plantations by up to 20 000 ha, in the vicinity of Yarram, Leongatha and Port Welshpool. These plantations have been managed on a rotation of around 35 years, or 28 years in hilly country for sites designated for conversion to eucalypt. However, this is varied to meet requirements for different product mixes from thinnings and final fellings for established and new customers. The hardwood plantations are managed on a rotation of around 30 years for Mountain Ash and 20 years for Tasmanian Blue Gum. Mountain Ash/Shining Gum (*E. regnans/E. nitens*) are used in the higher elevation, wetter sites with Blue Gum being used on the lower, drier sites.

APP currently plants 2600 ha per annum which is split evenly between replanting (softwood) and new planting (hardwood) to achieve an estate of 64 000 ha by 2015, with approximately equal areas of softwood and hardwood. It is rationalising its plantation estate to focus on hardwood in the western higher elevation/rainfall zones, and softwoods to the drier, flatter eastern areas with suitable rainfall. Most new plantings will be on purchased farmland with some on ex-softwood sites. The softwood plantations are managed for two thinnings, followed by clearfelling at about 26 years (varying from 24-30 years); the hardwoods are managed for clearfelling without thinning at 20 years. Blue Gum is the preferred species, but Shining Gum is used on higher elevation wetter sites.

The area of private plantations is also stable, with only minor additions being made by small growers, although the intention of Gippsland Farm Plantations Inc. program is to increase this figure over the next 10 years.

Plantation Management

Plantation management in Victoria must comply with the Code of Forest Practices for Timber Production (Code) (NRE 1996a). The Code provides Statewide goals and guidelines for plantation establishment and management, and a number of Statewide minimum standards (such as set back reservations along streamsides).

Compliance with the Code on private lands and public land vested with the Victorian Plantations Corporation (VPC), including plantations licensed to Hancock Victorian Plantations Pty Ltd, is required through Planning Schemes administered under the *Planning and Environment Act 1987*. Monitoring of operations on these lands is the responsibility of local municipalities through their planning scheme provisions.

The newly formed Hancock Victorian Plantations Pty Ltd acquired the rights to grow and harvest timber on licensed State owned land. The company acquired the rights over approximately 168 000 ha, with a net plantation area of approximately 107 000 ha of softwoods and 8000 ha of hardwoods. Of the 26 000 ha of plantations in the Gippsland region, approximately 30 per cent are hardwoods.

Australian Paper Plantations Pty Ltd (APP), part of the Amcor group of companies, manages its own plantations and purchases additional wood to supply its internal divisions, principally Australian Paper. APP is Australia's major private plantation owner. About 60 per cent of its 85 000 ha of plantations are within the region. The firm's policies are to maintain pine plantations to supply long fibre; manage pine plantations for optimum yields of softwood sawlogs and pulpwood; expand eucalypt plantations for short fibre production, and support private tree growing initiatives in areas economically feasible in relation to APP operations.

The Victorian Code and associated controls have been accredited by the Commonwealth Government as the basis for removing export controls on plantation products.

6.4 PLANTATION POTENTIAL

The total area of private land in the region is about 1.2 million ha, of which 955 000 ha are classified as 'not forested' (BRS 1997b). Although the region has the physical capability to support a variety of species, only a few would be appropriate for large scale plantations. This is due to the availability of markets, the composition of existing plantations in the region and processor preferences for a narrow range of species. Three species identified as having immediate plantation potential are *P. radiata*, *E. nitens* and *E. globulus*.

Land Capability and Suitability

Plantation land capability assessment identifies locations where the biological growth requirements of a species are satisfied (Bush *et al.* 1998). The capability of cleared private land in the Gippsland region for both *P. radiata*, *E. nitens* and *E. globulus* plantations has been assessed by Borschmann (1998) and mapped by BRS.

Borschmann correlated rainfall, elevation and geology with growth rates of existing plantations to estimate the mean annual increment (MAI), expressed in cubic metres per hectare (m³/ha) per year, that could be expected for new plantations in the region. The area of private land that is not forested and capable of supporting plantations for Blue gum, Shining gum and Radiata pine with an estimated MAI of at least 16 m³/ha/year is 761 000, 389 000 and 758 000 ha respectively. Less than 2.5 per cent of the land capable of supporting commercial plantations has slopes greater than 20 degrees, which require more expensive harvesting methods. All of the capable land in the region is within 100 km of either a processing centre or port, namely Melbourne, Geelong, Hastings, Barry's Beach, Morwell, Yarram, Sale, Orbost and Bairnsdale, and 80 to 90 per cent of this land is within 50 km of these centres.

Land that is capable of growing commercial plantations may not always be suitable for this purpose. Land suitability analysis involves the integration of biophysical (i.e. land capability) and socio-economic factors to determine the economic viability and social acceptability of using land for a particular use (Bush *et al.* 1998). In some instances, for example, there may be alternative uses that yield a superior economic return or the land may be too steep or too

distant from processing plants to be suitable for commercial plantations. A plantation suitability analysis has not been completed for the region, but is being considered by Gippsland Farm Plantations Inc.

Economic Analysis of Land Suitability

Discounted cash flow analysis can be used to estimate the value of land for softwood and hardwood plantation development. These values are then compared to current land values in order to determine economic suitability.

It should be noted, however, that specific plantation investment proposals are a matter for commercial decision by corporations, companies and individuals, and would need to be evaluated on a case-by-case basis after detailed resource and economic assessment.

There is considerable interest in Australia in growing hardwood plantations for sawlogs because they can be used to make high value products with appearance and strength properties that are superior to pine products. Although this may result in higher log prices for hardwood, the costs of production are also higher. Other factors favouring hardwood sawlog plantations are their additional aesthetic and environmental qualities for farm forestry.

The potential for expanding farm forestry or agroforestry is less dependent on the price of land and size of property. Landowners pursue small scale forestry activities for various reasons, including:

- environmental benefits — as part of a whole farm management strategy;
- relatively low maintenance in comparison to agriculture (attractive to absentee landlords);
- taxation purposes; and
- diversification of income.

6.5 PLANTATION OPTIONS

There are a number of options for establishing plantations in the Gippsland region. At one end of the spectrum, plantations could be established to augment the current large-scale commercial investment, whilst at the other, farm-forestry, agroforestry and land protection may be feasible options in certain circumstances. HVP is expected to replant second/third rotation plantations without expanding the current estate and it is APP's intention to expand its current estate by about 23 per cent. However, the opportunity exists for increasing the area of softwood plantations on private land, as well as a continuation of hardwood plantation establishment on sites with suitable rainfall, to supply products to existing and future industries.

The integration of farm forestry (agroforestry and land protection) into Australian farming systems contributes to:

- delivery of environmental benefits;
- diversification of agricultural enterprises;
- enhanced agricultural production;
- sustainable land management practices;
- land rehabilitation;
- habitat enhancement and biodiversity conservation; and
- aesthetic enhancement (RIRDC 1996).

Examples of broad options are represented in Figure 6.1 and outlined below.

Industrial or off-farm investor plantation options:

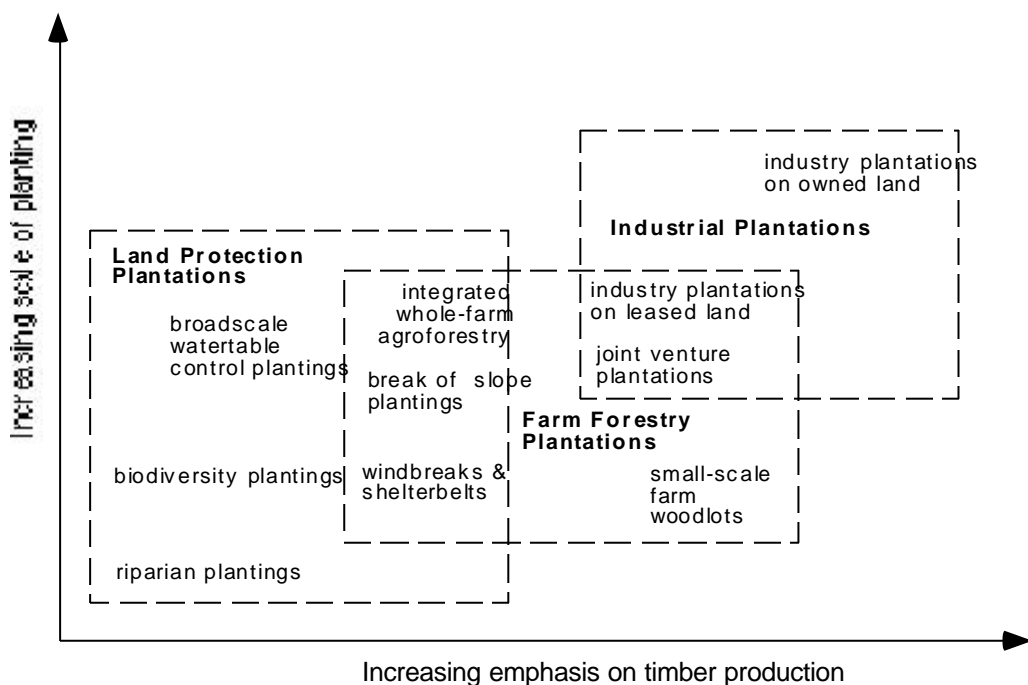
- Sawlog-driven softwood plantation — close spacing, 2-3 thinnings for pulp or preservation and clearfelling for sawlogs at 30+ years;

- Clearwood sawlog-driven softwood plantation — high lift pruning operations, thinning to lower stocking for faster, increased diameter growth;
- Eucalypt pulpwood plantation — close spacing, short (10-20 year) rotation; and
- Eucalypt sawlog/veneer plantation — normal spacing, high pruning, thinning to lower stocking for faster diameter growth, on a medium (30-60 year) rotation.

Farm-forestry/agroforestry options, which are integrated with a property’s agricultural pursuits and are applicable to both softwood and hardwood:

- Timberbelts — alley farming system managed for timber with pruning and thinnings, while providing shelter for agricultural land;
- Wide spaced trees pruned for clearwood with grazing or inter-cropping; and
- Woodlots (small plantations) with lots greater than 10 ha becoming more economically efficient — suited to joint venture arrangements or subject to Government funding initiatives (NRE 1997f).

Figure 6.1: Plantation Options: Scale and Purpose



For plantation expansion to occur in the region, a number of elements need to be brought together, these being land, capital and expertise. For new (and existing) plantations to be profitable, there must be markets (domestic and export) to which the various plantation products can be sold economically. Plantations are, and will be, grown by a range of entities for a variety of purposes. Table 6.1, prepared by Gippsland Farm Plantations Inc, summarises the characteristics and needs of existing and future participants in the Gippsland plantation industry (GFP 1997).

Table 6.1: Plantation Grower Characteristics and Needs

Increasing scale →						
Grower type	Farmer		Investor		Industrial/Corporate	
Objectives	Income diversity Farm value Farm productivity		Dollar return Income diversity Tax offsets		If Grower only: Dollar return If Vertically Integrated Processor: Resource security Price control	
Characteristic	Own land		Own capital		Own capital	
Variations	Own capital	Other's capital	Own land	Other's land	Own land	Other's land
Needs		Joint Venture agreement		Joint Venture agreement		Joint Venture agreement
	Establishment & silvicultural advice; Markets		Establishment & silvicultural advice; Markets		Markets, if not vertically integrated; Resource supplementation	

Source: Gippsland Farm Plantations Inc. Business Plan 1997-2000 (1997)

7. OTHER FOREST PRODUCE

Forests of the Gippsland region supply a range of products and benefits in addition to the sawlog and residual wood discussed in Chapter 3. These include minor forest produce such as posts and poles, other hewn timber, firewood, wood chop blocks and specialty timbers, and uses including grazing and apiculture. The current economic values arising from these activities and future opportunities for other forest produce are described in this chapter.

Other forest uses include recreation and tourism; water production; and mineral exploration and mining (including extractive industries such as gravel and stone). These uses are discussed in Chapters 8, 9 and 10 respectively.

7.1 MANAGEMENT

Like larger scale sawlog and residual wood production, management for other forest produce is aimed at sustaining supply and minimising environmental impacts.

Regulation of other forest production activities outlined in this chapter is through licensing systems. The operations are subject to conditions set out in the licences or permit. Management planning and supervision normally increase in relation to the potential impact of the activity.

Production of some minor forest produce complements other forest uses, e.g. specialty timbers and firewood may be by-products of sawlog harvesting or stand management operations.

7.2 PROFILE OF EXISTING SUPPLY, USAGE AND DEMAND

Minor Forest Produce

Most minor forest produce is harvested under short-term, small quantity licences, issued to individuals for private and small scale commercial use. Annual licences may be issued to commercial cutters for the production of posts, poles and firewood. Areas from which minor forest produce is taken, including commercial firewood, posts and poles, are included in the wood utilisation planning process discussed in Chapter 3.

Total royalties received by NRE for commercial production of other forest produce in the Gippsland region was \$131 175 in 1996-97 and \$88 322 in 1997-98 (Table 7.1). This excludes revenue from grazing and apiary licences, which are discussed later in this chapter.

Firewood

The extent of domestic firewood collection from forests varies across the Gippsland region. Major towns, including Traralgon, Bairnsdale, Sale, Lakes Entrance, Yarram and Warragul, have the greatest demand for firewood due to their population size. The increase in popularity of wood heaters has further increased demand in recent years. Firewood is supplied from both State forest and private property, and collection areas include designated areas of State forest to the north of Bairnsdale and Briagolong, Boola Boola State Forest, and Colquhoun State Forest near Lakes Entrance. In the south of the region, Mullungdung, Won Wron and Alberton West State Forests supply Yarram, Leongatha and surrounding towns. Towns outside the RFA region such as Erica and Nowa Nowa also use the State forests in Gippsland for firewood.

Table 7.1: Gippsland Other Forest Produce Royalty Revenues

Product	1996-1997 \$	1997-1998 \$
Sleepers	403	0
Hewn Timbers	3 312	1 782
Bush Sawn/Split Timbers	8 200	18 866
Round Timbers	27 725	5 058
Stakes and Props	0	74
Specialty Timbers and Craftwood	1 057	57
Wood-Chop Blocks	310	296
Firewood	66 488	59 688
Poles	1 865	2 187
Seed Capsules	21 815	14
Other	0	300
Total	131 175	88 322

Source: NRE Annual Reports 1996-97 and 1997-98; Note: 'Other' may include floral arrangement material, sawdust, barrel staves, banksia cones, etc.

Durable timbers including Red Ironbark (*Eucalyptus sideroxylon*), Red Box (*E. polyanthemos*), Gippsland Grey Box (*E. bosistoana*) and red gum species are often preferred by firewood collectors because of their higher density. Other species utilised include Yellow Stringybark (*E. muellerana*), White Stringybark (*E. globoidea*) and other foothill forest species.

Many firewood collection areas are open to the public during the drier months of the year, and some suitable sites are open all year. Firewood can be supplied from:

- residual material remaining after normal timber-harvesting operations;
- salvage operations, following for example wild fire;
- thinning operations;
- timber stand improvement works; and
- timber on the ground throughout areas of State forest and roadsides.

Firewood must be collected from material on the ground, as private firewood collectors are not permitted to fall trees.

Commercial cutters collect firewood from logging residues following sawlog harvesting or during thinning operations. For example, thinning residues from operations in the Boola Boola State Forest are collected for firewood.

Firewood collection requires considerable management input to address issues such as providing winter access, minimising road damage, supervising firewood cutters, marking of areas available for collection, operator and public safety, and collecting fees. The timing of regeneration burns in harvested areas that are available for firewood collection is another important consideration. Different firewood royalty rates are sometimes applied for summer and winter firewood licences, recognising the additional costs of maintaining firewood areas and access roads during winter.

Commercial cutters in State forests are required to hold a Forest Operator Licence and a Forest Product Licence, and their operations are subject to conditions set out in Forest Coupe Plans.

Firewood licences sold in Gippsland during 1997-98 returned \$59 688 in royalties (Table 7.1), which was for approximately 12 000 m³.

Posts, Poles and Other Hewn Timbers

While a number of commercial cutters supply posts and other hewn timbers to the local market, some land-owners have traditionally met their own requirements under licences issued over nearby forest. Provision of post and pole material varies across the region depending on availability of durable species. In some locations, Red Stringybark (*E. macrorhyncha*), Red Box and other durable species from low foothill forests and woodlands are utilised from State forest and private property. The small market for such timbers is reflected in the relatively low revenue detailed in Table 7.1.

Commercial cutters in State forest are required to hold a Forest Operator Licence and a Forest Produce Licence, and their operations are subject to conditions set out in Forest Coupe Plans.

Specialty Timbers and Craftwood

Species such as Red Ironbark and Yellow Stringybark produce timber with attractive colour and figure, making them sought after for use in furniture manufacturing and wood-turning. Burls from trees cut in harvesting coupes are also sought after by wood-turners. The supply of specialty timbers is generally small and is variable, depending on the availability of suitable species.

Specialty timbers such as Blackwood (*Acacia melanoxylon*) or Silver Wattle (*A. dealbata*) may become available in small quantities during sawlog harvesting operations or road construction. These are supplied under specialty timber/craftwood licences.

Grazing

Cattle grazing has a long-standing association with Gippsland, dating back to the 1800s in alpine areas. Cattle are taken to high elevation grazing blocks on public land in late spring or early summer and remain there until autumn, subject to licence conditions. Grazing in the higher elevations over the summer months allows for maintenance of stock condition and the conservation of home pastures for winter use. Grazing may also be carried out year-round on lower elevation grazing blocks in State forest and on other public land.

Graziers must obtain a licence to graze cattle or other livestock on public land. As shown in Table 7.2, grazing licences are issued in Gippsland covering four different categories. These licences are issued subject to conditions in accordance with the relevant legislation under which the land is managed, namely the *National Parks Act 1975*, *Forests Act 1958*, *Land Act 1958* and *Wildlife Act 1975*. Conditions in all licences usually include restrictions on the number of stock, access dates and transfer of these licences.

Alpine grazing licences, which generally cover areas above the snowline (1220 m elevation), are issued annually in State forest, although grazing may only take place during specified periods. Seasonal bush grazing licences cover sub-alpine and foothill forests on public land, and allow grazing for part of the year. Seven-year licences are being introduced for seasonal, alpine and bush grazing in State forest from 1998. This applies to 52 seasonal bush grazing licences in Gippsland. Other grazing licences are issued for a twelve-month period.

Grazing licences have been issued for the Alpine National Park, in accordance with the *National Parks Act 1975*. Grazing is prohibited in specified areas of the Park including the Howitt Plains and adjacent areas, and reference areas.

In 1997-98, licences covered over 470 000 ha of public land in Gippsland, returning around \$80 000 in revenue to NRE. A large number of these licences were issued for grazing under the *Land Act 1958*, which covers unreserved public land, e.g. unused roads and water frontages (Table 7.2).

Table 7.2: Number and Area (ha) of Grazing Licences Issued, 1997-98

Licence Type	Land Act 1958		Forest Act 1958		National Parks Act 1975		Total	
	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.
Grazing	50 700	275	15 157	8	3 415	6	69 272	289
Bush Grazing (seasonal)	27 512	10	17 222	5	7 856	8	52 590	23
Alpine Grazing	79 822	12	115 010	22	150 149	20	344 981	54
Alpine Contiguous	738	2	3 480	1	932	2	5 150	5
Total	158 772	299	150 869	36	162 352	36	471 993	371

Source: NRE Land Information Management System (LIMS) Parks Victoria; Alpine contiguous licences adjoin areas which are licensed for Alpine National Park Grazing; One grazing licence, covering 8 ha, was issued under the *Wildlife Act 1975*.

Cattle grazing on public land is economically important to graziers, allowing higher stock numbers to be carried by individual farms. Many graziers have devised systems of management that integrate feed supplies from the home paddock and grazing runs. A study commissioned by the LCC in 1977 found that alpine grazing enabled licence-holders to run up to 40 per cent more stock on average than their farm would otherwise allow (LCC 1977). Other studies on alpine grazing have found that cattle returning from runs are usually 'in first class condition and can bring top prices' due to a perceived increase in quality (Chisholm and Fraser 1997). At special autumn calf sales in Omeo and Benambra, stock grazed in alpine areas have historically attracted prices 10 per cent higher than other stock from Victoria and southern New South Wales (pers. comm. Office of Valuer General 1998).

The beef cattle industry accounts for approximately 24 per cent of the gross value produced by agricultural industries in the Gippsland region; in contrast, sheep and lamb production provide 3 per cent of the gross value in the region. As shown in Table 7.3, the contribution of beef cattle production to the total agriculture industry value in Gippsland is higher than the overall Victorian contribution.

On currently available data, it is not possible to quantify the contribution that public forests make to the beef cattle industry, although it is considered to be significant.

Table 7.3: Gross Value of Production (GVP) in Gippsland for the Beef Industry 1994-95

	Beef GVP (\$ million)	Proportion of GVP (%)	Total Agricultural GVP (\$ million)
Gippsland	132	24	555
Victoria	776	15	5147

Source: Statistical Information Services, NRE.; compiled October 1996 from ABS data.

Apiculture

Apiarists use forests of the Gippsland region for honey production. Small-scale production occurs in foothill forests, river valleys and coastal areas using species such as Yellow Box (*E. melliodora*), Red Ironbark (*E. sideroxylon*), But But (*E. bridgesiana*), Red Stringybark (*E. macrorhyncha*), Silvertop (*E. sieberi*) and Long-leaf Box (*E. goniocalyx*). Other forest types containing alpine eucalypt species e.g. Snow Gum (*E. pauciflora*) and Alpine Ash (*E. delegatensis*), and associated understorey species provide honey flow at times when the drier forest types are less productive.

Many apiarists monitor flowering patterns, shifting their hives to take advantage of the different flowering times of various species. When conditions are highly favourable, apiarists may bring hives from other regions into Gippsland (Abbott *et al.* 1993). However, a

proportion of forest in the region is not used by beekeepers, primarily due to poor access, inappropriate site conditions or unsuitable flora. Apiaries are excluded from areas proclaimed under the *Reference Areas Act 1978* and some other areas, such as Wilderness Parks and Wilderness Zones established under the *National Parks Act 1975*.

Apiculture on public land is controlled through the issue of annual licences and temporary permits (three and six months). Licences and permits allow access to a site for locating hives and use of forest nectar and pollen resources within a radius of 1.6 km or 0.8 km for annual and temporary sites respectively. Currently, there are eight annual bee sites and 385 temporary bee sites licensed in the Gippsland region (Table 7.4). There are numerous other temporary sites in the region which are not currently licensed.

Table 7.4: Licensed Bee Sites in the Gippsland Region

Land Tenure	Annual	Temporary	Total
<i>Land Act 1958</i>	-	235	235
<i>Forest Act 1958</i>	8	133	141
<i>National Parks Act 1975</i>	-	17	17
Total	8	385	393

Source: NRE Land Information Management System (LIMS) 1998

In 1997-98, NRE received \$15 570 in royalties from beekeeping licences and permits in Gippsland. These royalties represent only part of the economic value derived from beekeeping activities. Honey is the major product of the Victorian apiary industry, of which approximately half is exported. Other produce includes beeswax, pollen and royal jelly. Pollination of food and seed crops is an external benefit of apiculture. It has been estimated that increased food and seed crop production through pollination is approximately \$251 million in Victoria (Gibbs and Muirhead 1997).

The level of honey production in Gippsland is estimated to be an average of 675 tonnes per annum and as shown in Table 7.5, the total value of honey and related products is estimated to be \$1 million.

On the information currently available it is not possible to quantify the contribution that public forests make to this industry, although it is considered to be significant. According to Gibbs and Muirhead (1997), eucalypt species represent the bulk of available honey and pollen resources for Australian honeybees.

Table 7.5: Gippsland Beekeeping Production Values 1997-1998

	Honey (\$)	Other goods & services (\$)	Total (\$)
Gippsland ^(a)	950 000	50 000 ^(c)	1 000 000
Victoria ^(b)	7 700 000	1 600 000	9 300 000

Source: (a) Gippsland Apiarists Association, 1999 (pers. com.); (b) Gibbs and Muirhead 1997; (c) does not include pollination services

Other Produce

Presently there is low demand for other forest produce such as floral arrangement material, sawdust, barrel staves, banksia cones and live plant specimens. Protected flora species can only be taken from public land by permit under the *Flora and Fauna Guarantee Act 1988*. A permit for harvesting of minor forest produce and payment of a royalty is usually required.

NRE supplies suitable material to the organisers of wood chopping events. Alpine Ash (*E. delegatensis*), Messmate (*E. obliqua*) or other non-durable species are preferred for woodchop blocks. The market for this product is unlikely to increase in the future.

NRE employs contractors to collect seed for regeneration of logging coupes. In addition, quantities of seed are collected by private companies and other organisations under permit and a royalty is paid by capsule weight. The most sought-after species is Shining Gum (*E. nitens*) for plantation establishment.

7.3 OUTLOOK AND DEVELOPMENT OPPORTUNITIES FOR OTHER PRODUCE

Minor Forest Produce

Due to the close proximity and size of the potential markets for minor forest produce in Warragul, Traralgon, Sale and Bairnsdale, the demand for produce could increase in the future with the growth of these towns. Supply of some products such as specialty timbers and seed depends on their availability. The demand for other products is affected by competing products, e.g. hardwood posts and poles compete against treated pine products for market share. The product with the most potential for increased production in the Gippsland region is firewood.

Firewood

Steady growth in demand is expected with the increasing number of domestic wood burning stoves and heaters being installed in homes. While the long-term demand for fuel wood is linked with the price and availability of major energy sources such as natural gas, the demand for firewood is expected to continue to increase in line with population growth.

Residual timber remaining after timber harvesting operations is currently under-utilised. Opportunities exist for commercial operators to harvest firewood from State forests for sale in local and Melbourne markets. A proposal for large-scale firewood operations in the Gippsland region is currently being negotiated between NRE and the Australian Home Heating Association. This proposal would utilise residual timber remaining after sawlog harvesting operations, supplying Melbourne and interstate markets with firewood of guaranteed moisture content. It has the potential to use up to 100 000 tonnes of firewood annually. Other potential niche markets include the snowfield resorts at Mt Hotham, Dinner Plain and in southern New South Wales.

Firewood collection operations may also benefit silvicultural operations through reducing harvesting residue or by using products from thinning operations.

Specialty Timbers

At present, only a small amount of specialty timbers become available through normal forest operations in Gippsland. Specialty species such as Silver Wattle and Blackwood may become available during these harvesting operations and can produce excellent feature grade timbers.

With forecast increases in population growth and economic activity, it is likely that market opportunities for specialty grade timbers will increase. Supply of these species is linked to the

extent of sawlog harvesting operations. Opportunities exist for increased supply through better utilisation from existing sawlog operations.

Grazing

Grazing of domestic stock on public land provides direct agricultural benefits to producers. In Gippsland, demand and opportunities for grazing public land are likely to continue at the current scale.

Apiculture

Roads developed for timber production and other purposes potentially increase access to areas of State forest for beekeeping. However, due to the preference for particular forest tree species and access to suitable apiary locations, it is expected that current levels of demand for access to public land are likely to continue.

8. TOURISM AND RECREATION

8.1 INTRODUCTION

The Gippsland region provides a range of opportunities for natural and cultural experiences for which the region's coasts, forests, rivers, lakes and ranges provide an important focus. The region is characterised by a wealth of natural attractions, including two of Victoria's most popular tourist destinations — Wilsons Promontory National Park and the Gippsland Lakes.

Gippsland offers a combination of natural and developed tourism attractions for visitors to experience. Public land provides coastal, lake, river and alpine settings which are the basis for a diverse range of recreation activities, including boating, fishing, surfing, diving, forest drives, bushwalking, picnicking, camping, cross country skiing, white-water rafting and four-wheel driving. Developed attractions including historic towns such as Walhalla, gourmet agricultural produce and industry-related products add to the overall appeal of the region. The Great Alpine Road and other touring routes link attractions and activities throughout Gippsland.

The tourism and recreation industries provide an important contribution to regional economies throughout Australia. In 1995-96, tourism and recreation (calculated as the sum of cultural and recreational services, and accommodation, cafes and restaurants) contributed around 3.8 per cent (\$4.2 billion) of Victoria's gross state product (ABS 1996). For the same period, employment in the recreational, personal and other services accounted for 7.5 per cent, or 142 900 people in the State.

In 1995-96, cultural, recreational, personal and other services employed over 10 200 people or 10.4 per cent of the total employment in the Gippsland region. This does not, however, include the contribution of tourism and recreation to the retail and wholesale industries. Combined, these industries were the largest employer in 1995-96 in Gippsland, employing approximately 18 300 people, or 18.5 per cent of the total workforce. Retail and wholesale industries contributed 13.7 per cent of Victoria's gross state product for the same period (ABARE 1998).

Tourism is significant to the local economies of many centres in Gippsland. In towns such as Lakes Entrance, Metung and Bairnsdale, significant investment has been made in facilities for accommodation and entertainment including fishing, boating and cultural opportunities (USE 1996). The direct value of the Gippsland Lakes area to the tourism industry is approximately \$200 million per year (EGCALP 1997). Significant investment has also been made at Wilsons Promontory and along the Ninety Mile Beach. The economic contribution of the alpine industry to towns such as Omeo and Swifts Creek is also important, through the supply of services to travellers or as suppliers of accommodation (Buckby *et al.* 1993).

Regional Tourism Development Plans have been prepared for the thirteen tourism regions across Victoria. These plans are strategically important in the economic development of the region, and to the improvement of marketing and product development in the tourism industry. The 'Phillip Island and Gippsland Discovery' Regional Tourism Development Plan (USE 1997a) and the 'Lakes and Wilderness' Regional Tourism Development Plan (USE 1997b) cover the region and provide a guide to the tourism industry in Gippsland. These plans identify natural attractions as regional strengths and envisage Gippsland as a destination that provides access to nature-based and adventure activities.

8.2 OVERVIEW OF TOURISM AND RECREATION IN GIPPSLAND

Tourism Victoria defines a 'visitor' as an Australian resident or international visitor undertaking a trip within Victoria. A 'trip' is a tourism journey within Victoria and a 'visit' is

a stay of one or more nights to a place during a trip. A 'day tripper' is a Victorian resident undertaking a day trip within Victoria (Tourism Victoria 1996a).

The Gippsland Natural Discovery and Lakes and Wilderness tourism regions, as defined by Tourism Victoria in 1995 (Tourism Victoria 1996a, 1996b), extend from south Gippsland to far east Victoria. The Lakes and Wilderness region covers part of the Gippsland region as well as the East Gippsland RFA region. Tourism activity, in terms of visitor numbers and expenditure, in the Lakes and Wilderness region was previously considered in the East Gippsland RFA (VicRFASC 1996c). To avoid confusion this chapter only considers total visitor use and expenditure for the Gippsland Natural Discovery region. The Gippsland Natural Discovery region features the Strzelecki Ranges, Wilsons Promontory, the Ninety Mile Beach and alpine areas to the north of Traralgon. However, the discussion will include visitor trends across the entire RFA region.

In 1995 there were 937 000 visitors to the Gippsland Natural Discovery region, who spent a total of 2.42 million visitor nights in the region, accounting for only 5 per cent of the Victorian total. Expenditure by visitors in the region of approximately \$69 million, or an average of \$28 per trip, are both the lowest levels of spending in all regions (Tourism Victoria 1996a). Both the number of visitors and expenditure in the Gippsland Natural Discovery region are low in comparison with other tourism regions near Melbourne. Regions, such as the Goldfields and Great Ocean Road, presently provide a wider range of developed tourism attractions that encourage visitors (Tourism Victoria 1997).

For the same period, the Gippsland Natural Discovery region received 1.17 million day trippers, or 6 per cent of all Victorian day trips, who spent \$34 million (Tourism Victoria 1996b). Visiting friends and relatives, and shopping are the most popular day trip activities. Characteristics of visitors to the Gippsland region are shown in Table 8.1. Although the Lakes and Wilderness region extends outside the RFA region, visitor trends identified by Tourism Victoria can still be applied across the tourism region (C. Wrench, Lakes & Wilderness Tourism Association pers. comm. 1998).

Table 8.1: Gippsland Visitor Characteristics, 1995

Visitor Origin	Gippsland Natural Discovery Region	Lakes and Wilderness Region
Melbourne	62%	57%
Country Victoria	31%	31%
Victoria (total)	93%	88%
Interstate	6%	10%
International	2%	2%
Average length of visit (all visitors)	2.6 nights	3.9 nights
Average expenditure		
Per Visitor Night	\$28	\$39
Per Trip	\$73	\$150

Source: Tourism Victoria (1996a)

Visitors to Gippsland are predominantly Victorians, with around 90 per cent being tourists from Melbourne and country Victoria (Tourism Victoria 1996a). However, visitor trends differ significantly across the region, with accessibility from major visitor origins splitting the region into east and west areas (USE 1996). The high number of day trippers and 'short-break' (one to three days) visitors in the west of the region is a result of its proximity to Melbourne, which is the principal origin of travellers to Gippsland.

In comparison, the eastern area of Gippsland receives relatively few day trippers, the dominant trend being visits of a week or more, generally during holiday periods (USE 1996).

This reflects east Gippsland's remoteness from major urban centres and its traditional use for longer-term holidays (USE 1997b). Visitors to the east of the region, including towns such as Lakes Entrance, Bairnsdale and Omeo, tend to stay longer on average than visitors to other Victorian tourism regions. This high average length of visit is also reflected in higher trip expenditure.

More than half of the visitors to Gippsland travel for holidays or to visit friends and relatives. The most popular visitor activities in Gippsland are shown in Table 8.2. Outdoor activities, including visits to national parks and forests, bushwalking and water-based activities, are popular. Low levels of spending in west Gippsland, particularly on accommodation, are partially attributed to the high percentage of visits to friends and relatives (USE 1997a).

Table 8.2: Most Popular Visitor Activities in the Gippsland Region, 1995

Activity	Gippsland Natural Discovery Region %	Lakes and Wilderness Region %
Visiting friends and relatives	49	41
Drive to sightsee/pleasure	43	52
Shopping	32	47
Bushwalking	31	24
Restaurants/dining out	28	46
Visiting national park/forest	28	21
Swimming/diving/surfing	21	25
Visit a museum or historic site	9	11
Visit an art gallery/craft centre	8	17
Visit a Park or Garden	6	11

Source: Tourism Victoria 1996a. Note: percentages may not add up to 100 as visitors may have participated in more than one activity.

Tourism and recreation in the Gippsland region is generally focused on the natural environment with adventure and recreation activities, touring and agricultural production being the region's core tourism products. Public land across the region provides the basis for many activities and Wilsons Promontory National Park and the Gippsland Lakes are the major tourism destinations in the region. Lake Glenmaggie, and the Mitchell and Thomson Rivers are also significant attractions, providing for activities such as camping, canoeing, white-water rafting and fishing.

Coastal attractions including the Gippsland Lakes and Ninety Mile Beach are significant tourist destinations and recreational resources. More than 20 per cent of visitors to the Gippsland region (Table 8.2) participate in water-based activities such as swimming, diving and surfing, while boating and fishing are also popular activities. Recreational boating, particularly in larger craft, is growing in popularity in the Gippsland Lakes area, where a range of berthing, jetty and ramp facilities exist to cater for this activity (USE 1996).

Currently, Tourism Victoria is developing car touring routes throughout Victoria, of which four cross the Gippsland region. These touring routes, which follow the Great Alpine Road, the South Gippsland Highway and Highway One (Princes Highway), are important in linking Gippsland to other regions including the North East and East Gippsland. The strength of the region's agricultural produce has led to the creation of local touring routes, such as the gourmet food trails through south and west Gippsland. A number of walking and cycling

trails across the region such as the Howitt Cycle Trail and the McMillan Trail complement these car touring routes.

8.3 TOURISM AND RECREATION ON PUBLIC LAND IN GIPPSLAND

Gippsland is one of the most significant and concentrated areas for outdoor activities in Victoria, much of it occurring on forested public land. Both State forest and parks and reserves are popular and complement each other as visitor destinations. Major attractions on public land in the region include:

- Wilsons Promontory National Park and surrounding marine and coastal parks;
- the Gippsland Lakes and Ninety Mile Beach for camping and water-based activities;
- Lake Tali Karg and other remote areas of the Alpine National Park and State forest;
- snowfields at Mt Hotham Alpine Resort and cross-country skiing in alpine regions;
- the Thomson and Mitchell Rivers, and other rivers and streams, which are popular for fishing and rafting;
- mountain biking and two-wheel and four-wheel driving opportunities on roads and tracks throughout the region;
- a variety of forested landscapes used for horse-riding, bush-walking and nature observation;
- mountain and coastal regions providing opportunities for deer hunting in Victoria;
- history and heritage at Walhalla, Omeo and Oriental Claims; and
- relics of Aboriginal heritage, mining, grazing and timber production across the region.

Tourism has been widely advocated as an industry for regional economic growth as Gippsland has a diversity of natural resources. National Parks and State forests contribute to the overall attractiveness of the region as a potential tourist destination. However, there are some differences in the recreation opportunities available in National Parks compared with State forests. The types of activity that occur in individual parks and forests are largely governed by regulations, which vary with tenure, and the management plans for the park, reserve or forest. There are generally tighter constraints placed on recreation and tourism in National and State Parks in comparison with State forests.

Regional Tourism Boards like Gippsland Country Tourism coordinate tourism promotion, including the distribution of promotional material. Membership of these Boards is drawn from local tourist operators, business, and local and State Government representatives. Parks Victoria has membership on behalf of NRE on some of these Boards and liaises with them, local tourism associations, municipalities and Tourism Victoria to promote attractions in the region. Information about NRE facilities and recreational opportunities is made available to the Regional Tourism Boards for inclusion in tourism promotion activities.

NRE and Parks Victoria play major roles in the development and promotion of public land in the Gippsland region as a tourism and recreation destination. A wide range of information is provided for school groups and the general public for educational and promotional purposes. A number of education and information centres provide a basis for interpretation and activities, and numerous pamphlets, guides and brochures provide information on facilities and activities in individual areas.

Tourism and Recreation in National Parks and Reserves

Land reserved under the *National Parks Act 1975* is managed to preserve and protect flora, fauna and other natural features and to provide appropriate opportunities for enjoyment by visitors. Within the Gippsland region there are:

- six National Parks — Wilsons Promontory, Mitchell River, Morwell, Tarra-Bulga, The Lakes and part of the Alpine National Park;
- two State Parks — Holey Plains and Mount Worth;

- the Avon Wilderness Park; and
- Marine and Coastal Parks and reserves — Corner Inlet, Nooramunga, and Shallow Inlet Marine and Coastal Parks; the Gippsland Lakes Coastal Park; and Wilsons Promontory Marine Park and Wilsons Promontory Marine Reserve.

Visitor numbers to parks in Gippsland are shown in Table 8.3. A ‘visit-day’ is defined as a person staying in a protected area for a day or part day; each overnight stay counts as an additional visit day.

Table 8.3: Visitation to Parks in Gippsland Managed under the National Parks Act Total Visit-Days 1989–1998^(b)

Park Name	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Alpine NP (a)	29 800	18 400	36 500	40 300	41 600	45 000	65 900	70 500	55 300
Mitchell River NP	44 000	29 000	21 400	22 000	54 400	17 600	28 200	9 700	10 400
Morwell NP	27 400	33 200	32 300	31 800	43 900	33 200	34 900	31 500	32 900
Tarra-Bulga NP	109 600	37 500	102 300	85 000	110 000	80 000	80 000	68 700	67 700
The Lakes NP	105 900	89 900	81 530	80 000	75 700	64 400	52 500	57 300	64 600
Wilsons Promontory NP	423 800	426 300	402 800	364 500	400 800	378 800	369 400	407 100	396 000
Avon WP	-	-	-	100	100	120	1 200	1 100	1 200
Holey Plains SP	6 000	8 400	9 450	8 000	6 500	6 500	3 300	5 700	6 500
Mount Worth SP	17 000	21 300	20 820	21 000	21 000	17 000	16 700	13 900	13 900
Gippsland Lakes CP	-	197 300	182 700	200 000	200 000	71 700	101 300	211 600	232 600
Corner Inlet and Nooramunga M&CP	-	-	-	-	-	150 000	150 000	67 200	70 800
Shallow Inlet M&CP	-	-	-	-	-	45 000	45 000	4 500	7 900
Wilsons Promontory MP/MR	-	-	-	-	-	80 000	80 000	90 000	100 000
Total	763 500	861 300	889 800	852 700	954 000	989 320	1 028 400	1 038 800	1 059 800

Source: Parks Victoria unpublished data (1998); NP = National Park, SP = State Park, WP = Wilderness Park, CP = Coastal Park; M&CP = Marine and Coastal Park, MP/MR = Marine Park/Marine Reserve, (a) this estimate for the Gippsland region is based on 15 per cent of total visitation to the Alpine National Park. (b) Figures have been rounded. Visitor numbers recorded for parks without controlled entry points are estimates only. Counting methods include mechanical counters and periodic staff observation. Estimates for remote parks with multiple entry points have limited reliability and are subject to significant annual variability. An ongoing program is in place to audit and improve the accuracy of visitor number monitoring in Victorian parks.

Across Victoria, land managed under the *National Parks Act 1975* received approximately 12.3 million visit days in 1997-98, of which approximately 9 per cent were in the Gippsland region. Wilsons Promontory National Park, attracting 34 per cent of visits to parks and reserves in Gippsland in 1997-98, and the Gippsland Lakes Coastal Park (20 per cent) are the most popular parks in the region. Nearly one third of all overnight stays in parks and reserves in Victoria are spent at Wilsons Promontory (Parks Victoria, unpublished data 1998). Many visitors also enjoy other parks and reserves in Gippsland, e.g. Nyerimilang Park attracts around 28 000 visits annually.

Activities in Gippsland’s parks and reserves include picnicking, camping, fishing, bushwalking, nature observation, horse-riding, rock-climbing, rafting/canoeing, cycling, and four-wheel and pleasure driving. Coastal parks also provide the setting for activities such as boating, sailing, swimming, surfing and diving. Cross-country skiing is also a popular activity in alpine areas such as the Tamboritha ski area. In some cases and under special conditions, organised or competitive events, such as ski and foot races, rogaining and orienteering, may be permitted in some areas. Deer hunting by stalking is legally permitted on a seasonal basis

in parts of the Alpine National Park and Mitchell River National Park, the Avon Wilderness Park and sections of the Gippsland Lakes Coastal Park.

In order to preserve the natural environment in parks and reserves, recreation activities are managed with the general aim of minimising impacts on the environment. Park regulations and management plans specify which activities are permitted in Parks. General restrictions also apply across National Parks, including the prohibition of pets such as cats and dogs. Voluntary codes of practice have been developed in association with user groups for activities such as horse-riding, bush-camping, trail bike and mountain bike riding, and bushwalking.

Management zones and overlays are designated in management plans to provide a geographic framework in which to manage the Park. Zones indicate which management objective has priority in different parts of the Park. The six primary zones are: reference, wilderness, conservation, conservation and recreation, recreation development and education. The zoning system is designed to reduce conflicts between various types of visitor use and protection of other park values. Overlays are used to reinforce or modify the management of the underlying zone and can include land use designations to provide for legislative requirements, special protection areas or special management areas.

Tourism and Recreation in State Forest

Read Sturgess and Associates (1995) estimated that State forests in Gippsland attract around 347 000 visitor days per year (Table 8.4). Forests close to population centres are popular for activities such as bushwalking, picnicking, forest drives, camping, horse-riding, trail-bike and mountain-bike riding and nature observation. In the more remote areas of State forest activities also include fishing, hunting, rafting, canoeing and four-wheel driving (Read Sturgess and Associates 1995).

Visitors to State forest in the south east of the Gippsland region are generally day trippers, from major tourist centres such as Bairnsdale and Lakes Entrance, visiting these forests for picnics and forest drives. Recreation in the Heyfield, Yarram and Swifts Creek areas tends to be of a more dispersed nature and includes four-wheel driving, bushwalking and camping. Another popular activity is rafting along the Thomson and Dargo Rivers. Fairy Dell and Moormung reserves currently attract around 4000 visitors while picnic areas in the Colquhoun State forest attract around 3000 visitors (NRE unpublished data 1998). Deer hunting by stalking or with the use of hounds is generally permitted in State forest.

Table 8.4: Recreational Usage of State Forest in Gippsland 1994-95

Forest Management Area	Total Number of Visitor Days
Central Gippsland	179 000
Tambo	156 000
Wodonga	12 000
Total	347 000

Source: Read Sturgess and Associates (1995)

NRE promotes many of the voluntary codes of practice, mentioned previously, as being equally applicable to State forest.

In managing State forest, NRE aims to provide a wide range of recreational opportunities while conserving the natural environment. Forest Management Plans are prepared to ensure State forests continue to provide opportunities for public recreation and education. A Forest Management Plan for the Gippsland region will be released during 1999.

Tourism and Recreation in Alpine Resorts

Victoria's alpine resorts are some of Australia's premier tourist attractions and ski-field developments represent the greatest concentration of tourism investment in the state outside Melbourne. The alpine resorts provide a unique recreational experience. During the snow season they provide for downhill and cross country skiing, snowplay and general alpine experience. In the summer period, the resorts offer recreational opportunities such as mountain biking, bushwalking, horse-riding and four-wheel driving.

Mt Hotham Alpine Resort is partially located in the Gippsland region and attracts an average of 97 000 visitors annually, with 234 000 visitor days spent at the resort each year (ARC, unpublished data 1998). Most visitors are from Victoria (80 per cent) with day trippers making up only nine per cent of the total (Pannell Kerr Forster 1997; Buckby *et al.* 1993). Expenditure by resort visitors, as observed in a survey of visitors in 1996, is shown in Table 8.5. Based on these figures, expenditure by visitors to Mt Hotham Alpine Resort in 1996 was approximately \$40 million. However, the quality of snow and length of the ski season can significantly affect visitor numbers to Alpine Resorts.

Table 8.5: Mt Hotham Alpine Resort Visitor Characteristics, Winter 1996

Total Visitor Nights ^(a)	302 000
Average Total Trip Expenditure ^(b)	\$451
Average Expenditure (per person, per day) ^(b)	\$133
Preparation and Travel ^(b)	\$60
During Stay ^(b)	\$73

Source: (a) ARC, unpublished data 1998; (b) Yann Campbell Hoare Wheeler (1996)

The *Alpine Resorts (Management) Act 1997* introduced a new management regime for Victoria's alpine resorts. The Act provides for the control and management of these resorts through separate Alpine Resort Management Boards. Resorts must be managed in a manner that recognises the varied, and potentially conflicting, needs of recreationists, commercial interests and the environment. Resort planning must also consider issues such as the re-establishment of vegetation and the protection, conservation or preservation of flora, fauna or natural features.

Outdoor Education

Outdoor education is an important forest based activity undertaken by a number of commercial operators, school groups and clubs in the region. Activities include bush walking, kayaking/rafting, mountain bike riding, cross-country skiing, wildlife observation, historic site interpretation and camping. There is an increasing focus on the environment in outdoor education, with these activities used as a link to environment awareness. Activities usually include an interpretation component, particularly those for the Victorian Certificate of Education (VCE) subject 'Outdoor Education', which has components related to human impacts on the natural environment.

Currently, 19 commercial operators conduct educational and training tours in the forests of Gippsland. Other commercial tour operators may be used by school groups depending on the activity to be undertaken or the skills of the teacher. The outdoor education industry estimated that, in the Central Highlands, the industry was growing at a rate of 15 to 20 per cent per annum (VicRFASC 1997c). This estimate also applies to the industry in Gippsland. Public land across the Gippsland region, including the Thomson, Mitchell and Macalister Rivers, Wilsons Promontory and the Gippsland Lakes are some of the most popular areas for outdoor education in Victoria.

School groups, from primary to tertiary level, are the most prolific users of public land for educational purposes. As many schools from within and outside the Gippsland region utilise its resources, it is impossible to accurately estimate student numbers. However, it is estimated that 100 secondary schools conduct outdoor education activities in the region each year, with around 60 per cent being regular users (Victorian Outdoor Education Association, pers. comm. 1998). Wilsons Promontory National Park is one of the most popular areas of public land for outdoor education with approximately 5500 students per year taking part in the park's education program.

A number of formal education and interpretation facilities exist in Gippsland. Privately operated 'not-for-profit' outdoor education centres are located in Gippsland and provide educational services to schools utilising forested public land. In addition, a number of schools have outstation campuses which use public land, particularly around the Gippsland Lakes, the Macalister River Valley and Lake Glenmaggie. These campuses are used permanently throughout the year.

Commercial Tourism Operations on Public Land

The private sector's role in providing a range of services to tourists and recreationists is increasing in importance and commercial tours are becoming a popular means for tourists to enjoy forest areas. Most tour operators in the Gippsland region utilise parks and conservation reserves, including the Alpine National Park and Wilsons Promontory National Park. Over 90 per cent of all commercial tour operators in Gippsland propose to use either of these parks (Parks Victoria, unpublished data 1998).

Remote areas of State forest north of Heyfield and surrounding Dargo are popular for bushwalking and four-wheel drive tours, which may also include visits to the Grant and Walhalla Historic Areas. The Thomson and Mitchell Rivers and adjoining public land are popular for rafting/kayaking tours while coastal and marine parks around Wilsons Promontory and the Gippsland Lakes are used by a number of tour operators for water-based activities such as diving, snorkelling, sailing and surfing.

Regulation of commercial tours is through a Commercial Tours Permit System that operates across all public lands. These permits set out conditions for tour operations and are renewed annually. However, three-year permits can be issued to industry-accredited operators. Parks Victoria administers this system on behalf of NRE.

There are currently 121 commercial tour operators licensed to use public land in Gippsland. However, although these permits extend across public land in Gippsland, not all operators choose to conduct tours in the region. For example, a tour operator permitted to use the Alpine National Park may only complete tours in sections of that park situated in the North East. Ninety-seven operators conduct tours within the Gippsland region, which represents about 25 per cent of all tour operators licensed by NRE in Victoria.

In the Gippsland region, bushwalking tours are most popular, with 38 per cent of the commercial tour licences issued providing for this type of activity. Other licensed tour activities include rafting, horse-riding, vehicle-based tours, snow- and water-based activities, and natural history tours as shown in Table 8.6. Although many tour operators are licensed to utilise public land in the Gippsland region, tours may be seasonal or run on an irregular basis. Bushwalking, rafting/canoeing tours and horse riding are the most regular form of tour undertaken.

Table 8.6: Commercial Tour Activities on Public Land in the Gippsland Region

Activity	No. of Commercial
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	Tour Operators
Bushwalking	37
Rafting/canoeing/kayaking	27
Vehicle-based tours	22
Four-wheel drive tours	18
Natural history/nature observation	15
Water-based activities including sailing, diving and charter boat tours	13
Skiing and other snow-based activities	12
Horse-riding	11
Rock climbing, abseiling and caving	10
Mountain bike tours	7
Other including fishing and trail bike tours	10

Source: Parks Victoria (1998), unpublished data; Note: numbers may not add up to 97 as tour operators may provide for more than one activity.

8.4 ECONOMIC VALUE OF TOURISM IN NATIONAL PARKS AND STATE FOREST

A study by Read Sturgess and Associates (1995) suggests that the net economic value of recreation in Victorian State forests is within the range of \$6–18 per visitor day. Another study (Read Sturgess and Associates 1994b) suggests a net value of \$18 per visitor day for the Grampians National Park; however, caution is required in extrapolating this figure to other Victorian parks. An economic assessment of all Victorian parks is in progress and is due for completion in 1999.

In 1994-95, there were 347 000 visitors to State forest and 989 320 visitors to national parks in Gippsland. Using the estimates from the above reports, this equates to a total net economic value for tourism and recreation of between \$2.1 million and \$6.3 million in State forests in the Gippsland region, whereas parks may have a net economic value for tourism and recreation of \$17.8 million.

The 1995 study also suggests that a range of \$20 to \$50 per visitor day be used as a guide to calculate the stimulus of tourism and recreation in State forests to the regional economy. On this basis, State forest is estimated to contribute between \$6.9 million and \$17.4 million per year to the regional economy in Gippsland. Using an estimate of \$131 per visitor day as a guide to calculate the stimulus of tourism and recreation to the regional economy derived from the 1994 Grampians study, parks in the Gippsland region could generate up to \$129.6 million. However, as indicated above, caution is required in extrapolating these figures to other Victorian parks. Based on these aggregated figures, tourism and recreation based on public land in Gippsland is estimated to contribute between \$136.5 million and \$147.0 million per year to the regional economy.

These estimates suggest that tourism and recreation is an important part of the economic values derived from Gippsland's publicly owned forests.

In Gippsland, recreational deer hunting is an important contributor to the economy as two of Victoria's most commonly hunted deer species occur in the region. Sambar deer occur across the Alpine region shared by Gippsland, Central Highlands and the North East. The largest Sambar deer populations occur near the Wonnangatta, Moroka and Macalister Rivers and this

area, between Licola and Dargo, is the most popular for hunting trips. Hunting of Sambar deer is permitted in parts of the Alpine National Park, Avon Wilderness Park, Mitchell River National Park and State forest (except where restrictions apply). Hog deer occur only in coastal Gippsland and hunting is permitted on public land, including parts of the Gippsland Lakes Coastal Park, Jack Smith Lake State Game Reserve and Gelliondale.

It is estimated that 10 000 deer hunters, or 57 per cent of all licensed hunters, reside in Victoria (ADA 1998) with the majority hunting Sambar deer. In 1989, expenditure by Victorian hunters on equipment totalled \$33 million. During the same period, these hunters spent approximately \$6.7 million on trips for hunting both Sambar and Hog deer (ADA 1998).

The resorts managed by Alpine Resorts Management Boards also provide significant input into Victoria's economy. A study of the economic significance of alpine resorts, undertaken in 1991 (Buckby *et al.* 1993), indicated that all resorts created more than 5700 full time equivalent jobs. This study also estimated a winter gross expenditure by visitors of \$230 million, and an additional \$39 million from summer visitors (ARC 1998). These figures represent the economic significance of all alpine resorts however, at the time of the study, Mt Hotham Alpine Resort accounted for 13 per cent of all alpine visitors. Part of the resort is in the Gippsland region.

In addition, resorts support a large number of commercial enterprises that offer services that are reliant on the alpine environment (e.g. ski lift and ski hire businesses) or which service the resorts (e.g. bus charter firms). Alpine-generated visitation also generates investment opportunities in manufacturing, hotels, infrastructure and visitor facilities, providing direct and indirect economic benefits (Buckby *et al.* 1993).

8.5 DEMAND FOR TOURISM AND RECREATION IN FORESTS

Tourism is one of Australia's fastest growing industries. The Tourism Forecasting Council predicts that during the period 1997 to 2007, domestic visitor nights in Victoria will increase by 1.8 per cent per annum. This growth rate is slightly higher than the expected national average of 1.1 per cent per annum (ONT 1998a). Total international visitor arrivals are expected to grow at an average annual rate of between 3.6 and 6.1 per cent to reach 5.9 to 7.5 million visitors in 2006 (TFC 1997), depending on economic conditions in Asian countries. These forecasts are lower than previous forecasts of 7.8 per cent growth per annum to 2006. As Asian countries account for half of Australia's inbound tourists, recent changes in economic conditions in several Asian countries suggest that earlier forecasts may not be met.

Both internationally and domestically, the tourism industry is currently undergoing a transition from traditional mass market tourism to a more diverse market seeking new and experiential products (USE 1997b). Short breaks and ecotourism are examples of these new tourism trends.

Ecotourism, or nature-based travel, has broad appeal among international visitors and domestic tourists, and the demand for ecotourism experiences in Australia has increased with growth in the nature-based travel market. Ecotourists generally appear to be seeking travel experiences that involve areas or attractions of natural beauty, are away from crowds, and have some level of interaction with the environment (ONT 1998b). Increased sales of four-wheel drive vehicles, camping and outdoor equipment has also led to an increased demand for places for recreation. In addition, the production of specialist recreational magazines, and an increased awareness of activities such as abseiling and paragliding have also led to an increase in the number of people participating in these activities (Pannell Kerr Forster 1997).

Work commitments and decreasing leisure time are contributing to growth in the short break market. In Victoria, short breaks account for 53 per cent of domestic nights, which is higher

than the national average. In contrast, medium and longer term holidays are not growing and, in Victoria, account for only 47 per cent of nights compared with 60 per cent nationally (Tourism Victoria 1998).

These trends are affecting the tourism industry in Gippsland. USE (1997b) identified an overall decrease in visitation in the east of the region, with the exception of Dinner Plain and sections of Metung. They attributed this to increases in short breaks undertaken by metropolitan people; distance from major population centres, and population decline in the Latrobe Valley were also considered important factors in this change. However, by promoting the region's competitive strengths — natural attractions, adventure activities and touring — Gippsland has the potential to provide tourism opportunities based on these new trends (USE 1996).

The Victorian National Parks Visitor Segmentation Study was completed by NRE in March 1996. The main findings relating to the total population of park visitors were similar to those of the Office of National Tourism (ONT 1998b) and included:

- visitors were concerned with doing things with the family and enjoying the great outdoors during their leisure time;
- there was strong interest in educational and adventure activities;
- visitors had a high interest in rainforests and a moderate interest in forests, rivers, beaches and mountains;
- main reasons for visiting parks included picnicking, day bushwalking, visiting historic sites and experiencing Aboriginal culture; and
- visitors had large, but mainly unrealised interests in experiencing four wheel driving, canoeing, learning about Aboriginal culture/history, white water rafting, scuba diving, cross country skiing, hang gliding and working as volunteers in parks.

This visitor segmentation study also indicated that the key market segments for the Gippsland region are:

- visitors with an interest in adventure activities including bush camping, four-wheel driving and white water rafting/kayaking; and
- visitors seeking opportunities for scenic driving and short accessible walks.

Using these findings as a guide, public land in the Gippsland region is well suited for much of the population, particularly the key market segments listed above. For example, the region provides opportunities for family activities and enjoying the great outdoors. Educational opportunities are provided for visitors and there are opportunities for adventure activities such as cross country skiing, canoeing and four-wheel driving; and settings for scenic drives, picnics and short bushwalks. The trend toward nature-based tourism over recent years suggests a potential increase in tourism and recreation in Gippsland forests in the years to come.

The growth in visits to Victorian State forests has been estimated to remain at least in the order of 3 to 5 per cent per annum until the end of the decade (Read Sturgess and Associates 1995). Applying these growth rates to the 1995 visitation levels in the Gippsland region, between 348 000 and 364 000 visits are expected in the region's State forests by 2000. Visits to National Parks in Victoria averaged around 5 per cent per annum in the eight years to 1996-97 and this growth is expected to continue.

9. WATER AND CATCHMENTS

9.1 INTRODUCTION

Water is essential for maintaining natural environments and for recreational, agricultural, industrial and domestic uses. It is an important resource that is harvested from forested catchments in the Gippsland region. These catchments are also used for a range of other activities such as recreation, conservation, agriculture, scientific research and timber production. Any activity within a catchment has the potential to affect both the quality and quantity of water supplies.

The relationship of water, forests and forest use is complex, and based on many variables including climate and geology, soils and vegetation. Links exist between the properties of soils, the forest structure, the impacts of land use (including both the area and spatial distribution of uses), and water quality and quantity.

Activities within catchments, such as agriculture, recreation, timber harvesting, roading and other disturbances, have the potential to affect water quality and quantity. The significance of these effects depends on physical factors such as soils, topography, vegetation and climate, as well as the scale and spatial distribution of these activities.

This chapter describes the policy and planning framework that governs water management in Victoria, and examines water resources, production and use in the context of the current land uses in the Gippsland region. These descriptions include a brief review of relevant research underpinning forest management.

A major consideration of the RFA process is the implementation of ecologically sustainable forest management (ESFM). Principles of ESFM encompass the protection of water and other resources, including maintaining both quality and quantity of these resources. A review of the Statewide systems for ESFM is described in a separate report (VicRFASC 1997a) and summarised in Chapter 17 of this report.

9.2 WATER RESOURCES IN GIPPSLAND

Water resources can be broadly classified as surface water or ground water. Water enters a forested catchment as rainfall, snow, fog or sleet, and is usually intercepted by vegetation before reaching the soil. At the soil surface, water infiltrates until saturation occurs, then runs off as surface flow. This surface flow contributes to short-term river flow following rainfall, whereas infiltration contributes to underground water (aquifer) reserves which may be discharged into rivers and streams over a longer period.

Infiltration is a function of soil porosity and storage capacity. Sands and loamy soils absorb water more quickly than clays or rock, but have limited storage capacity. When soil becomes saturated, or rain falls quicker than it can infiltrate, overland flow occurs which can lead to erosion. Vegetation disperses the energy of water before it hits the ground and has the capacity to bind soil, thus stabilising slopes. Vegetation also uses water to maintain physiological functions. Water use by forests varies with forest type and age. For example, a very young forest uses less water than a mature forest, but the greatest demands for water are usually associated with vigorously growing, even-aged juvenile forests.

Human activities can affect water values through their impact on vegetation cover and the levels of disturbance associated with different patterns, types and intensity of land use. Management arrangements and practices implemented at the local level can also influence *in situ* as well as downstream water characteristics. The relationships between land use and

catchment values at the local level are well documented and these are considered in section 9.5.

At the broader level, catchments in developed or developing areas of the Gippsland region, mainly the foothills and coastal areas, have undergone complex land use or management changes including:

- modification of vegetation cover;
- timber production;
- mining and quarrying;
- industrial development e.g. power stations, pulp and paper mills;
- modification of waterways to supply water for domestic and industrial purposes;
- application of fertilisers, herbicides, pesticides and other chemicals;
- road construction, maintenance and use;
- various forms of recreation; and
- urban and rural residential development.

Although the CRA is concerned largely with public lands, water bodies such as Lake Glenmaggie and the Gippsland Lakes, also draw water from other tenures including private property. Land uses on private property in the region include agriculture, residential, and industrial activities that have significant implications for water yield and quality. Within forests, recreation, tourism, grazing, extractive (e.g. gravel) and other production activities may also impact on water quality and yield.

In the Gippsland region, public land accounts for 1.45 million ha, or 55 per cent of the region, and over 95 per cent of this area is forested (Table 9.1). Private land covers 1.16 million ha, mainly in the south and west of the region, of which approximately 220 000 ha, or 19 per cent, is forested. Map 1 shows land tenures in the region and the detail of public land tenures is provided in Chapter 2 of this report.

While native vegetation has been retained in the mountainous areas to the north and east of the region, clearing has been extensive on the plains to the south and along the valleys of major rivers such as the Tambo, Macalister and Dargo Rivers. These areas are substantially freehold and land uses include urban/rural residential; industrial, including electricity production; agriculture and horticulture, including large irrigated areas; and extensive plantations.

Surface Water Resources

The Australian Water Resources Council (AWRC) has divided Australia into 12 Drainage Divisions, which are further sub-divided into river basins. The Gippsland region is almost entirely within the South East Coast Division, and covers sections of nine river basins that are described in Table 9.1.

All river basins covering the Gippsland region also extend outside the region. While the Mitchell and Thomson River basins are almost entirely within the Gippsland region, only small sections of the Snowy, Goulburn and Bunyip River basins are in the region. Information on the Snowy River basin is contained in the East Gippsland CRA (VicRFASC 1996c). The Thomson, Bunyip and Goulburn River basins (VicRFASC 1997b) and the Upper Murray River basin (VicRFASC 1998) were also considered as part of the Central Highlands and North East RFA regions respectively.

Areas of public land within the region have high proportions of forest cover, although clearing on freehold land has reduced the total forest cover across these catchments (Table 9.1). In the south and west of the region, the Latrobe River, South Gippsland and Bunyip River basins are generally freehold, with forest covering less than one third of each of

these basins. Forested public land is concentrated in river basins such as the Tambo, Thomson and Mitchell, all of which have high levels of forest cover.

Table 9.1: Drainage Basins in the Gippsland Region

AWRC Basin and No. ^(a)		Major Rivers in the Gippsland Region ^(a)	% in the Gippsland Region ^(b)	Land Tenure ^(b)	Total Area (ha) ^(b)	% Forest Cover ^(b)
1	Upper Murray River	Mitta Mitta	30	Public land	75%	98
		Cobungra		Private	25%	27
		Bundarra		Total	302 300	80
5	Goulburn River	Goulburn	1	Public land	100%	100
		Black		Private	-	-
				Total	18 400	100
22	Snowy River	-	< 1	Public land	100%	98
				Private	-	-
				Total	1 820	98
23	Tambo River	Tambo	81	Public land	71%	99
		Timbarra		Private	29%	27
		Nicholson		Total	340 190	78
24	Mitchell River	Mitchell	90	Public land	74%	98
		Wonnangatta		Private	26%	21
		Dargo		Total	470 950	78
25	Thomson River	Thomson	91	Public land	67%	97
		Macalister		Private	33%	19
		Avon		Total	544 900	71
26	Latrobe River	Latrobe	65	Public land	19%	66
		Morwell		Private	81%	30
				Total	331 420	37
27	South Gippsland	Tarwin	89	Public land	23%	80
		Tarra		Private	77%	19
		Albert		Total	555 000	33
28	Bunyip River	Lang Lang	12	Public land	2%	11
				Private	98%	2
				Total	45 120	3

Source: a) DWR 1989a; b) NRE unpublished data (1998); forest cover is defined as vegetation > 2m height or > 10% crown density; lands leased or licensed for plantation purposes are included as private land.

Estimates of the area, mean annual stream flow and the divertible and developed surface water resource of each basin are provided in Table 9.2.

Australian rivers and streams have highly variable flows (Table 9.3) with much of the variability being a function of seasonality. Most Gippsland streams carry the greater proportion of their annual flow in winter and spring. Water storages in the Gippsland region, such as Lake Glenmaggie, are used to modify and regulate stream flow in major rivers for reasons such as irrigation and flood mitigation. High-intensity rains at any time of the year can cause high stream flows and floods in the lower reaches of most major rivers in the Gippsland region (LCC 1982b).

As water storages are used to artificially regulate stream flows, allocations for the use of water are required to make provision for the maintenance of ecological values. Under the *Water Act 1989*, all future water resource developments are required to make provision for the maintenance of environmental flows. These minimum flows, also known as passing flows, are provided along rivers in the Gippsland region, such as the Thomson River, for maintaining aquatic ecosystems.

Table 9.2: Mean Annual Stream Flow of River Basins

River Basin ^(c)	Total Area (ha)	Mean Annual Stream Flow (ML)	Divertible Resource (ML) ^(a)	Developed Resource (ML) ^(b)
Upper Murray	1 000 000	3 920 000	550 000	4 640
Goulburn	1 619 158	3 040 000	1 930 000	1 780 000
Tambo	425 600	325 000	100 000	5 000
Mitchell	544 884	960 000	640 000	18 000
Thomson	596 947	1 215 000	805 000	512 000
Latrobe	521 386	980 000	525 000	457 000
South Gippsland	658 231	700 000	225 000	18 000
Bunyip	389 033	355 000	120 000	49 000

Source: DWR 1989a; (a) the divertible resource is the average annual volume of water which could be removed from the water resource on a sustained basis; (b) the developed resource is the proportion of the divertible resource which has already been harnessed to supply water use requirements; (c) Less than one per cent of the Snowy River basin is within the Gippsland region. Data for the Snowy River Basin is contained in the East Gippsland CRA (VicRFASC 1996d).

Surface water quality varies from good to excellent across the region. In the Mitchell River and Tambo River basins, agriculture and forestry are the dominant land uses. Rivers in these basins are generally in good to excellent condition, particularly in forested areas, although gold mining, grazing and clearing since European settlement has degraded the condition of some streams (WATER ECOscience 1997). Conditions are similar in the Thomson River basin, with stream conditions in the Macalister and Avon Rivers being excellent in forested areas. However water quality in the Macalister River below Lake Glenmaggie, and the Thomson River below the Cowwarr Weir, is poor, with contributing factors being nutrient inputs from agriculture and urban developments, river bank erosion and extraction of water for irrigation purposes.

The Latrobe River basin is the most developed in the region in terms of industry and agriculture, and water quality in the lower reaches of the basin is adversely affected by discharges from urban, mining and industrial activities (WATER ECOscience 1997). In the Gippsland region, the Latrobe River flows through freehold land which has been largely cleared for agricultural purposes, and sections have been highly modified by river management activities and flow regulation. Most tributaries in the south east of the basin are also in poor condition with impacted water quality.

Most waterways in south Gippsland are in poor condition due to long-term land clearance. Nearly all streams of good quality in the south Gippsland are restricted to Wilsons Promontory (WATER ECOscience 1997).

The Gippsland Lakes experience a variety of water quality problems, including increasing turbidity, salinity and nutrient inputs, algal blooms, and changes in benthic and shoreline vegetation. Causes of these problems include the permanent opening of the lakes at Lakes Entrance, the development of primary and secondary industries, and urban activities across the catchments (DWR 1992). These activities affect water quality in the river systems flowing into the Lakes. About a third of the river flows and over half the nutrient load to the Lakes comes from the Latrobe, Macalister and Thomson Rivers (CSIRO 1998).

Table 9.3: Mean Annual Discharge, Maximum and Minimum Daily Discharge for Selected Watercourses in the Gippsland Region

Watercourse	Gauging station	Mean Daily Discharge (ML)	Max. Daily Discharge (ML)	Min. Daily Discharge (ML)
Upper Murray River Basin				
Morass Creek	Uplands	91.5	2 528.0	0.0
Victoria River	Victoria Falls	87.6	954.0	9.2
Goulburn River Basin				
Goulburn	Eildon ^(a)	3 645.3	17 192.0	150.0
Tambo River Basin				
Tambo	Swifts Creek	174.9	388.9	51.0
Nicholson	Deptford	61.5	205.0	21.3
Mitchell River Basin				
Mitchell	Glenaladale	1 971.0	32 537.0	0.0
Dargo	Lower Dargo	463.7	5 930.0	0.0
Thomson River Basin				
Macalister	Licola	1 082.8	9 693.9	4.6
Thomson	Wandocka	915.6	13 062.0	0.0
Avon	Stratford	742.5	37 818.0	9.2
Latrobe River Basin				
Latrobe	Rosedale	2 202.9	11 903.0	40.8
Morwell	Yallourn	427.7	1 904.3	1.8
South Gippsland Basin				
Tarwin	Meeniyan	772.4	6 072.0	12.0
Tarra	Yarram	120.3	439.0	39.6
Bunyip River Basin				
Bunyip ^(a)	Iona	383.7	9 431.0	24.0

Source: NRE (1997a); (a) outside Gippsland RFA region

Ground Water Resources

The Gippsland region lies within the Highlands and Gippsland groundwater provinces. The Highlands are made up of sedimentary basement rock of Palaeozoic age with igneous intrusions, while the Gippsland province is distinguished by younger unconsolidated Cainozoic sediments which extend offshore under Bass Strait. Groundwater quality is generally good in the eastern half of Victoria, which covers the Gippsland region, and large volumes of groundwater exist in the region.

Aquifer systems, which occur mainly in unconfined fractured rock or sedimentary deposits, in the region include:

- the out-cropping Quaternary alluvium and 'Haunted Hill' gravel aquifer which covers most of the Gippsland province including the Mitchell, Avon, Macalister and Thomson River valleys, and surrounding the Gippsland Lakes;
- the Gippsland Limestone aquifer which is restricted to the south east of the Gippsland province, occurring at a depth of 150 to 250 m. The aquifer thickness varies between 100 m and 500 m;
- the Boisdale formation of sands and clays with some ligneous and coaly seams occurring at a depth of five to 75 m;
- the Latrobe Valley Group (Yallourn, Morwell and Traralgon formations) comprising deep aquifers formed from gravels and sands separated by relatively impermeable brown coals and clays. Aquifer thickness varies from 100 to at least 770 m while depth to the aquifer varies from less than 50 m in the west of the region to deeper (600 to 900 m) toward the coast; and

- Palaeozoic and Mesozoic fractured rock aquifers in the Eastern Victorian Uplands (Highlands) consisting of igneous rock or consolidated sediments (DWR 1989a; NRE 1998d).

Thermal groundwater occurs in the Latrobe Valley aquifer, which covers much of southern Gippsland, to the west of Lake Wellington; near Bairnsdale and Lakes Entrance; and also at Morwell and Yallourn. Water temperatures vary from 20° to 70°C (LCC 1982b).

Within the Gippsland basin, the divertible groundwater resource is estimated to be 325 000 ML per year and approximately 45 per cent of the available renewable resource is extracted each year (NRE 1998d). The resource is generally fresh (salinity < 500 mg/L). However, water quality is marginal (salinity 500-1500 mg/L) in the south of the region, near the Latrobe River and near Omeo. North of Welshpool, water quality is marginal to brackish (salinity 1500-5000 mg/L) (DWR 1989a).

The Boisdale Formation occurs throughout the Gippsland basin to the east of Traralgon and underlies much of the Gippsland plains and Lakes. Its best aquifer sequence is the highly permeable sands that usually occur at a depth of 20 to 80 m (LCC 1982b). The towns of Sale, Boisdale and Briagolong receive their domestic supply from this good-quality (salinity < 500 mg/L) aquifer. Aquifers in alluvial sediments such as those along the Mitchell River between Glenaladale and Bairnsdale are also used extensively for irrigation and stock water supplies.

More than 27 000 ML per year is pumped from sands in the Latrobe Valley Group aquifer, which lie below the brown coal open cut mines at Morwell and Loy Yang, to reduce the upward pressure of groundwater, thus maintaining stability in the coal faces and to stop heaving of the pit floor. Groundwater pumping in open-cut mines has caused lowering of regional water levels, for distances of up to 30 km, in the Latrobe Group aquifer (DWR 1992). Water from this formation is also used for irrigation at Yarram and in the Longford area, and commercially at the Longford gas plant (NRE 1998d). Bore yields in this aquifer can reach 150 L per second.

Although not widely used as a source of water, the fractured rock aquifers occurring in the highlands are important as they provide a large proportion of the summer flow of the region's major rivers. This groundwater is generally of excellent quality (salinity < 200 mg/L) and is reflected in the good quality of summer stream flow (LCC 1982b).

A number of groundwater management areas have been delineated in the Gippsland region. These include Seacombe, Sale, Moe, Denison, Wa-de-lock, Wy-yung, Leongatha and Tarwin. The Denison, Sale, and Wy-yung groundwater management areas have been proposed as Ground Water Supply Protection Areas; these areas are primarily beneath agricultural land.

9.3 WATER USE AND STORAGE IN GIPPSLAND

The forested slopes of the Great Dividing Range are an important source of water for use both within and outside the Gippsland region. The streams and catchments of the region also have significant ecological, heritage, tourism and recreation values.

Water derived from the region is primarily used for domestic, industrial, agriculture, irrigation and recreation purposes, and for maintaining stream environments. Major water storages constructed in the catchments of the Gippsland region are listed in Table 9.4 and are shown on Map 9.1.

Water storages located outside the region, including the Blue Rock Lake and the Thomson and Moondarra Reservoirs, are also sources of water for industry, irrigation and environmental needs within the Gippsland region. Lakes Eildon, Dartmouth and Hume

receive water from catchments in the Gippsland region and are discussed in detail in the Central Highlands and North East CRAs (VicRFASC 1997b; VicRFASC 1998).

Table 9.4: Major Surface Water Storages in the Gippsland Region

River Basin	Storage	Capacity (ML)	Primary Purpose	River
Thomson	Lake Glenmaggie	190 000	irrigation	Macalister
Latrobe	Lake Narracan (Yallourn Storage) Hazelwood Pondage	7 995 31 000	domestic; power generation power generation	Latrobe Off river

Source: DWR 1989a

The relative amounts of water used for different purposes are shown in Table 9.5. Much of the water used across the Gippsland region is surface water, however groundwater resources are important in rural areas for rural, stock and domestic use, and irrigation, and in towns such as Sale, Briagolong, Dinner Plain, Swifts Creek and Boisdale which rely on groundwater for permanent or emergency supplies (DWR 1992).

Table 9.5: Water Use within River Basins in Gippsland

River Basin	Urban and Industrial (ML)	Rural (ML)	Irrigation (ML)	Total Use (ML)
Upper Murray	1 140	130	3 560	4 830
Goulburn	14 920	26 760	739 020	780 700 ^(a)
Tambo	1 640	430	1 610	3 680
Mitchell	3 000	1 060	11 000	15 060
Thomson	13 780	8 780	182 000	204 560
Latrobe	106 980	2 510	55 860	165 350 ^(b)
South Gippsland	5 550	3 500	5 190	14 240
Bunyip	2 600	9 560	18 280	30 440

Source: DWR (1989a); (a) 6 000 ML imported from Murray River (b) 25 per cent imported from Thomson River and Bunyip River Basins' surface waters.

There has been substantial water resource development in the Latrobe and Thomson basins, which contain several significant urban centres such as Warragul, Moe, Morwell, Traralgon and Sale. Water use in these basins accounts for over 90 per cent of total usage in all Gippsland basins.

In the Latrobe River basin, the electricity generation and pulp and paper production industries, which use both high and low quality water, are major industrial water users. Power generation accounts for nearly half of the urban and industrial water use in the basin and draws on both ground and surface water sources (DWR 1989a).

Irrigation is also a major user of water from the Mitchell River, Latrobe River and Thomson River basins. Over 200 000 ML of water is used for irrigation in the region. The majority of this water is used in the Macalister Irrigation District which is the second largest Irrigation District in Victoria, covering 53 000 ha. It is supplied by Lake Glenmaggie and the Thomson Reservoir. Small water impoundments are located at Cowwarr Weir on the Thomson River, and Maffra Weir on the Macalister River where water is diverted for irrigation (WATER ECOscience 1997). Water is also used across the region to irrigate pastures, mostly for dairy

and beef cattle, crops and horticulture. Water from the Goulburn and Upper Murray River basins is mostly used in the irrigation districts in the north west of Victoria. Surface water is the main source water for irrigation.

The Gippsland Lakes system, comprising Lake Wellington, Lake King, Lake Victoria, Lake Reeve, Lake Coleman and extensive wetlands like Dowd and Clydebank Morass, receives water from a catchment of 20 600 km². The five main river systems of the catchment providing about 10 per cent of Victoria's annual stream flow. It is the only catchment where large streams discharge into a major estuary system before entering Bass Strait.

The Lakes are a major recreation area for local communities and supports large tourist and commercial fishing industries. It is Victoria's major boating destination east of Melbourne, and Lakes Entrance is also home to the largest offshore commercial fishing fleet in the State (GCB 1998). Fisheries reliant on the Gippsland Lakes account for 2.5 per cent of the total Victorian catch (EGCALP 1997). This system, and wetlands along the coast to Wilsons Promontory, also have considerable value in the conservation of aquatic plant and animal communities. For example, these wetlands support over 40 000 water birds and a number of sites are nominated under the Ramsar Convention (WGCALP 1997).

Many of the forested catchments of the Gippsland region also provide for a diverse range of water-based and water-enhanced recreational activities in State forest and parks and reserves. Activities include fishing, canoeing/rafting, boating, water skiing, swimming, and associated activities such as camping and nature observation. Rivers including the Thomson, Mitchell and Macalister, and water storages such as the Hazelwood Pondage and Lake Glenmaggie, are popular for water-based recreation. Further discussion of tourism and recreation is included in Chapter 8.

9.4 LEGISLATIVE AND POLICY FRAMEWORK

Commonwealth Policies and Initiatives

Under the Australian constitution, responsibility for water resource planning and management lies with the State and Territory Governments. The Commonwealth Government has a complementary role in natural resource management. This relationship is best demonstrated in the Council of Australian Government (COAG) Water Reform Framework.

COAG Water Reform Framework

In 1994, COAG agreed to a strategic framework for water reform in Australia. This framework has a key role in improving the sustainability of natural resource use, achieving better environmental outcomes and contributing to the overall micro-economic reform agenda. In the case of rural water services, the framework is intended to generate the funds to maintain supply systems and, through a system of tradable entitlements, to allow water to flow to higher value uses, subject to social, physical and environmental constraints.

The key elements of the framework are:

- pricing reform;
- clarification of property rights;
- allocation of water to the environment;
- adoption of trading arrangements in water;
- institutional reform; and
- public consultation and participation.

The framework also includes the adoption of an integrated catchment management approach to water resource management.

The State and Territory Governments are currently implementing this framework with a view to completion by 2001. In Victoria property rights are being formalised and water trading has been established where property rights are in place. Implementation will be measured progressively by determining whether or not milestones have been met by the States. The implementation of the framework is linked to payments to State and Territory Governments by the Commonwealth Government that will be made available under the Competition Principles Agreement (COAG 1994).

Each State and Territory is developing approaches to implement the framework. This has been assisted by the work of the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and the Australian and New Zealand Environment and Conservation Council (ANZECC). ARMCANZ developed a paper entitled 'Water Allocations and Entitlements — A National Framework for the Implementation of Property Rights in Water' (ARMCANZ 1995) and ARMCANZ and ANZECC developed the 'National Principles for the Provision of Water for Ecosystems'.

National Water Quality Management Strategy (NWQMS)

The NWQMS has been developed since 1992 and consists of a number of separate documents that outline national approaches and guidelines for different water qualities. The objective of the NWQMS is to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development. The NWQMS provides for a nationally consistent approach to water quality management through the co-operative development of guidelines. These guidelines promote a shared national objective while allowing flexibility to respond to regional and local differences.

One of the guiding principles of the Strategy is the adoption of an integrated approach to water quality management. Such an integrated approach to resource management includes:

- a holistic approach to natural resource management within catchments, marine waters and aquifers, with water quality considered in relation to land use and other natural resources;
- co-ordination of all the agencies, levels of government and interest groups within the catchment; and
- community consultation and participation (ARMCANZ/ANZECC 1995).

As part of the NWQMS, guidelines have been developed for Fresh and Marine Waters which collate available scientific information to recommend water quality guidelines for aquatic ecosystems; drinking water; recreational water; industrial; and agricultural water (ANZECC 1992).

National River Health Program (NRHP)

The objective of the NRHP is to improve the management of Australia's river systems through improved information bases on the state of rivers (PMSEC 1996). The NRHP was primarily established to implement the Monitoring River Health Initiative that aims to develop a national approach to river health monitoring. Under this program, the Australian Rivers Assessment Scheme (AUSRIVAS) has developed a number of predictive models to evaluate and report on river health. Another major component of the NRHP is developing means of assessing the water requirements that are necessary to maintain a healthy functioning river ecosystem (NRHP 1993).

National Rivercare Initiative

The National Rivercare Initiative will build on existing programs to help ensure the sustainable management, rehabilitation and conservation of rivers outside the Murray-Darling Basin. It is intended that the Initiative will provide financial assistance for catchment management planning and implementation. Local communities will be encouraged to develop

catchment and sub-catchment management plans to ensure water resources are managed sustainably, according to local goals that are consistent with NWQMS guidelines (PMSEC 1996).

Victorian Policies, Legislation and Initiatives

Victorian State government policy, as reflected in recent initiatives and legislation, emphasises that land and water are inseparable and, consequently, the State government has directed public authorities to aim for stable, well managed systems which will protect and not damage rivers and their environments. State government policy to protect water quality is implemented through a range of policy and legislative mechanisms, including:

- the *Water Act 1989*;
- the *Catchment and Land Protection Act 1994*;
- State environment protection policies declared under the Environment Protection Act 1970;
- the *Environment Conservation Council Act 1997*;
- the former *Land Conservation Act 1970*;
- management planning, Code of Forest Practices for Timber Production and regional prescriptions enacted under the provisions of the *Forests Act 1958* and the *Conservation, Forests and Lands Act 1987*; and
- management planning under the provisions of the *National Parks Act 1975*.

Provisions of the *Water Act 1989*

Water authorities and river management authorities were appointed for catchments under the provisions of the *Water Act*. The general objectives of water authorities are related to the management of the major water systems, the provision of bulk supplies to (non-metropolitan) urban and rural water authorities, and delivery of irrigation water, domestic and stock supplies, and drainage services. Through amendments to the *Catchment and Land Protection Act* in 1997, river and other waterway management authorities no longer exist as separate statutory bodies.

The *Water Act 1989* establishes a system of allocating the available water resource outside the Melbourne metropolitan area and provides for the integrated and sustainable management of water resources across the State. The Act sets up a system of well-defined rights, which partitions the water available to each consumptive user and to the environment. The Act allows for these rights to be traded amongst water authorities.

The Act provides for entitlements, known as ‘bulk entitlements’, to be granted to water authorities, other public bodies and the environment. Furthermore, it provides for the rights that are allocated from the bulk entitlement to an authority to be passed on to private individuals or the environment. These allocations, for example, may be a licence to take and use water from a waterway or groundwater resource.

Table 9.6: Special Water Supply Catchment Areas in the Gippsland Region

Name of Catchment	Area (km ²)	For the Protection of:	Special Area Plan	Slope (°)	Seasonal Closure	Stream Buffers (m)	Filter Strips
Agnes River	67	Town					
Battery Creek (Fish Creek)	2	Town					
Bellview & Ness Creeks (Korumburra)	6	Town					
Billys Creek	21	Town	Yes	14 ^o (a)		5 chain (b) 1,2,3 chain (c)	
Buchan River (Buchan)	801	Town					
Deep Creek (Foster)	18	Town					
Glenmaggie	1 909	Irrigation			1 June - 31 Oct.	40 (d)	
Lake Hume	10 062	Irrigation			1 July - 30 Sept.		
Lake Hume (Northern)	6902	Town Water, Irrigation	Yes	18 ^o (e)			
Little Bass River (Poowong-Loch)	7						
Merrimans Creek (Seaspray)	423	Town					
Mirboo North	8	Town	Yes			100 (f) 20, 40 (g)	
Mitchell River (East Gippsland)	3900	Irrigation, Town					
Narracan Creek	82	Town					
Nicholson River	451	Town	Yes	30 ^o		200 (h) 40 (i)	
Rollo Creek	6	Town					
Ruby Creek (Leongatha)	9	Town					
Sunny Creek	5	Town					
Tambo River	2 650	Town, Industrial					
Tanjil River	509	Irrigation, Industrial, Town	Yes		1 June - 31 Oct.		
Tarra River	28	Town	Yes		1 June - 31 Oct.	200 (j)	
Tarwin River (Meeniyan)	137	Town					
Tyers River	317	Town	Yes		1 June - 31 Oct.		
Upper Goulburn	2836	Irrigation					
Walkley Creek	8	Town					

Source: *Catchment and Land Protection Act 1994*, DWR (1989a), NRE (1998pres); 1 chain = 20.12 m; (a) any clearing operations greater than 14' shall be carried out in accordance with conditions made or approved by the Soil Conservation Authority (b) Morwell W.W.T. off-take weir (c) from banks of streams and watercourses specified on Plan No. 1870; (d) on specified sections of the Macalister, Wellington, Barkley Rivers and Glenmaggie Creek; (e) applying to pasture establishment, pine plantation establishment or any other purpose, but excluding forest operations carried out under management prescriptions approved by the Soil Conservation Authority; (f) off-take weir at Mirboo; (g) streams and watercourses shown on Plan No. S-101 but also includes other streams, watercourses and springs in the catchment; (h) Nicholson Reservoir and water supply off-take as shown on Plan No. S-1411; (i) Nicholson and Barmouth Rivers as shown on Plan No. S-1411; (j) any domestic water supply off-take managed by South Gippsland Water

Bulk water entitlements are currently being established in the Gippsland region. Victoria has made some progress in meeting the COAG reforms in relation to clarification of property rights by formalising existing bulk water entitlements (both consumptive and environmental). The bulk water entitlement conversion process is based on recognition of existing

infrastructure, and community investment, of each water supply system. In many systems this may result in bulk entitlements being issued for greater volume than is currently used. Under these arrangements there is the potential for the environment to suffer, and so Victoria has established an environmental review panel to assess the likely impact on downstream flow and review storage operation to identify opportunities for increased environmental flows (Allan and Lovett 1996).

Major water entitlements exist for the Latrobe River, and are currently being developed for the Thomson and Macalister Rivers, to provide for irrigation and industry; allocations for Melbourne's water supply are also required from the Thomson River. Implementation of the bulk entitlement conversion process has already led to significant increases in environmental flows for the Thomson and Latrobe Rivers. Environmental flows in the lower Thomson River were increased to five times the previous volumes while environmental flows had not been previously specified for the Latrobe River.

The Catchment and Land Protection Act 1994

Catchment Management Authorities (CMA) were established under the *Catchment and Land Protection Act 1994* to facilitate implementation of the regional catchment strategies. These CMAs combine the roles of a range of former groups including CALPs, river management authorities and other waterway management groups. The Gippsland region is mainly covered by two CMAs — West Gippsland and East Gippsland. (The Port Phillip and North East CMAs cover small sections of the region to the west and north respectively; Port Phillip is all freehold.) The major task of these CMAs is to implement regional catchment strategies (WGCALP 1997; EGCALP 1997). The objectives in implementing the regional catchment strategies include the maintenance and improvement of the quality of water and condition of rivers, and conservation and protection of the diversity and extent of natural ecosystems.

Land managers are required to have regard to any regional catchment strategy applying to the land.

Areas within catchments warranting particular attention, such as areas required for water supply, can be declared Special Areas by CMAs under the *Catchment and Land Protection Act*. In the Gippsland region, there are 25 Special Areas classified as Special Water Supply Catchments (Table 9.6). These areas were formerly called Proclaimed Water Supply Catchments under the now repealed *Soil Conservation and Land Utilisation Act 1958*. Special Water Supply Catchment Areas are identified because of their significance as a source of water.

Under the Act, Special Area Plans, which can be prepared for declared areas, specify how particular land management issues in the special areas will be addressed. Land Use Determinations previously prepared for proclaimed water supply catchments are now regarded as Special Area Plans under the *Catchment and Land Protection Act*.

Land managers, including NRE, must have regard to any Special Area Plan applying to land under its control. Special Area Plans within the Gippsland region place specific requirements on forest management, including seasonal restrictions on harvesting in particular areas, and restrictions on the level, type and location of activities, including recreation and extractives. The Billy's Creek Water Supply Catchment provides an example of this form of management arrangement. Provisions have been set out in a Special Area Plan (SCA 1965) relating to protection of the off-take weir and watercourses, and slope limitations are specified for pasture establishment, forest utilisation operations and road construction.

The Code of Forest Practices for Timber Production (Code) requires that water quality and yield are protected in water supply catchments. These requirements are discussed in more

detail in Section 9.5. Where Special Area Plans do not exist or specify minimum standards, the Code or regional prescriptions provide minimum requirements for seasonal closures, stream buffers, filter strips and slope limitations. Minimum widths for stream buffers and filter strips are a function of the soil type, stream class and slope, and can vary from 10 to 40 m depending on soil permeability and potential for overland flow.

Land Conservation Council (LCC) Recommendations

The *Environment Conservation Council Act 1997* came into operation on 1 July 1997. This Act which established the Environment Conservation Council (ECC), revoked the *Land Conservation Act 1970*, and replaced the Land Conservation Council. The ECC advises the Victorian Government on public land use planning and has a wider role than the LCC, being able to advise on all natural resource matters, taking account of all relevant issues that may impact on their use. Orders in Council to approve and require implementation of previous recommendations made by the LCC continue to apply.

Under the *Land Conservation Act 1970*, the LCC completed reviews of public land use in the Gippsland area. Land use recommendations were completed in stages (LCC 1975, LCC 1979a, LCC 1982b, LCC 1984a, LCC 1994), and Statewide Special Investigations into both Wilderness, and Rivers and Streams were completed in 1991 (LCC 1991b, LCC 1991a). Other Special Investigations relevant to the area include Stradbroke (LCC 1979b), Gellions Run (LCC 1982a), Hill End (LCC 1984b), Alpine (LCC 1985) and Latrobe Valley (1987).

The LCC recommended that a range of public land tenures, namely State forest, National Parks and State Parks within Gippsland also be used for water supply and to protect stream and water catchments. No catchment in Gippsland is used solely for water production. However, areas such as buffers surrounding diversion works and storages must be managed to protect water quality, which may restrict the type of activity, permitted in these zones.

1991 Rivers and Streams Special Investigation

In recognising the diverse values of streams and water catchments within Gippsland, the LCC made specific recommendations for the protection of Heritage Rivers, 'Essentially Natural Catchments', River Zones in State forests and Natural Feature Reserves (i.e. Public Land Water Frontage reserves passing through freehold and public land Streamside Reserves).

Heritage Rivers were identified in the LCC Statewide investigation into Rivers and Streams (LCC 1991a) in which the Council was required to 'carry out an investigation of the scenic, recreational, cultural and ecological values of rivers and streams in Victoria, and to make recommendations on the use of these rivers and how their identified values can best be protected'. Recommendations for the management of heritage rivers included:

- protection of the specified values;
- provision of a range of recreational activities;
- structural barriers or impoundments that impede flow or the passage of in-stream fauna should not be constructed;
- establishment and maintenance of appropriate environmental flows;
- timber harvesting should not be permitted except where specified;
- strict controls on grazing;
- road construction should minimise on-site sediment losses to the stream network; and
- controls on the location of new roads and bridges relative to watercourses.

In the Gippsland region, the corridors of the Mitta Mitta, Mitchell and Wonnangatta, and Thomson Rivers have been designated as Heritage Rivers and are protected under the *Heritage Rivers Act 1992*, which implements the LCC recommendations described above.

Those catchments, which have not been subject to physical or biological processes that leave the environment impaired or changed, have been designated as Essentially Natural Catchments. In the Gippsland region, seven catchments were identified and recommended as Essentially Natural Catchments: Avon, Turton and Dolodrook Rivers, and Ben Cruachan Creek; Stony Creek; Wongungarra River headwaters; Blue Rag Creek; Pinnacle Creek; Punchen Creek; and Mount Vereker Creek.

These areas are to be managed with little or no modification or disturbance to the environment in accordance with the Heritage Rivers Act. However, they are to be available for water production, education and existing recreational activities.

The Heritage Rivers Act overlays, but does not change, existing land tenure. However, it may require changed management objectives to achieve protection of special values. A draft management plan for heritage rivers and natural catchments in Gippsland was released for comment in November 1997 (NRE 1997h). This plan was prepared by the Department of Natural Resources and Environment, as the principal land manager in these areas, in conjunction with Catchment Management and other waterway authorities.

Representative Rivers have also been recommended by the LCC (LCC 1991a) as a part of this investigation. These rivers contain significant natural or scenic values and are representative of distinct river-catchment types found across Victoria. The four rivers designated as Representative Rivers in the Gippsland region are: the Tarra, Macalister, Nicholson and Dargo Rivers. The primary aim for the protection of these Representative Rivers is to maintain examples of these river types and thus to avoid or prevent modification to their geomorphological and hydrological attributes (LCC 1991a).

State Environment Protection Policy ^{3/4} *Environment Protection Act 1970*

The *Environment Protection Act 1970* provides for the declaration of State Environment Protection Policies (SEPP) for defined areas in order to maintain environmental quality sufficient to protect existing and anticipated beneficial uses. State Environment Protection Policies relevant to the Gippsland region include:

- State Environment Protection Policy (Waters of Victoria) 1988, including Schedule F5 (The Latrobe and Thomson River Basins and Merriman Creek Catchment) and Schedule F3 (Waters of the Gippsland Lakes and Catchment); and
- SEPP (Groundwaters of Victoria).

Each of these documents sets out the beneficial use to be protected, objectives for various water quality indicators and a program for attaining these objectives.

The SEPP (Waters of Victoria) 1988 applies to surface waters throughout the State except when varied by separate SEPPs, clauses or schedules for specific areas. Two schedules are specific to the Gippsland region: Schedule F5 and Schedule F3, as previously listed. These variations to the SEPP (Waters of Victoria) allow the whole of the Lake Wellington catchment to be managed in a consistent manner by the new Schedule F5.

The main beneficial uses to be protected in the region include potable and agricultural water supply; water-based recreation; fishing and aquaculture; industrial water use; and maintenance of natural aquatic ecosystems. Beneficial uses specific to each scheduled area include: the production of molluscs, and the commercial and recreational use of edible fish and crustacea in the Gippsland Lakes; and aquifer recharge in the Latrobe and Thomson River Basins.

Specific water quality monitoring recommendations were made in these schedules and include a requirement to develop an integrated monitoring program to identify spatial distribution of nutrient loads to the Gippsland Lakes (Schedule F3) and for the EPA, in

conjunction with all organisations whose activities affect or are affected by water quality, to develop a water quality management strategy for the area scheduled in F5.

Controls Enacted under the *Forests Act 1958*

The Timber Industry Strategy (Victoria Government 1986) cites 'ensuring the sustained capability of forests to maintain and enhance water quality and yield' as one of six objectives for environmental management. It also indicates that priority will be given to water production in those catchments with limited stream flows that service regions with high current or potential water demand. The strategy for achieving this water quality and yield objective includes undertaking land capability assessments to delineate hazardous areas; preparing appropriately detailed codes of practice/prescriptions to set required standards; and monitoring adherence to standards, together with periodic re-evaluation of the standards themselves. To maintain or enhance yield, the forest age class distribution, forest structure and rotation lengths may be manipulated.

The implementation of management arrangements under the Forests Act is considered in Section 9.5. These include provisions of the Code of Forest Practices for Timber Production, forest management plans and regional harvesting prescriptions.

Provisions of the *National Parks Act 1975*

National Parks and State Parks are managed in accordance with the *National Parks Act 1975*, which requires that a plan of management be prepared for each park. Management zones and overlays are designated in these management plans to provide a geographic framework in which to manage the park. The zoning system is designed to reduce conflicts between various types of visitor use and protection of other park values. Overlays are used to reinforce or modify the management of the underlying zone and can include land use designations to provide for legislative requirements, special protection areas or special management areas.

Management plans have been completed for the nine National, State and Wilderness parks in the Gippsland region. Through this management framework, plans aim at minimising risk to water quality and quantity through managed recreation, fire protection, soil conservation and the protection of vegetation. They must have regard to special area plans for declared catchments in or adjacent to the park boundary.

Victorian Water Quality Monitoring

There are two major Statewide environmental water quality monitoring programs in Victoria:

- the Victorian Water Quality Monitoring Network (VWQMN), managed by the Department of Natural Resources and Environment; and
- a network of fixed sites run and funded by the Environment Protection Authority (EPA).

Under these programs, physico-chemical, biological and salinity monitoring is undertaken at a number of sites across Victoria. The water quality monitoring and reporting arrangements were reviewed in 1991 and 1996 resulting in proposed extensions to the Statewide coverage of the VWQMN and changes in the parameters monitored. The VWQMN currently monitors water quality and algae in rivers and streams, lakes and wetlands across Victoria.

Extensive and intensive regional water quality monitoring programs are also conducted as part of the Major Storages Operational Monitoring Program. Water quality in Lake Glenmaggie is monitored as part of this program. Regional Water Authorities may also undertake water quality monitoring within their boundaries.

9.5 ISSUES FOR WATER MANAGEMENT

The major issues for water management are related to the quality and quantity of water. As discussed earlier, many water quality issues are related to land tenure, as this is a major determinant of the condition and level of disturbance as well as the use of the land, which largely determines the access and management arrangements applicable to an area.

Water Quality and Quantity

The physical, chemical and biological characteristics of water determine its quality. A significant loss of quality can have a deleterious effect on aquatic and riparian ecosystems and the value of the resource for a range of human uses. Catchment conditions and water quality are closely linked. Undisturbed and forested catchments generally ensure high water quality while, in contrast, agricultural and urban environments are often associated with lower water quality. As a result, some domestic water supplies in the Gippsland region require treatment to ensure that water quality is suitable for domestic consumption. Land use practices resulting in erosion and the transport of nutrients, as well as urban runoff and point discharges of pollutants, are major causes of poor water quality in streams.

Water quality issues in some areas of the Gippsland region include: nutrient enrichment; sedimentation; eutrophication; and turbidity of surface waters. In general, water quality is good to excellent within the forested areas of Gippsland especially in the eastern river basins (DWR 1990). However, there is a trend for water quality to deteriorate in the lower catchments in Gippsland in response to land uses in non-forested areas (DWR 1989a). For example, high levels of salinity in streams of the Latrobe River and South Gippsland basins have been attributed to intensive land use, including power generation and agriculture. Water quality in the central and south east sections of the Latrobe River basin is poor.

Recreational activities can adversely affect water quality where activities such as camping and recreational vehicle use result in significant soil compaction, erosion or bacteriological contamination of surface water. A reduction in water quality through erosion of roads and tracks attributable to forest activities and recreational vehicle use has been identified within some areas in Gippsland, though this is not widespread. Boating and fishing tend to be concentrated in lakes and the lower reaches of rivers, and have added to problems of bank erosion through pedestrian traffic, boat launching and landing, and boat wash (WATER ECOscience 1997).

Water quantity (including quantity of surface and groundwater available) is influenced by a range of land use activities occurring in a catchment, and is therefore an important consideration in forest management. The potential for forest management activities to impact water quality and quantity, and aquatic values is well recognised, and a large amount of information has been compiled on this subject both in Australia and overseas. The following sections outline research and management arrangements relating to water quality and quantity.

Research on Water Quality and Yield

Much research on water quality and yield has been undertaken in forested catchments of the adjoining Central Highlands region given the importance of these catchments to Melbourne's water supply. About half of Melbourne's forested water supply catchments are covered by ash-type forests, with the remainder covered by mixed species eucalypt forest. The ash-type forests yield 70 to 80 per cent of Melbourne's water and, therefore, most catchment research has concentrated on the ash forests. Results from this research are relevant to ash-type forests in Gippsland and more generally to other forest types.

In the Central Highlands, catchment experiments have been established in both mature and regrowth dominated catchments. Studies have included the affects of fog drip, canopy

interception, soil moisture depletion, transpiration and plant water relations on water yields in Mountain Ash. This research has also investigated the effects on water yield of:

- the conversion of old forest to regrowth stands, through wildfire and clearfelling;
- the selective cutting of mature stands;
- thinning in regrowth stands; and
- initial stand stocking at the time of regeneration.

Furthermore, aspects of water quality have been investigated through studies on:

- fuel reduction burning;
- wildfire; and
- the effect of traffic patterns and road maintenance procedures on the generation of silt from unsurfaced roads (O'Shaughnessy and Jayasuriya 1987).

The effects of 'best practice' forest harvesting and regeneration operations on water yield and water quality were investigated in the Corranderrk Experiment, which involved a comparative study based on analyses of long-term base data, a control catchment, and two roaded and logged catchments. One of the logged catchments was clearfelled and regenerated, and the other was selectively felled (O'Shaughnessy and Jayasuriya 1991). The results to date indicate that water yield in the selectively felled catchment declined less than in the clearfelled area. However, the more intensive road network of the selectively felled catchment affected water quality for 10 years, compared with five years for the clearfelled catchment (Langford *et al.* 1982).

The hydrology of 1939 regrowth ash forests has been studied using 15 catchments receiving various treatments since 1969 as part of the North Maroondah Experiments. These treatments include:

- **Thinning** — a 54 per cent patch cut and a 50 per cent uniform thinning increased stream flows by about 20 per cent over 12 years, with the 50 per cent thinning being more persistent. The thinned forest maintained its annual growth rate because the remaining trees grew faster (O'Shaughnessy and Jayasuriya 1991).
- **Clear felling and regeneration** — at densities of 500, 2000 and 20 000 trees per hectare. Monitoring of the effects on stream flow is continuing, but a longer data run is required before conclusions can be drawn (O'Shaughnessy and Jayasuriya 1991).
- **Strip thinning** — alternate 35 m wide strips cut along the contour have increased stream flow by 20-25 per cent (O'Shaughnessy and Jayasuriya 1991, O'Shaughnessy *et al.* 1993). Overall reduction in annual growth rate by 40 per cent has occurred because growth response to thinning has been restricted to the boundaries of the retained strips (O'Shaughnessy and Jayasuriya 1991).

A study by Grayson *et al.* (1993) in catchments in the Central Highlands concluded that the impact of well supervised timber harvesting on water quality is small. They noted that the suspension of logging during wet weather, the use of buffer strips, and the management of runoff from roads, snig tracks and log landings, eliminated contaminated runoff into streams. Results from the East Kiewa project indicated increased stream flows and sediment concentrations following harvesting of Alpine Ash forests (O'Shaughnessy and Bren 1998), however, these findings are qualified by inadequacies in the sampling of sediments and the effects of a relatively dry period during part of the study.

O'Shaughnessy and Associates (1995) noted that roads and tracks might present a greater hazard than timber harvesting with regard to sedimentation of streams. Preliminary results of monitoring in the Traralgon Creek catchment by Sadek *et al.* (1998) showed that the existence of unsealed roads and associated landslides in forested catchments have an impact on stream turbidity and suspended sediments. The research by Grayson *et al.* (1993) and work by Haydon *et al.* (1991) also suggests that there is a positive relationship between the frequency of road use and the production of coarse sediment and total sediments. This highlights the

need for high standards of road construction and management to help prevent the entry of runoff into streams (Haydon *et al.* 1991).

Dargavel *et al.* (1995) also discussed the impact of timber harvesting and roads on water quality. Based on local and overseas studies, they concluded that avoiding direct stream disturbance and preventing turbid inflows provided a high level of protection. Dargavel *et al.* (1995) highlighted the importance of developing standards, and the application and monitoring of these in forest management. These include the application of codes to road construction and maintenance.

The literature demonstrates that different silvicultural systems have different impacts on water yield and quality within the harvesting areas, but that the greater impacts are caused by associated infrastructure and roading. In clearfelling operations, for example, much of the road network can be closed and revegetated after harvesting, whereas the alternative selection systems might require more regular access, hence the need to maintain the road network (O'Shaughnessy and Jayasuriya 1987). In this sense, alternative silvicultural systems may generate higher sediment loads in comparison with clear felling systems.

Hydrological research in the Central Highlands also indicates that large-scale regeneration or reforestation activities following timber harvesting or wildfire may reduce long-term water yields in Ash forests (Kuczera 1985), as young, fast growing forests use more water. A significant reduction in water yield has the potential to adversely affect aquatic values and may also necessitate additional water storage capacity to maintain domestic and irrigation water supplies.

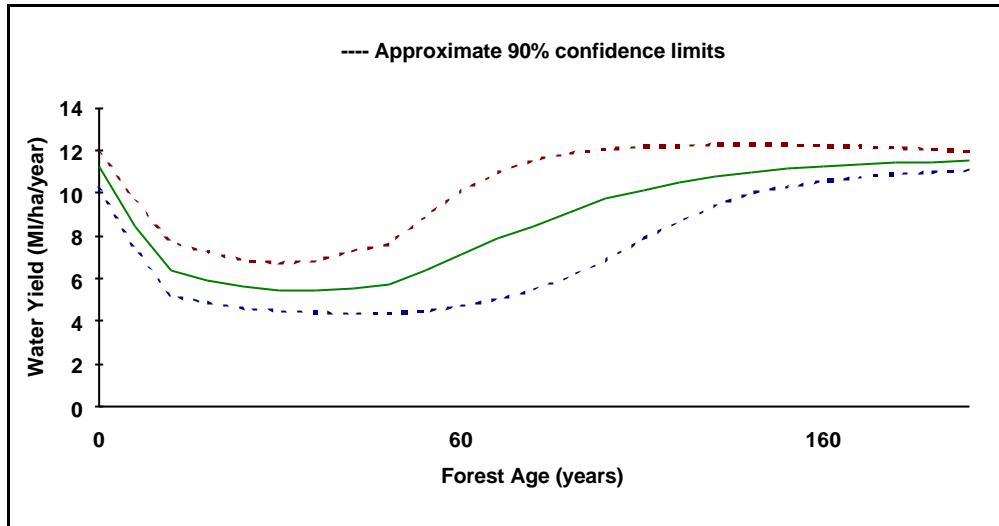
In a study of water yields of regenerating Ash forests following the 1939 bushfires, Kuczera (1985) established a model for predicting changes in water yield following wildfire. The model indicates that immediately following wildfire there is an initial increase in water yield due to increased surface run-off and groundwater flows. As the forest regenerates, water yield decreases to a minimum of about half the original yields at 20-30 years, and then steadily increases to pre-fire yields at around 150 years (Figure 9.1). This relationship between forest age and water yield in Ash forest also applies to areas subjected to clearfelling, which can be considered as a silvicultural replication of wildfire disturbance. Kuczera (1985) also showed that for every one per cent of mature forest converted to regrowth, a decline of 6 mm in annual water yield could be expected some 30 years later. The model has wide confidence limits, particularly for forests aged between 50 and 120 years, and Kuczera (1985) indicated that another 30-40 years of data are required for validation of the model.

Monitoring of sub-catchments under controlled conditions has shown the effects of clearfelling/regeneration in the Melbourne Water experimental catchments to be broadly consistent with the Kuczera model. In the Piccaninny catchment, a decline in water yield to 50 per cent of the pre-treatment level has been recorded in response to clearfelling and regeneration of 80 per cent of the catchment. Similarly, harvesting and regeneration of Alpine Ash in the West Kiewa River catchment, between 1960 and 1982, led to a reduction in stream flow that approximated predictions made by Kuczera's model (Lawrence 1990 in O'Shaughnessy and Bren 1998).

The effects of timber harvesting and wildfire on water yield in mixed species forests are less well understood. Read Sturgess and Associates (1994a) in a study of the Thomson catchment noted that water yields from mixed species forests are much lower than in ash forests because these forests grow in areas with lower rainfall and have higher evapotranspiration rates. Mixed species forests are generally found in the more exposed, lower elevation areas, and on northern and western slopes at higher elevations, where fire occurs more frequently, but at lower intensity than in ash. Consequently, mixed species forests are dominated by fire resistant eucalypts, such as the stringybarks and peppermints. They are capable of recovering

from low and medium intensity fire disturbance and are usually of mixed age, with fewer areas of regrowth forest created after a given disturbance event (Kuczera 1985).

Figure 9.1: Relationship between Forest Age and Water Yield in Ash Forests of the Central Highlands



Source: Abbott *et al.* 1993

Accordingly, fire may not have as significant an effect on the water yield in these forests as in ash type forests. There are no recent long-term catchment results available for mixed species forests on the eastern seaboard that indicate the effects of clear felling and regeneration on stream flows (Dargavel *et al.* 1995). However, following clearfelling of mixed species forest in the Reefton experiment in the Central Highlands, Nandakumar and Mein (1993) estimated that a reduction of 10 per cent in the catchment forest cover, led to a corresponding 33 mm increase in runoff. Water yields peaked two to three years after the clearing and then declined to pre-treatment levels after five to eight years. These results should be regarded as preliminary at this stage.

Other research, which addresses water yields and silvicultural practices in mixed species forest, has produced variable results. The yields from these forests, according to Moran (1988), vary considerably depending on the location and vigour of stands and possibly the forest age, with little or no change in catchment yield with age in the drier forests and changes similar to low rainfall ash forests in the wetter areas. O'Shaughnessy *et al.* (1995) showed that in the Lerderderg mixed species forest there was no statistical long-term effect on water yield, after logging 16 per cent of an area. However, work by Cornish (1993) in high rainfall (non-ash) forests of Karuah in northern NSW has shown a similar response to Victorian ash forest over the six years since harvesting. In response to these disparate results, Dargavel *et al.* (1995) recommended that further research was required into the hydrological responses in mixed species forests.

Forest Management Arrangements

On State forest, water quality is protected through a range of techniques that limit the opportunities for soil or high energy water to flow directly into drainage lines. Forest operations in the Gippsland region are regulated in accordance with the Code of Forest Practices for Timber Production (NRE 1996a) and regional prescriptions which provide for the protection of filter strips and buffers on drainage lines and streams, and sets limitations on timber harvesting operations in steep terrain. Standards for the design, construction and maintenance of roads consider soil properties and their management to protect water quality. Timber harvesting and road use are constrained seasonally in response to weather conditions

through the application of road closures and harvesting restrictions to minimise adverse effects on water resources.

The Code provides the basis for detailed harvesting prescriptions and the preparation of individual coupe plans, taking account of local conditions such as soil type, rainfall and the type of harvesting operations. Minimum standards are provided as guidelines, but these may be increased to enhance environmental protection through regional prescriptions in coupe plans. Forest operations in the Gippsland region are also conducted in accordance with a set of regional timber harvesting prescriptions (NRE 1998e), which include specifications for the construction, drainage and maintenance of roads and tracks.

Key features and provisions of the Code for minimising soil erosion and protecting water quality in forest areas are summarised in the box below. However, it is emphasised that the full Code and regional prescriptions contain significantly more detail on measures to protect water quality and aquatic habitat.

The road and track network in forests of the Gippsland region is managed by NRE, Parks Victoria, Hancock Victorian Plantations (HVP), Australian Paper Plantations (APP), local municipalities and the Roads Corporation (VicRoads). The majority of roads in State forest and plantation areas were built prior to the introduction of the Code of Forest Practices for Timber Production. Since the release of the Code there has been a progressive improvements in the standard of road construction and maintenance. However, some of the road network, established prior to the Code, does not meet current standards and therefore is a potential source of sediment. Many of these roads were built to carry traffic for a short period, or to cater for infrequent use in the drier periods of the year, but they are now used for recreation purposes throughout the year. The use of these roads and tracks can be unsafe during wet conditions and can cause serious degradation to environmental values. Restrictions on the use of roads occur in some water supply catchments.

Table 9.7: Overview *of Code of Practice (NRE 1996a) Relating Specifically to Water Quantity and Quality Issues

ISSUE	CODE OF PRACTICE
Water Quantity	Priority to be given to the protection of catchments with limited stream flow which service regions with high current or potential water use. Consultation required with appropriate authorities. Adoption of longer rotations, control of stand density by thinning to maintain stream flow, limits on annual harvest areas (if appropriate) or other techniques as research knowledge becomes available.
Water Quality and Aquatic Habitat	Maintenance of buffer and filter strips, the minimum width of which will be determined by stream classification and will take account of local conditions including soil erodibility, rainfall erosivity and slope.
Slope Limitations	Harvesting operations should be excluded from slopes >30°, or on lesser slopes of unstable soil where erosion risk is high. Lower slope limitations will apply as necessary according to soil type, stability and moisture content, intensity and magnitude of the harvesting, the type and size of logging machinery, and season.
Log Landings and Dumps	Located, constructed and maintained to minimise soil disturbance and water quality deterioration. Stockpiling of topsoil should occur, where appropriate, for later use during rehabilitation. Rehabilitation required when no longer used.
Snig Tracks and Forwarding Tracks	Must not be located parallel to drainage lines. Crossing of filter strips is to be limited.
Fuel Dumps and Machinery Servicing	Located to minimise pollution of streams and wetlands.

ISSUE	CODE OF PRACTICE
Wet Weather Restrictions	Snigging and forwarding operations must be suspended when stream quality is threatened by compaction, rutting or soil mixing, or when water begins to flow along tracks.
	Flexible prescriptions for closure when climatic conditions make timber harvesting detrimental to the environment.
Roading	
Design	Roads must accommodate anticipated frequency, type and speed of traffic, soil and sub-grade conditions, road drainage and water quality requirements.
Location	Roads must be located to minimise the number of stream crossings and interference with natural drainage.
	Align roads with topography, avoiding steep side slopes and damp southern aspects. Roads should not be located in or closely aligned to natural drainage lines or areas of poor or restricted drainage.
	Avoid steep and unstable slopes, and any disturbance to streams, buffer strips, riparian vegetation and rainforest in areas not associated with approved crossings.
	Avoid entry of sidecast material into streams or drainage lines.
	Road surface runoff to be discharged away from streams and drainage lines, as far as practicable.
Construction	Undertaken when climatic and site conditions minimise impact on water quality.
Culverts and Drains	Must be installed concurrently with road construction. Draining by cross drains or out-sloping required if construction is to be left over winter or an extended period.
Partially Built Roads	Closed to traffic until completed. Temporary stabilisation works required for drainage and erosion control.
Drainage	Roads must be cross sloped and crowned to minimise the concentrations and velocity of run-off.
Provision of Silt Traps	Drainage must discharge onto undisturbed vegetation or energy dissipating structures.
Stream Crossings	Fill positioned to minimise sediments being transported into streams.
	Earth embankments revegetated or surfaced, or retaining walls constructed.
Maintenance	Road drainage must be maintained to minimise discharge of turbid water into streams

* As noted in the text, it is emphasised that the full Code and regional prescriptions are detailed documents and this description provides an indication of the mechanisms that are employed to protect water quality and aquatic habitat.

The EPA (1996) identifies key management priorities to achieve the objectives for suspended solids in Central Gippsland including the enforcement of the Code of Forest Practice, and improved design and management of forest tracks and other rural roads.

Increased stream sedimentation is regarded as a threat to species such as the Spotted Tree Frog (*Litoria spenceri*) and Giant Burrowing Frog (*Heleioporus australiacus*). Therefore, management prescriptions, including special requirements, are in place for stream buffers, roads and stream crossings in catchments containing these species.

The affect of timber harvesting and regeneration on water quantity and quality can also be managed by spatial (size and distribution) and temporal (time) controls on timber harvesting operations in catchment areas.

The standards established by the Code provide a high level of security to water quality and yield over the majority of Gippsland forests. However, for some catchments used for domestic water supply, and where treatment is minimal, an additional level of security for the water supply may be warranted. In catchments where State forests comprise a large

proportion of the catchment, the catchment is relatively small or where minimally treated water storages lie within or adjacent to State forest, water yield and quality may be influenced by forest operations. In these instances, special management strategies may be defined in Forest Management Plans to apply to these designated catchments, including seasonal suspension of operations, maximum coupe size and annual harvest area, and road and track management.

The Code of Practice for Fire Management on Public Land (CNR 1995d) lays down principles, standards and guidelines that apply to fire management on all public land in Victoria. This code is complementary to the Code of Forest Practices for Timber Production. It provides guidelines for fire preparation, suppression and rehabilitation activities to ensure the conservation of water catchment values. They specify that:

- fire preparation activities should be conducted in a manner that protects water values by minimising the impact of these activities, e.g. location of water points must include consideration of impacts on wetlands, riparian and aquatic communities;
- soils should be protected to prevent destruction of physical and chemical properties, and to promote stabilisation of bare or disturbed earth;
- fire control lines should be constructed outside stream beds and riparian zones, and be constructed around the contour on sloping ground;
- rehabilitation works should consider the risk of erosion, particularly in water supply catchments; and
- fire access tracks must, where practicable and without compromising their primary purpose, be constructed and maintained to minimise soil disturbance and erosion.

Gippsland Forest Management Planning Process

The Gippsland Forest Management Plan is currently being developed in accordance with the requirements of:

- the *Forests Act 1958*;
- the *Flora and Fauna Guarantee Act 1988* and associated Statements;
- the *Catchment and Land Protection Act 1994*; and
- the Code of Forest Practices for Timber Production.

Maintaining the quality and yield of water supplied from State forest is a key objective of forest management planning. A Forest Management Plan establishes a series of management actions and guidelines to protect water yield, and prevent soil erosion and stream sedimentation. Planning objectives in relation to water and catchments include maintaining biological values associated with rivers and streams; ensuring water quality is suitable for current and likely future use; and maintaining at least current water yields from catchments used for domestic and irrigation supply.

The forest management planning process must consider the range of legislation and policies discussed in Section 9.4 that are relevant to State forest. Prescriptions set out by Special Area Plans prepared under the *Catchment and Land Protection Act 1994* are applied where relevant. Similarly, requirements of the *Heritage Rivers Act 1992* for Heritage Rivers and Essentially Natural Catchments are incorporated into the planning process.

The development of strategies to protect the quality and yield of water requires consideration of a wide range of issues in the context of a management plan, several of which are briefly discussed below.

- **Coupe planning and design:** The planning process provides direction for harvesting within catchments to prevent loss of water quality and yield. Guidelines can relate to the need for varying silvicultural practices, limitations on annual harvest area, management and location of landings, and grade and location of snig tracks.

- **Roading:** Planning considers the extent and condition of the road network and may incorporate guidelines relating to road location, design, construction, use and maintenance activities. It also reviews the need for seasonal, temporary or permanent road closures, based on the requirements of harvesting, recreation and fire management activities, and environmental protection.
- **Fire:** The planning process, in conjunction with the Code of Practice for Fire Management, considers the effects that fuel reduction burning may have on water quality and yield, and aquatic habitat, providing guidelines for the use of fire in water supply catchments.
- Other forest uses including recreation and extractive activities: The impact of these activities is addressed through the use of forest management zoning or the implementation of management actions aimed at protecting water quality and yield, such as the rehabilitation of redundant gravel pits.

Monitoring

The management arrangements in place for the protection of water values are not static, and are subject to review through Victoria's environment management systems, which are considered further in the ESFM assessment in Chapter 17 of this report. However, the major processes and actions relevant to monitoring and reporting of hydrology related issues include:

- regular audits of timber harvesting operations against the Code and regional prescriptions; and
- regular monitoring of water quality in State forest streams through the Victorian Water Quality Monitoring Network, including monitoring by the EPA. Data from this is used to detect trends in water quality and yield in forest catchments.

10. MINERALS

10.1 INTRODUCTION

The aim of the regional assessment of minerals potential is to draw together new and existing information to aid the consideration of economic effects of forest use options to be considered in the development of the RFA. In particular, this assessment contributes to the evaluation of:

- the nature of mineral resources in forested land;
- current and potential uses of forested land;
- economic value of mineral products;
- structure and regional significance of the mining industry; and
- resource, infrastructure and policy requirements for the establishment of minerals industries.

The National Forest Policy Statement recognises the need to consider access for mineral exploration and extraction activities in deciding on land use for public native forests. Access for mining and exploration varies with land tenure. Due to the incomplete nature of information on minerals resources and the fact that exploration is a dynamic information-gathering process, continued access to land is a significant issue for the mining industry and for future mineral development.

This chapter outlines: identified mineral deposits; the potential for a number of deposit types; indicators of the region's potential mineral value, and factors affecting this value. Mineral deposits outside but close to the boundary of the region (within 15 km) are noted if they are considered to have significance for mineral potential within the region.

In this report, the study area is referred to as 'the Gippsland region' or as 'the region'. A technical report detailing the assessment of mineral resources is available on request.

The major mining activity in the Gippsland region is the exploitation of brown coal resources, which provide a major source of energy for electricity generation. Total brown coal reserves for the Gippsland Basin have been estimated at 96 300 million tonnes, while total resources have been calculated at over 172 874 million tonnes (Gloe & Holdgate 1991).

The region was a major gold producer last century, and many old deposits have recently attracted exploration interest. Resources have been identified at a number of prospects within the region or just adjacent to it.

The region is highly to moderately prospective for a number of mineral deposit types and is therefore likely to contain a number of undiscovered deposits.

Where access for exploration is possible, both undeveloped and as yet undiscovered deposits may be mined in the future subject to normal approval processes, and yield economic benefits.

10.2 KNOWN AND POTENTIAL RESOURCES OF METALLIFEROUS AND EXTRACTIVE MINERALS

Geological Setting

The regional geological setting is shown on Map 10.1, and the main geological and mineralising events are summarised in Tables 1a and 1b (Appendix 4). In the Gippsland region the Palaeozoic basement rocks in the northern part of the region are grouped into three structural zones. From west to east, these zones are:

- Melbourne Zone.
- Tabberabbera Zone.

- Omeo Zone.

The Mount Wellington Fault Zone marks the boundary between the thick Silurian-Devonian marine Melbourne ‘Trough’ sequence and the Tabberabbera Zone to the east. Discontinuous exposures of the underlying Cambrian greenstone basement rocks occur along the fault zone. The Kiewa Fault zone defines the eastern limit of the Tabberabbera Zone and separates it from the Omeo Metamorphic Complex to the east.

Volcanic rocks and associated granite plutons of Silurian and Devonian age form a large magmatic province. Volcanic cover rocks of Upper Devonian age occur within large calderas. These are overlain by sediments that are part of the Howitt Province, a broad north-west-trending graben that continues almost to the coast at Bairnsdale.

The Palaeozoic basement rocks are overlain by Cretaceous and Tertiary sediments of the *Gippsland Basin* in the southern portion of the region.

The geological history of the region can be broadly divided into three main episodes:

- Cambrian to Early Carboniferous (c. 500-350 Ma): the development of the Lachlan Fold belt with cycles of marine and non-marine deposition alternating with three major phases of rock deformation [Benambran (c. 430 Ma), Tabberabberan (c. 385 Ma) and Kanimblan (c. 350 Ma)], involving folding, faulting, intrusion of granites, volcanism and metamorphism. Most of the mineral deposit formation in the region took place during this episode; it is associated with magmatic, volcanic and metamorphic processes, and with phases of major deformation.
- Early Carboniferous to mid-Mesozoic (c. 355-100 Ma): widespread erosion followed the land uplifts associated with the Tabberabberan and Kanimblan deformations resulting in a landscape of low to gentle relief over most of south eastern Australia.
- Mid-Mesozoic to the present day (c. 100-0 Ma): Australia separated from Antarctica and New Zealand during the break-up of the Gondwana super continent about 95 million years ago. The Tasman Sea began to open and the Gippsland region was uplifted, followed by erosion of the landscape and a brief period of basaltic eruption. During the earlier part of this period, 65-11 Ma, sands, clays and brown coal seams were deposited over most of the Gippsland Basin and the thick brown coal seams of the Traralgon, Morwell and Yallourn Formations accumulated in slowly subsiding shallow water basins. The extensive alluvial gold and tin deposits mined at the turn of this century were formed near the end of this period.

Known Occurrences and Resources of Metalliferous and Extractive Minerals

Map 10.2 shows 1057 mineral occurrences, old mines and deposits in the Gippsland region. Most of the 813 gold occurrences occur within 29 goldfields. Major resources of brown coal occur in the region, which form the basis of the Victorian electricity power industry. During the period 1923-95, brown coal production exceeded 1.1 billion tonnes.

Exploration and mining have historically focused on gold, then coal, oil and, more recently, base metals. Historical production of antimony, tin, tungsten and related minerals has been recorded. Of 34 current mining licences for gold (10 more are under application or renewal), none produced more than one kilogram of gold in 1996-97 (pers comm R Buckley, Geological Survey of Victoria 1998).

Mines within the Bairnsdale 1:250 000 scale map area (covering much of the northern half of the region) have intermittently produced in excess of 13.7 tonnes of gold, 45 000 tonnes of copper, 21 000 tonnes of zinc, 15 tonnes of silver and unknown quantities of lead, iron and other metals. The region includes several of Victoria's most important mineral deposits, including Wilga and Currawong, the States largest base metal deposits (Maher *et al.* 1996).

Sales of non-metallic minerals produced within the Bairnsdale 1:250 000 scale map area have exceeded \$2 million per annum.

Gold

Victoria's total gold production until 1988 was approximately 2450 tonnes (Ramsay & Willman 1988), of which 60 per cent was alluvial and 40 per cent from a primary (hard rock) source (Ramsay 1995). Since its discovery in 1851, in excess of 13.7 tonnes of gold have been mined within the Bairnsdale 1:250 000 scale map area, with about 33 per cent from alluvial and 67 per cent from primary sources respectively (Maher *et al.* 1996).

Known gold resources remaining within the region amount to 520 000 tonnes at 4.1 grams per tonne at Cohens Reef and 64 000 tonnes at 3.4 grams per tonne at Cassilis in tailings.

Base Metals

Small to medium scale base metal mining occurred at the Wilga copper-zinc-silver, volcanogenic massive sulphide (VMS) deposit in the Limestone Creek Graben between 1992 and July 1996. Other small base metal deposits and occurrences are common in the eastern part of the region and are related to rocks of the Buchan Rift and Limestone Creek Graben (Maher *et al.* 1996). There are 44 base metal occurrences in the region (see Map 10.2).

Mining at Wilga ceased in 1996, but the nearby Currawong deposit has not been mined. Prior to mining, Wilga had proven reserves of 0.64 million tonnes at 9.45 per cent copper, 0.09 per cent lead and 2.39 per cent zinc, 38 grams/tonne silver and 0.16 grams/tonne gold. Currawong has 8.84 million tonnes of measured, indicated and inferred resources. Both of these are the largest known base metal deposits in Victoria. Several other minor base metals occurrences are located in the Limestone Creek Graben (Maher *et al.* 1996).

Copper and Platinum Group Metals

A number of gold mines associated with the Woods Point dykes, extending into the western edge of the region, have produced copper and platinum group metals as by-products. Intermittent operations at the Thomson River mine prior to 1971 gave a total estimated production of about 13 000 tonnes of ore (Cochrane 1982, cited in Maher *et al.* 1996). The only profitable period of production was from 1874 to 1881, but mining continued until 1913. Very small production occurred from 1966 to 1971 and a small resource remains.

The East Walhalla copper and platinum mine produced small amounts of ore from three small open-cuts and a short underlay shaft, but no production details are known. Small amounts of platinum and osmiridium are found with alluvial gold at Turtons Creek, Foster and in beach sands at Waratah Bay (Douglas 1984).

Tin

There are 22 primary (hard rock) and alluvial tin occurrences in the region (Map 10.2). Alluvial tin is found as the mineral cassiterite at Toora, Yanakie and Wilsons Promontory. The Toora field was first worked in the 1870s and produced 400 tonnes of concentrate up to 1939 (Cochrane 1971, in Douglas 1984). Alluvial tin mining occurred at Mount Hunter, on Wilsons Promontory from 1920 to 1934, but failed because of poor values (Douglas 1984). Primary greisen tin deposits in the eastern part of the region occur at the southern end of the elongate north-south trending Mount Tallebung (NSW)-Albury-Mount Wills Tin Province (Cochrane & Bowen 1971, cited in Oppy *et al.* 1995).

Tungsten

There are four tungsten occurrences in the region (Map 10.2). Much of Victoria's tungsten production was from the Mount Murphy Wolfram mine, in the north east corner of the region, where a total of 90.4 tonnes of tungsten concentrate was produced from 1908 to 1920. Wolframite (tungsten mineral) was mined at the Fainting Range mine until about 1945.

Iron Ore

At Narracan, limonite with 36 per cent iron has formed on ferruginous grit and sandstone. Highly ferruginous Tertiary age gravel and clay containing 79 per cent iron occurs at Mirboo North. A small deposit of limonite derived from basalt at Alberton West has 44 per cent iron, and bog iron at Inverloch contains 11 per cent iron (Douglas 1984). There are 13 iron occurrences in the region (see Map 10.2).

Chromite

Some 200 tonnes of chromite ore has been taken from the Dolodrook River serpentinite (VandenBerg 1977). Chromite also occurs at the Howqua River Chromium Field, just west of the region, in Cambrian greenstones that extend into the region.

Bismuth

Alluvial bismuth is an accessory to alluvial tin and gold in the Mount Wills goldfield (Oppy *et al.* 1995) at several locations.

Antimony

There are five significant antimony occurrences in the region in addition to gold occurrences that often contain minor antimony (Map 10.2).

Silver

Silver has been recorded in association with lead at a number of localities including Silver Flat, Quartz Pot Flat (both near the north-west boundary of the region) and the Mammoth Complex. Silver, associated with galena, is generally hosted by fissure quartz veins and breccias at or near the contact of major faults (Oppy *et al.* 1995).

Brown Coal

Very large brown coal resources are present within the Latrobe Valley Depression of the Gippsland Basin, which covers much of the south-eastern part of the region. Total reserves for the Gippsland Basin have been estimated at 96 300 million tonnes, while total resources have been calculated at over 172 874 million tonnes (Gloe & Holdgate 1991).

Production for 1923-98 from the Morwell, Yallourn, Yallourn North, Yallourn North Extension and Loy Yang mines totals around 1333 million tonnes (Barton *et al.* 1992, BRS estimate 1997, NRE Annual Reports 1996-1998). Brown coal in Victoria is mainly used for electricity generation, but briquettes are also produced for industrial and domestic use.

Black Coal

Past production from black coal seams has been from scattered deposits in the south-west part of the region but mainly from deposits in the Wonthaggi area, just to the south west of the region (Map 10.2). The coal is a banded bituminous type with medium moisture and volatile content, and medium to high ash content. It is of good steaming quality and was used for power stations and locomotive boilers (Knight 1988). Total Wonthaggi production, between 1909 and 1968, was 17 070 780 tonnes of coal. Faulting and mechanisation difficulties made mining uneconomical once the thicker seams were worked out (Knight 1988).

Smaller scale production from within the region occurred in the Korumburra, Jumbunna-Outtrim, Kilcunda-Woolamai coalfields, and at Coalville and Boolarra. Production ranged from two million tonnes at Korumburra down to 500 tonnes at Boolarra, and occurred from 1884 to 1966 (Knight 1988).

Oil

Oil was accidentally discovered in a water well at Lakes Entrance in 1924 (see Map 10.2) and minor production (3063 barrels) occurred from numerous wells from 1930 to 1941 (Boutakoff 1964, cited in Smith 1988). A further 4935 barrels were produced between 1948 and 1951 from the Lakes Entrance Oil Shaft (Beddoes 1973, cited in Smith 1988). Numerous onshore exploration wells (67 to the end of 1987) were drilled in east Gippsland during the 1960s, but none was successful (Smith 1988).

Peat

At Morwell, peat of thicknesses up to a few metres occurs in overburden above brown coal measures, but its use in horticulture is limited because of acidity (McHaffie & Buckley 1995).

Limestone

Silurian limestone occurs in the Limestone Creek Graben, in the north west of the region where it occurs as large megaclasts in the Cowombat Siltstone. Analysed samples contain up to 97 per cent calcium carbonate (CaCO_3) (McHaffie & Buckley 1995).

Limestone deposits of Silurian and Devonian age have also been recognised at Morass Creek and Wombat Creek and are potential sources for limestone extraction. A 70 m thick deposit of limestone occurs at Wombat Creek, west of the Mitta Mitta - Gibbo River junction, and contains 97 per cent CaCO_3 (VandenBerg, 1988). Future extraction is precluded by their inclusion within the Alpine National Park.

Limestone is also extracted from the Boola Quarry (north of Tyers) for lime production in Traralgon. Limestone of the same age has been extracted for use in paper manufacture at Maryvale from the Tyers and Boola quarries, where several million tonnes of reserves are estimated (Douglas 1984). A high-grade limestone body of about 1.6 million tonnes and up to 80 m thick has been identified within the several million tonnes (McHaffie 1980, in McHaffie & Buckley 1995). There are limestone occurrences at Toongabbie (Marble Creek) and Licola (Serpentine Creek), in the south west of the region. Parts of the Coopers Creek Limestone are potential quarriable sources of high to very high-grade limestone. A major part of this limestone is in the Tyers Regional Park (McHaffie & Buckley 1995).

Lower Devonian limestone at Walkerville, on Waratah Bay, was burned for lime. Talent (1959) (cited in Douglas 1984) estimated reserves of about 500 000 tonnes and two samples analysed gave 95 per cent calcium carbonate with fairly high magnesia and silica contents.

The Tertiary age Gippsland Limestone outcrops in the southern part of the region and reaches a maximum thickness of 500 m onshore. The constituent Bairnsdale Limestone Member is quarried in the south and just east of the region for aggregate and agricultural purposes (McHaffie & Buckley 1995, cited in Maher *et al.* 1996).

Gippsland limestone has been quarried at Merriman Creek and Darriman (McHaffie 1976, cited in Douglas 1984). It is used in cement manufacture and agricultural lime production. Quaternary calcareous dunes now within the Wilsons Promontory National Park have been quarried for agricultural lime (Douglas 1984).

Silica

Quaternary dune sands and alluvial sands of Tertiary age are present within the Gippsland region. At Lang Lang, just west of the region, sand deposits of similar ages have supported a major operation extracting sand for glass manufacture since the 1950s. Both Quaternary age dune sands and Tertiary age alluvial sands are extracted, but the latter less-pure product has become more important as the dune sands are depleted. Production averages 240 000 tonnes per year (McHaffie & Buckley 1995).

Construction Materials

At November 1998, there were 69 current and five applications for construction material Work Authorities in the region. A total of 41 Work Authorities extract sand/gravel, 12 extract basalt and the rest extract limestone, sedimentary rocks, clay/shale and granite. Numerous smaller pits used for minor rural road maintenance are not covered by these Work Authorities. Construction materials worth approximately \$2.2 million were extracted in 1994-95 under the *Extractive Industries Development Act 1995* (NRE records).

Granite aggregate is extracted from the Sarsfield Granite, north of Bairnsdale. Basalt for road making, building and concreting has been quarried from Older Volcanics at Yallourn North, Jeeralang North, Ruby, Dumbalk North and Leongatha South. Sandstone for road building is quarried from a number of localities with large quarries near Jerralang Junction, Mount Speed and Trafalgar (Douglas 1984).

Limestone and sandstone used for agriculture and aggregate is extracted from the Seaspray and Sale Groups, east of Bairnsdale.

Sand and gravel pits operated by the former Department of Conservation and Natural Resources are an important local source of road surfacing material (Maher *et al.* 1996). The Haunted Hill Gravel is the principal source of sand and gravel in the south west of the region and it is used in roads, housing, concreting and pipe manufacture (Douglas 1984). Major potential construction sand resource areas are at Trafalgar and overlying brown coal basins in the Latrobe Valley in the south-west corner of the region (McHaffie & Buckley 1995).

Extensive deposits of clay are associated with brown coal at Morwell. Soft, weathered siltstone from the Boola Formation is used to make bricks at Morwell and clay derived from basalt is also quarried at Tyers for bricks. There is another clay pit at Hallora in the Childers Formation (Douglas 1984).

Dimension Stone

The Gippsland region has a number of rock types which could be suitable as dimension stone at Bindi (marble), Limestone Creek (marble), Colquhoun (granite), Mount Taylor (granite) and The Brothers (granite) (Map 10.2).

The Colquhoun granite and the sandstones in the MacAlister, Avon and Mitchell River Basins have been used for dimension stone. The sandstone at Briagolong has been used for local buildings and shows no significant deterioration even after 105 years (King & Weston 1997). An Extractive Industry Work Authority has been granted for quarrying micaceous lithic sandstones in the Valencia Creek-Avon River area.

Kaolin

A secondary kaolinitic clay deposit below the mid-Tertiary age Morwell No 1 brown coal seam in the Morwell open cut mine is up to 10 m thick and contains some grit and organic

matter. A pit in the floor of the open cut is periodically used to extract this clay for making white ware. The upper 6 m of overburden clay on the northern side of the open cut have been used to make wall tiles, but are now inaccessible. At nearby Yallourn, a similar, but less pure, secondary kaolinitic clay layer lies under the brown coal open cut (McHaffie & Buckley 1995).

At Heyfield white kaolinitic clay occurs as two seams interbedded with early Tertiary age sand and gravel. This clay has been worked for the ceramic and chemical industries (VandenBerg 1977). Further east a 10 m thick kaolinitic clay sequence occurs which may be suitable for ceramics (McHaffie & Buckley 1995).

Bauxite

A cluster of deposits south west of Morwell are the only known deposits with economic significance in Victoria. There are about 40 bauxite occurrences in this area and about half have been identified as small residual deposits formed by deep weathering of basalt and tuffaceous volcanics (McHaffie & Buckley 1995). Estimated initial resources of the two largest deposits were about 200 000 tonnes of bauxite each and the other deposits each contained less than 50 000 tonnes. Most of these resources have been worked out (Nott 1988, cited in McHaffie & Buckley 1995).

Bauxite mining for production of aluminium salts began in Victoria in 1919 near Thorpdale. A little further south, Geelong Cement and Asko Chemicals mined bauxite until 1992 from the Paynes and Watkins deposits for use as an additive in cement manufacture. Total recorded bauxite production for Victoria since 1926 is about 200 000 tonnes and in 1991-92 was about 5 000 tonnes (McHaffie & Buckley 1995). Resources at the Watkins and Paynes deposits are sufficient for many years at past production rates, and Geelong Cement has found significant new resources near Paynes. At Watkins there is a substantial resource of high alumina clay beneath the bauxite (Nott 1988, cited in McHaffie & Buckley 1995).

Feldspar

Significant occurrences of feldspar are located at Pyles and The Brothers, and at Mount Taylor.

Precious and Semi-precious Stones

Gemstone occurrences are known at Avon River (jasper), Toora (agate, chert, jasper, quartz, ruby, sapphire, topaz and zircon), W-tree/Gelantipy (common [opaque to translucent] opal), Cape Liptrap and Walkerville (jasper, serpentinite and green nickeliferous quartz), Yanakie (garnet, zircon, green and blue sapphire, topaz and almandine ruby), and Wilsons Promontory (tourmaline) (McHaffie & Buckley 1995, Stone 1967 cited in Douglas 1984).

Phosphate

Phosphate occurs in the Hoddle Range in the south of the region where it is hosted by intraformational breccia of Ordovician age. An analysis of 19.7 per cent P₂O₅ is recorded, but grades are usually low and quantities are small (Cooney 1967, cited in Douglas 1984). Cambrian age tuffaceous sediments also contain phosphate at Fullarton Spur, north of Licola (McHaffie & Buckley 1995).

Barite

Barite has been recorded at Gibbo River (Oppy *et al.* 1995).

Wollastonite

Wollastonite occurs at Morass Creek and Pyles.

Pyrophyllite

Pyrophyllite is recorded from the Wilga deposit, and the Pyramid Mountain and Blue Spur prospects (Maher *et al.* 1996).

Talc

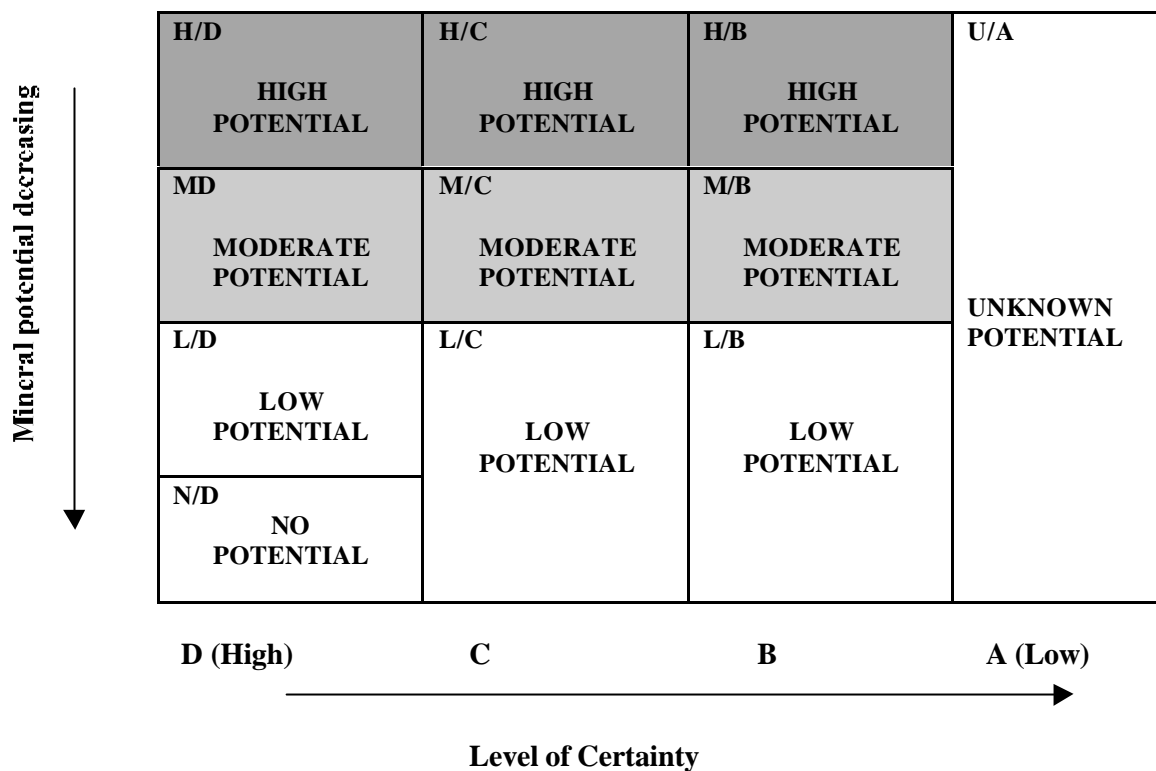
At Bingo Munjie North, talc occurs in altered basic dykes in red granite (Bartlett & Learmonth, 1955, cited in Maher *et al.* 1996).

Potential Mineral and Extractive Resources***Mineral Potential Assessment Methodology***

A qualitative assessment of the potential resources of an area is an estimate of the likelihood of occurrence of mineral deposits, which may be of sufficient size and grade to constitute a mineral resource. The term 'mineral resource' is restricted to material, the extraction of which is judged to be potentially viable, either now or within the next 25 years.

The mineral potential of the Gippsland region has been assessed by determining the types of mineral deposits likely to be found within the geological framework known or believed to exist there. This approach identifies geological units (tracts) which could contain particular types of mineral deposits. The general methodology was developed by the United States Geological Survey and has been used successfully for mineral resource assessments of wilderness areas in North America and elsewhere. A summary of the qualitative assessment methodology is described by Marsh *et al.* (1984), Taylor and Steven (1983), and Dewitt *et al.* (1986).

Figure 10.1: Relationship between Levels of Resource Potential and Levels of Certainty



An assessment of a region's potential mineral resources combines knowledge of its geology, geophysics, geochemistry, mineral deposits and occurrences with current theories of mineral deposit genesis and results of mineral exploration. The assessment uses available geoscientific data to determine the history of geologic processes and environments. Geologic environments judged to have characteristics known to be associated with specific types of mineral deposits are then identified. In particular, the assessment draws on regional and local characteristics of mineral deposit models to establish whether or not specific types of deposits are likely to occur.

The mineral potential of an area — that is, the likelihood of a particular type of mineral deposit occurring — is ranked as 'high', 'moderate', 'low' or (where there is insufficient data) 'unknown'. To reflect the differing amounts of information available, assessments of mineral potential are ranked from A–D according to levels of certainty, 'A' denoting the lowest level of certainty and 'D' the highest (Figure 10.1).

As geological knowledge of an area can never be complete, it is not possible to have a 'final' assessment of potential mineral resources at any given time. Mineral resource potential needs to be monitored and periodically reassessed to take account of new data and advances in geological understanding, including new mineral discoveries. Advances in mineral exploration and mining technologies and market changes may also change the mineral resource potential of an area.

Mineral Potential in the Gippsland Region

Mineral potential tracts were identified for 15 types of mineral deposits, five types of industrial minerals and for brown coal (Table 10.1).

The tracts of mineral potential for various types of mineral deposits have been combined and summarised in two different ways in Maps 10.3 and 10.4. Extraction sites for low value construction materials are often dictated by other land uses and by costs of transport and mineral potential for construction materials is not included in combined mineral potential Maps 10.3 and 10.4.

The levels of mineral potential for the various types of mineral deposits are listed in Table 10.1. Descriptions of the favourable geological tracts for deposit types are summarised in Appendix 5 and are fully described in the Gippsland CRA Minerals Assessment Report (VicRFASC 1999).

Map 10.3 is a composite of mineral potential tracts over the Gippsland region (Table 10.1) and shows the highest level of mineral potential assessed (in December 1998) for any particular area in the region. Where tracts for different types of deposits overlap, this area is assigned the highest potential level of all the overlapping tracts. In this approach, the tract having the highest mineral potential in any particular area obscures tracts of lower mineral potential.

In terms of mineral potential, the region can be divided by a line running through Warragul and Bairnsdale, with the older Palaeozoic and Mesozoic rocks in the north and the younger Gippsland Basin in the south. The northern part of the region has extensive tracts of high and moderate to high potential for deposits of slate-belt gold and moderate to high potential for disseminated gold (Map 10.3). There are smaller tracts of high potential for epithermal gold deposits and volcanic associated massive sulphide base metal deposits in the central north

Table 10.1: Summary of Potential Mineral Resources at April 1999

Deposit type	Mineral potential	Certainty level	Area of tract (sq. km)	% of region covered by tract	% of tract in Exempt Crown Land*
Slate belt gold	High	B-C	6 990	26.4	16.4
	Moderate-High	B	4 258	16.1	35.4
	Moderate	B	89	0.3	0.0
	Low-Moderate	B	134	0.5	2.2
Disseminated gold	Moderate-High	B-C	6 990	26.4	16.4
	Moderate	B	4 258	16.1	35.4
	Low-Moderate	B	89	0.3	0.0
	Low	B	134	0.5	2.2
Epithermal gold-silver	High	B-C	253	1.0	1.4
	Moderate	B	428	1.6	5.1
Alluvial gold	Low-Moderate	B-C	2 630	9.9	7.5
Porphyry copper-gold	Moderate-High	B-C	879	3.3	0.1
	Moderate	B-C	798	3.0	3.5
Volcanic associated massive sulphide base metals	High	C	207	0.8	1.4
	Moderate-High	B	64	0.2	0.6
Volcanic associated massive sulphide gold	Moderate-High	C	207	0.8	1.4
	Moderate	B	64	0.2	0.6
Irish Style	High	C	33	0.1	0.0
Tin veins	Moderate	B-C	908	3.4	13.4
	Low-Moderate	B-C	57	0.2	0.0
	Unknown	A	11	0.0	0.0
Tin greisen	Low-Moderate	B	5	0.0	0.0
	Low	B	267	1.0	5.1
	Unknown	A	11	0.0	0.0
Tungsten-molybdenum veins	Low-Moderate	B	1 023	3.9	8.9
	Unknown	A	1 696	6.4	1.7
Tungsten skarn	Moderate	C	20	0.1	0.4
	Low-Moderate	B	20	0.1	0.0
	Unknown	A	258	1.0	3.4
Nickel-copper deposits	Moderate-High	B	454	1.7	0.0
Sandstone uranium	Low-Moderate	B-C	4 583	17.3	28.2
Sediment hosted copper	Moderate	B-C	2 203	8.3	27.5
Brown Coal	High	D	1 092	4.1	1.4
	Moderate-High	C	5 539	20.9	1.9
Dimension stone	High	C	204	0.8	0.5
	Moderate-High	B	2 290	8.6	29.7
	Moderate	C	0.2	<0.1	0.0
	Low	B-C	448	1.7	0.0
Limestone	High	C	124	0.5	2.1
	Moderate-High	B	17	0.1	0.0
	Moderate	B	192	0.7	0.2
Silica Sand	High	C	147	0.6	0.0
	Moderate	B	2 015	7.6	2.3
	Low	B	353	1.3	2.1
Kaolin	High	C-D	107	0.4	0.0
	Moderate	B	1 032	3.9	1.4
	Low	C	1 488	5.6	1.2
Bauxite	Moderate	C	520	2.0	0.0

* Exempt Crown land in this column comprises National and State Parks, Wilderness and Reference Areas

west and in the north east of the region (Map 10.3). Future discoveries of gold and other metalliferous deposits would most likely occur in the northern part of the region, which also contains nearly all of the old goldfields. There is moderate to high potential for porphyry copper-gold along the eastern boundary of the region and for nickel-copper along the western boundary north of Walhalla. There is also moderate potential for tin vein deposits north west of Benambra and the Wilsons Promontory. Potential for other types of tin, tungsten and molybdenum deposits is primarily restricted to small tracts of low to moderate potential in the northern part of the region.

Most of the southern part of the region is dominated by tracts of high and moderate to high potential for brown coal in the Gippsland Basin. All the brown coal sequences with an overburden ratio of 2:1 are within the high potential tracts in this part of the region. There are less extensive tracts of high and moderate potential for silica sand, kaolin and moderate potential for bauxite.

Map 10.3 is a composite of mineral potential tracts for different types of mineral deposits that do not have equal economic values. For example, a tract with moderate to high potential for slate belt gold may be considered to have a higher economic value than a tract with moderate to high potential for dimension stone.

The mineral potential tracts for different types of mineral deposits are superimposed on Map 10.4 to highlight areas with overlapping tracts. This presentation takes account of the diversity of mineral resource potential as well as the level of potential. This was done by allocating standard scores according to a subjective ranking of levels of mineral potential as follows: high potential (18), moderate/high (12), moderate (6), low/moderate (2), low (1), unknown potential (no score). In those areas where tracts overlap, the scores are added and this cumulative score is assigned to overlapping areas. For example where there is an overlap of high potential for slate belt gold (score 18), moderate to high potential for disseminated gold (score 12), and moderate potential for limestone (score 6) then this area will have a cumulative potential score of 36.

It should be understood that the areas with overlapping tracts highlighted by Map 10.4 emphasise the diversity of deposit types and their mineral potential, but these areas are not necessarily always more prospective than a single tract of high potential, e.g slate belt gold. As with Map 10.3, the relative economic potential of different deposit types has not been accounted for. The relative economic significance of the tracts for different types of mineral deposits, as perceived by mining companies, would be influenced by their perceptions of prospectivity, commodity prices, future market conditions, land access and other factors.

In the northern part of the region (Map 10.4) the areas with the higher cumulative mineral potential scores occur in the north east and along the western boundary of the region. In the north east of the region, in the Limestone Creek Graben area, there is potential for eight different types of deposits for gold, base metals and industrial minerals with a cumulative score of 48. This part of the region includes the base metal deposits of Wilga and Currawong. In the nearby Bindi Creek Graben the cumulative score reaches 114 from seven overlapping tracts and includes tracts for five types of deposits having high potential for gold, base metals, limestone and dimension stone. In the area adjacent to the Buchan Rift in the south east, there are partly overlapping tracts for seven different types of deposits, giving a cumulative score of 60. On the western boundary of the region, north and south of Walhalla, there is a partial overlap of mineral potential tracts for nine types of deposits for gold, base metals, industrial minerals and coal. South of Walhalla the cumulative score reaches a maximum of 64.

In the Gippsland Basin, in the southern part of the region, the maximum cumulative score reaches 42 to 44 in scattered small areas where there are overlapping tracts for brown coal and three types of industrial minerals. This part of the region illustrates the differences in

presentation of mineral potential between Maps 10.3 and 10.4. Although the brown coal deposits are very important and show up as areas of high mineral potential on Map 10.3, there is potential for only a few other types of deposits in these areas; hence the relatively lower cumulative score reflects the low diversity of potential in these areas.

10.3 CURRENT EXPLORATION, MINING AND EXTRACTION ACTIVITIES AND POTENTIAL ECONOMIC VALUE

The potential economic value of the region's mineral resources is affected by a number of factors including: mineral prospectivity; geological knowledge base and intensity of data over the region, timing and significance of discoveries; future metal prices and mining costs; and rules and regulations governing exploration and mining.

The mineral potential assessment provides an indication of areas of land which are more likely to be most prospective for particular minerals. However, an assessment of the potential value of mineral resources in these areas is not possible without an estimate of the number and type of deposits likely to occur in a particular region. Therefore, it has not been possible to compare the 'mineral' value of particular areas of land that have been assessed as prospective for minerals with other land (whether prospective or not). These limitations, when combined with the dynamic information-gathering nature of exploration, have significant implications for land access arrangements for exploration and mining in these areas.

Current and historical exploration expenditures provide some indication of the potential value of the undiscovered mineral resources of the Gippsland region. This is because a decision to invest in exploration is based largely on a company's perception of the mineral potential of an area, i.e. exploration expenditure will tend to be higher in areas of higher perceived mineral potential. However, given the uncertainty, different risk attitudes of companies and the difficulty of exploration, expenditures only provide an approximation of true prospectivity. Sometimes deposits are found in previously unprospective areas when new ideas or technology are applied where little previous exploration has occurred.

Exploration

While there are presently no significant operating metallic mineral mines in the Gippsland region, exploration expenditure totalled about \$1.1 million in 1997-98. The major commodity target was gold, with interest also in copper and other minerals.

Alluvial gold was discovered at Livingstone Creek, near Omeo, in 1851 and at Cobungra River in the Dargo High Plains goldfield in 1852. Major goldfields established during the early days (from north to south) included Omeo, Dargo High Plains, Dargo, New Rush Creek, Swifts Creek, Grant, Haunted Stream and Shady Creek, Yahoo Creek, Bullumwaal, Debtford, Store Creek, Gladstone Creek, and Limestone Creek in the far north east and the Woods Point-Walhalla region in the far west of the area. Mining of alluvial gold was extended with the arrival of low-cost alluvial dredges or floating large-scale processing plants on pontoons, which were introduced in the 1890s and early 1900s along Livingstone Creek, and later on Swifts Creek, ending in the early 1920s.

An Exploration Licence system was introduced by the Department of Mines and Industrial Development in the mid-1960s, which allowed exploration of large areas. This greatly facilitated company-scale exploration for minerals. Since 1965, almost 200 Exploration Licences have been granted over the Gippsland region or its margins (Figure 10.2).

Exploration in the central-western and north-eastern portions of the area has been hampered by rugged topography, difficult access and at times severe weather. Hence, at least some exploration programs in the region may have been inconclusive and significant mineral

deposits may remain undetected and a number of quite prospective areas remain, to a large degree, untested.

The exploration targets sought since 1965 have varied in accordance with relative metal prices, perceived prospectivity, relative recovery costs of metals and new exploration paradigms or mineral deposit models. Until 1967, the gold price was fixed at a relatively low level compared with its post-1980 price, although base metal prices were relatively strong in the 1960s and 1970s. Gold prices did not begin to move rapidly upward until after 1972. Commodities explored for in the region include gold, silver, copper, lead, zinc, platinoids, tin, tungsten, molybdenum, uranium and fluorite.

During the period 1965 to 1973, the area attracted around 44 companies most of whose exploration targets were either base metals, gold or tin/tungsten, although uranium was sought by Conzinc Riotinto of Australia Exploration near Limestone Creek in 1972, and heavy mineral beach sands were targeted in Tertiary sediments of the Gippsland Basin lapping onto basement in the Stratford region by Strahan Sands in 1971. Rio de Janeiro Mines Pty Ltd were the first to explore for carbonate-hosted Mississippi Valley Type (MVT) lead-zinc-silver in the Buchan region in 1966, and that company and Pickands Mather & Co International first explored there during 1967 to 1970 for porphyry copper mineralisation in and around plutons intruding the Devonian Snowy River Volcanics. From 1968 to 1970, both Conzinc Riotinto of Australia and Gippsland Minerals explored unsuccessfully over areas that were later to yield the Wilga-Currawong VMS discoveries east of Benambra. Tin and tungsten were sought in the Glen Wills-Sunnyside and Limestone Creek areas by Gippsland minerals in 1969-70. In 1972, the Endeavor Oil Company NL sought alluvial gold in the Dargo High Plains and Grant Goldfields, and Western Mining Corporation Ltd targeted VMS-style deposits in the area east of Benambra, while Comalco Ltd explored for fluorite in the Devonian limestone around Buchan.

After the lull in exploration activity from 1975 to 1978, during which there was some ongoing interest in MVT and Volcanic Massive Sulphide (VMS) base metal targets in the Buchan and Benambra areas respectively, the period 1979 to 1981 witnessed a growth in exploration activity based on strong interest in base metals and also tin, molybdenum and gold within the region. Exploration for base metals included a strong interest in MVT lead-zinc-silver in the Buchan Limestone by Preussag Australia Pty Ltd, while exploration for VMS in volcanics in the region was stimulated by WMC Ltd's 1978 announcement of the discovery of the Wilga copper-lead-zinc-silver-gold deposits in the area east of Benambra. In late 1977, sedimentary uranium and vanadium were targeted in Tertiary sediments of the Gippsland Basin north of Maffra-Stratford by Northern Mining Corporation NL. The tin boom of 1979-80 resulted in Freeport Australia exploring for vein and porphyry-type tin deposits in and around granitic bodies near Omeo and south east towards Buchan, while the soaring gold price at that time resulted in accelerated interest in lode and alluvial deposits in the Dargo and Gladstone Creek goldfields as well as in the small Tara goldfield south east of Buchan.

Exploration activity peaked again in 1981 when 12 Exploration Licences were granted. Apart from exploration for tin, gold and base metals, particularly porphyry copper-gold, there was a burst of interest in brown coal within the Tertiary Gippsland Basin sediments stretching from Orbost westward to Stratford, where seven Exploration Licences were granted, four to BHP, one to BP Mining & Development, and two to Shell Australia.

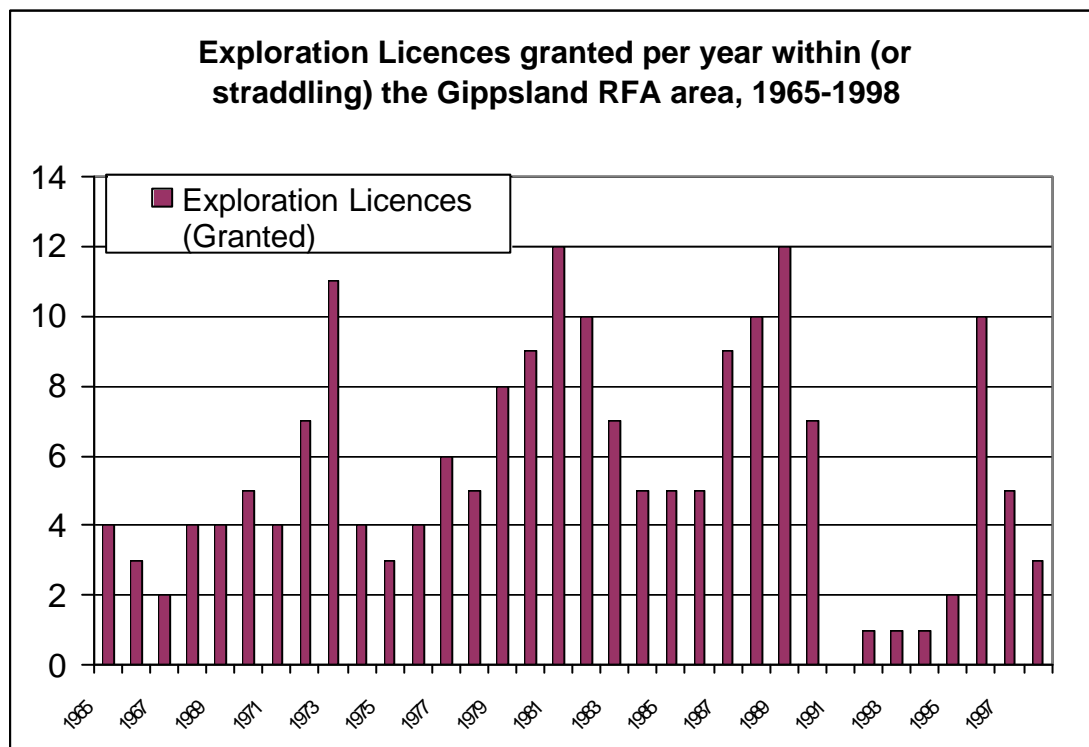
The period 1982 to 1986 saw a general decline of exploration interest with an average of around five licences per year granted during 1984 to 1986, with the emphasis changing from VMS targets in volcanics to more pure gold-type exploration targets. However, in the period from 1986 to 1989, the number of licences granted increased to peak at 12 in 1989. Most exploration was concentrated on porphyry gold-copper, epithermal gold, slate belt gold and lode-type, replacement and disseminated-type gold targets, as well as alluvial gold.

The pattern of exploration during the 1990s was similar with gold being the principal commodity targeted. Exploration seemed to drop off markedly after 1990 and did not show any improvement until 1996 when 10 licences were granted. In the period 1991 to 1998, the whole range of gold deposit types was sought within the area and included porphyry gold-copper deposits. There has been intensive interest by BHP in MVT lead-zinc-silver deposits within the limestones and dolomites of the Buchan Basin since 1990. Also there has been continuing interest in VMS-type base metal deposits by Denehurst Ltd which was granted a licence in 1996.

From the beginning of 1984 to the end of 1998, the major exploration focus in the region has been for gold and about 76 Exploration Licences were granted during this time. The number of Exploration Licences granted annually fluctuated between none in 1991 and 12 in 1989.

About 90 per cent of exploration was directed at gold, while VMS and MVT base metals were targeted (about five per cent) as well as porphyry copper-gold-type deposits (about five per cent).

Figure 10.2: Exploration Licences Granted for the Gippsland Region



In 1997-98, total exploration expenditure in the Gippsland region was about \$1.123 million (Minerals and Petroleum Victoria 1998), being \$1.119 million on Exploration Licences and \$4 200 on exploration under Mining Licences (Tables 10.2 and 10.3).

Mining and Quarrying

In addition to expenditure on Exploration Licences there has been significant expenditure on Mining Licences in the Gippsland region, which includes expenditure on exploration and developmental activities (Table 10.3). Prior to 1996, most of this expenditure was on Mining Licences that overlie historical gold workings, as well as the Wilga base metal mine. The significant increase in expenditure after 1996 was due to the inclusion of expenditure on the

Latrobe Valley coal mines, which were granted a Mining Licence after 1996 as part of the privatisation of the former State Electricity Commission.

Table 10.2: Total Mineral Exploration Expenditure, Gippsland Region, 1991-92 to 1997-98 (1997-98 dollars)

Year	Gippsland Region Exploration Expenditure (\$)	Victorian Exploration Expenditure (\$million)	Gippsland Region Expenditure, as a percentage of Victorian Expenditure
91-92	8 192	11.3	0.07
92-93	80 431	16.4	0.49
93-94	827 340	20.5	4.03
94-95	1 580 224	44.3	3.61
95-96	2 083 090	35.8	5.82
96-97	1 475 790	37.9	3.9
97-98	1 123 283	36.6	3.07
Total	7 178 350	202.8	3.59

Note: Figures include mineral exploration expenditure on Exploration and Mining Licences, as derived from Mineral and Petroleum Victoria records. Expenditure expressed in current dollars in each financial year has been converted to constant 1997-98 dollars using changes in the consumer price index.

Table 10.3: Expenditure on Mining Licences in the Gippsland Region, 1991-92 to 1997-98 (1997-98 dollars)

Year	Mining Licences Exploration Expenditure (\$)	Mining Licences Other Expenditure ^a (\$)	Mining Licences Total Expenditure (\$)	Number of Mining Licences
91-92	Nil recorded	Nil Recorded	Nil Recorded	50
92-93	30 877	7 956 123	7 987 000	41
93-94	541 968	9 059 488	9 601 456	33
94-95	1 045 390	16 492 499	17 537 890	36
95-96	880 070	12 139 751	13 019 821	31
96-97	72 610	81 388 006	81 460 616	29
97-98	4 200	102 852 655	102 856 855	28
Total	2 575 115	229 888 522	232 463 638	

Note: Figures derived from Mineral and Petroleum records. Expenditure expressed in current dollars in each financial year has been converted to constant 1997-98 dollars using changes in the consumer price index. Mining licence exploration expenditure included in Table 10.2.

^aOther expenditure on mining licences includes costs associated with mining and extraction of ore, processing plant, capital costs and rehabilitation.

At November 1998, there were 69 current and five applications for construction material Work Authorities in the region. A total of 41 Work Authorities extract sand/gravel, 12 extract basalt and the rest extract limestone, sedimentary rocks, clay/shale and granite. Numerous smaller pits used for minor rural road maintenance are not covered by these Work Authorities. Construction materials worth approximately \$2.2 million were extracted in 1994-95 under the *Extractive Industries Development Act 1995* (NRE records).

A small copper-zinc-silver deposit, the Currawong is about three kilometres north east of another small base metal deposit, the Wilga deposit that was mined out a few years ago. A case study of this type of deposit was carried out by ABARE for the East Gippsland

Comprehensive Regional Assessment and published in the East Gippsland CRA report in 1996 (VicRFASC 1996).

Case Study: Slate Belt Gold and the Nagambie Mine

While the resource assessment found that the region is prospective for slate belt gold deposits, no assessment was made of the potential number or size of undiscovered slate belt gold deposits that may lie within the Gippsland region. However, the size of identified slate belt gold deposits in Victoria (which contain virtually all the gold mined in Victoria to date) provide an indication of the potential size of undiscovered slate belt gold deposits that may lie within the region.

Of 163 Victorian slate belt gold deposits surveyed by Bowen (1974), 85 per cent of these deposits had total production of between 1000 and 6228 kilograms. The Nagambie mine which closed after production of 4185 kg (Register of Australian Mining), provides an example of a gold deposit within this range. Moreover, the Nagambie mine occurred close to a small rural town and the history of the Nagambie operation provides a useful insight into the effect that such a mine (if found in the Gippsland region) could have on local towns and regional economies.

The Nagambie gold deposit was discovered in 1985 by Frank Green of East Union Prospecting (Hughes 1990). Perseverance Corporation acquired the title over the area in 1987 and began a program of drilling to delineate a resource of 7 million tonnes at a 1.2 grams per tonne gold grade using a 0.4 grams per tonne cut off grade (Hughes 1990). Ore was mined from July 1989 until June 1993, however, spraying of the heap leach to extract minor amounts of gold continued until March 1997. The mine generated gross revenues of around \$74 million over the eight year mine life. Direct employment and gross revenue flows from the mine over its operating life are shown in Table 10.4.

Table 10.4: Gross Revenue and Direct Employment, Nagambie Gold Mine. Real 1995-96 dollars

Year	Gross Revenue (\$)	Direct Employment (no.)
1989	2 663 377	90
1990	25 129 676	178
1991	18 095 995	105
1992	12 370 433	125
1993	11 155 253	34
1994	3 387 699	32
1995	1 251 428	21
1996	351 320	14

Source: J. Kelly, Perseverance Corporation Ltd, personal communication, February 1997.

Adding to the net economic benefits associated with the rents from production (not calculated in this chapter), the Nagambie mine also generated considerable indirect benefits which have been detailed by Sinclair (1991):

- It was estimated that the mine resulted in the stimulation of an additional 73 jobs in Victoria and 7.5 jobs within the Nagambie region through indirect employment multiplier effects.
- Perseverance spent \$465 000 on local infrastructure, which included upgrading the electricity relay station and road improvements. These enabled a \$1.5 million mushroom farming business to establish in the area which created eight new jobs in the region. These benefits are in addition to the multiplier effects described above.

- The mine introduced a variety of workers into the region, increasing the diversity and level of skill in the Nagambie region's occupational structure (31 of the mines' employees were new residents to the area). In addition, the population growth in the region was around 4.5 per cent over the period 1989 to 1991 — reversing the previous trend of population decline in the area.

Mines like Nagambie may be temporary (three to ten years life in many cases) but it is apparent that these projects — in addition to bringing economic benefits to the local and wider economies during their operating life — also provide infrastructure and demographic benefits to smaller communities, which can have lasting effects.

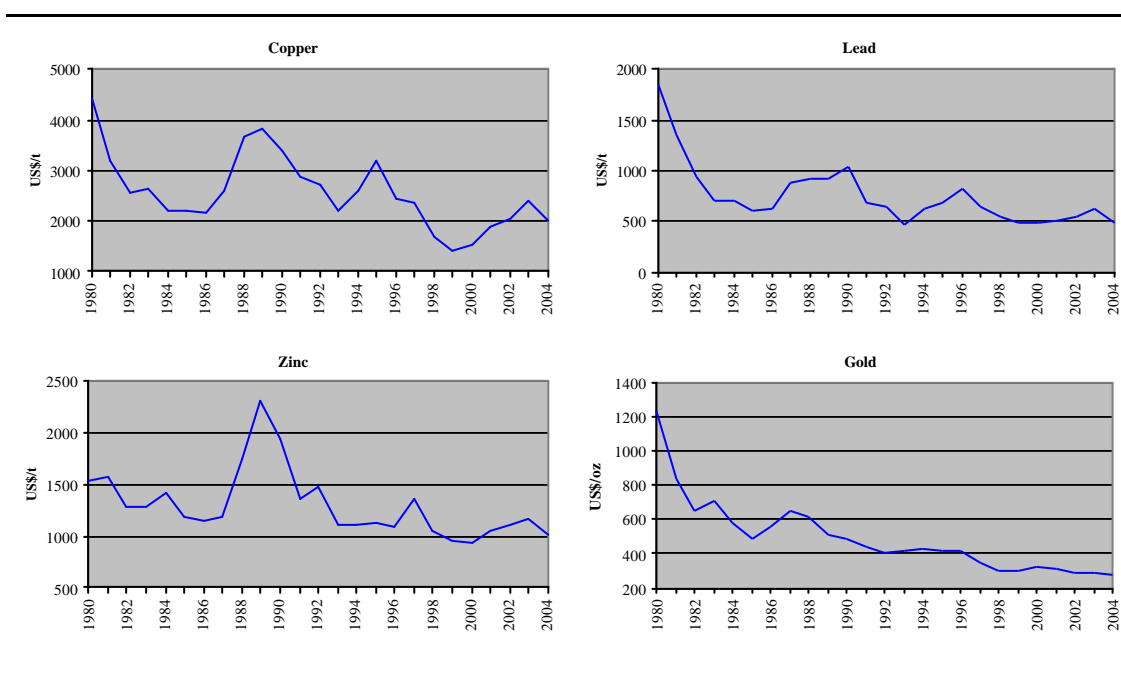
Outlook for Mineral Production

Developments in world metals markets will influence exploration trends for metalliferous deposits in the Gippsland region. The outlook for the gold and base metal markets is reviewed in this section. Detailed market outlook assessments for the medium term are given in Allen and Evans (1999) and Haine and Berry (1999) for gold and base metals, respectively.

Gold

Historical and projected real gold prices are shown in Figure 10.3. It can be seen that real gold prices have experienced a clear declining trend since 1980. This trend in price reflected important changes in the structure of the world gold market, which are expected to continue into the coming decade. Over this period annual gold consumption (measured by net additions to stock holdings) declined, while annual non-investment gold consumption (mainly jewellery) increased. The growth in world consumption of non-investment gold has stemmed mainly from changes in a number of developing economies (notably India and China), as incomes in these countries increased. Although non-investment gold consumption has increased faster than world mine production (tending to increase prices), real prices have been prevented from rising by concurrent sales of investment gold bars and coins (by governments and private investors).

Figure 10.3: Base Metals and Gold Prices (1999 dollars)



The changing patterns in gold holding and consumption behaviour, which underlie the easing real price, are expected to continue into the medium term. However, it is envisaged that real price falls will be mitigated by three important market influences. First, the official sector faces strong incentives (collectively) to control the rate at which their extensive holdings of monetary gold are sold (and replaced with higher yielding alternative reserve assets). These incentives stem from the requirements of central banks to maintain international financial stability, and the prospect of faster disposal rates rapidly eroding the prices received and therefore, returns from such sales. In addition, recent currency crises may provide encouragement for official purchases in some countries.

Second, demand for non-investment gold use (primarily jewellery) is expected to continue growing strongly in response to lower gold prices and higher incomes in developing economies, which have strong cultural affinities for gold jewellery consumption, notwithstanding shorter term economic disruption in Asia. Third, downward pressures on price will be moderated to the extent that lower prices bring about slower growth of world gold mine output, although it is clear that the gold mining industry is continuing to lower its costs.

Overall, the forecast for strong world demand for gold is expected to be met by expanding mine supply and from official and investment sources. While periodic market imbalances are likely, particularly some shorter term price volatility, the easing trend in real prices seen over the past two decades is expected to be maintained at least over the medium term.

Base Metals

Asia (including Japan and China) accounted for 33 per cent of world base metals consumption in 1998, down from 36 per cent in 1997. The fall reflects the current economic downturn in parts of Asia and the share of developing Asian countries is expected to fall slightly in the short term. Over the medium to longer term, Asia's share of world base metals consumption is projected to increase, reflecting a resumption of relatively fast economic growth in these countries.

The developed market economies, which accounted for around 51 per cent of world base metals consumption in 1998, are assumed to continue to expand. Thus, demand for base metals in these countries is expected to continue to grow. Overall, world base metals consumption is projected to increase at around 2.0-2.5 per cent per year over the medium term before easing gradually over the longer term, reflecting expected trends in world economic growth and industrial production.

World mine supply of the three base metals is expected to rise in 1999. World refinery production of the three base metals is expected to keep pace with increases in mine production. A number of large committed and planned development projects are expected to be the major contributors to the projected rise in base metals supply over the next few years. Substantial increases are projected up to the end of 2000 as low-cost mines, primarily copper mines in Chile and zinc mines and lead in Australia, commence production. However, these rises are expected to be partially offset by the closure of some older, high-cost producers, which are likely to become uneconomic with projected lower prices, particularly for copper.

Over the longer term, continuing technological developments can be expected to place downward pressure on costs. Thus, together with projected demand growth, the long-term downward trend in real prices experienced for each of the base metals is expected to continue. Price projections to 2003 are shown in Figure 10.3.

Brown Coal

Brown coal from the Latrobe Valley Depression in the Gippsland region is the fuel source for just under 80 per cent of Victoria's electricity generation capacity. In 1996-97 the Yallourn Energy, Loy Yang Power and Hazelwood Power companies mined 27.8, 17.1 and 14.9 million tonnes of coal respectively. Production from each mine is predominantly integrated with major power stations of the same name. Known resources at the mines are extensive, with a minimum of 40 years production possible at current levels of production.

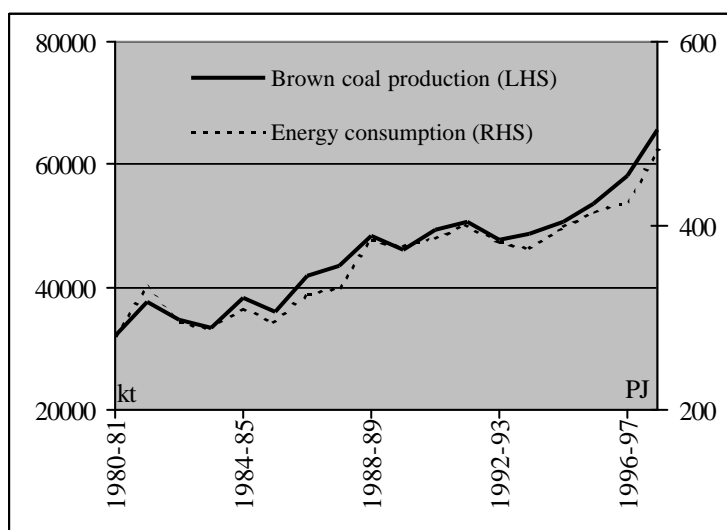
Outlook for Brown Coal

Brown coal is used almost exclusively for electricity generation by power generators in Victoria. The growth in energy consumption in the Victorian electricity generation sector over the past three or four years, apparent in Figure 10.4, is linked to the effects of recent microeconomic reforms, including the construction of a national electricity market (Bush *et al.* 1999).

Brown coal has benefited significantly from the reforms and in the five years to 1997-98 the share of brown coal as an energy source (excluding hydroelectricity) increased from 42.3 per cent to 47.9 per cent within the interconnected electricity market of New South Wales, Victoria and South Australia. Aside from an underlying increase in electricity demand, a number of reasons explain the comparatively greater increase in demand for brown coal. Primarily, brown coal generators are very low cost producers of electricity. As a result of brown coal's cost advantage, expected low electricity prices in the national electricity market are expected to support the recent high levels of Victorian brown coal production.

Over the longer term, brown coal production and consumption may ease for two broad reasons. First, improvements in thermal efficiency through other generation technologies, against a background of evolving policies on greenhouse gas emissions, are expected to increase the use of other fuels. Second, power generation from brown coal will become more efficient in itself (and require less coal per unit of power output) as old plant is gradually replaced over time.

Figure 10.4: Energy Consumption for Electricity Generation and Production of Brown Coal in Victoria, 1980-81 – 1997-98



Source: Bush *et al.* 1999

Information on the expected production and consumption of brown coal in the context of Australia's longer term energy outlook is available in *Australian Energy: market developments and projections to 2014-15* (Bush *et al.* 1999).

10.4 LEGISLATION AND LAND ACCESS

Access to land is an important issue for exploration and mining. At this stage, the implications of the RFA for exploration and mining in the Gippsland region are not yet known.

The nature of access for mineral exploration and mining has a large bearing on the level and type of exploration and mining that occurs in a region. Transparent and well-defined access arrangements reduce uncertainty and facilitate exploration and mining activities. Access provisions of relevant legislation are outlined below.

More detailed discussion of resource access issues relating to exploration, mining and environment can be found in Industry Commission (1991), Cox *et al.* (1994) and Murray *et al.* (1995).

Legislation and Regulation Relevant to Exploration, Mining and Extractives

In Australia ownership of mineral resources and control of mineral exploration and development largely lies in the hands of the State and Territory governments. The Commonwealth Government has control over mining and exploration activities outside three nautical miles offshore and over radioactive substances in the Northern Territory. Broad Commonwealth responsibilities in such areas as economic policy, taxation, Aboriginal affairs, foreign investment, industrial relations and some environment and heritage issues influence the climate for the resource industry in all states and territories.

The principal legislation covering mining and exploration licences in Victoria is the *Mineral Resources Development Act 1990* (MRDA). This Act is the responsibility of the Minister for Agriculture and Resources and is administered by the Victorian Department of Natural Resources and Environment. It sets out the rules for granting licences and attaining approval to start operations.

All exploration and mining activities are subject to a range of environmental requirements before, during and after the life of the project, including:

- lodging a rehabilitation bond, before starting an exploration or mining program, to serve as a security should the company be unable to satisfy its rehabilitation liability;
- exploration and mining is subject to standard conditions, and where appropriate supplementary site-specific conditions;
- regular reporting of exploration activities;
- mining and exploration starting only after a work plan has been approved and other approvals obtained; and
- monitoring of environmental management activities by government officers.

Under the MRDA there are four main land types:

- private land;
- exempt Crown land (e.g. National Parks, State Parks and Wilderness Areas);
- restricted Crown land (e.g. flora and fauna reserves and historic reserves); and
- unrestricted Crown land (e.g. State forests).

No exploration or mining activities can be carried out on exempt Crown land, unless the licence was in place before the land became exempt. The approval of the Minister for Conservation and Land Management is required before exploration or mining can be carried out on restricted Crown land. On unrestricted Crown land the Minister for Conservation and Land Management's consent is not required, however, the Minister must be consulted. Work

can start on private land once the consent of the owner and occupier is obtained or compensation arrangements are made.

The principal legislation covering extractive industries in Victoria is the *Extractive Industries Development Act 1995* (EIDA), which provides for granting work authorities for extractive operations. The four main land types under the EIDA are the same as those in the MRDA. Landowner consent is required before extractive activities can be undertaken on freehold land and land manager consent for operations on Crown land.

Mining and exploration is currently excluded from 16 per cent of the land (i.e. Exempt Crown land) in the Gippsland region (Table 10.5). The consent of the Minister is required for exploration and mining to be carried out within a further 6 per cent of the region (i.e. Restricted Crown land).

Table 10.5: Land Use Categories as a Proportion of Total Land Area, Gippsland

Land use category	Area (ha)	Proportion of Gippsland (%)
Exempt Crown land	426 000	16
Restricted Crown land	154 000	6
Unrestricted Crown land	865 500	32
Freehold land	1 231 000	46
Totals	2 676 500	100

Source: NRE, March 1999 Victoria

Nature of Exploration and Mining

Mineral exploration is the assessment of the earth's crust to determine if mineral deposits, which can be commercially mined, are present. Mining is the commercial extraction of mineral deposits from the earth's crust. While there is often a close relationship between exploration and mining, they are effectively two quite separate activities.

In order to examine the implications of alternative land access arrangements for exploration and mining it is important to understand both the nature of exploration and its likely costs and benefits.

The potential benefits for a private firm from an exploration program derive from the economic returns that will accrue from the discovery of an economic deposit. Given that exploration is a high-risk activity (i.e. there is a small probability of any one venture being successful), companies will approach exploration in a sequential and systematic fashion. This enables the decision to abandon or keep exploring in the area to be made in an efficient manner.

The cost and duration of exploration programs vary from company to company and across commodities. Clark (1996) suggested that the development of a typical major deposit (worldwide) involves a five to twenty year lead time. This estimate results from a typical three to ten years exploration program before the mine development phase.

Exploration is primarily an information-gathering process so it is necessarily dynamic, and most regions can never be regarded as 'completely explored'. Many recent Australian discoveries have occurred in known mineral provinces that have been the subject of exploration efforts for over 100 years. There are a number of reasons for continuing exploration in such areas. Technology and scientific understanding of geological processes continue to develop with time. These advances not only encourage exploration in areas where

prospectivity was previously considered low, but also lower the costs and increase the efficiency of exploration (e.g. in highly prospective areas such as Kanowna Belle in Yilgarn, WA and Century in the Mount Isa Inlier, Qld or in areas not previously known to be of very high potential, e.g. Olympic Dam on Stuart Shelf, SA). Further, changing economic conditions (e.g. changes in metal prices or the costs of extraction) affect the expected returns from exploration and can significantly affect the level and type of exploration.

The exploration process starts with assessments of very large regions and is then systematically narrowed down as the exploration target becomes better defined. The direct costs facing explorers increase as the target area becomes smaller and exploration methods become more intense. The environmental impact associated with exploration also increases as the area being explored becomes smaller and the exploration methods used become more invasive (e.g. drilling), unless special steps are taken to reduce such impacts.

Exploration methods used in the Gippsland region include:

- Regional reconnaissance using remote sensing techniques such as satellite imagery, aerial photography and regional mapping. This exploration phase has little, if any, impact on the land. Activities may cover hundreds of square kilometres in order to identify areas of exploration interest. Geological mapping involves the search for and examination of rock outcrops and exposures in a licence area.
- Sampling in the field which usually involves taking small rock chip, soil or stream sediment samples. Samples are typically obtained by shovel, hand auger or hammer. More intensive sampling and localised mapping may also be carried out using trenches or small pits. All of the above may occur on a surveyed grid.
- Geophysics uses a range of techniques to look for anomalous physical properties indicating structures or mineralisation not visible at the surface. The geophysical properties being assessed include magnetism, electrical conductivity, resistivity or capacitance; gravity; natural radioactivity or seismic properties. Surveys can be airborne for regional surveys, or ground based. The impact of ground-based survey is generally very low, but will vary depending upon the extent of grid and track development required.

The above methods are broad scale in scope and provide information that builds up a picture of where mineralisation is most likely to occur. The most economical way to assess in detail the possible presence of an ore body is by drilling, which may be supplemented by bulk sampling:

- Drilling is usually carried out by truck-mounted equipment to yield samples for mineralogical, chemical or metallurgical analysis. Drill holes are usually around 10 cm in diameter. Follow-up-drilling may be required should earlier drilling show positive results. The impact of drilling on the environment depends on the openness of the vegetation and the topography. Usually, drilling rigs are able to be manoeuvred around trees or the drill hole relocated to avoid disturbance of trees. A small level pad, typically around 6 m square, may need to be constructed to accommodate the drilling rig.
- Bulk sampling gives another level of confidence in the drilling results, particularly when gold is not evenly dispersed throughout the ore and coarsely grained. The 'nugget-effect' can give rise to misleading reserve assessments and large samples are needed to overcome it. Bulk samples are usually excavated from a site, typically less than 5 m deep and 10 m square.

Rehabilitation of areas disturbed by exploration is required in Victoria.

Compared with exploration, mining generally covers relatively small areas, involves greater disturbance to the land surface in the immediate area of the mine and may leave changed landforms when mining is finished. Mining is generally seen as posing greater difficulties in terms of compatibility with other land uses.

Many potential environmental effects of mining activities can be eliminated or mitigated, though at a cost to the mining company. Relatively limited areas of land are disturbed by the operation of a mine. However, off-site impacts such as water pollution may represent a potential threat to the environment and must be carefully managed. This can be controlled by using techniques such as impoundment and evaporation of tailings, sedimentation, filtration and pH neutralisation. Rehabilitation of mine sites is mandatory in Victoria. Modern site rehabilitation, at the completion of operations, can restore many features of the landscape that existed before mining began, substantially replacing and assisting the re-establishment of vegetation, and reducing the potential for pollution from the former mine site.

All mining projects in Victoria require approval under local government planning controls or by preparation of an Environmental Effects Statement. Both processes provide for public input and independent scrutiny of projects. Detailed assessments of impacts on natural values are a routine aspect of mining approvals. Such assessments may include impacts on flora and fauna, water supply, catchment management and public safety.

11. SOCIAL ASSESSMENT

11.1 INTRODUCTION

Over the past decade, there has been a growing awareness by government, industry and the community of the importance of considering the social implications of decisions. Social assessment is a tool used to predict the future effects of policy decisions upon people, their physical and psychological health, well-being and welfare, their traditions, lifestyles, institutions and interpersonal relationships (D'Amore 1978).

A social assessment provides a 'snapshot' of the people and communities that may be affected by planning and policy decisions. Detailed information is collected on the social and biophysical environment, the historical background of an area and its response to change, contemporary issues, political and social structures, culture, attitudes, social-psychological conditions, community vitality and population statistics. This information is then used to predict the likely impacts, both positive and negative, which may be experienced by individuals and groups within the community, and to determine ways in which such impacts may be managed. As Armour (1990) has outlined, such impacts may include changes that occur in:

- people's way of life (how they live, work, play and interact with one another on a day-to-day basis);
- their culture (shared beliefs, customs and values); and/or
- their community (its cohesion, stability, character, services and facilities).

Social assessment is also a mechanism that facilitates stakeholder and community participation in a decision-making process. Through participatory techniques such as workshops and public meetings, people can become involved in the collection of social information relating to their area. This information is considered critical in the social assessment process, as people who may be directly affected by a particular policy proposal are in the best position to say how such events are experienced.

Information collected in the assessment phase will be used as a platform from which impact predictions can be made during the integration phase of the Regional Forest Agreement process.

A variety of data collection methods and data sources have been used as part of the Gippsland social assessment to strengthen the study design and validate the results. The methods included documentary analysis, secondary statistical analysis, mail and telephone surveys, personal interviews, participant observation, informal networking and workshop techniques.

Information gained from the various study methods showed that the Gippsland RFA region can be divided into distinct regional groupings or clustering of towns. The geographic clustering of towns, known as Town Resource Clusters (TRCs), are shown in Map 11.1. The six TRCs consist of four within the Gippsland RFA area - Bairnsdale (inner), Latrobe Region (inner), Sale and the South Coast. Another two sub-regions were identified adjacent to the Gippsland RFA area - Latrobe Region (outer) and Bairnsdale (outer). Both of these outside sub-regions have several forest based industries accessing forest resources from the Gippsland RFA area. The regional profile and the analysis of the mail and telephone surveys are based on these TRC regions.

Mail surveys were distributed to forest contractors, timber processing industries, forest-user businesses (eg apiarists, seed collectors, graziers, firewood collectors, prospectors and miners), and tourism operators. A total of 488 surveys were distributed to businesses with an overall response rate of approximately 13.7 per cent (variations were evident across different

forest-user groups). Separate questionnaires were distributed to the employees of these businesses. A total of around 2500 surveys was administered.

The community telephone survey undertaken as part of the social assessment work was based on a sample size of 1100 households. Results of the telephone survey were stratified over the four TRCs located within the Gippsland RFA area.

More detailed assessment work was undertaken in a series of case studies covering six communities across the region: Yarram, Heyfield, Dargo, Swifts Creek, Bairnsdale and Sale. These communities differed in terms of their population size, dependence on forest uses and values, diversity of the local economy and geographic location.

This chapter contains the views of many people in Gippsland or those with an interest in the forests of the region. The views expressed are not necessarily those of the Steering Committee or the Commonwealth or Victorian Governments.

11.2 SOCIAL AND ECONOMIC PROFILE

In 1996, the total population of the Gippsland RFA region was 174 073 persons, with little change in the population of the Gippsland region between 1986 and 1996. The age and life cycle profiles for the Gippsland region are almost identical to rural Victoria as a whole. However, there has been an increase in the number of residents over 40 years of age and some decline in the number of younger families and residents below 40 years of age within the region.

The percentage of residents born overseas was slightly higher than the average in rural Victoria. Some variation was also found over the sub-regions, with the Latrobe Region (inner) TRC having more residents born overseas, especially from non-English speaking countries.

The labour force has a similar percentage of white- and blue-collar workers in the Gippsland region when compared with rural Victoria as a whole. The main employment industries in Gippsland include the Retail Trade (14.5 per cent) and Agriculture, Forestry and Fishing (13.5 per cent). The Gippsland region has a higher rate of employment in the Mining and Electricity, Gas and Water Supply industries than the average in rural Victoria. This is mostly due to the power industries located in the Latrobe Region.

The education profile for the Gippsland region is similar to that of rural Victoria as a whole. There has been some decline between 1986-1996 in the number of residents attending pre-primary and secondary educational institutions, and there has also been an increase in the number of residents attending TAFE and university or other tertiary institutions.

The unemployment rate within the Gippsland region increased from 7.8 per cent in 1986 to 12.2 per cent in 1996. This rate is higher than the 10.2 per cent found in rural Victoria as a whole. Across each of the six TRCs, the unemployment rate varied from 9.6 per cent and 9.7 per cent in the South Coast and Sale sub-regions to 14.5 per cent and 13.7 per cent in the Bairnsdale (inner) and Bairnsdale (outer) sub-regions.

11.3 CHANGES IN FOREST LAND USE

In the Gippsland region, changes in both Federal and State government policies have required some readjustment of the management of forest resources with subsequent implications for its communities.

Throughout this century, forest related industries have experienced varying degrees of economic growth and diversification due to a range of economic, technological, and social changes. Within the Gippsland region, changes in government regulation of land use and

forest management practices have required significant readjustment by these industries with an associated contraction in employment.

A number of inquiries/strategies have been initiated to address the balance between environmental protection and industry development. These include:

- Timber Industry Inquiry;
- Victoria's Timber Industry Strategy (1986);
- Code of Forest Practices (1989, 1996);
- State Plantations Impact Study (1990);
- National Forest Policy Statement (1992); and
- numerous studies by the former Land Conservation Council (LCC).

In the 1970s, 1980s and 1990s, the LCC conducted a series of land use studies in Gippsland. These studies included regional investigations and Statewide theme investigations such as wilderness. Each study considered the full range of values and uses on public land in the region, including assessment of socio-economic impacts.

The LCC collected a large volume of social and economic information on a range of values and uses in Gippsland, and took this into account in making its recommendations in the various studies. This information was also used to minimise the social and economic impacts of various recommendations on individual enterprises and local communities.

11.4 STAKEHOLDER VIEWS

In recent years, there has been a growing interest in forest issues and a considerable increase in the number of groups wishing to influence forest use and management. These groups often bring quite different perspectives and values to particular issues. Often it is those groups in close proximity to the forest, those with pre-existing rights, local knowledge and high dependency that have less power or influence in the forest debate (Colfer 1995). An analysis of the main issues and the response of different stakeholder groups is useful in predicting how individuals and groups may respond to different policy alternatives.

Timber Industry

Issues raised by the timber industry related predominantly to access to the forest and resource security. Those involved sought better public education on regeneration potential. They expressed the desire for long-term planning in harvesting operations to create employment certainty, facilitate job creation and allow them to pursue new business and market opportunities. There was also a desire to minimise conflict with conservation groups.

Tourism, Recreation and Outdoor Education

Tour operators were concerned about some forest management practices, particularly the visual impact of harvesting on their operations. There was support for selective harvesting, replanting of mixed species after harvesting, and the need for greater maintenance of forest tracks and control of noxious weeds. Access was identified as an issue and the need to be informed about harvesting and forestry activities, which may restrict access to public forests. Opportunities identified by tour operators related to increased linkages between tourist operators and other forest industries, in particular, the need for educational tours between the timber industry, forest staff and tourism operators. Development of eco-tourism was identified by tour operators as a further opportunity in the Gippsland area. Opportunities were seen for increased support for outdoor education.

Conservation

People particularly interested in conservation expressed concern about forest management practices and their environmental impacts, and were keen to have a greater participation in the management of forests. They expressed a desire for more areas to be placed in National and

State parks and reserves. Stakeholders also raised issues in relation to loss of biodiversity, wilderness and old growth values, soil erosion and weed infestation. Within Gippsland, major opportunities identified by conservation interests included expansion of nature-based tourism to support other regional economic developments, and there is also a potential for greater links between the 'High Country' and the coastal environments.

Other Forest Uses (Apiculture, Seed Collection, Firewood, Craftwood and Grazing)

Those involved in forest uses, other than timber harvesting, questioned particular management practices in relation to their business. For example, apiarists believed that selective harvesting enabled better retention of trees valuable for honey and identified a need for mixed species reforestation. Concerns were also expressed in regard to the need for all forest uses to be fully considered, and improved availability of long-term licenses for other forest produce such as seed and craftwood collection. Opportunities were seen to lie in continued access for multiple use and increased links between other forest products and tourism.

Mineral Production

Access to public land was a prominent issue for miners and prospectors, who believed that enough forest areas were already in reserves. They expressed a desire to have a greater participation in forest management, and would like to see improved practices in relation to fire management, weed control and track maintenance. It was also indicated that outcomes could be achieved which satisfied both industry and conservation goals, and that more tourism opportunities could be made from mining, prospecting and fossicking activities.

Landholders

Landholders discussed the need for shared use of forests by industry, tourism and recreational users. Concern was raised about the visual impact of harvesting and the need for adequate buffer zones to minimise the visual impacts of forestry activities. Landholders were concerned about weed infestation and water quality because of harvesting techniques and burning practices. Road damage and safety issues were also outlined. Opportunities for farm forestry and plantation development were considered important on both public and private land.

Local Government

Local government representatives focused on planning controls and infrastructure provision, particularly concerning road maintenance and upgrading. Concerns were raised regarding water quality and environmental aesthetics. Opportunities were seen to exist in terms of increased support for farm forestry, improved relationships with the timber industry and the economic benefits of this partnership for local communities.

Aboriginal Groups/Communities

Aboriginal groups expressed a need for ongoing dialogue and involvement after the signing of the RFA to ensure that their perspectives and interests were taken into account. These included continued access to sites of significance, input into forest management plans and respect for their right to not have some significant sites identified or listed on maps. Other issues were Native Title and associated land claims, the impacts of logging in sensitive areas of historical/cultural significance and employment opportunities in forest management.

11.5 COMMUNITY TELEPHONE SURVEY

The views of the Gippsland community were obtained through a telephone survey of the region. The results illustrate a range of attitudes and views towards the use and management of native forests in the region. Map 11.1 indicates the sub-regional sectors from which the

respondents were sampled. In comparison with the 1996 population census, the survey tended to over-sample female respondents. However, the sample ages were within 5 per cent of census percentages for the same age ranges.

Twenty-seven per cent of respondents or household members of respondents were employed in one or more forest based industries. Of these, 53 per cent were employed in grazing, with a further 22 per cent employed in tourism and 13 per cent in plantation timber production. Of the four sub-regions that comprise the Gippsland RFA region, the Latrobe Region (inner) sub-region had the highest concentration of residents participating in activities and industries that use land in public native forests, with the majority (57 per cent) involved with plantation timber production.

Eleven per cent of the total respondents indicated that they have been involved in native forest management, planning or preservation in Victoria. Thirty six per cent have been involved in tree planting on a farm, school or organised events, while a further 20 per cent have been involved in environmental groups such as Landcare.

Within the last year, 51 per cent of respondents had visited a National Park in Victoria. However, across the sub-regions there was a significant variation in the use of National Parks, with relatively few respondents in the Bairnsdale (inner) sub-region (42 per cent) and relatively more (67 per cent) of respondents in the South Coast sub-region visiting National Parks. There was also a trend for respondents in the Latrobe Region (inner) sub-region to visit National Parks less frequently than respondents in other sub-regions. During the last year, 35 per cent of respondents indicated that they had visited State forest in Victoria, with relatively higher percentages visiting State forests in the Latrobe Region (inner) and South Coast sub-regions than respondents from either the Sale or Bairnsdale sub-regions. While a greater number of people have visited a National Park within the last year when compared with a State forest, the frequency of use of State forests is significantly higher than that of National Parks.

The most frequently visited National Parks during last year were Wilsons Promontory National Park (38 per cent), Tarra Bulga National Park (27 per cent), and the Alpine National Park (27 per cent). The majority of respondents could not identify the State forests they visited during the past year, so those forests most frequently visited have not been identified. Walking or bushwalking was the primary activity of respondents when visiting either a National Park (86 per cent) or State forest (50 per cent). Other popular activities in National Parks included sightseeing (26 per cent), picnics or barbeques (22 per cent), camping (21 per cent), driving or four-wheel drive travel (16 per cent) and fishing or hunting (11 per cent). In comparison, other major activities in State forests were driving or four-wheel drive travel (32 per cent), picnic or barbeques (18 per cent), sightseeing (18 per cent), firewood collection (12 per cent) and camping (11 per cent).

Ninety per cent of respondents were interested in the management and use of National Parks and 85 per cent of respondents were interested in the management of State forests, with no significant differences across sub-regions. Sixty one per cent of the respondents were confident that National Parks are being managed well in Victoria, similarly, 56 per cent were confident that State forests are being managed well. When asked to nominate the three most important things that needed to be considered in the management of National Parks in Victoria, 21 per cent of respondents indicated maintaining public access, 19 per cent indicated maintaining or improving fire management, and 13 per cent indicated protection of native flora and fauna. In comparison, the three most frequently raised issues in State forest management were fire control and management (22 per cent), replanting and reforestation (20 per cent) and maintaining public access (13 per cent), however, 20 per cent of respondents were not able to identify issues important to the management of National Parks and 25 per cent were unable to identify issues important to the management of State forests.

Respondents were also asked if there had been changes in the use of native forests in the past five years which affected their community. Twenty eight per cent indicated that there had been a change, however, there was some variation in these responses when a sub-regional comparison was made. In the Bairnsdale sub-region, 42 per cent of respondents indicated there had been a change in the use of native forests which had affected their community, as compared with 30 per cent in the South Coast, 28 per cent in Sale and 24 per cent in the Latrobe Region. The three most common changes included restrictions on native timber harvesting (15 per cent), loss of population (10 per cent) and loss of employment opportunities (8 per cent).

The results of the survey indicate that the people in the Gippsland region value the forests for their environmental values, with the majority interested in their management. The results also highlight that people are aware of the importance of the forests to their local economy. Eighty per cent of respondents believe that National Parks are important to the local economy of the area they live in. Similarly, 80 per cent of respondents believe that State forests are important to the local economy of the area they live in.

11.6 FOREST INDUSTRY ACTIVITY AND LINKAGES

This section provides an analysis of industry mail surveys conducted as part of the social assessment for the Gippsland RFA. It identifies communities that are reliant on forest based industry activity in the region, and identifies significant relationships between specific areas of forest resource in the region and communities dependent on that resource.

The analysis is based on six township resource clusters (TRCs) identified in the Gippsland RFA region, which are communities geographically distinct from other areas. The six TRCs include the Latrobe Region (inner), South Coast, Sale, Bairnsdale (inner), Latrobe Region (outer) and Bairnsdale (outer).

The six TRCs were defined on the basis of the geographic distribution of mills and resource drawn from the Forest Management Areas (FMAs) in the Gippsland region. Gippsland contains three FMAs, all of the Tambo FMA and parts of the Central Gippsland and Wodonga FMAs.

Native Timber Processing Industry and Forest Contracting Industry Employee Profile

There are 22 timber processing industries drawing their resource from the Gippsland region, comprising 20 hardwood mills and 2 pulpwood processors. The timber processing industries employ 1508 people. The APP Maryvale mill employs 940 people which is approximately two thirds of all employment, however, only part of the resource comes from native forests in the region.

The Latrobe Region (inner and outer) TRCs have nine mills and 81.5 per cent of all timber processing industry employees. In addition, the Bairnsdale (inner and outer) TRC has eight mills and 9.2 per cent of all industry employees. Neither the Sale nor South Coast TRCs contain any timber mills, and the remaining five mills outside the Gippsland region are not included in the TRC analysis.

The majority of all timber processing industry employees (73.5 per cent) lives in the Latrobe Region (inner) TRC which draws the majority of its resource from the Central Gippsland FMA. These employees primarily reside in the towns of Traralgon, Heyfield, Morwell, Moe, Hazelwood North, Tyers and Glengarry. Any change in resource status from this FMA, which may impact on employment, has the potential to affect these towns. Mills located in Bairnsdale (inner) TRCs draw the majority of the resource from the Tambo FMA. Employees of mills in this TRC reside in the towns of Bairnsdale, Buchan and Bruthen. Again, any

change in the status of the resource in the Tambo FMA, which may affect employment, is likely to impact on these towns.

An examination of the profile of forest industry employees indicates that 84 per cent of mill employees are male, and the mean age is 40 years. On average, these employees have been working in the current business for nine years and have worked in this industry sector for 11 years. The majority of employees are long-term residents of the town they live in and have lived there for an average of 19 years. Fifty-one per cent of employees have an education level of year 10 or less. Two thirds of all employees are married, with 22 per cent of employed partners working in the same industry.

An estimated 79 contracting businesses involved in native sawlog harvesting, transportation and forest roading, access forest resources within the Gippsland RFA region. The majority (51 per cent) is located within the Latrobe Region (inner) TRC and, in particular, Traralgon (19 per cent).

As survey information was available for only 34 per cent of contracting business employees, the residential location of all contracting business employees could not be identified from the surveys. However, analysis shows that most employees live in the same TRC as the one in which they are employed. It was therefore estimated that there were 387 employees of contracting businesses, with 196 employees in the Latrobe Region (inner) TRC, mostly in Traralgon (74 employees), Heyfield (34 employees) and Tyers (29 employees).

The profile of contractor business employees indicates that 89 per cent are male and have a mean age of 42 years. On average, employees have been working in the current business for 10 years and have worked in this industry sector for 17 years. The majority of employees are long-term residents of the towns they live in and have lived there for an average of 27 years. Of the employees 55 per cent have an education level of year 10 or less, 82 per cent are married, with 26 per cent of all employed partners working in the same industry.

Native Timber Processing Industry and Forest Contracting Industry Household Expenditure

Timber processing industries located in the Latrobe Region (inner) TRC source much of their goods and services from the towns of Traralgon and Leongatha, while timber processing industries in the Bairnsdale (inner) TRC source their goods and services primarily from Bairnsdale and Bruthen. In addition, industries located within the Latrobe Region (outer) TRC source their goods and services from Warragul and, to a lesser extent, from Melbourne and Traralgon.

Forest contracting industry businesses located in the Latrobe Region (inner and outer) TRCs source many of their goods and services from the towns of Traralgon and Warragul, while forest contracting industry businesses in the Sale TRC source their goods and services from Sale, Traralgon and Maffra. Due to the low survey response rate, no statistically valid information was available from businesses located in the Bairnsdale (inner and outer) TRCs. However, it is evident that the town of Traralgon is a major supplier of goods and services to contracting businesses in the Gippsland RFA region.

Timber processing industries located in the six TRCs generate \$26.1 million in annual household expenditure. Of this, the APP Maryvale mill alone generated \$18 million in annual household expenditure. In addition, the mill at Heyfield generates \$2.8 million and the mill at Drouin West generates \$1.3 million in annual household expenditure.

In addition, forest contracting businesses employees involved in native sawlog harvesting, transportation and forest roading are estimated to generate an additional \$7.4 million in annual household expenditure. The majority of this occurred from employees based/residing/working within the Latrobe Region (inner) TRC (\$3.7 million).

The timber industry (including contractors) sourcing resource from the Gippsland region makes a significant contribution to the local and regional economy, with an estimated \$33.5 million in employee household expenditure generated by these business each year.

Other Forest Related Industries

Other forest related industries within the region include cattle grazing, apiary, mining and prospecting, and tourism. The return rate of questionnaires from businesses which held licenses for these activities was low; grazing (1.6 per cent), apiary (11.5 per cent), prospecting and mining (7.3 per cent) and tourism businesses (9.7 per cent). The return rate for employees of those businesses was also low.

The town location of grazing businesses was examined. Of the 44 grazing businesses identified, 26 (59 per cent) were located in the Bairnsdale (inner) TRC, primarily around the towns of Omeo and Benambra. An additional 20 per cent was located in the Sale TRC, primarily around the towns of Glenmaggie and Maffra. Responses also show that several businesses hold multiple grazing permits.

Of the 78 apiarist businesses identified, 53 (68 per cent) were located in the Bairnsdale (inner) TRC, primarily in the towns of Bairnsdale, Lakes Entrance and Omeo. Many towns had apiarists businesses that held multiple permits, which may provide some indication of the size of the businesses in the town. On the basis of the number of permits held, the towns of Bruthen and Bairnsdale had the largest apiarist businesses.

The majority of prospecting and mining businesses are located in the Bairnsdale (inner) TRC (74 per cent) and in particular in the towns of Bairnsdale (34 per cent) and Omeo (26 per cent). An employee profile of prospecting and mining businesses has been developed, although some caution should be used in interpreting this profile given the low sample size on which it is based.

Responses from prospecting and mining employees show that all employees were male, with a mean age of 56 years. On average, employees have been working in the current business for 24 years and have worked in this industry sector for 27 years. The majority of employees are long-term residents of the town they live in, having lived in their current town for an average of 32 years. Seventy per cent of employees had a year 10 or lower level of education. Sixty-seven per cent of all employees were married with no employed partners working in the same industry (based on returned industry surveys).

Of the 97 tourism businesses that held permits to operate in public forests, 76 per cent of the Victorian businesses were located outside of the six TRCs and the Gippsland RFA region, with 44 per cent of all tourism businesses based in Melbourne metropolitan area. Of the 15 per cent of tourism businesses located within the Gippsland RFA region, about half were located in the South Coast TRC.

For each of the 97 tourism businesses which had permits to access public native forests within the Gippsland RFA, 35 per cent were licensed to use the Alpine National Park, with the Wonnangatta and Bogong the most commonly licensed areas within the Alpine National Park. In addition to the use of the Alpine National Park, Wilsons Promontory National Park (17 per cent) and the Mitchell River National Park (11 per cent) were also frequently licensed by tourism businesses.

The questionnaire distributed to tourism businesses (permit holders) asked each business operator to identify those towns in the Gippsland RFA region they considered tourists were most likely to visit. Although only based on 11 responses, the main towns are Mt Hotham (91 per cent), Walhalla (73 per cent), Lakes Entrance (64 per cent) and Bairnsdale (55 per cent).

An employee profile of tourism businesses was developed based on the responses of 33 employees. A profile of tourism business (permit holder) employees shows 52 per cent of employees were male and the mean age of employees was 36 years. On average, employees had been working in their current business for six years and had worked in this industry sector for nine years. The majority of employees were not long-term residents of the town in which they lived, having lived in their current town for an average of nine years. Of the employees, 79 per cent had a year 12 or higher level of education. Fifty eight per cent of employees were married, with 41 per cent of all employed partners working in the same industry.

11.7 COMMUNITY CASE STUDIES

As part of the social assessment process, detailed assessment was undertaken in six communities across the region (refer to Map 11.2). A variety of methods was used to develop a detailed profile of each community. Information was obtained through secondary data source such as ABS statistics, Shire reports, government publications and community service directories and through community workshop and extensive fieldwork in each of the communities. This information was collected to assess the socio-economic structure, historical response to change, community attachment and to identify forest values and attitudes towards forest use and management.

The township of **Yarram** provides a major service role for the surrounding rural communities, and the agricultural, timber, fishing and tourism industries. Over the past 10 years the significant events for the township have included the restructuring of local Government and Government agencies, changes to the timber industry and agriculture sector, and an increase in environmental awareness. Participants indicated there had been a loss of services, jobs and employment prospects but believe the community is now more resourceful and self-reliant. Major forest and agricultural issues for the region include improving water quality, the effect of downsizing NRE and the impact of transferring management responsibilities for plantation timber in the Strzelecki Ranges to the Victorian Plantations Corporation (which was sold in December 1998 to Hancock Victorian Plantations). One of the major visions for Yarram is the desire to see a major National Park in the Strzelecki Ranges. Another vision is the expansion of educational and employment opportunities for younger people.

Heyfield provides an entry point to the Alpine National Park and the high country. Heyfield is seen as a service centre for the agriculture and timber sectors and surrounding dairying and beef cattle district. It is the centre of the hardwood timber industry in the Wellington Shire. Significant events for Heyfield include the decline of the agriculture sector and the restructuring of local government, government agencies and health services and loss of services/employment such as the closure of Ladners Mill. The restructure of the Council resulted in a loss of jobs for the local contractors as larger contracts were awarded to bigger firms. The closure of Ladners Mill, initially meant the loss of 45 jobs. However, Neville Smith Timber Industries has subsequently employed 23 of those retrenched workers. The new mill operations and restructure have brought greater stability to the township and greater job security. The participants identified the key visions for the township as to improve water management, have a stable district population (provide opportunities for young people to remain in town), and find new tourism opportunities including construction of a 'Timber and High Country Interpretation Centre'.

Dargo is a small township located on the Dargo River, and is a gateway to the snowfields and the 'High Country' National Parks. Its major industry is beef cattle, although there is some sheep farming. It also produces a significant amount of walnuts for commercial purposes, and is experiencing an increase in tourism. Significant events in Dargo have been the closure of the Dargo sawmill, the downturn of the agriculture sector and natural disasters, such as drought and floods. Participants noted the district income had declined and most farm families are now supported by off-farm income. The closure of the Dargo mill and the resulting job losses impacted on the social and economic life of the town. The workshop participants

recognised that Dargo would change and develop but wanted the town to retain its special qualities. Tourism was seen to be the most likely economic base for the town, especially with the interest in deer hunting. Some participants felt an all-weather sealed road to Mount Hotham would also help promote tourism.

Swifts Creek is a small highland settlement along the Great Alpine Road. The area relies on agriculture, the timber industry, tourism and some mining. Significant events in Swifts Creek include the closure of the Ezard mill and Benambra mine, restructuring of local government and government agencies, withdrawal of commercial and government services, and the opening of Great Alpine Road. The closure of the Ezard mill resulted in a loss of jobs and young people from the district. There was also a feeling of alienation as Government decisions which impact on the town are made by those outside the community. A central vision of the workshop participants is to maintain and improve the community's access to services, so that it has a standard of living similar to city dwellers. Participants also wanted to broaden the economic base of the township by encouraging sustainable agriculture, mining, tourism and value adding at the Swifts Creek mill. Since the social assessment workshop was held, there has been a fire at the mill and Neville Smith Timbers has decided to close the mill and give staff the option to relocate to Heyfield.

The township of **Bairnsdale** is the major service centre for the East Gippsland Shire, and contains a full range of commercial and retail facilities, a regional hospital, a range of educational facilities, public sector services and an airport. The significant events for Bairnsdale include the general economic decline, and the restructure of the forest industries, local government, government agencies and health services. The participants believe Bairnsdale is suffering from the cumulative effects of drought, agricultural economic downturn and the rationalisation of government departments and utilities. This has depressed the town's economy and increased unemployment. Changes in the timber industry, including closure of some small mills, have resulted in a loss of jobs. Some participants felt that, since the Timber Industry Strategy, there has been an increase in planning, better supervision and more professional forest management practices. Others expressed scepticism about the industry's performance now that it is self-regulating. One vision for Bairnsdale related to increased employment for future generations through a broader economic base, such as tourism. However, there was concern that the push for tourism was causing environmental problems, including blue-green algae in the lakes.

Sale is the largest centre for retail, commerce, administrative and human services, including education, within the Wellington Shire. It also has a large regional arts centre. The significant events in the community have been the restructuring of the timber industry, the loss of major industries and services, restructuring of local government and government agencies, natural disasters and the Longford Gas Plant incident. Participants recounted how the local agricultural industry had faced depressed wool and beef prices, as well as suffering drought and sheep disease in the past few years. Until the 1990s, Sale had been a prosperous town but now many industries have left the region causing high unemployment. Participants felt that the major issue for forests in the region was the shift in forest use towards increased timber production rather than mixed species forests for multiple use. The participants identified a number of tourism opportunities for Sale including the development of world class wetlands, the re-development of the Port of Sale and an improved road over the mountains past Dargo.

Forest Values and Usages

Forest values and uses were also examined across the six case study areas. 'Representation of Place' maps generated by community workshop participants were used to capture the range and diversity of values people ascribe to their local environment.

It is evident from the community workshops that people living within the Gippsland region participate in a variety of economic, recreational and cultural forest related activities and identify with a range of forest values. The following table is a summary of the forest values

and uses nominated by workshop participants across the six case study areas. Maps and further information from the community workshops are included in the Gippsland Social Assessment report (VicRFASC in prep). This information provides an insight into the variety of values and uses that people associate with the forests of Gippsland. However, given that it was derived from workshop participants it should not be viewed as a comprehensive assessment of the range of uses or the only locations where those activities or values occur.

11.8 CONCLUSION

The information collected as part of the social assessment process indicates that there are a range of positive and negative impacts that may be associated with changes in forest policy within the Gippsland region. These impacts will vary according to geographic location, regional/community context and by stakeholder group. Based on the data gathered, social impacts may be studied further during the development of a proposed reserve design for the Gippsland RFA.

While the data collected in the social assessment will be used to inform the RFA decision-making process, it is anticipated that this information will be useful in facilitating future social and economic development within the Gippsland RFA region.

Forest Values and Usage
Historic e.g historic towns, gold mines, saw mills, cemeteries, swing bridge and research; and Aboriginal cultural sites, heritage trails, 'High-country' stations and hut sites.
Aesthetic e.g sightseeing, scenic views and drives, coastal reserves, lakes and river surrounds, bird and fauna watching, scenic dairy country, landscape, alpine visual amenity, and waterfalls.
Environment e.g Mountain Ash forests, cool-temperate rainforest, water catchments, wetlands, Strzelecki Ranges, algae in lakes, Red Gum plains, landcare, salinity problems, erosion, burrowing frog, bats, wild dogs, limited access for bees and need for fuel reduction burns.
Recreation e.g surf fishing, camping, horse riding, four-wheel driving, water recreation, boating, canoeing, swimming, surfing, skiing, winter sports, picnicking, barbeques, trail bike riding, deer/duck hunting, bushwalking, port and coastal walks.
Economic e.g tourism, firewood collection, apiary, farming, walnuts, mountain cattle grazing, droving, aquaculture, timber harvesting, plantations, geological activity, prospecting, restaurants, and eco-tourism.
Education e.g 'Forestech' - living resources centre, nature study, school trips, school camps, low-cost recreation for youth, forest interpretation, field naturalist activities, and retreats.
Social/ Cultural e.g cultural heritage tours through the Bairnsdale Aboriginal Co-operative, lifestyle attractions, sheer enjoyment, holidays, Ninety Mile Beach marathon, family ties, galleries, arts and cultural activities, and visiting friends and family.

12. BIODIVERSITY

12.1 INTRODUCTION

Biological diversity is the variety of all life forms and is usually considered at three levels:

- ‘Genetic diversity’ refers to the variety of genetic information contained in all individual plants, animals and micro-organisms.
- ‘Species diversity’ refers to the variety of living species.
- ‘Ecosystem diversity’ refers to the variety of habitats, biotic communities and ecological processes.

The National Forest Reserve Criteria (JANIS 1997), jointly developed by the Commonwealth and States, identifies the following objectives of biodiversity conservation:

- to maintain ecological processes and the dynamics of forest ecosystems in their landscape context;
- to maintain viable examples of forest ecosystems throughout their natural ranges;
- to maintain viable populations of native forest species throughout their natural ranges; and
- to maintain the genetic diversity of native forest species.

To achieve these objectives, the National Forest Reserve Criteria include a number of biodiversity criteria for establishing a Comprehensive, Adequate and Representative (CAR) reserve system. These are outlined in the box below.

The strategy for conserving biodiversity relies not just on a CAR reserve system, but also on the application of ecologically sustainable forest management practices in off-reserve areas.

Both the Commonwealth and Victoria have a number of responsibilities in connection with the conservation of biodiversity. A list and description of key Commonwealth and State legislation relating to RFAs in Victoria is given in Appendix 1.

Summary of the Biodiversity Criteria

1. As a general criterion, 15 per cent of the pre-1750 distribution of each forest ecosystem should be protected in the CAR reserve system.
2. Where forest ecosystems are recognised as vulnerable, then at least 60 per cent of their remaining extent should be reserved.
3. All remaining occurrences of rare and endangered forest ecosystems should be reserved or protected by other means as far as is practicable.
4. Reserved areas should be replicated across the geographic range of the forest ecosystem to decrease the likelihood that chance events such as wildfire or disease will cause the forest ecosystem to decline.
5. The reserve system should seek to maximise the area of high quality habitat for all known elements of biodiversity wherever practicable, but with particular reference to:
 - the special needs of rare, vulnerable or endangered species;
 - special groups of organisms, for example species with complex habitat requirements, or migratory or mobile species;
 - areas of high species diversity, natural refugia for flora and fauna, and centres of endemism; and
 - those species whose distributions and habitat requirements are not well correlated with any particular forest ecosystem.
6. Reserves should be large enough to sustain the viability, quality and integrity of populations.
7. To ensure representativeness, the reserve system should, as far as possible, sample the full range of biological variation within each forest ecosystem.

8. In fragmented landscapes, remnants that contribute to sampling the full range of biodiversity are vital parts of a forest reserve system and should be protected.

12.2 METHODS USED IN BIODIVERSITY ASSESSMENT

The Victorian and Commonwealth Governments have agreed that the Gippsland biodiversity assessment should be undertaken at the species and ecosystem levels (see above) and should include reviews of the main threats to such biodiversity in the region. Because information about genetic variation within species is very limited and costly to obtain, genetic diversity was not assessed, although it is recognised that it does overlap with species and ecosystem diversity and these are addressed by the National Forest Reserve Criteria.

The biodiversity assessment has therefore been based on an analysis of information about forest ecosystems and communities, flora and fauna species and their habitats, and the threats to these in the region. This chapter is based on the findings of the Gippsland Comprehensive Regional Assessment Biodiversity Assessment Report (VicRFASC in prep. b). Additional references relating to the information provided in this chapter can be found in the Biodiversity Assessment Report.

Data Review

Biodiversity assessment relies on having adequate information about the distribution of species. It is important to know whether or not surveys undertaken for species or groups of species have been adequately distributed across the range of environments represented within the region. As part of this assessment, analyses were undertaken to determine where surveys for biodiversity were undertaken in the Gippsland region, which species were targeted, and whether survey sites are reasonably distributed to detect most species in most geographic or environmental components. The results of these analyses were used to highlight gaps in information and identify those areas which may require further survey work.

Ecosystem Assessment

Ecological Vegetation Classes (EVCs) have been used as the basis of the forest ecosystem diversity assessment for Gippsland. EVCs are derived from a Statewide level of vegetation classification and are considered to be the most appropriate units for assessing biodiversity conservation at the landscape scale in Victoria (Comprehensive Regional Assessment, East Gippsland: Environment and Heritage Report - ref VicRFASC 1996a). The first part of the assessment involved determining and mapping the types of forest communities occurring in Gippsland today and the area occupied by each. An analysis and mapping exercise was also completed to determine how much of each forest type may have occurred prior to European settlement in order to provide an assessment of the extent to which each type is protected in proportion to its pre-1750 extent and how much of each type has been lost.

Target Flora and Fauna Groups (Priority Species)

Species which are threatened (endangered or vulnerable to extinction), declining in numbers, patchy in distribution, migratory or mobile, good indicators, or unique to the region have been reviewed in this assessment. All nationally endangered or vulnerable forest species listed under the Commonwealth *Endangered Species Protection Act 1992* and known to occur in the region were considered a high priority, as were species listed under the Victorian *Flora and Fauna Guarantee Act 1988*.

Vulnerability Assessment

The degree to which a species is vulnerable to extinction is influenced by a number of factors. These include characteristics or attributes of the species itself such as its habitat requirements, reproductive output and longevity. Other factors such as rarity and whether populations are increasing or decreasing (possibly due to extrinsic factors), are also important in determining the risk of decline or extinction. Vulnerability assessments were conducted for several Gippsland flora and fauna species of conservation significance. This information assists in

identifying and prioritising those species which are most in need of management actions to improve the prospects for their long-term survival.

Reservation Analysis

Reservation analysis is another component of the Comprehensive Regional Assessment process. Essentially it is an analysis to identify the degree to which a species or vegetation community is known to be represented in reserves within the region. The results of such analyses can be used to assist in the identification of species and communities that require particular attention because of their special conservation needs. Conservation objectives can in some cases be met by increasing representation of populations and communities within reserves and/or minimising the impacts of threatening processes throughout the forested estate. Reservation analyses have been conducted for flora, fauna and EVCs.

Disturbances (Threatening Processes)

The decline of species can be largely attributed to the impacts of disturbances, both directly on the species and indirectly on essential components of their habitat. For example, predation of Broad-toothed Rats by introduced species such as Foxes and feral Cats has a direct effect on population numbers, whereas grazing of its habitat by domestic stock can indirectly affect its chances of survival by altering essential components of its habitat such as food and shelter. Disturbances which can have negative effects (direct or indirect) on a species are referred to as potentially threatening processes. This assessment describes potentially threatening processes relevant to Gippsland and the management arrangements currently in place to address these.

12.3 DATA REVIEW FOR TERRESTRIAL SPECIES

Introduction

The data review process involves systematically working through databases to determine the adequacy of information about the distribution of species within the Gippsland region. This information is important for understanding the distribution of flora and fauna and relating this to their habitat requirements. The data review relies on expert knowledge and professional judgement but is supplemented by explicit analyses where appropriate. The methods described here were used for terrestrial flora and fauna only - the data review for aquatic species is discussed in section 12.8.

The first step in the process is to select only those survey data which meet required standards of accuracy, precision and reliability. This allows a degree of confidence when analysing the distribution of species.

The next step involves assessing the extent to which the site records for flora and fauna are representative samples of the environmental and geographic variation of the region. This is achieved by dividing the region into units or “strata” which exhibit similar sets of environmental factors or variables. Although there are many variables to choose from (eg temperature, rainfall, elevation, slope), those which are considered to most influence the distribution of species in that region are selected to create the stratification. Each stratum may be represented by several discrete areas (or substrata) within a region.

These strata and substrata are then analysed to determine how well each has been surveyed for flora and fauna. That is, the density of survey sites is determined for each (such as number of survey sites per 10 000 ha). Calculations are also made for each stratum of the probability of encountering species that have not previously been recorded in surveys there.

Methods

Analyses of the variation in annual rainfall, temperature extremes and rock types across the region were used to classify the major types of environments occurring in Gippsland. The classification analysis identified 104 different strata for the region, each characterised by a

particular combination of rainfall, temperature and rock type. They ranged in size from 6 to nearly 280 000 hectares. It is important to note that only forested areas were considered. Thirty-seven of the 104 strata had an area of less than 500 hectares each. These small strata comprised only 0.3 per cent of the area under forest cover, and were not evaluated while the 33 largest strata (>10 000 ha) occupied 90 per cent of the forested land area. This environmental stratification was subsequently used for the analyses of flora and fauna databases presented below.

Flora

The dataset used for the assessment of Gippsland flora was derived from the Flora Information System of Victoria. It comprises all available data from vegetation surveys and studies of the region and includes 4112 site records, of which 3196 are on forested land.

The distribution and density of site records (summarised in Table 12.1), together with cumulative species curve analysis (probability that the next species encountered for a stratum would not already have been encountered), were used to evaluate the adequacy of sampling of the environmental variation in the region.

Table 12.1: Proportion of Flora Sampling Density Classes for the Gippsland Region

Density class	Sampling density for flora sites/10 000 ha)	Number of strata	Total area (ha)	% of forest in the Gippsland region
high	> 40	15	185 193	12 %
moderate	10-40	29	699 061	44 %
low	>0-10	19	684 671	43 %
zero sites	0	4	5 311	0.34 %

Approximately equal proportions of forested land in the Gippsland region have either a low (43 per cent) or moderate (44 per cent) survey intensity with 12 per cent of the region having a high survey intensity. The results from a cumulative species curve analysis suggests a more adequate data coverage than the survey intensity analysis, with 84 per cent (33 strata) of the forested area of the region having probabilities of ≤ 20 per cent that the next species will be new.

Fauna

In Victoria, much of the existing site data for fauna has come from incidental records from a range of sources supplemented by information from systematic surveys. A lack of surveyed sites in certain strata does not necessarily mean that the strata have not been sampled; rather, it means that the information may not have been appropriate for use in this analysis. To ensure an adequate database of systematic survey records for terrestrial fauna, a general survey covering over 200 sites was undertaken in the Gippsland region and used to supplement the existing data sets. This data audit includes only data from formal surveys and strata under forest cover.

The site-based biological data sets used in the fauna assessment were drawn from the Atlas of Victorian Wildlife. A number of groups were excluded from the study including marine birds, waders (except Latham's Snipe), marine mammals, marine reptiles and invertebrate fauna; records with less geographic precision were also excluded. Survey data were analysed for each of the species groups indicated in Table 12.2.

As was done for flora, the distribution and density of survey site records were used to evaluate the adequacy of sampling of the environmental variation in the region. The 67 strata larger than 500 hectares were included in the evaluation. Strata and large polygons with low densities of sites were identified. The probability of the next species recorded for a particular stratum being new (ie. not previously recorded in surveys for that fauna group in that stratum) was used as an indication of the adequacy of sampling effort. The analysis was mostly

confined to the 33 most extensive strata, which range from 18 per cent to 0.04 per cent of the area (totalling 90 per cent of the forested area). A summary of results for these strata is given in Table 12.2.

Table 12.2: Adequacy of Terrestrial Vertebrate Fauna Survey, by Species Group

Faunal group	Arboreal Mamm	Large Mamm.	Small Ground Mamm.	Bats	Diurnal Birds	Nocturnal Birds	Large Forest Owls	Reptiles	Amphibian
Number of sites surveyed across all 104 strata	1003	1510	952	487	686	610	969	469	489
Number of the 67 strata with surveys	58	58	52	46	46	53	54	41	42
Number of the 33 largest strata with surveys	32	32	29	27	27	31	31	26	26
No. of the 33 largest strata with low probability (≤ 5 per cent) of new species in next survey	13	4	10	10	8	11	9	3	2

Of the 33 largest strata generated by the stratification of the Gippsland region, between 26 and 32 contained surveyed sites for each of the fauna groups considered, although for most groups, survey intensity is generally low. Arboreal mammals and nocturnal birds are the most comprehensively surveyed groups across the region, based on them having the most large strata with low probabilities of new species being detected (Table 12.2). Small ground mammals, bats and diurnal birds have been moderately well surveyed, with approximately 30 per cent of the large strata surveyed having a low probability of detecting new species. For the majority of the largest strata, future surveys for reptiles, amphibians and large mammals are most likely to detect species not previously recorded in formal surveys.

12.4 FOREST ECOSYSTEM ASSESSMENT

Introduction

Assessment of forest ecosystems is important to determine whether representative examples of these ecosystems and the natural ecological processes that support them are maintained throughout their natural range. The assessment of forest ecosystems has involved describing, mapping and analysing the distribution and variation of these ecosystems in Gippsland.

Ecological vegetation classes (EVCs) are the basic mapping units used for biodiversity planning and conservation assessment at landscape, regional and broader scales in Victoria. They are derived from large-scale forest type and plant community mapping and are based on the following types of information:

- plant communities and forest types (including species and structural information);
- ecological information relevant to the species that comprise the communities (including life-form and reproductive strategies); and
- information that describes variation in the physical environment (including aspect, elevation, geology and soils, landform, rainfall, salinity and climatic zones).

Each EVC represents one or more plant (floristic) communities that occur in similar types of environments. The floristic communities within each EVC tend to show similar ecological responses to environmental factors such as disturbance (e.g. wildfire). As well as representing plant communities, EVCs can be used as a guide to the distribution of individual species and groups of species, including animals and lower plants such as mosses and liverworts.

Ecological Vegetation Classes have been accepted as robust and appropriate units for assessing forest ecosystem diversity and conservation at the landscape scale, provided that the variability within widely distributed EVCs is also considered as part of the assessment (EVC Methodology Paper, Appendix G, Comprehensive Regional Assessment, East Gippsland: Environment and Heritage Report - ref VicRFASC 1996a). A detailed description of the EVC concept can also be found in that report. A total of 103 extant EVCs have been identified as currently occurring in Gippsland. These EVCs have been mapped across all land in the region at a scale of 1:100 000 and are listed in Table 12.3. A detailed description of

each EVC is available in the Gippsland Biodiversity Assessment Report for the Comprehensive Regional Assessment (CRA). It should be noted that approximately a quarter of the EVCs in Gippsland are described as mosaics or complexes (see Table 12.3 footnotes for definitions).

To allow a comparison of the current distribution of each EVC with its approximate distribution prior to European settlement, a map of the pre-1750 distribution of EVCs in the Gippsland region has been constructed (see Map 3). The map is based on predictions derived from existing vegetation, a variety of physical environmental attributes, and expert knowledge.

Twelve EVC mosaics and five EVCs were not recorded in the public land vegetation mapping of the study area. These occur either on lowland, riverine, and coastal plains or rolling hills and in estuaries which have been largely cleared for agriculture, or occur on less fertile areas that have been cleared for urban development on the fringes of the larger towns.

Reservation Status of Ecological Vegetation Classes

A reserve system that is comprehensive, adequate and representative in its regional coverage of forest ecosystems is an important component of the Regional Forest Agreement for Gippsland. The extent of representation of EVCs in conservation reserves has been used as the basis for evaluating the current reservation status of forest ecosystems in the region.

Table 12.3 shows the distribution of EVCs across all land tenures in Gippsland. Descriptions of some of the land tenure categories represented in the table are as follows:

Conservation Reserves: includes National Parks, State Parks, Wilderness Parks, Reference Areas, Regional Parks (where timber harvesting does not occur), Flora and Fauna Reserves, Flora Reserves, Natural Features Reserves, Heritage Rivers and Natural Catchment Areas established under the Heritage Rivers Act, and Remote and Natural Areas not available for timber harvesting.

Other Parks and Reserves: includes Regional Parks, historic and cultural features reserves where timber harvesting may be permitted.

Other Public Land: includes Bushland Reserves and land managed by water supply authorities.

Private Land: includes freehold land and land leased or licensed for plantation purposes.

Fourteen EVCs occur predominantly on private land, with the remaining 89 occurring mainly on public land. For those extant EVCs that are not considered endangered, vulnerable or rare, the national reserve criteria reservation target of 15 per cent of the pre-1750 extent has been met for all EVCs except Lowland Forest, Damp Forest, Wet Forest, Tableland Damp Forest, Montane Grassy Woodland, Dry Valley Forest, Shrubby Wet Forest, Shrubby Foothill Forest/Damp Forest Complex, and Lowland Herb-rich Forest.

For many of the EVCs which are endangered, vulnerable or rare as a result of depletion (Table 12.7), the only occurrence outside conservation reserves is either on private land or in State Forest. These reflect the effects of disturbances, which are discussed in Section 12.7. Table 12.7 lists threatening processes associated with EVCs determined to be endangered, vulnerable or rare.

Sub-regional Reservation of Ecological Vegetation Classes

The Gippsland region has been divided into 21 Geographic Representation Units (GRUs) based on variation in landform, geology, vegetation and climate across the region (Table 12.4). The GRUs reflect environmental change in the region at a landscape scale. These GRUs are shown on Map 1.

Table 12.3: Representative Conservation (percentage reservation status) of EVCs in the Gippsland Region based on Pre-1750 Vegetation Mapping

EVC No.	EVC Name	Area (ha)		Percent Remaining	Percent of EVC (pre-1750 extent) in each land category						
		pre-1750	Current		Conservation Reserves	State Forest	Other Parks & Reserves	Commonwealth Land	Other Public Land	Private Land	Water Bodies
1	Coastal Dune Scrub Mosaic	11200	8925	79.7	59.3	0.0	0.0	0.0	2.4	17.8	0.2
2	Coast Banksia Woodland	3475	1382	39.8	23.1	0.0	0.0	0.0	0.3	16.4	0.0
3	Damp Sands Herb-rich Woodland	40883	14306	35.0	19.3	0.0	0.0	0.0	1.1	14.5	0.1
5	Coastal Sand Heathland	23	23	100.0	73.2	0.0	0.0	26.8	0.0	0.0	0.0
6	Sand Heathland	8289	7402	89.3	82.0	0.0	0.0	0.0	3.6	3.7	0.0
7	Clay Heathland	683	685	100.3	46.7	42.0	0.0	0.0	0.0	11.6	0.0
8	Wet Heathland	14390	7408	51.5	44.7	2.0	0.0	0.0	0.4	4.4	0.0
9	Coastal Saltmarsh	7710	7059	91.6	57.0	0.0	0.0	0.0	2.7	27.3	4.6
10	Estuarine Wetland	8377	12266	146.4	79.3	0.0	0.0	0.0	6.5	57.5	3.2
11	Coastal Lagoon Wetland	59	59	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
12	Wet Swale Herbland	171	193	112.5	112.5	0.0	0.0	0.0	0.0	0.0	0.0
15	Limestone Box Forest	1430	746	52.1	9.2	10.4	5.9	0.0	0.7	25.3	0.7
16	Lowland Forest	258999	116680	45.1	5.4	22.4	1.8	0.0	0.6	14.9	0.0
17	Riparian Scrub Complex	0	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	Riparian Forest	9687	9014	93.0	36.0	44.8	3.3	0.0	3.2	5.3	0.4
19	Riparian Shrubland	4375	1660	37.9	8.9	8.4	0.0	0.0	5.3	2.5	12.8
20	Heathy Dry Forest	88161	85017	96.4	44.9	43.7	2.0	0.0	0.2	5.5	0.1
21	Shrubby Dry Forest	272744	263826	96.7	24.3	66.6	1.6	0.0	0.0	4.2	0.0
22	Grassy Dry Forest	39824	33368	83.8	20.2	39.1	2.9	0.0	0.3	21.2	0.0
23	Herb-rich Foothill Forest	130909	116606	89.1	43.1	37.9	1.6	0.0	0.3	6.1	0.0
27	Blackthorn Scrub	7429	7378	99.3	16.5	81.0	0.0	0.0	0.0	1.8	0.0
28	Rocky Outcrop Shrubland	1816	1807	99.5	36.3	60.2	0.0	0.0	0.3	2.5	0.2
29	Damp Forest	183397	106062	57.8	6.5	43.9	1.4	0.0	0.2	5.8	0.0
30	Wet Forest	111093	68453	61.6	7.2	20.3	0.3	0.0	0.8	32.9	0.0
31	Cool Temperate Rainforest	2207	893	40.5	15.3	8.1	0.0	0.0	0.0	17.0	0.0
32	Warm Temperate Rainforest	6078	2513	41.4	21.8	15.7	0.0	0.0	0.4	3.3	0.1
34	Dry Rainforest	31	13	41.2	9.6	21.3	0.0	0.0	0.0	10.3	0.0
35	Tableland Damp Forest	11034	11031	100.0	12.8	87.1	0.1	0.0	0.0	0.0	0.0
36	Montane Dry Woodland	139459	131619	94.4	42.2	47.6	0.8	0.0	0.2	3.6	0.0
37	Montane Grassy Woodland	58302	29952	51.4	5.1	31.9	0.3	0.0	0.8	13.2	0.0
38	Montane Damp Forest	105672	104135	98.5	40.0	56.9	0.7	0.0	0.4	0.6	0.0
39	Montane Wet Forest	11694	11613	99.3	37.6	61.1	0.3	0.0	0.0	0.3	0.0
40	Montane Riparian Woodland	7476	2759	36.9	13.2	7.0	0.0	0.0	8.0	8.7	0.0
41	Montane Riparian Thicket	2631	2654	100.9	15.4	82.7	1.2	0.0	0.7	0.8	0.0
42	Sub-alpine Shrubland	111	111	100.0	96.7	3.3	0.0	0.0	0.0	0.0	0.0
43	Sub-alpine Woodland	38468	38388	99.8	72.6	24.6	0.0	0.0	2.0	0.6	0.0
44	Treeless Sub-alpine Mosaic	167	167	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
45	Shrubby Foothill Forest	133917	36887	27.5	4.7	20.1	1.2	0.0	0.1	1.5	0.0
47	Valley Grassy Forest	11697	3118	26.7	4.8	4.3	1.2	0.0	0.3	16.1	0.0

Table 12.3: Representative Conservation (percentage reservation status) of EVCs in the Gippsland Region based on Pre-1750 Vegetation Mapping

EVC No.	EVC Name	Area (ha)		Percent Remaining	Percent of EVC (pre-1750 extent) in each land category						
		pre-1750	Current		Conservation Reserves	State Forest	Other Parks & Reserves	Commonwealth Land	Other Public Land	Private Land	Water Bodies
48	Heathy Woodland	44049	34506	78.3	38.2	17.1	0.0	0.0	6.4	16.6	0.0
53	Swamp Scrub	82570	4180	5.1	2.0	0.8	0.0	0.0	0.1	2.2	0.0
55	Plains Grassy Woodland	134044	3112	2.3	0.5	0.1	0.1	0.0	0.2	1.5	0.0
56	Floodplain Riparian Woodland	17817	1080	6.1	0.0	0.0	0.0	0.0	1.7	4.1	0.2
61	Box Ironbark Forest	7503	2497	33.3	2.6	8.7	8.0	0.0	0.4	13.6	0.1
72	Granitic Hills Woodland	3979	3979	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
73	Rocky Outcrop Shrubland/Herbland Mosaic	9383	9394	100.1	73.5	22.4	3.6	0.0	0.0	0.6	0.0
74	Wetland Formation	580	1871	322.4	164.3	21.0	0.0	0.0	3.6	73.1	60.4
82	Riverine Escarpment Scrub	9231	8637	93.6	30.2	58.1	0.0	0.0	0.1	5.1	0.1
83	Swampy Riparian Woodland	15630	97	0.6	0.1	0.3	0.0	0.0	0.1	0.1	0.0
84	Riparian Forest/Swampy Riparian Woodland/Riparian Shrubland/Riverine Escarpment Scrub/Disturbed Mosaic	105	7	6.7	0.0	2.2	0.0	0.0	0.0	3.0	1.6
107	Lake Bed Herbland	605	712	117.7	117.7	0.0	0.0	0.0	0.0	0.0	0.0
123	Riparian Forest/Warm Temperate Rainforest Mosaic	2023	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
125	Plains Grassy Wetland	1093	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
126	Swampy Riparian Complex	8549	667	7.8	0.0	0.1	0.0	0.0	2.1	5.6	0.0
127	Valley Heathy Forest	1242	1130	91.0	0.0	85.5	0.0	0.0	0.0	5.5	0.0
128	Grassy Forest	1794	7	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0
132	Plains Grassland	37284	291	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0
133	Limestone Pomaderris Shrubland	174	74	42.3	0.1	32.1	0.0	0.0	0.0	9.9	0.3
135	Gallery Rainforest	269	46	17.2	4.4	0.0	0.0	0.0	0.0	11.0	1.8
136	Sedge Wetland	2215	965	43.6	17.0	1.5	0.0	0.0	4.3	20.9	0.0
140	Mangrove Shrubland	2933	3074	104.8	85.6	0.0	0.0	0.0	1.6	8.1	9.6
141	Sandy Flood Scrub	2456	394	16.1	4.1	0.0	0.0	0.0	6.6	4.9	0.4
143	Estuarine Wetland/Coastal Saltmarsh Mosaic	0	642	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
144	Coast Banksia Woodland/ East Gippsland Coastal Warm Temperate Rainforest Mosaic	13	13	100.0	93.8	0.0	0.0	0.0	0.0	0.0	6.2
151	Plains Grassy Forest	88017	19781	22.5	1.6	15.0	0.0	0.0	0.4	5.5	0.0
154	Bird Colony Shrubland	50	50	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
159	Clay Heathland/Wet Heathland/Riparian Scrub Mosaic	55	42	76.8	0.0	68.1	0.0	0.0	0.0	8.7	0.0
160	Coastal Dune Scrub	31	31	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
161	Coastal Headland Scrub	1110	949	85.4	67.0	0.0	0.0	1.4	0.0	17.1	0.0
163	Coastal Tussock Grassland	1348	1231	91.3	70.4	0.0	0.0	0.0	0.0	13.9	7.0
164	Creepline Herb-rich Woodland	1009	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
169	Dry Valley Forest	24999	18851	75.4	10.2	53.0	0.0	0.0	4.5	7.6	0.1
175	Grassy Woodland	48592	13981	28.8	11.1	2.9	0.6	0.0	0.6	13.6	0.0

Table 12.3: Representative Conservation (percentage reservation status) of EVCs in the Gippsland Region based on Pre-1750 Vegetation Mapping

EVC No.	EVC Name	Area (ha)		Percent Remaining	Percent of EVC (pre-1750 extent) in each land category						
		pre-1750	Current		Conservation Reserves	State Forest	Other Parks & Reserves	Commonwealth Land	Other Public Land	Private Land	Water Bodies
177	Valley Slopes Dry Forest	1996	1840	92.2	26.7	51.7	0.0	0.0	0.6	11.2	1.9
191	Riparian Scrub	13549	3903	28.8	18.5	4.0	0.0	0.0	1.4	4.9	0.0
192	Montane Rocky Shrubland	3259	3259	100.0	92.0	8.0	0.0	0.0	0.0	0.0	0.0
195	Seasonally Inundated Shrubby Woodland	131	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
201	Shrubby Wet Forest	2250	2250	100.0	0.9	94.4	4.7	0.0	0.0	0.0	0.0
206	Sub-alpine Grassland	15827	15386	97.2	88.3	5.4	0.0	0.0	1.2	2.3	0.0
207	Montane Grassy Shrubland	88	29	32.3	0.0	0.7	3.5	0.0	0.0	28.0	0.0
210	Sub-alpine Wet Heathland	2106	1224	58.1	22.2	34.5	0.0	0.0	0.0	1.4	0.0
233	Wet Sand Thicket	65	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
265	Valley Grassy Forest/Grassy Dry Forest Mosaic	7	2	26.7	0.0	26.4	0.0	0.0	0.0	0.3	0.0
307	Sand Heathland/Wet Heathland Mosaic	3440	3719	108.1	107.9	0.0	0.0	0.0	0.0	0.3	0.0
309	Calcareous Swale Grassland	552	305	55.3	55.3	0.0	0.0	0.0	0.0	0.0	0.0
310	Wet Rocky Outcrop Scrub	521	521	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
315	Shrubby Foothill Forest/Damp Forest Complex	7995	7707	96.4	2.8	89.3	1.0	0.0	0.0	3.4	0.0
316	Shrubby Damp Forest	68783	68161	99.1	16.0	81.1	0.6	0.0	0.0	1.4	0.0
317	Sub-alpine Wet Heathland/Sub-alpine Grassland Mosaic	3654	3413	93.4	37.5	46.7	0.1	0.0	0.0	9.1	0.0
318	Montane Swamp	702	219	31.2	2.8	0.0	0.0	0.0	26.5	1.9	0.0
319	Montane Herb-rich Woodland	24766	22421	90.5	31.4	51.4	0.5	0.0	2.0	5.1	0.0
320	Grassy Dry Forest/Heathy Dry Forest Complex	529	503	95.1	95.1	0.0	0.0	0.0	0.0	0.0	0.0
322	Dry Rainforest/Warm Temperate Rainforest/Gallery Rainforest/Riparian Shrubland Mosaic	185	198	106.7	0.9	1.9	0.0	0.0	10.0	4.3	89.7
334	Billabong Wetland	851	12	1.4	0.0	0.0	0.0	0.0	0.2	1.2	0.0
342	Rocky Outcrop Shrubland/Herbland Mosaic/Shrubby Foothill Forest Complex	3	3	100.0	0.0	31.1	0.0	0.0	0.0	68.9	0.0
637	Swampy Scrub/Damp Sands Herb-rich Woodland/ Wet Heathland Mosaic	4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
638	Swamp Scrub/Wet Heathland Mosaic	1128		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
639	Swamp Scrub/Plains Grassy Forest Mosaic	4280	164	3.8	0.0	3.6	0.0	0.0	0.0	0.3	0.0
681	Deep Freshwater Marsh	8173	3982	48.7	14.7	0.0	0.0	0.0	0.0	31.5	2.5
686	Wet Heathland/Damp Heathland Mosaic	7085	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
687	Swamp Scrub/Plains Grassland Mosaic	22233	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
688	Swampy Riparian Woodland/Swamp Scrub Mosaic	4112	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
689	Gippsland Plains Grassy Woodland/Gilgai Wetland Mosaic	31018	73	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0
690	Floodplain Riparian Woodland/Billabong Wetland Mosaic	3057	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 12.3: Representative Conservation (percentage reservation status) of EVCs in the Gippsland Region based on Pre-1750 Vegetation Mapping

EVC No.	EVC Name	Area (ha)		Percent Remaining	Percent of EVC (pre-1750 extent) in each land category						
		pre-1750	Current		Conservation Reserves	State Forest	Other Parks & Reserves	Commonwealth Land	Other Public Land	Private Land	Water Bodies
691	Aquatic Herbland/Plains Sedgy Wetland Mosaic	1153	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
695	Dry Valley Forest/Swamp Scrub/Warm Temperate Rainforest Mosaic	4938	18	0.4	0.1	0.0	0.0	0.0	0.0	0.2	0.0
698	Lowland Forest/Heathy Woodland Mosaic	9638	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
699	Valley Grassy Forest/Swamp Scrub Mosaic	222	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
700	Swamp Scrub/Plains Sedgy Wetland Mosaic	26	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
701	Swamp Scrub/Warm Temperate Rainforest/Billabong Wetland Mosaic	1814	4	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0
702	Montane Grassland	2013	69	3.4	1.0	0.0	0.0	0.0	1.9	0.5	0.0
703	Montane Grassy Woodland/Montane Grassland Mosaic	1867	71	3.8	0.1	0.1	0.0	0.0	3.6	0.0	0.0
795	<i>Gippsland Plains</i> Lowland Forest/Damp Sands Herb-rich Woodland Mosaic	24958	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
858	Calcarene Dune Woodland	3568	3831	107.4	107.3	0.0	0.0	0.0	0.0	0.0	0.0
863	Floodplain Reedbed	1623		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
875	Blocked Coastal Stream Swamp	29	32	110.8	110.8	0.0	0.0	0.0	0.0	0.0	0.0
876	Spray-zone Coastal Shrubland	47	47	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
877	Lowland Herb-rich Forest	36051	20444	56.7	3.7	29.7	0.4	0.0	0.5	22.5	0.0
878	Damp Sands Herb-rich Woodland/Swamp Scrub Complex	5103	157	3.1	2.9	0.0	0.0	0.0	0.0	0.2	0.0
879	Coastal Dune Grassland	34	34	100.0	97.6	0.0	0.0	0.0	0.0	0.0	2.4
985	Bare Sand	1209	1345	111.3	111.2	0.0	0.0	0.0	0.0	0.0	0.0
986	Rocky Shore	356	359	100.8	96.9	0.0	0.0	3.9	0.0	0.0	0.0
993	Bare Rock/Ground	60	60	101.3	101.3	0.0	0.0	0.0	0.0	0.0	0.0
995	Ocean	16747									
58	Cleared Severely Disturbed	2	11544	-	-	-	-	-	-	-	-
149	Plantation	-	84958	-	-	-	-	-	-	-	-
997	Non-vegetated/Non-treed	332	982564								
998	Water Body – Natural or man made	47321	52962								
999	Unknown/Unclassified	0	16								
		2676284	2676284								

Note: A vegetation mosaic consists of discrete floristic entities (EVCs) which were unable to be distinguished in the mapping due to the scale used (i.e. 1:100 000). A vegetation *complex* occurs where flor entities are unable to be distinguished in an area but are known to exist discretely elsewhere. Plantations are based on records of overstorey plantings. Both overstorey and understorey vary between na and non-native species. EVC descriptions will be available in the companion Biodiversity Assessment Report (VicRFASC in prep. b)

Table 12.4: Geographic Representation Units in the Gippsland Region

Geographic Representation Unit (GRU)	Description
Aberfeldy Foothills	Steeply dissected ranges of Palaeozoic sedimentary and metamorphic rocks in the rainshadow of the Baw Baw massif. Rainfall moderate.
Avon Foothills	Dissected foothills of Ordovician sandstones. Rainfall moderate.
Bunyip Foothills	Rolling hills and small ranges in moderate to high rainfall zones south of the Great Dividing Range (only a small portion occurs in this Region)
Cobungra Mountains	Palaeozoic granitic mountain ranges of the Great Divide, includes southern slopes of Mount Hotham. Rainfall moderate to high.
Dargo Mountains	Foothills and dissected ranges of Ordovician sandstones and older Volcanics around Dargo. Rainfall moderate.
Fish Creek Coastal	Gently undulating erosional and depositional plains of Cainozoic marine sedimentary and continental deposits. Rainfall moderate.
Haunted Mountains	Dissected foothills and ranges of Ordovician sediments and metamorphics. Rainfall low to moderate.
King Coastal Plains	Flat Quaternary Alluvial Plain below 100m. Includes Lakes Victoria and King. Rainfall low.
Latrobe Foothills	Foothills country of varied geology (sediments, outwash, alluviums and basalts) south of the Great Divide on the margins of the Latrobe Valley. Moderate to high rainfall.
Latrobe Valley	Broad erosional and alluvial plains, in part overlying extensive Tertiary brown coal deposits. Rainfall moderate.
Macalister Mountains	Alpine to montane uplands of Palaeozoic sediments and older volcanics. Rainfall moderate to high.
Matlock Mountains	Steeply dissected ranges south of the Great Dividing Range, consisting of Devonian and Silurian sediments in low to moderate rainfall areas.
Mullungdung Coastal	Relatively flat coastal plain underlain by marine Tertiary rocks. Coastline is characterized by Quaternary depositional features and includes the islands east of Corner Inlet. Rainfall low to moderate.
Nunniong Mountains	Montane ranges above 400m of predominantly Ordovician sediments and metamorphics. Rainfall moderate.
Strzelecki Foothills	Ranges of mainly mesozoic sandstones with widespread older volcanic basalts. Rainfall high to very high.
Taylor Foothills	Steeply dissected foothills of Ordovician sandstone north of Bairnsdale. Rainfall low to moderate.
Upper Murray Mountains	Alpine to montane ranges of varied geology (Palaeozoic sediments, metamorphics and volcanics) comprising the headwaters of the Murray River. Rainfall moderate to high.
Wellington Coastal Plains	Broad alluvial plains at the western edge of the Gippsland Lakes. Includes Lake Wellington and Quaternary depositional barrier features around Loch Sport . Rainfall low.
Wellington Mountains	High alpine plains of Mesozoic and Palaeozoic sediments. Rainfall moderate to high.
West Gippsland Foothills	Rolling foothills (predominantly cleared) at the western edge of the Strzelecki Ranges, formed of mesozoic sandstones and mudstones. Rainfall moderate.
Wilson's Promontory	Granitic massif linked to the mainland by a narrow neck of dunes. Peaks rise to 750m. Rainfall moderate

Note: Rainfall is classified as low (<700mm), moderate (700-1000mm), high (1000-1200mm) or very high (>1200mm).

An analysis of the percent reservation of pre-1750 EVCs within each GRU can assist in evaluating the extent to which the reserve system encompasses regional variation in forest ecosystems. The results of this analysis are presented in Table 12.5.

Table 12.5: Representative Conservation (per cent reservation status) of EVCs in the Gippsland Region by Geographic Representation Unit

EVC	Per 1000 ha	Alpine Foothills		Alpine Foothills		Bayside Foothills		Cabbage Gullies		Derby Mountains		Fell Creek Coastal		Heartland Mountains		High Coastal Plains		Lalorke Foothills		Lalorke Valley		Moolambidgea Mountains						
		Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %	Area (ha)	Per %					
1 Coastal Dune Scrub Mosaic	11,280																412	37										
2 Coastal Heathland Woodland	3,276	8		81								4,217	40				22	47										
3 Heath Woodland with Ironwood	48,988	8						80		28		1,233	7			3,888	86			180								
4 Coastal Heathland	21																											
5 Coastal Heathland	8,289																											
6 Coastal Heathland	583																											
7 Coastal Heathland	14,380																											
8 Coastal Heathland	7,770																											
9 Coastal Heathland	8,371																											
10 Coastal Heathland	59																											
11 Coastal Heathland	1,171																											
12 Coastal Heathland	3,400																											
13 Coastal Heathland	288,289	12,717	4	18,157	9	1,458						42,371	3	1,889		4,730	5	14,982	2	15,685	4	8	51					
14 Coastal Heathland	3,917	1,309	28	982	35			494	80	1,128	28			289				587	18	52	1,119	21						
15 Coastal Heathland	4,276	68	23	1,681	7			200	4	81	53			114		140	35	17		139		39						
16 Coastal Heathland	88,181	6,890	28	6,282	46			32,390	80	1,843	22			3,382				80	52		4,352	89						
17 Coastal Heathland	272,744	13,828	28	62,828	23			6,829	27	42,787	16			17,889				622	17	280	35,827	66						
18 Coastal Heathland	38,674	1,809	28	8,681	34			1,899	1	6,371	24			6,333				684	8		3,217	90						
19 Coastal Heathland	138,888	3,344	27	7,381	76			2,907	88	16,282	21	178		4,881							38,828	88						
20 Coastal Heathland	7,228			412	34					3,888	21			1,812														
21 Coastal Heathland	1,978							883	81	88	27			22									304	88				
22 Coastal Heathland	182,281	30,229	6	8,626	35	1,312		2,344	85	7,526	2	10,211	2	17,884				7,244	2	1,785	8	6,434	72					
23 Coastal Heathland	111,282	2,888	2	1,134	34			75	180	2,448	4	5,126	2	6,877				222		82		7,288	8					
24 Coastal Heathland	2,281	28		14	2																		4					
25 Coastal Heathland	6,030			31	37																							
26 Coastal Heathland	31																											
27 Coastal Heathland	11,034	837	11	1,681	85			30	180	844				5,360									473	30				
28 Coastal Heathland	158,492	1,832	17	2,528	35			35,827	39	17,723	34			11,830	3								30,445	80				
29 Coastal Heathland	28,282			221	85			10,272	5	800	4			7,489	1								15	180				
30 Coastal Heathland	93,672	2,258	8	1,446	34			16,238	54	9,811	24			9,872	1								5,708	51				
31 Coastal Heathland	11,684	892	2	2	82			3,824	91	7				1,889	1									112	2			
32 Coastal Heathland	2,426			1	7			2,594	6	0	180			896														
33 Coastal Heathland	1,071	1	100					892	21	30				889	8									72	84			
34 Coastal Heathland	111																											
35 Coastal Heathland	38,488	888	8	881	88			10,848	82	4,883	48			347	8									24	180			
36 Coastal Heathland	187																								304	180		
37 Coastal Heathland	133,871	8,828	8	8,811	88			288	80	2,388	6	27,888	7,888	7,888										2,212	1			
38 Coastal Heathland	11,881	808	1	887	81			21	2,812	1				1,888										808	25			
39 Coastal Heathland	44,949																											
40 Coastal Heathland	30,620	242	18	2	42																							
41 Coastal Heathland	1,044	1,714		8,276																								
42 Coastal Heathland	17,017	1,886																										
43 Coastal Heathland	7,585	3,468	3	81	89																							
44 Coastal Heathland	3,259																											
45 Coastal Heathland	8,863	345	29	1,621	34			62	85	2,274	45			36											2,827	85		
46 Coastal Heathland	580																											
47 Coastal Heathland	8,231	1,815	28	2,189	36			45	87	751	18			9	180													
48 Coastal Heathland	14,630			16						84				4,824	1													
49 Coastal Heathland	185			7																								
50 Coastal Heathland	685							800	180																			
51 Coastal Heathland	2,023																											
52 Coastal Heathland	1,988			41																								
53 Coastal Heathland	8,468					1,782	1																					
54 Coastal Heathland	1,242			179																								
55 Coastal Heathland	7,384					311																						
56 Coastal Heathland	20,244	618		2,172																								
57 Coastal Heathland	114																											
58 Coastal Heathland	289																											
59 Coastal Heathland	2,215																											
60 Coastal Heathland	2,815																											
61 Coastal Heathland	1,486			136																								
62 Coastal Heathland	15																											
63 Coastal Heathland	38,017	3,718		2,892																								
64 Coastal Heathland	90																											
65 Coastal Heathland	80																											
66 Coastal Heathland	1,770																											
67 Coastal Heathland	1,288																											
68 Coastal Heathland	1,029																											
69 Coastal Heathland	24,289	2,888	18	4,882	26			26	81	1,875	6			3,211												2,818	21	
70 Coastal Heathland	48,882	1,613		2,088	31			1,288	76	4,888	9			9,822													2,758	22
71 Coastal Heathland	1,988	867	28	278	22			47	12	275	10			12														
72 Coastal Heathland	71,549																											
73 Coastal Heathland	1,259			474	180																							
74 Coastal Heathland	111																											
75 Coastal Heathland	2,280	1,842		30	12					496				307														
76 Coastal Heathland	14,621			11	180			1,888	80	1,324	54																	
77 Coastal Heathland	188							88																				
78 Coastal Heathland	2,186			1	180			844	30	9	180																	
79 Coastal Heathland	85																											
80 Coastal Heathland	7																											
81 Coastal Heathland	7,440																											
82 Coastal Heathland	882																											
83 Coastal Heathland	821																											
84 Coastal Heathland	2,886	1,288	7	88	22																							
85 Coastal Heathland	88,881	3,388																										

Reservation status of Ecological Vegetation Class growth stages

Forest disturbance categories have been used to represent the major growth stages that characterise the dynamics of forests in the region. The growth stage/disturbance categories used have been derived from Woodgate *et al.* (1994), and include: old-growth forest, negligibly disturbed forest, significantly disturbed forest and non-forest. The reservation status of EVCs on public land in the region assessed for each of the forest disturbance categories will be available in the Biodiversity Technical Report.

Threatened Forest Ecosystems

The conservation status of EVCs in Gippsland has been assessed using the criteria derived from the National Forest Reserve Criteria (JANIS 1997) (see Table 12.6 for an abridged version of the criteria).

Table 12.6: The National Forest Reserve (JANIS) Criteria Used to Assess the Conservation Status of EVCs

Status of EVC	Criteria
Rare	R1. Total range generally less than 10,000 ha. R2. Total area generally less than 1,000 ha. R3. Patch sizes generally less than 100 ha.
Vulnerable	V1. Approaching greater than 70 per cent lost (depletion) and remains subject to threatening processes. V2. Includes EVCs where threatening processes have caused significant changes in species composition, loss or significant decline in species that play a major role within the ecosystem, or significant alteration to ecosystem processes. V3. Not depleted but subject to continuing threatening processes which may reduce its extent.
Endangered	E1. Distribution has contracted to less than 10 per cent of original range. E2. Less than 10 per cent of original area remaining. E3. 90 per cent of area is in small patches subject to threatening processes and unlikely to persist.

From a total of 103 EVCs, 59 have been classified as endangered, vulnerable or rare within the Gippsland RFA region - these are listed in Table 12.7.

Table 12.7: Endangered, Vulnerable and Rare Ecological Vegetation Classes in Gippsland, their per cent Reservation in the Region, and Threatening Processes

EVC No.	EVC Name	Criteria	% Res. ¹	Threatening Processes ²
2	Coast Banksia Woodland	V2, V3	23.1	Recreation, clearing, inappropriate fire regimes, residential and commercial development
3	Damp Sands Herb-rich Woodland	V1, V2, V3, E3	19.3	Grazing, weed invasion, inappropriate fire regimes, clearing, agriculture, plantation development
5	Coastal Sand Heathland	R1, R2, R3, V3	73.2	Recreation
7	Clay Heathland	R2	46.7	
9	Coastal Saltmarsh	R2, E3, V2, V3	57.0	Alteration of drainage patterns and flooding regimes, recreation, clearing, residential and commercial development

EVC No.	EVC Name	Criteria	% Res. ¹	Threatening Processes ²
10	Estuarine Wetland	V2, V3, E3	79.3	Residential and commercial development, alteration of drainage patterns and flooding regimes, recreation
11	Coastal Lagoon Wetland	R1, R2, R3	100.0	
12	Wet Swale Herbland	R2, R3	112.5	
15	Limestone Box Forest	R1, R2, V2, V3	9.2	Grazing, clearing, minor forest produce, weed invasion, habitat loss, timber harvesting, fragmentation, inappropriate fire regimes
18	Riparian Forest	V2, V3	36.0	Weed invasion, grazing, recreation, mining, clearing, fire, indirect impacts of road construction and maintenance and timber harvesting
19	Riparian Shrubland	R3	8.9	Weed invasion
28	Rocky Outcrop Shrubland	R3	36.3	Weed invasion, inappropriate fire regimes
31	Cool Temperate Rainforest	R2, R3, E3, V2, V3	15.3	Fire, clearing, indirect effects of timber harvesting and of road construction and maintenance
32	Warm Temperate Rainforest	R3, E3, V2	21.8	Fire, clearing, indirect effects of timber harvesting and of road construction and maintenance
34	Dry Rainforest	R1, R2, R3, V2, V3, E3	9.6	Fire
40	Montane Riparian Woodland	E3	13.2	Weed invasion, grazing, indirect impacts of road construction and maintenance, inappropriate fire regimes
41	Montane Riparian Thicket	R3	15.4	Indirect impacts of road construction and maintenance, indirect impacts of timber harvesting
42	Sub-alpine Shrubland	R2, R3, E3	96.7	Recreation
44	Treeless Sub-alpine Mosaic	R2, R3, E3, V2, V3	100.0	Grazing, recreation, weed invasion
45	Shrubby Foothill Forest	V1	4.7	Minor forest produce, timber harvesting, inappropriate fire regimes
47	Valley Grassy Forest	V1, V2, V3	4.8	Weed invasion, grazing, clearing, minor forest produce, agriculture, minor forest produce
53	Swamp Scrub	E2, E3	2.0	Grazing
55	Plains Grassy Woodland	R3, E2, E3, V2, V3	0.5	Habitat loss, clearing, agriculture, fragmentation, grazing, weed invasion, road construction and maintenance, minor forest produce, timber harvesting, inappropriate fire regimes
56	Floodplain Riparian Woodland	R2, E2, E3, V2, V3	0.0	Habitat loss, clearing, agriculture, fragmentation, timber harvesting, minor forest produce, alteration of drainage patterns and flooding regimes, grazing, weed invasion, indirect impacts of road construction and maintenance, agriculture

EVC No.	EVC Name	Criteria	% Res. ¹	Threatening Processes ²
61	Box Ironbark Forest	R1, V1, V2, V3	2.6	Timber harvesting, firewood and post and pole production, mining, habitat loss, fragmentation, weed invasion, clearing, inappropriate fire regimes
83	Swampy Riparian Woodland	R2, R3, V3, E2, E3	0.1	Clearing for agriculture, grazing, weed invasion, alteration of drainage patterns and flooding regimes, indirect impacts of road construction and maintenance
107	Lake Bed Herbland	R1, R2, E3, V2, v3	117.7	Grazing, alteration of drainage patterns and flooding regimes, weed invasion
126	Swampy Riparian Complex	R2, E2, V3	0.0	Clearing for agriculture, grazing, weed invasion, alteration of drainage patterns and flooding regimes, indirect impacts of road construction and maintenance
127	Valley Heathy Forest	R2, R3, V2	0.0	Clearing, agriculture, habitat loss, weed invasion, inappropriate fire regimes
128	Grassy Forest	R1, R2, R3, E2, E3, V2, V3	0.0	Grazing, weed invasion, clearing, agriculture, timber harvesting, minor forest produce
132	Plains Grassland	R2, R3, E2, E3, V2, V3	0.8	Inappropriate grazing regime, clearing, agriculture, habitat loss, fragmentation, weed invasion, road construction and maintenance, inappropriate fire regimes
133	Limestone Pomaderris Shrubland	R2, R3, V2, V3, E3	0.1	Grazing, weed invasion, mining
135	Gallery Rainforest	R2, R3, V1, V2, V3, E3	4.4	Fire, clearing, indirect effects of timber harvesting and of road construction and maintenance,
136	Sedge Wetland	R2, R3, V3, E3	17.0	Grazing, alteration of drainage patterns and flooding regimes, weed invasion
140	Mangrove Shrubland	E3, V2, V3	85.6	Alteration of drainage patterns and flooding regimes, recreation, earthworks and construction associated with development
141	Sandy Flood Scrub	R1, R2, V1	4.1	Inappropriate fire regimes
143	Estuarine Wetland/Coastal Saltmarsh Mosaic	R1, R2, V2, V3	-	Alteration of drainage patterns and flooding regimes, recreation
151	Plains Grassy Forest	V1, V2, V3	1.6	Grazing, minor forest produce, agriculture, clearing, weed invasion, timber harvesting
154	Bird Colony Shrubland	R2, R3	100.0	Soil erosion
160	Coastal Dune Scrub	R2, R3	100.0	
161	Coastal Headland Scrub	R1, R2, R3, V3, E3	67.0	Recreation, soil erosion, weed invasion, residential development, clearing
163	Coastal Tussock Grassland	R3	70.4	Soil erosion
175	Grassy Woodland	V1, E3, V2, V3	11.1	Grazing, weed invasion, habitat loss, fragmentation, clearing, agriculture, timber harvesting, minor forest produce
177	Valley Slopes Dry Forest	R1, R3	26.7	Soil erosion, weed invasion

EVC No.	EVC Name	Criteria	% Res. ¹	Threatening Processes ²
191	Riparian Scrub	R1, R3, V1, V3	18.5	Clearing, weed invasion, recreation, alteration of drainage patterns and flooding regimes
192	Montane Rocky Shrubland	R1, R3	92.0	Inappropriate fire regimes, weed invasion
207	Montane Grassy Shrubland	R2, R3, V1, V2, V3	0.0	Grazing, weed invasion
210	Sub-alpine Wet Heathland	R1, R3, V2, V3	22.2	Grazing, fire, recreation
309	Calcareous Swale Grassland	R1, R2, R3	55.3	
310	Wet Rocky Outcrop Scrub	R1, R2, R3	100.0	
318	Montane Swamp	R2, R3, V1, V2, V3, E3	2.8	Grazing, alteration of drainage patterns and flooding regimes, weed invasion
334	Billabong Wetland	R2, R3, V2, V3, E2, E3	0.0	Grazing, altered water/drainage regimes, weed invasion, habitat loss, salination, clearing, agriculture
681	Deep Freshwater Marsh	E3, V2, V3	14.7	Alteration of drainage patterns and flooding regimes, weed invasion
689	<i>Gippsland Plains</i> Grassy Woodland/Gilgai Wetland Mosaic	R2, R3, E2, E3, V2, V3	0.0	Altered drainage patterns and flooding regimes, weed invasion, clearing, agriculture, grazing, minor forest produce, fragmentation, habitat loss, road construction and maintenance
702	Montane Grassland	V1, R1, R2, R3, E2, E3, V2, V3	1.0	Grazing, weed invasion
858	Calcareous Dune Woodland	R1	107.3	Recreation
875	Blocked Coastal Stream Swamp	R1, R2, R3	110.8	Alteration of drainage patterns and flooding regimes
876	Spray-zone Coastal Shrubland	R2, R3	100.0	Soil erosion
879	Coastal Dune Grassland	R1, R2, R3, V3, E3	97.6	Recreation, soil erosion

Notes:¹ Percent Reservation in Conservation Parks and Reserves is based on pre-1750 extent. ² Threatening processes are those which have occurred in the past, and may or may not be current threatening processes for these EVCs. Minor forest produce includes produce harvested other than sawlogs or residual logs. It is often collected by small operators or individuals and includes products such as sleepers, posts and poles, craftwood, firewood, and honey.³ Extinct EVCs and EVC mosaics of small extent which are artefacts of mapping methods have not been included.

Management mechanisms currently available to address the threatening processes tabulated above include: the Code of Practice for Fire Management on Public Land, Native Vegetation Retention Controls, Weed Control, Fencing, and the Land for Wildlife scheme. Further details are included in section 12.7 below.

Several relatively common EVCs are subject to a variety of threatening processes but are not currently judged to be impacted to a sufficiently significant degree (i.e. in extent and/or severity) to be considered endangered, vulnerable or rare in accordance with the JANIS criteria. For example, EVCs with heathy understories (Heathy Dry Forest, Heathy Woodland, Granitic Hills Woodland) are particularly sensitive to altered fire regimes and the resultant reduced diversity is commonly identified across the study area. The understory composition of mountain forest EVCs (Damp Forest, Wet Forest, Montane Wet Forest, Shrubby Damp Forest, Shrubby Wet Forest), particularly old individuals of some prominent understory species (e.g. tree ferns), is significantly impacted by mechanical disturbance associated with

timber harvesting. Open fertile EVCs (Montane Grassy Woodland, Sub-alpine Grassland) are favoured for grazing and are relatively more prone to weed invasion. The conservation status of these EVCs is analogous to the “near threatened” category that is applied to some species. Stabilising the status of these EVCs relies on a range of management strategies aimed at minimising any long-term impacts. See section 12.7 for further information.

12.5 FLORA SPECIES ASSESSMENT

Introduction

Assessment of the Gippsland flora has involved analysing the distribution and viability of individual plant species and their populations in the region. The purpose of this assessment is to assist in determining whether:

- viable populations of all terrestrial and aquatic plant species are maintained throughout their natural range in the region;
- representative populations of each species are included in the reserve system; and
- populations and their habitats both within and outside the reserve system are subject to management appropriate for their long-term maintenance.

Priority Species Information

A total of approximately 2,500 species of vascular plants have been recorded for the Gippsland region, including 348 species of conservation significance and approximately 600 exotic species. However, the amount and quality of information on particular species is highly variable. Forty-two species of conservation significance are listed (or recommended for listing) as Threatened in Victoria under Schedule 2 of the *Flora and Fauna Guarantee Act* 1988 (FFG Act) and/or listed as nationally Endangered or Vulnerable under Schedule 1 of the Commonwealth *Endangered Species Protection Act* 1992 (ESP Act) (see Table 12.8). Complete lists and details of the 348 species of conservation significance are contained in the Biodiversity Assessment Report.

Both the ESP Act and the FFG Act include provisions for the preparation of management plans for listed taxa. Action Statements and Recovery Plans outline the actions necessary to maximise the long-term prospects for survival of the species in the wild. The status of Action Statements and Recovery Plans for FFG/ESP Act listed species is indicated in Table 12.8. It should be noted that the implementation of management actions is dependent on available resourcing and priorities within and between species.

The distribution of plants of conservation significance is often associated with particular habitats or other environmental factors. Some groupings have been identified for plants of conservation significance based on their abundance, distribution and habitats (Table 12.9).

Species Vulnerability Assessment

A vulnerability assessment was undertaken for all plant species of conservation significance in Gippsland. It was designed to identify those rare or threatened plants that are at greatest risk of further significant decline and extinction as a result of activities, ongoing threatening processes and catastrophic events in the region. As the assessment is confined to each species' Gippsland distribution, the results do not necessarily accord with the national or statewide status of species shown in Table 12.8.

Quantitative criteria such as those endorsed by the IUCN (IUCN 1994) provide an internationally recognised framework to assess the risk of extinction. Three categories of threatened taxa are defined; Critically Endangered (CR), Endangered (E) and Vulnerable (V). Categories are determined using rule sets based on population size, distributional range and rates of decline. A taxon is considered Lower Risk (LR) when it does not satisfy the criteria for any of the above categories, or Data Deficient (DD) when there is inadequate information to make an assessment. The IUCN criteria were developed primarily for fauna and there are several difficulties in applying them for flora. Recently Keith (1998) critically reviewed the

IUCN criteria and suggested modifications, developing a system called 'RARE' (Rules for the Assessment of the Risk of Extinction in vascular plants).

Both the IUCN and RARE rule sets were applied to 301 of the 348 rare or threatened plants considered in this assessment. The other 47 had insufficient information in Gippsland to make an assessment of their risk of extinction using either rule set. Those species which were ranked as Critically Endangered or Endangered against the IUCN rule set are listed in Table 12.10. In the following discussion of the results, precedence is given to the IUCN rating as RARE is recently published and has not been canvassed within the broader scientific community.

Table 12.8: Gippsland Plant Species Listed (or Recommended for Listing) under the FFG Act and/or ESP Act

Species Name	Common Name	FFG Act Listing	Action Statement (FFG)	ESP Act Status	Recovery Plan (ESP)
<i>Acacia caerulescens</i>	Limestone Blue Wattle	-		Vulnerable	no
<i>Adiantum diaphanum</i>	Filmy Maidenhair	listed	yes	-	
<i>Adriana quadripartita</i> (pubescent form)	Coast Bitter-bush	listed	no	-	
<i>Adriana quadripartita</i> s.s. (glabrous form)	Rare Bitter-bush	listed	no	-	
<i>Agrostis billardierei</i> var. <i>filifolia</i>	Gilgai Blown-grass	listed	in prep.	-	
<i>Almaleea capitata</i>	Slender Parrot-pea	listed	no	-	
<i>Amphibromus fluitans</i>	River Swamp Wallaby-grass	-		Vulnerable	no
<i>Asplenium hookerianum</i>	Maidenhair Spleenwort	final rec	-	Vulnerable	yes
<i>Asplenium obtusatum</i>	Shore Spleenwort	-		Vulnerable	no
<i>Boronia galbraithiae</i>	Aniseed Boronia	listed	no	-	
<i>Brachyscome tenuiscapa</i>	Mountain Daisy	listed	no	-	
<i>Bracteantha palustris</i>	Swamp Everlasting	listed	in prep.	-	
<i>Caladenia fragrantissima</i> ssp. <i>orientalis</i>	Eastern Spider-orchid	listed	no	Endangered	no
<i>Carex paupera</i>	Dwarf Sedge	listed	no	-	
<i>Celmisia sericophylla</i>	Silky Daisy	listed	no	-	
<i>Cyathea cunninghamii</i>	Slender Tree-fern	listed	in prep.	-	
<i>Cyathea leichhardtiana</i>	Prickly Tree-fern	listed	no	-	
<i>Discaria nitida</i>	Shining Anchor Plant	listed	no	-	
<i>Discaria pubescens</i>	Hairy Anchor Plant	listed	yes	-	
<i>Diuris ochroma</i>	Pale Golden Moths	-		Vulnerable	no
<i>Diuris punctata</i> var. <i>punctata</i>	Purple Diuris	listed	no	-	
<i>Drabastrum alpestre</i>	Mountain Cress	listed	no	-	
<i>Epilobium brunnescens</i> . <i>beaugleholei</i>	Bog Willow-herb	-		Vulnerable	no
<i>Epilobium willisii</i>	Carpet Willow-herb	listed	no	-	
<i>Eucalyptus strzeleckii</i>	Strzelecki Gum	-		Vulnerable	no
<i>Euphrasia collina</i> ssp. <i>muelleri</i>	Purple Eyebright	-		Endangered	no
<i>Euphrasia scabra</i>	Rough Eyebright	listed	yes	-	
<i>Glycine latrobeana</i>	Clover Glycine	listed	no	Vulnerable	yes
<i>Isopogon prostratus</i>	Prostrate Cone-bush	listed	in prep.	-	
<i>Lepidium aschersonii</i>	Spiny Pepper-cress	listed	in prep.	Vulnerable	no
<i>Olearia astroloba</i>	Marble Daisy-bush	listed	in prep.	Vulnerable	no
<i>Poa saxicola</i>	Rock Poa	listed	no	-	
<i>Prasophyllum correctum</i>	Gaping Leek-orchid	listed	yes	Endangered	no
<i>Prasophyllum frenchii</i>	Maroon Leek-orchid	final rec	-	Vulnerable	no
<i>Pseudoraphis paradoxa</i>	Slender Mud Grass	final rec	-	-	
<i>Pterostylis cucullata</i>	Leafy Greenhood	listed	yes	Vulnerable	no
<i>Pterostylis tenuissima</i>	Swamp Greenhood	-		Vulnerable	no
<i>Rulingia prostrata</i>	Dwarf Kerrawang	listed	in prep.	Endangered	no
<i>Thelymitra epipactoides</i>	Metallic Sun-orchid	listed	no	Endangered	no
<i>Thelymitra matthewsii</i>	Spiral Sun-orchid	listed	no	Vulnerable	no
<i>Thesium australe</i>	Austral Toad-flax	listed	yes	Vulnerable	in prep.
<i>Wahlenbergia densifolia</i>	Fairy Bluebell	listed	no	-	

Table 12.9: Plant Groupings of Conservation Significance in Gippsland

Plant Grouping	Species of conservation significance
Plants of restricted, highly localised and naturally rare habitat types	<p>Plants of alpine and sub-alpine habitats</p> <p>In Australia, alpine and sub-alpine environments are relictual, their distribution having contracted over time. These environments act as refugia for plants confined to the narrow range of environmental variables typical of such environments.</p> <p>Sixteen percent of all the rare or threatened plants found within the Gippsland Region grow primarily at high altitudes (>1000m asl) in alpine and sub-alpine habitats. Due to the restricted nature of their habitat, their usually low population numbers, and occurrence in the Alpine National Park, the bulk of these taxa are considered rare, but not threatened. Of the 55 plants confined to alpine and subalpine habitats, 12 are considered threatened in Victoria. These are Snow Aciphyll <i>Aciphylla glacialis</i>, Mountain Water-fern <i>Blechnum vulcanicum</i>, Mountain Daisy <i>Brachyscome tenuiscapa</i>, Archer's Sedge <i>Carex archeri</i>, Dwarf Sedge <i>Carex paupera</i>, Slender Gingidia <i>Gingidia harveyana</i>, Matted Brooklime <i>Gratiola nana</i>, Silver Carraway <i>Oreomyrrhis argentea</i>, Mountain Geebung <i>Persoonia asperula</i>, Harsh Phebalium <i>Phebalium squameum</i> ssp. <i>coriaceum</i>, Tasmanian Bladderwort <i>Utricularia monanthos</i> and Fairy Bluebell <i>Wahlenbergia densiflora</i>.</p> <p>Plants of riparian or wetland habitats</p> <p>Although widespread, riparian vegetation has a narrow range of habitat requirements and as such is restricted in extent.</p> <p>Twelve percent of all the rare or threatened plants found within the Gippsland Region grow primarily in riparian or wetland habitats. Out of these 43 plants, 16 are considered threatened and two of these, Bog Willow-herb <i>Epilobium brunnescens</i> ssp. <i>beaugleholei</i> and Native Wintercress <i>Barbarea grayi</i>, are currently considered to be threatened at a national level (Bog Willow-herb <i>Epilobium brunnescens</i> ssp. <i>Beaugleholei</i>, although not having a ROTAP status, is listed as vulnerable under the <i>Endangered Species Protection Act 1992</i>). Although Enigmatic Greenhood <i>Pterostylis aenigma</i> and Winged Everlasting <i>Ozothamnus adnatus</i> are suspected of being threatened at a national level, further survey is required to better document their distribution and identify any potential threats. The other 12 taxa threatened at a State-level are Filmy Maidenhair <i>Adiantum diaphanum</i>, Brickmakers' Saw-sedge <i>Gahnia grandis</i>, Prickly Tree-fern <i>Cyathea leichhardtiana</i>, Star Cucumber <i>Sicyos australis</i>, Water Parsnip <i>Berula? erecta</i>, Mountain Water-fern <i>Blechnum vulcanicum</i>, Shining Anchor Plant <i>Discaria nitida</i>, Showy Willow-herb <i>Epilobium pallidiflorum</i>, Gippsland Red Gum <i>Eucalyptus tereticornis</i>, Slender Gingidia <i>Gingidia harveyana</i>, Blue-tongued Greenhood <i>Pterostylis dubia</i> and Slender Mud-grass <i>Pseudoraphis paradoxa</i>. Enigmatic Greenhood <i>Pterostylis aenigma</i> is endemic to the Gippsland Region.</p> <p>Plants of coastal habitats</p> <p>The dominant land system throughout the coastal regions of this study area is the Gippsland Plain. This land system is characterised by gently sloping terrain south of the Eastern Highlands to the Victorian Coast. Along the coastline a typical series of vegetation types dominate the littoral zone, calcareous dune systems and immediate hinterland. The dominant EVCs in this area are Coast Banksia Woodland, Coastal Dune Scrub, Coastal Tussock Grassland, Coastal Saltmarsh and Mangrove Shrubland. All are commonly found along the Victorian Coast, including the recent Quaternary deposits that can be found around the mountainous granitic outcrop that forms Wilsons Promontory.</p>

Plant Grouping	Species of conservation significance
	<p>Only three plants of all the rare or threatened plants found within the Gippsland Region grow primarily in coastal habitats. These are Coast Fescue <i>Austrofestuca littoralis</i>, Coast Stackhousia <i>Stackhousia spathulata</i> and White Mangrove <i>Avicennia marina</i> ssp <i>australasica</i>. Coast Fescue <i>Austrofestuca littoralis</i> is considered to be vulnerable in Victoria. Other priority taxa that occur within coastal habitats are Gilgae Blown-grass <i>Agrostis billardierei</i> var. <i>filifolia</i>, Marsh Saltbush <i>Atriplex paludosa</i>, Ribbed Thryptomene <i>Thryptomene micrantha</i> and Tiny Arrow-grass <i>Triglochin minuitissimum</i>.</p>
<p>Plants localised to natural regions of the Gippsland CRA Region</p>	<p>Plants of Wilsons Promontory Wilson's Promontory is a mountainous granitic mass connected to the mainland by the Yanakie Isthmus. Geologically this range represents the most northerly point of a formation extending from northeastern and eastern Tasmania. Although geologically distinct within Victoria the vegetation in this region is similar to the nearby Gippsland Highlands. Consequently only one plant of all the rare or threatened plants found within the Gippsland Region, viz. Broad-leaved Prickly Mosses <i>Acacia verticillata</i> var. <i>latifolia</i>, is endemic to Wilsons Promontory. Other threatened taxa that occur within Wilsons Promontory are Crimson Berry <i>Cyathodes juniperina</i>, Bushy Peppergrass <i>Lepidium desvauxii</i>, Coast Bitter-bush <i>Adriana quadripartita</i> (pubescent form), Brickmakers' Saw-sedge <i>Gahnia grandis</i>, Beech Finger-fern <i>Grammitis magellanica</i> ssp. <i>nothofagei</i>, Long Clubmoss <i>Huperzia varia</i>, Promontory Daisy-bush <i>Olearia allenderae</i>, Prawn Greenhood <i>Pterostylis pedoglossa</i> and Tunstall's Greenhood <i>Pterostylis tunstallii</i>.</p> <p>Plants of the Strzelecki Ranges The Strzelecki Ranges is an isolated series of mountains in the southern sections of the Gippsland Region that is surrounded by the Gippsland Plain. Previously covered in tall forests, most of this vegetation has been cleared for agriculture and some areas have subsequently been revegetated and established as plantations. The principal EVCs remaining in this area include Cool Temperate Rainforest, Warm Temperate Rainforest, Damp Forest, Wet Forest, Herb-rich Foothill Forest, Lowland Forest, Shrubby Foothill Forest and Riparian Forest. Some of the priority taxa common in the Strzelecki Ranges are Filmy Maidenhair <i>Adiantum diaphanum</i>, Strzelecki Gum <i>Eucalyptus strzeleckii</i>, Slender Tree-fern <i>Cyathea cunninghamii</i> and Sticky Wattle <i>Acacia howittii</i>.</p> <p>Plants of the Gippsland Plains The Gippsland Plains are extensive coastal plains that extend across the southern section of the Gippsland Region. The vegetation in this area is both structurally and floristically diverse resulting in a wide range of ecological vegetation classes. Some of the main EVCs include Coast Banksia Woodland, Coast Dune Scrub, Damp Sands Herb-rich Woodland, Lowland Forest, Grassy Forest, Heathy Woodland, Plains Grassland and Plains Grassy Forest.</p> <p>Threatened taxa known to occur on the Gippsland Plains include Gilgae Blown Grass <i>Agrostis billardierei</i> var. <i>filifolia</i>, Wavy Swamp Wallaby-grass <i>Amphibromus sinuatus</i>, Swamp Everlasting <i>Bracteantha palustris</i>, Purple Diuris <i>Diuris punctata</i> var. <i>punctata</i>, Gippsland Red Gum <i>Eucalyptus tereticornis</i>, Prostrate Cone-bush <i>Isopogon prostratus</i>, Woolly Waterlily <i>Philydrum lanuginosum</i>, Gaping Leek-orchid <i>Prasophyllum correctum</i>, Maroon Leek-orchid <i>Prasophyllum frenchii</i>, Holey Plains Mint-bush <i>Prostanthera</i> sp. aff. <i>linearis</i> (Holey Plains), Dwarf Kerrawang <i>Rulingia prostrata</i>, Metallic Sun-orchid <i>Thelymitra epipactoides</i>. Holey Plains Mint-bush <i>Prostanthera</i> sp. aff. <i>linearis</i> (Holey Plains) and Dwarf Kerrawang <i>Rulingia prostrata</i> are endemic to the Gippsland Region.</p>
<p>Plants endemic to the Gippsland CRA Region</p>	<p>Nine priority taxa are endemic to the Gippsland Region. Two taxa are considered threatened nationally, viz. Marble Daisy-bush <i>Olearia astroloba</i> and Dwarf Kerrawang <i>Rulingia prostrata</i>, and another four considered threatened in Victoria, viz. Lemon-scented Boronia <i>Boronia citrata</i>, Aniseed Boronia <i>Boronia galbraithiae</i>, Leafy Phebalium <i>Phebalium frondosum</i> and Enigmatic Greenhood <i>Pterostylis aenigma</i>. The other endemic taxa not considered threatened are Promontory Peppermint <i>Eucalyptus willisii</i> ssp. <i>willisii</i> s.s. (Prom), Mount Elizabeth Hovea <i>Hovea pannosa</i> (Mount Elizabeth form) and Holey Plains Mint-bush <i>Prostanthera</i> sp. aff. <i>Linearis</i> (Holey Plains).</p>

Table 12.10: Plants Occurring in Gippsland Which are Rated as Critically Endangered or Endangered according to the IUCN and RARE Rule Sets

Critically Endangered					
TAXON	IUCN	RARE	TAXON	IUCN	RARE
<i>Acacia caerulescens</i>	CR	CR	<i>Microtis orbicularis</i>	CR	EN
<i>Adiantum diaphanum</i>	CR	CR	<i>Olearia astroloba</i>	CR	CR
<i>Adriana quadripartita</i> s.s. (glabrous form)	CR	EN	<i>Olearia viscosa</i>	CR	CR
<i>Adriana tomentosa</i> var. <i>tomentosa</i>	CR	CR	<i>Oreobolus pumilio</i> ssp. <i>pumilio</i>	CR	EN
<i>Agrostis meionectes</i>	CR	VU	<i>Ozothamnus argophyllus</i>	CR	EN
<i>Amphibromus sinuatus</i>	CR	VU	<i>Persoonia asperula</i>	CR	CR
<i>Aristida calycina</i> var. <i>calycina</i>	CR	EN	<i>Poa fordeana</i>	CR	VU
<i>Atriplex paludosa</i> ssp. <i>paludosa</i>	CR	VU	<i>Poa saxicola</i>	CR	VU
<i>Austrofestuca littoralis</i>	CR	CR	<i>Polystichum formosum</i>	CR	CR
<i>Banksia saxicola</i>	CR	CR	<i>Pomaderris discolor</i>	CR	VU
<i>Berula ? erecta</i>	CR	DD	<i>Prasophyllum correctum</i>	CR	CR
<i>Bracteantha palustris</i>	CR	EN	<i>Prasophyllum patens</i>	CR	CR
<i>Celmisia sericophylla</i>	CR	CR	<i>Prasophyllum rogersii</i>	CR	EN
<i>Cyathea leichhardtiana</i>	CR	EN	<i>Prostanthera rhombea</i>	CR	CR
<i>Discaria nitida</i>	CR	EN	<i>Pseudoraphis paradoxa</i>	CR	EN
<i>Epilobium brunnescens</i> ssp. <i>beagleholei</i>	CR	CR	<i>Pterostylis aestivalis</i>	CR	VU
<i>Epilobium willisii</i>	CR	CR	<i>Pterostylis tenuissima</i>	CR	EN
<i>Eucalyptus bosistoana</i>	CR	CR	<i>Pultenaea foliolosa</i>	CR	CR
<i>Eucalyptus yarraensis</i>	CR	VU	<i>Rulingia prostrata</i>	CR	EN
<i>Euphrasia collina</i> ssp. <i>muelleri</i>	CR	CR	<i>Rytidosperma nivicolium</i>	CR	VU
<i>Euphrasia scabra</i>	CR	EN	<i>Schizeilema fragoseum</i>	CR	EN
<i>Geranium obtusisepalum</i>	CR	CR	<i>Solanum linearifolium</i>	CR	VU
<i>Glycine latrobeana</i>	CR	VU	<i>Sorghum leiocladum</i>	CR	CR
<i>Grammitis magellanica</i> ssp. <i>nothofagei</i>	CR	VU	<i>Tetratheca subaphylla</i>	CR	VU
<i>Gratiola nana</i>	CR	VU	<i>Thelymitra epipactoides</i>	CR	EN
<i>Grevillea celata</i>	CR	VU	<i>Thelymitra matthewsii</i>	CR	CR
<i>Irenepharsus magicus</i>	CR	EN	<i>Thelymitra mucida</i>	CR	EN
<i>Lepidium aschersonii</i>	CR	CR	<i>Thesium australe</i>	CR	CR
<i>Lepidium pseudohyssopifolium</i>	CR	CR	<i>Tmesipteris elongata</i> ssp. <i>elongata</i>	CR	VU
<i>Leptorhynchus elongatus</i>	CR	VU	<i>Utricularia monanthos</i>	CR	EN
<i>Lotus australis</i>	CR	CR	<i>Viola fuscoviolacea</i>	CR	EN
Endangered					
<i>Aciphylla simplicifolia</i>	EN	VU	<i>Luzula acutifolia</i> ssp. <i>acutifolia</i>	EN	VU
<i>Agrostis muelleriana</i>	EN	LR	<i>Monotoca glauca</i>	EN	EN
<i>Almaleea capitata</i>	EN	EN	<i>Myriophyllum alpinum</i>	EN	VU
<i>Amphibromus fluitans</i>	EN	VU	<i>Nymphoides geminata</i>	EN	LR
<i>Asplenium obtusatum</i>	EN	VU	<i>Olearia frostii</i>	EN	EN
<i>Australopyrum velutinum</i>	EN	LR	<i>Olearia stellulata</i>	EN	EN
<i>Austrodanthonia</i> sp. (syn. <i>Danthonia procera</i>)	EN	VU	<i>Olearia tenuifolia</i>	EN	EN
<i>Barbarea grayi</i>	EN	VU	<i>Oreobolus oxycarpus</i> ssp. <i>oxycarpus</i>	EN	VU
<i>Botrychium australe</i>	EN	VU	<i>Oreomyrrhis argentea</i>	EN	VU

TAXON	IUCN	RARE	TAXON	IUCN	RARE
<i>Brachyscome petrophila</i>	EN	VU	<i>Ozothamnus adnatus</i>	EN	EN
<i>Brachyscome radicans</i>	EN	VU	<i>Pimelea pauciflora</i>	EN	EN
<i>Carex echinata</i>	EN	VU	<i>Platysace ericoides</i>	EN	EN
<i>Carex paupera</i>	EN	EN	<i>Polygala japonica</i>	EN	VU
<i>Desmodium varians</i>	EN	VU	<i>Pomaderris aurea</i>	EN	DD
<i>Drabastrum alpestre</i>	EN	EN	<i>Prasophyllum frenchii</i>	EN	VU
<i>Epilobium pallidiflorum</i>	EN	VU	<i>Prostanthera decussata</i>	EN	EN
<i>Eucalyptus globulus</i> ssp. <i>globulus</i>	EN	VU	<i>Pseudanthus divaricatissimus</i>	EN	VU
<i>Eucalyptus kitsoniana</i>	EN	EN	<i>Pterostylis alveata</i>	EN	DD
<i>Euphrasia caudata</i>	EN	VU	<i>Pterostylis dubia</i>	EN	VU
<i>Euphrasia collina</i> ssp. aff. <i>diversicolor</i> (Cobberas)	EN	VU	<i>Pterostylis grandiflora</i>	EN	VU
<i>Geranium sessiliflorum</i> ssp. <i>brevicaule</i>	EN	VU	<i>Ranunculus collinus</i>	EN	LR
<i>Gingidia harveyana</i>	EN	VU	<i>Ranunculus millanii</i>	EN	LR
<i>Goodenia macmillanii</i>	EN	EN	<i>Sagina namadgi</i>	EN	DD
<i>Grevillea miqueliana</i>	EN	EN	<i>Samolus valerandii</i>	EN	VU
<i>Herpolirion novae-zelandiae</i>	EN	LR	<i>Scleranthus singuliflorus</i>	EN	EN
<i>Hypsela tridens</i>	EN	EN	<i>Senecio pectinatus</i> var. <i>major</i>	EN	EN
<i>Juncus phaeanthus</i>	EN	EN	<i>Senna aciphylla</i>	EN	VU
<i>Lepidium desvauxii</i>	EN	EN	<i>Spiranthes sinensis</i>	EN	VU
<i>Leucopogon juniperinus</i>	EN	EN	<i>Uncinia nemoralis</i>	EN	EN

CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LR = Lower Risk, DD=Data Deficient

Of the 301 taxa assessed, 62 were rated as Critically Endangered under the IUCN criteria. This category signifies the highest risk of extinction in the wild. Most of these ratings were based on the very small extent of occurrence or area of occupancy and fragmented population or continuing decline in habitat for each species. Of these species, those with an important part of their distribution in Gippsland include Rock Banksia *Banksia saxicola*, Bog Willow-herb *Epilobium brunnescens* ssp. *beaugleholei*, Marble Daisy-bush *Olearia astroloba*, Gaping Leek-orchid *Prasophyllum correctum*, Shining Anchor Plant *Discaria nitida*, Rough Eyebright *Euphrasia scabra*, Elusive Cress *Irenepharsus magicus*, Dwarf Kerrawang *Rulingia prostrata*, Alpine Bent *Agrostis meionectes*, Colquhoun Grevillea *Grevillea celata*, Rock Poa *Poa saxicola* and Slender Fork-fern *Tmesipteris elongata* ssp. *elongata*.

The 'Endangered' category signifies that a taxon is facing a very high risk of extinction in the wild. Fifty-eight of the taxa were rated as Endangered under the IUCN criteria, based on their low population numbers or their low extent of occurrence with a continuing decline in habitat. For 27 of these species, Gippsland forms a major part of their distribution. These are: Golden Pomaderris *Pomaderris aurea*, Dwarf Sedge *Carex paupera*, Mountain Cress *Drabastrum alpestre*, Bog Gum *Eucalyptus kitsoniana*, Pinnate Goodenia *Goodenia macmillanii*, Oval-leaf Grevillea *Grevillea miqueliana*, Hypsela *Hypsela tridens*, Dark-flower Rush *Juncus phaeanthus*, Currant-wood *Monotoca glauca*, Poison Rice-flower *Pimelea pauciflora*, Mueller's Bent *Agrostis muelleriana*, Mountain Wheat-grass *Australopyrum velutinum*, Sky Lily *Herpolirion novae-zelandiae*, Strawberry Buttercup *Ranunculus collinus*, Dwarf Buttercup *Ranunculus millanii*, Mountain Aciphyll *Aciphylla simplicifolia*, Native Wintercress *Barbarea grayi*, Austral Moonwort *Botrychium australe*, Star Sedge *Carex echinata*, Southern Blue Gum *Eucalyptus globulus* ssp. *globulus*, Tailed Eyebright *Euphrasia caudata*, Purple Eyebright *Euphrasia collina* ssp. aff. *diversicolor* (Cobberas), Sharp-leaf Woodrush *Luzula acutifolia* ssp. *acutifolia*, Tuft-rush *Oreobolus oxycarpus* ssp. *oxycarpus*, Maroon Leek-orchid *Prasophyllum frenchii*, Tangled Pseudanthus *Pseudanthus divaricatissimus* and Blue-tongue Greenhood *Pterostylis dubia*.

In addition to the plants listed in Table 12.10, 179 taxa were rated as Vulnerable under the IUCN criteria. The 'Vulnerable' category signifies that a taxon is facing a high risk of extinction in the wild in the medium-term future. Most of the 179 were rated as Vulnerable based on their low population numbers or their low area of occupancy.

Species Reservation Analysis

A reservation analysis has been undertaken to assess the extent to which plant species of conservation significance in the Gippsland are protected in the reserve system. In this analysis the reserve system includes only conservation reserves (National Parks, State Parks, Wilderness Parks, Reference Areas, Flora Reserves, Flora and Fauna Reserves, Wildlife Reserves). The assessment was based on a combination of expert opinion and site records and other information available in NRE databases and the scientific literature. Each species was evaluated according to the proportion of its Australian distribution that occurs within the Gippsland region, and the proportion that occurs in conservation reserves, other public land and private property (see Table 12.11 for ESP/FFG Act listed species, and see Gippsland Biodiversity Assessment Report for other species).

Table 12.11: Tenure in Gippsland of Populations of Plant Species Listed under the FFG Act and/or the ESP Act

Species Name	Conservation Status		% of Australian Range	Tenure %		
	ESP	FFG		Conservation Reserve	Other Public Land	Private Land
<i>Acacia caerulescens</i>	V	-	0-25	-	10	90
<i>Adiantum diaphanum</i>	-	listed	0-25	-	90	10
<i>Adriana quadripartita</i> (pubescent form)	-	listed	unknown	100	-	-
<i>Adriana quadripartita</i> s.s. (glabrous form)	-	listed	0-25	-	-	100
<i>Agrostis billardiervar. filifolia</i>	-	listed	26-50	50	-	50
<i>Almaleea capitata</i>	-	listed	0-25	100	-	-
<i>Amphibromus fluitans</i>	V	-	0-25	-	-	100
<i>Asplenium hookerianum</i>	V	final rec	26-50	100	-	-
<i>Asplenium obtusatum</i>	V	-	0-25	100	-	-
<i>Boronia galbraithiae</i>	-	listed	76-100	100	-	-
<i>Brachyscome tenuiscapa</i>	-	listed	26-50	80	10	10
<i>Bracteantha palustris</i>	-	listed	unknown	30	70	-
<i>Caladenia fragrantissima</i> ssp. <i>orientalis</i>	E	listed	0-25	k	k	k
<i>Carex paupera</i>	-	listed	51-75	100	-	-
<i>Celmisia sericophylla</i>	-	listed	0-25	-	100	-
<i>Cyathea cunninghamii</i>	-	listed	0-25	70	10	20
<i>Cyathea leichhardtiana</i>	-	listed	0-25	100	-	-
<i>Discaria nitida</i>	-	listed	51-75	10	80	10
<i>Discaria pubescens</i>	-	listed	26-50	-	60	40
<i>Diuris ochroma</i>	V	-	76-100	100	-	-
<i>Diuris punctata</i> var. <i>punctata</i>	-	listed	0-25	-	10	90
<i>Drabastrum alpestre</i>	-	listed	26-50	100	-	-
<i>Epilobium brunnescens</i> ssp. <i>beaugleholei</i>	V	-	76-100	100	-	-
<i>Epilobium willisii</i>	-	listed	0-25	100	-	-
<i>Eucalyptus strzeleckii</i>	V	-	76-100	-	50	50
<i>Euphrasia collina</i> ssp. <i>muelleri</i>	E	-	0-25	-	100	-

Species Name	Conservation Status		% of Australian Range	Tenure %		
	ESP	FFG		Conservation Reserve	Other Public Land	Private Land
<i>Euphrasia scabra</i>	-	listed	26-50	80	20	-
<i>Glycine latrobeana</i>	V	listed	0-25	100	-	-
<i>Isopogon prostratus</i>	-	listed	0-25	100	-	-
<i>Lepidium aschersonii</i>	V	listed	0-25	-	100	-
<i>Olearia astroloba</i>	V	listed	76-100	-	100	-
<i>Poa saxicola</i>	-	listed	26-50	100	-	-
<i>Prasophyllum correctum</i>	E	listed	76-100	-	100	-
<i>Prasophyllum frenchii</i>	V	final rec	26-50	20	-	80
<i>Pseudoraphis paradoxa</i>	-	final rec	0-25	100	-	-
<i>Pterostylis cucullata</i>	V	listed	26-50	90	-	10
<i>Pterostylis tenuissima</i>	V	-	0-25	100	-	-
<i>Rulingia prostrata</i>	E	listed	76-100	-	30	70
<i>Thelymitra epipactoides</i>	E	listed	0-25	90	10	-
<i>Thelymitra matthewsii</i>	V	listed	0-25	-	100	-
<i>Thesium australe</i>	V	listed	0-25	100	-	-
<i>Wahlenbergia densifolia</i>	-	listed	51-75	80	10	10

Other Public Land includes State forest, lands leased and licensed for plantations, and other public land

Of the 348 rare or threatened plants in Gippsland, 130 have more than 25 per cent of their geographic range within the region - the subsequent discussion is based on these 130. For 55 of these taxa, over half their known distribution occurs within the Gippsland region, and consequently effective conservation measures within the Gippsland region are critical for their long-term survival.

Of the 130 taxa, 89 have the largest proportion (or equal largest proportion) of their Gippsland population within conservation reserves. Six of the nine taxa endemic to Gippsland fall into this category, Lemon-scented Boronia *Boronia citrata*, Aniseed Boronia *Boronia galbraithiae*, Mount Elizabeth Hovea *Hovea pannosa* (Mount Elizabeth form), Leafy Phebalium *Phebalium frondosum*, Holey Plains Mint-bush *Prostanthera* sp. aff. *linearis* (Holey Plains) and Enigmatic Greenhood *Pterostylis aenigma*.

Of the remaining 41 taxa, 21 have the largest proportion of their Gippsland population on other public land. One species, Marble Daisy-bush *Olearia astroloba*, is endemic to the region; it has only one known population of approximately 1000 individuals dispersed over 40 hectares. The species and its unique habitat – Limestone Pomaderris Shrubland Community – are listed on the *Flora & Fauna Guarantee Act 1988*. The main threats relate to the small population size and its susceptibility to stochastic events.

Priorities for Management

Species with a high priority for management in the Gippsland region based on the above vulnerability assessment are listed in Table 12.12. Species have been included in this list if the region represents a major part of their distribution and they have been rated Critically Endangered, Endangered, or Vulnerable in the region.

For 73 of the species listed in Table 12.12 at least 50 per cent of their population is within conservation reserves and for seven species the majority of the occurrence is on private land. Nineteen species have at least 50 per cent of their occurrence on other public land.

The Department of Natural Resources and Environment has developed a simple form and database for monitoring populations of rare and threatened plants, envisaged for widespread

use in regularly monitoring major populations of all threatened plant species in Victoria. Active habitat management (environmental weed control, exclusion of predators or browsers, and ecological burning) is the most common form of management being implemented for species whose habitat is degrading or where direct external threats are operating. Where populations have declined to critical levels, active population management techniques (population reinforcement, reintroduction, translocation and artificial pollination) are sometimes recommended. Action Statements have been or are being prepared for seven of the species in Table 12.12. Section 12.7 provides a more detailed discussion of potentially threatening processes affecting flora, including aspects of management.

Table 12.12: Plant Species with High Regional Priority for Management Action

TAXON	IUCN	RARE	VROTS	FFG	Action Statement	ROTAP	ESP	Recovery Plan
<i>Banksia saxicola</i>	CR	CR	r	-	-	-	-	
<i>Epilobium brunnescens</i> ssp. <i>beaugleholei</i>	CR	CR	v	-	-	-	V	no
<i>Olearia astroloba</i>	CR	CR	v	listed	in prep.	V	V	no
<i>Prasophyllum correctum</i>	CR	CR	e	listed	yes	E	E	no
<i>Discaria nitida</i>	CR	EN	e	listed	no	R	-	
<i>Euphrasia scabra</i>	CR	EN	e	listed	yes	K	-	
<i>Irenepharsus magicus</i>	CR	EN	r	-	-	R	-	
<i>Rulingia prostrata</i>	CR	EN	e	listed	in prep.	E	E	no
<i>Agrostis meionectes</i>	CR	VU	r	-	-	R	-	
<i>Grevillea celata</i>	CR	VU	v	-	-	-	-	
<i>Poa saxicola</i>	CR	VU	v	listed	no	-	-	
<i>Tmesipteris elongata</i> ssp. <i>elongata</i>	CR	VU	v	-	-	-	-	
<i>Pomaderris aurea</i>	EN	DD	r	-	-	-	-	
<i>Carex paupera</i>	EN	EN	v	listed	no	R	-	
<i>Drabastrum alpestre</i>	EN	EN	v	listed	no	R	-	
<i>Eucalyptus kitsoniana</i>	EN	EN	r	-	-	R	-	
<i>Goodenia macmillanii</i>	EN	EN	r	-	-	-	-	
<i>Grevillea miqueliana</i>	EN	EN	r	-	-	-	-	
<i>Hypsela tridens</i>	EN	EN	k	-	-	-	-	
<i>Juncus phaeanthus</i>	EN	EN	r	-	-	-	-	
<i>Monotoca glauca</i>	EN	EN	r	-	-	-	-	
<i>Pimelea pauciflora</i>	EN	EN	r	-	-	-	-	
<i>Agrostis muelleriana</i>	EN	LR	r	-	-	-	-	
<i>Australopyrum velutinum</i>	EN	LR	r	-	-	-	-	
<i>Herpolirion novae-zelandiae</i>	EN	LR	r	-	-	-	-	
<i>Ranunculus collinus</i>	EN	LR	r	-	-	-	-	
<i>Ranunculus millanii</i>	EN	LR	r	-	-	-	-	
<i>Aciphylla simplicifolia</i>	EN	VU	r	-	-	-	-	
<i>Barbarea grayi</i>	EN	VU	v	-	-	E	-	
<i>Botrychium australe</i>	EN	VU	v	-	-	-	-	
<i>Carex echinata</i>	EN	VU	v	-	-	-	-	
<i>Eucalyptus globulus</i> ssp. <i>globulus</i>	EN	VU	r	-	-	-	-	
<i>Euphrasia caudata</i>	EN	VU	r	-	-	-	-	
<i>Euphrasia collina</i> ssp. aff. <i>diversicolor</i> (Cobberas)	EN	VU	v	-	-	-	-	
<i>Luzula acutifolia</i> ssp. <i>acutifolia</i>	EN	VU	r	-	-	-	-	
<i>Oreobolus oxycarpus</i> ssp. <i>oxycarpus</i>	EN	VU	r	-	-	-	-	
<i>Prasophyllum frenchii</i>	EN	VU	e	final rec	-	V	V	no
<i>Pseudanthus divaricatissimus</i>	EN	VU	r	-	-	R	-	
<i>Pterostylis dubia</i>	EN	VU	e	-	-	-	-	
<i>Acrotriche leucocarpa</i>	VU	CR	r	-	-	-	-	
<i>Arthropodium</i> sp. 1 (robust glaucous)	VU	CR	r	-	-	-	-	
<i>Carex raleighii</i>	VU	DD	r	-	-	R	-	
<i>Coprosma nivalis</i>	VU	DD	r	-	-	-	-	
<i>Dillwynia sieberi</i>	VU	DD	r	-	-	-	-	
<i>Leucopogon pilifer</i>	VU	DD	r	-	-	-	-	
<i>Pimelea biflora</i>	VU	DD	r	-	-	-	-	
<i>Eucalyptus strzeleckii</i>	VU	EN	e	-	-	V	V	no
<i>Acacia verticillata</i> var. <i>latifolia</i>	VU	LR	r	-	-	-	-	
<i>Agrostis australiensis</i>	VU	LR	r	-	-	-	-	
<i>Agrostis avenacea</i> var. <i>perennis</i>	VU	LR	k	-	-	-	-	

TAXON	IUCN	RARE	VROTS	FFG	Action Statement	ROTAP	ESP	Recovery Plan
<i>Boronia citrata</i>	VU	LR	v	-	-	R	-	
<i>Bossiaea bracteosa</i>	VU	LR	r	-	-	-	-	
<i>Brachyscome obovata</i>	VU	LR	r	-	-	-	-	
<i>Brachyscome tenuiscapa</i>	VU	LR	v	listed	no	-	-	
<i>Clematis microphylla</i> var. <i>leptophylla</i>	VU	LR	k	-	-	-	-	
<i>Cystopteris tasmanica</i>	VU	LR	r	-	-	R	-	
<i>Diuris ochroma</i>	VU	LR	v	-	-	V	V	no
<i>Eucalyptus perriniana</i>	VU	LR	r	-	-	-	-	
<i>Euchiton umbricolus</i>	VU	LR	r	-	-	-	-	
<i>Grevillea chrysophaea</i>	VU	LR	r	-	-	-	-	
<i>Isolepis montivaga</i>	VU	LR	r	-	-	-	-	
<i>Luzula alpestris</i>	VU	LR	r	-	-	-	-	
<i>Olearia adenophora</i>	VU	LR	r	-	-	R	-	
<i>Olearia allenderae</i>	VU	LR	v	-	-	R	-	
<i>Oschatzia cuneifolia</i>	VU	LR	r	-	-	R	-	
<i>Poa clivicola</i>	VU	LR	r	-	-	-	-	
<i>Poa gunnii</i>	VU	LR	r	-	-	-	-	
<i>Prostanthera</i> sp. aff. <i>linearis</i> (Holey Plains)	VU	LR	v	-	-	-	-	
<i>Pterostylis cucullata</i>	VU	LR	v	listed	yes	V	V	no
<i>Pultenaea tenella</i>	VU	LR	r	-	-	-	-	
<i>Ranunculus eichlerianus</i>	VU	LR	r	-	-	R	-	
<i>Ranunculus gunnianus</i>	VU	LR	r	-	-	-	-	
<i>Ranunculus victoriensis</i>	VU	LR	r	-	-	-	-	
<i>Scleranthus diander</i>	VU	LR	r	-	-	-	-	
<i>Wahlenbergia densifolia</i>	VU	LR	v	listed	no	-	-	
<i>Acacia alpina</i>	VU	VU	r	-	-	-	-	
<i>Aciphylla glacialis</i>	VU	VU	v	-	-	-	-	
<i>Agrostis billardierei</i> var. <i>filifolia</i>	VU	VU	v	listed	in prep.	-	-	
<i>Asplenium hookerianum</i>	VU	VU	e	final rec	-	V	V	yes
<i>Austrofestuca eriopoda</i>	VU	VU	r	-	-	-	-	
<i>Blechnum vulcanicum</i>	VU	VU	e	-	-	-	-	
<i>Boronia galbraithiae</i>	VU	VU	v	listed	no	R	-	
<i>Brachyscome tadgellii</i>	VU	VU	r	-	-	-	-	
<i>Caladenia hildae</i>	VU	VU	r	-	-	-	-	
<i>Carex archeri</i>	VU	VU	v	-	-	-	-	
<i>Carex capillacea</i>	VU	VU	r	-	-	R	-	
<i>Correa reflexa</i> var. <i>cardinalis</i>	VU	VU	r	-	-	-	-	
<i>Cyphanthera anthocercidea</i>	VU	VU	r	-	-	R	-	
<i>Diplaspis nivis</i>	VU	VU	r	-	-	-	-	
<i>Discaria pubescens</i>	VU	VU	v	listed	yes	R	-	
<i>Epacris microphylla</i> var. <i>rhombifolia</i>	VU	VU	r	-	-	-	-	
<i>Eucalyptus kybeanensis</i>	VU	VU	r	-	-	-	-	
<i>Eucalyptus neglecta</i>	VU	VU	r	-	-	R	-	
<i>Grevillea willisii</i>	VU	VU	r	-	-	R	-	
<i>Gynatrix macrophylla</i>	VU	VU	r	-	-	-	-	
<i>Hibbertia hermanniifolia</i>	VU	VU	r	-	-	R	-	
<i>Hovea pannosa</i> (Mount Elizabeth form)	VU	VU	r	-	-	-	-	
<i>Monotoca oreophila</i>	VU	VU	r	-	-	R	-	
<i>Muehlenbeckia axillaris</i>	VU	VU	r	-	-	-	-	
<i>Phebalium frondosum</i>	VU	VU	v	-	-	R	-	
<i>Phebalium squameum</i> ssp. <i>coriaceum</i>	VU	VU	v	-	-	-	-	
<i>Pimelea axiflora</i> ssp. <i>alpina</i>	VU	VU	r	-	-	-	-	
<i>Poa labillardierei</i> var. <i>acris</i>	VU	VU	v	-	-	-	-	
<i>Poa petrophila</i>	VU	VU	v	-	-	-	-	
<i>Pomaderris oraria</i>	VU	VU	r	-	-	R	-	
<i>Pomaderris oraria</i> ssp. <i>calcicola</i>	VU	VU	r	-	-	R	-	
<i>Pomaderris oraria</i> ssp. <i>oraria</i>	VU	VU	r	-	-	R	-	
<i>Pterostylis aenigma</i>	VU	VU	e	-	-	K	-	
<i>Pultenaea fasciculata</i>	VU	VU	r	-	-	-	-	
<i>Taraxacum aristum</i>	VU	VU	r	-	-	R	-	
<i>Thryptomene micrantha</i>	VU	VU	r	-	-	-	-	
<i>Tmesipteris ovata</i>	VU	VU	r	-	-	-	-	
<i>Trochocarpa clarkei</i>	VU	VU	r	-	-	-	-	
<i>Viola improcera</i>	VU	VU	k	-	-	R	-	

CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LR = Lower Risk, DD = Data Deficient

12.6 TERRESTRIAL FAUNA SPECIES ASSESSMENT

Introduction

The purpose of this terrestrial fauna assessment is similar to that described earlier for flora. It provides information to be used in addressing the biodiversity criteria for the Gippsland Region.

The assessment of Gippsland fauna has been handled separately for terrestrial and aquatic species (see section 12.8 for aquatic species assessment).

Priority Species Information

The assessment of terrestrial fauna is based largely on a subset of species found in Gippsland which are considered high priority because their long-term survival is threatened in some way. Those that are threatened may be considered to be threatened nationally, or just in Victoria. They are listed under the Commonwealth *Endangered Species Protection Act 1992* (ESP Act) and/or the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) and/or included on the *Threatened Vertebrate Fauna in Victoria* list (NRE 1999b). Indicator species were chosen to provide a broader assessment of fauna in the region and included species representative of taxa at risk from various management activities (eg in alpine environments). A number of these are either poorly known species with unclear status and species known to be declining. All of these species are shown in Table 12.13.

As well as showing the status (endangered, vulnerable etc) of each species under the FFG and ESP Acts, Table 12.13 also indicates whether an Action Statement and/or a Recovery Plan exists or is being prepared for that species.

Table 12.13: Terrestrial Fauna Species included in the Assessment

Species Name	Common Name	TVFV 1999	FFG Status	Action Statement (FFG)	ESP Status	Recovery Plan (ESP)	Secure in Other States
Mammals							
Priority species							
<i>Dasyurus maculatus</i>	Spot-tailed Quoll	E	L	Yes	V	No	No
<i>Potorous longipes</i>	Long-footed Potoroo	E	L	Yes	E	In prep.	No
<i>Mastacomys fuscus</i>	Broad-toothed Rat	LR					No
<i>Pseudomys fumeus</i> eastern form	Smoky Mouse	E					No
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	C	L	Yes			Yes
<i>Canis familiaris dingo</i>	Dingo	D					Yes
<i>Rhinolophus megaphyllus</i>	Southern Horseshoe-bat	V	L	No			Yes
<i>Miniopterus schreibersii oceanis</i>	Eastern Bent-wing Bat	V	L	In prep			Yes
Indicator species							
<i>Perameles nasuta</i>	Long-nosed Bandicoot						Yes
<i>Petaurus australis</i>	Yellow-bellied Glider						No
<i>Macropus rufogriseus</i>	Red-necked Wallaby						No
<i>Sminthopsis leucopus</i>	White-footed Dunnart						No
Birds							
Priority species							
<i>Lathamus discolor</i>	Swift Parrot	E	L	In prep	V	Yes	No
<i>Xanthomyza phrygia</i>	Regent Honeyeater	C	L	Yes	E	Yes	No
<i>Lophoictinia isura</i>	Square-tailed Kite	E	R				No
<i>Accipiter novaehollandiae</i>	Grey Goshawk	LR					No
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	E	L	Yes			No
<i>Ninox connivens</i>	Barking Owl	E	R	No			No
<i>Ninox strenua</i>	Powerful Owl	E	L	In prep			No
<i>Tyto novaehollandiae</i>	Masked Owl	E	L	In prep			No
<i>Tyto tenebricosa</i>	Sooty Owl	V	L	In prep			No
<i>Hylacola pyrrhopygia</i>	Chestnut-rumped Heathwren	D					No

Indicator species

Species Name	Common Name	TVFV 1999	FFG Status	Action Statement (FFG)	ESP Status	Recovery Plan (ESP)	Secure in Other States
<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo						Yes
<i>Alecedo azurea</i>	Azure Kingfisher						No
<i>Petroica rodinogaster</i>	Pink Robin						No
<i>Melanodryas cucullata</i>	Hooded Robin						Yes
<i>Coracina tenuirostris</i>	Cicadabird						Yes
Reptiles							
Priority species							
<i>Pseudemoia rawlinsoni</i>	Glossy Grass Skink	LR					No
<i>Egernia coventryi</i>	Swamp Skink	V					No
<i>Varanus varius</i>	Lace Monitor	D					Yes
Indicator species							
<i>Pseudemoia spenceri</i>	Spencer's Skink						Yes
Amphibians							
Priority species							
<i>Litoria spenceri</i>	Spotted Tree Frog	C	L	In prep	E	In prep	No
<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	C					Yes
<i>Litoria littlejohni</i>	Large Brown Tree Frog	V					Yes
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	L	Yes			No
<i>Uperleia martini</i>	Martin's Toadlet	D					Yes
<i>Uperleia tyleri</i>	Tyler's Toadlet	D					Yes
Indicator species							
<i>Litoria citropa</i>	Blue Mountains Tree Frog						Yes
<i>Litoria phyllochroa</i>	Leaf Green Tree Frog						Yes

Notes: Threatened Vertebrate Fauna in Victoria - 1999 (NRE 1999b) – C-critically endangered, E-endangered, V-vulnerable, R-rare, LR-Lower Risk, D-data deficient. Flora and Fauna Guarantee Act (FFG): L-Listed, R-recommended for listing. Commonwealth Endangered Species Protection Act (ESP): E-endangered, V-vulnerable.

More information on each of the species listed in Table 12.13 is provided in later sections and in the Biodiversity Assessment Report.

Terrestrial Invertebrates

Many of the invertebrate records from forested areas in the south of the region date from early this century and include sites now wholly or largely cleared for agricultural or pastoral purposes. For most groups, there has been no recent census of their status.

Land-snails (Pulmonata)

There are a number of Gippsland snail species associated with wetter forest habitats which are shared with northern Tasmania (e.g. *Prolesophata dyeri* and *Miselaoma and Pernagera* species). Regional endemics include the Punctid *Turbolaoma turbinuloides* (Bairnsdale environs) and the Charopids *Allocharopa tarravillensis* (south Gippsland), *Dentherona illustra*, *D. jemmysensis*, *Cralopa colliveri* (Gippsland Lakes area) and *Egilodonta bairnsdalensis*. Most species are highly sensitive to disturbances such as removal or modification of native vegetation and fire. Many are dependent on fallen timber for the maintenance of microhabitat.

Earthworms (Oligochaeta)

The region was well sampled by W. Baldwin Spencer at the turn of the century, though many of his sites are now devoid of native vegetation. Some 8 species were identified in the Warragul district alone. The genera *Diporochoaeta* and *Simsia* dominate the fauna. Endemics include species such as *Diporochoaeta arnoldi* (Mt Arnold, near Marysville), *D. walhalla* (Walhalla) and *Megascolides australis*. The latter is better known as the Giant Gippsland Earthworm, the only oligochaete listed under the FFG and ESP legislation. It is a deep-burrowing species of heavy clay soils, favouring south-facing aspects. It appears tolerant of some disturbance, provided that it has access to vegetated gullies.

Velvet-worms (Onychophora)

The only known regional endemic is *Ooperipatus bulgensis*, which, though recorded only from the Tarra-Bulga National Park (first collected in 1988), is probably of wider distribution in the Strzelecki Ranges. Lack of information on other species is perhaps more symptomatic of low collecting effort than of a paucity of taxa.

Insecta

Details for this group are to be found in the Biodiversity Technical Report.

Species Vulnerability Assessment

As for a similar assessment described earlier for plants, a vulnerability assessment was done for terrestrial vertebrate fauna to identify those species which are likely to be at higher risk of decline or extinction. The following characteristics of a species influence the likelihood of its decline or becoming extinct:

1. Rarity - based on the geographic range and abundance of populations, as well as how tightly they are restricted to specific habitat types. Species or populations most predisposed to extinction are those that have small geographic ranges, low abundance and narrow habitat specificity.
2. Population dynamics - whether a population is increasing, stable or decreasing.
3. Spatial dynamics - the way in which individual populations increase or decrease and their ability to disperse and hence interact with other populations. Populations most predisposed to extinction are those with high population variability and low powers of dispersal.
4. Life history parameters - aspects of a species' biology that may make it susceptible to extinction. Reproductive output and longevity are considered most important. Species most predisposed to extinction are those which are long-lived and those with low reproductive outputs (eg small litter or clutch sizes).

Priority and indicator terrestrial vertebrate species occurring in Gippsland have been rated against the above biological characteristics, which may predispose species or populations to decline or extinction. (see Table 12.14). This information provides a basis for identifying and prioritising those species that are most in need of management actions to improve the prospects of their long-term survival. This assessment should also be considered in conjunction with the information relating to threatening processes discussed later.

Most of the species assessed have either medium or large geographic ranges within the Gippsland Region. Species with a small geographic range (including four of the amphibians considered here) are more vulnerable to regional extinction as a result of localised disturbance.

As expected for a group of species selected because there is some concern for their status, most species have a low abundance. Six of the threatened species with a low abundance, including Spot-tailed Quoll, Eastern Bent-wing Bat, Dingo, Powerful Owl, Chestnut-rumped Heathwren, and Swift Parrot, nevertheless have a large geographic range over Gippsland (based on low numbers of widely scattered records).

Many of the species covered by the review were rated as habitat specific (ie. with narrow habitat specificity). These species often depend on a combination of certain habitat components - for example, the Regent Honeyeater appears to rely on nectar from a few key eucalypt species and needs this food source to be produced in copious amounts. Loss or reduction of a critical habitat component is likely to lead to population declines.

Four of the 39 species listed in Table 12.14 have a combination of small geographic range size, low abundance and narrow habitat specificity – they are Long-footed Potoroo, New Holland Mouse, Southern Horseshoe Bat, and Swamp Skink. These species exist in small isolated populations, making them particularly vulnerable to disturbances, especially stochastic events such as wildfire, which can cause local extinctions. Species in this group are more predisposed to the threat of decline or extinction within the Region and should be given particular consideration in developing priorities for management action.

Table 12.14: Summary of Life History and Population Dynamics Information for Fauna Species

Species	Population trend in the last 10 years	Rarity Ratings			Spatial Dynamics Ratings		Life History Parameter Ratings	
		Geographic Range	Abundance	Habitat Specificity	Population Variability	Powers of Dispersal	Reproductive Output	Longevity
Mammals								
Spot-tailed Quoll	declined	large	low	wide	low	*high	medium	unknown
Long-footed Potoroo	unknown	small	low	narrow	*low	low	low	long
Broad-toothed Rat	*declined	medium	low	narrow	*low	unknown	low	long
Smoky Mouse	declined	medium	low	narrow	high	*low	medium	short
New Holland Mouse	unknown	small	low	narrow	high	unknown	high	short
Dingo	unknown	*large	low	wide	*low	high	low	long
Southern Horseshoe Bat	unknown	small	low	narrow	low	low	low	long
Eastern Bent-wing Bat	unknown	large	low	narrow	low	high	low	long
♦ Long-nosed Bandicoot	*declined	large	medium	wide	unknown	*high	high	*short
♦ Yellow-bellied Glider	*declined	large	medium	wide	low	high	low	long
♦ Red-necked Wallaby	declined	large	unknown	wide	*low	high	low	unknown
♦ White-footed Dunnart	declined	medium	unknown	wide	unknown	high	high	short
Birds								
Swift Parrot	declined	large	low	narrow	high	high	high	*long
Regent Honeyeater	declined	medium	low	narrow	high	high	low	unknown
Square-tailed Kite	unknown	small	low	wide	unknown	high	low	*long
Grey Goshawk	unknown	medium	low	narrow	unknown	high	low	*long
White-bellied Sea-Eagle	unknown	medium	low	wide	low	high	low	long
Barking Owl	unknown	medium	low	narrow	low	high	low	*long
Powerful Owl	stable	large	low	wide	low	high	low	long
Masked Owl	*declined	medium	low	medium	unknown	high	low	long
Sooty Owl	*declined	medium	low	narrow	low	high	low	long
Chestnut-rumped Heathwren	unknown	large	low	narrow	unknown	low	low	short
♦ Gang-gang Cockatoo	*declined	large	medium	wide	*high	high	low	*long
♦ Azure Kingfisher	unknown	large	low	narrow	high	unknown	medium	*long
♦ Pink Robin	stable	large	medium	wide	low	high	low	short
♦ Hooded Robin	declined	medium	low	wide	*low	low	low	unknown
♦ Cicadabird	unknown	large	low	wide	unknown	high	low	long
Glossy Grass Skink	unknown	medium	low	narrow	unknown	low	low	unknown

Species	Population trend in the last 10 years	Rarity Ratings			Spatial Dynamics Ratings		Life History Parameter Ratings	
		Geographic Range	Abundance	Habitat Specificity	Population Variability	Powers of Dispersal	Reproductive Output	Longevity
Reptiles								
Swamp Skink	unknown	small	low	narrow	unknown	low	low	long
Lace Monitor	unknown	large	medium	wide	unknown	unknown	low	long
♦ Spencer's Skink	unknown	large	unknown	narrow	unknown	unknown	low	unknown
Amphibians								
Spotted Tree Frog	declined	medium	low	narrow	high	low	low	long
Alpine Tree Frog	declined	medium	low	narrow	unknown	low	low	unknown
Large Brown Tree Frog	unknown	small	low	wide	unknown	unknown	high	unknown
Giant Burrowing Frog	unknown	medium	low	wide	unknown	unknown	unknown	unknown
Tyler's Toadlet	unknown	small	unknown	narrow	unknown	unknown	unknown	unknown
Martin's Toadlet	unknown	small	unknown	narrow	unknown	unknown	unknown	unknown
♦ Blue Mountains Tree Frog	unknown	medium	unknown	narrow	unknown	unknown	unknown	unknown
♦ Leaf Green Tree Frog	declined	large	unknown	narrow	unknown	unknown	high	unknown

* Unknown, but most likely classification. ♦ Denotes indicator species.

Species with high population variability and low powers of dispersal are more vulnerable to metapopulation collapse. Low powers of dispersal limits the ability of species to recolonise areas where local population extinctions have occurred. Species with low powers of dispersal and high population variability are Smoky Mouse and Spotted Tree Frog. These two species also have either a low reproductive rate or short longevity, increasing their risk of decline and identifying them as high priority for management in the Gippsland Region.

Population trends are the clearest indicators of a species likelihood of decline or extinction. The majority of species are thought to have declined in abundance since European settlement, usually as a result of loss of habitat through clearing for agriculture and urban development. Of the species whose population trend in the past 10 years could be determined, the majority has declined, including a number of the non-threatened species. Although Powerful Owl numbers are thought to have decreased since European settlement, they appear to have become stable over the past 10 years.

Unfortunately, the population trend in the past 10 years could not be determined for a range of species. This, together with other gaps in knowledge of species indicated in Table 12.14 highlights the need for further biological information on a number of the species assessed.

Species Reservation Analysis

A reservation analysis has been undertaken to assess the extent to which terrestrial vertebrate species in Gippsland are protected in the reserve system.

Using data from the Atlas of Victorian Wildlife, both formal survey and incidental records were intersected with existing land tenure to calculate the total proportion of records for each species in each of the major land tenure categories - see Table 12.15. There are 13 species for which less than 20 per cent of records are in Reserves, however none of these species have their major occurrence in the Gippsland region.

The results should be considered in conjunction with the information on threatening processes. Many threatening processes operate across reserve and off-reserve areas and other measures are in place, in addition to reservation, to provide protection at the species level.

Table 12.15: Reservation Analysis of Priority Fauna Species Records in Gippsland

Species Name	Total	Conservation reserves		State Forests and Other Public Land		Private Land including plantation leasehold		Water bodies	
		No.	%	No.	%	No.	%	No.	%
Mammals									
Spot-tailed Quoll	3		0	3	100	0	0		0
Long-footed Potoroo	1	1	100	0	0	0	0		0
Broad-toothed Rat	25	21	84	4	16	0	0		0
Smoky Mouse	28	24	86	4	14	0	0		0
New Holland Mouse	171	158	92	2	1	4	2	7	4
Dingo	2		0	2	100	0	0		0
Southern Horseshoe Bat	11		0	11	100	0	0		0
Eastern Bent-wing Bat	28	5	18	9	32	5	18	9	32
Birds									
Swift Parrot	9	3	33	0	0	5	56	1	11
Regent Honeyeater	3		0	1	33	1	33	1	33
Square-tailed Kite	3		0	1	33	2	67		0
Grey Goshawk	85	26	31	0	0	34	40	25	29
White-bellied Sea-Eagle	480	191	40	6	1	144	30	139	29
Barking Owl	5		0	2	40	3	60		0
Powerful Owl	182	23	13	124	68	33	18	2	1
Masked Owl	20		0	9	45	10	50	1	5
Sooty Owl	89	5	6	80	90	4	4		0
Chestnut-rumped Heathwren	10	7	70	1	10	1	10	1	10
Reptiles									
Glossy Grass Skink	26	9	35	1	4	11	42	5	19
Swamp Skink	20	14	70	1	5	4	20	1	5
Lace Monitor	139	12	9	64	46	63	45		0
Amphibians									
Spotted Tree Frog	24	7	29	17	71	0	0		0
Giant Burrowing Frog	11		0	10	91	1	9		0
Alpine Tree Frog	211	108	51	53	25	50	24		0
Martin's Toadlet	4	1	25	1	25	2	50		0
Tyler's Toadlet	1	1	100	0	0	0	0		0
Large Brown Tree Frog	1		0	1	100	0	0		0
Invertebrates									
Giant Gippsland Earthworm	117	1	1	3	3	113	97	0	0

Only records post 1970 and with an accuracy of one minute or better were used in this analysis.

12.7 REVIEW OF DISTURBANCES AND IMPLICATIONS FOR FLORA AND FAUNA

Introduction

The decline of species can be largely attributed to the impacts of disturbances, both direct — on species, and indirect — on essential components of their habitat. In this review, disturbances are defined as activities or events with associated environmental impacts. The environmental impacts may constitute potentially threatening processes for particular taxa. Such potentially threatening processes, as defined under the *Flora and Fauna Guarantee Act 1988* (FFG Act), could pose a significant threat to the survival, abundance and evolutionary development of native species or ecological communities of flora or fauna.

A range of mechanisms is in place in Gippsland to ensure that threatening processes which affect individual species are addressed. These include:

- a conservation reserve system which includes a sample of habitats on public land;
- requirements under the FFG Act and the *Endangered Species Protection Act 1992* (ESP Act);
- a range of provisions in the Code of Forest Practices for Timber Production (NRE 1996a) and the Code of Practice for Fire Management on Public Land (CNR 1995d) which address many of the threatening processes operating in the region.

Additional protection will be afforded by measures in the proposed Mid-Gippsland Forest Management Plan (in prep), including specific threatened species strategies and Special Protection Zones.

Methods

Disturbances that impact on flora and fauna in Gippsland were identified as part of an assessment of vulnerability, population parameters and life history attributes of 301 vascular plants and 39 terrestrial vertebrates. These species were selected for analysis because they are either classified as rare or threatened in Victoria or considered to be indicators, representative of a suite of species which may be vulnerable to the continued action of threatening processes. The 39 fauna species are listed in Table 12.13. The full flora list appears in Appendix F of the Biodiversity Assessment Report.

Each disturbance was evaluated to determine the extent of its occurrence within Gippsland, the potentially threatening processes which are associated with it, the overall significance of the threat to native flora and fauna in the region, species attributes which might predispose taxa to negative impacts, and examples of the plants and animals that might therefore be susceptible to the disturbance. Management systems, including policies and processes, for the amelioration of the adverse biodiversity impacts of the disturbance were also summarised.

The significance of threats to flora and fauna were assessed through reference to the current literature and consultation with recognised experts in the biology of the species. Threatening processes which potentially affect more than one component of a species' life cycle or habitat scored higher ratings than threats which affect fewer life cycle or habitat components. For each disturbance identified, a score was assigned for each priority species being considered, indicating the level of threat.

Disturbances were scored for each species as follows:

- Effect unknown;
- 0** Processes not likely to be operating as a threat or there is no information to suggest that it is a threat;
- 1** Process is a minor threat, which by itself is unlikely to lead to broad scale decline of the species;

- 2 Process is a moderate threat, which is likely to lead to some decline of the species, especially if it operates in combination with other threatening processes; and
- 3 Process is a major threat, which if not checked poses a significant risk to the viability of the species in Gippsland.

The assessments were made recognising that practices on public land follow minimum prescriptions required under the Code of Forest Practices for Timber Production and various State Acts and Regulations and that practices on private land are in accord with the *Planning and Environment Act 1987* and the *Catchment and Land Protection Act 1994*. However, the assessments do not take account of additional protection afforded in various Action Statements, Park management plans, nor any additional measure that may be established in the Mid-Gippsland Forest Management Plan, which is currently in preparation. The following discussion applies only to the Gippsland RFA region.

Results and Discussion

Because of the large number of species and Ecological Vegetation Classes (EVCs) assessed, the results of the flora disturbance assessment have not been tabulated here. Details for ESP Act/FFG Act listed species are available in the Biodiversity Assessment Report. The results of the fauna disturbance assessment are summarised in Table 12.16.

The combined score for each threatening process can provide an indication of the relative importance of different threatening processes affecting taxa in Gippsland (as shown in Table 12.16). Overall, timber harvesting was the highest scoring threat for fauna, followed by clearing of native vegetation and unplanned fire. Clearing of native vegetation was also identified as affecting the greatest number of fauna species.

An explanation of each threatening process follows, with a discussion of the key species and EVCs affected in Gippsland, and management arrangements that are in place to mitigate these threats.

Timber Harvesting

As outlined in Chapter 4, the net productive area of Ash type forest in the region is approximately 59,950 ha (24 per cent of the total forest area in the region), while the net productive area of mixed species forest is 193,900 ha (76 per cent) of the forested area in Gippsland. Timber harvesting methods used in Gippsland include seed tree, clearfell and selection systems. The seed tree system involves the felling of all except five to nine well spaced trees per hectare with regeneration achieved through the release of seed from these retained trees onto a prepared seed bed. Clearfelling involves the removal of all standing timber except for designated habitat trees. Regeneration is achieved through sowing of seed collected in other forest stands. The selection system involves the harvesting of small patches or single mature trees while retaining habitat trees and minimising damage to the remaining trees. The choice of harvesting system is largely determined by the requirements of different eucalypt species for successful regeneration following harvesting.

Associated potentially threatening processes may affect EVCs and individual plant species through direct impacts such as falling, snigging and loading and indirect impacts on the site and surrounding vegetation, and the impacts of a cycle of harvesting on forest structure and ecology. Potentially threatening processes directly associated with harvesting operations include damage or loss of individuals, disturbance to the superficial soil structure or soil-stored seedbanks and compaction of the soil surface on snig tracks and log landings. These processes are localised and generally of moderate overall significance at the landscape scale.

Table 12.16: Impacts of Threatening Processes on Fauna Species

SPECIES	Clearing of Native Vegetation	Timber Harvesting	Fuel Reduction Burning	Firewood Collection	Unplanned Fire	Introduced Species	Grazing/Trampling	Pest Control	Road Construction and Maintenance	Mining/Quarrying	Tree Dieback	Recreation	Illegal Collecting/Harvesting	Vandalism	Dams/Impoundments	Interspecific Competition	Climate Change	Genetic Dilution	Mineshaft Collapse	Draining of Wetland Habitat
MAMMALS																				
Broad-toothed Rat	1	2	1	1	2	2	3	0	2	0	0	2	0	0	1		2			
Dingo	1	2	1	1	1	2	2	3	1	1	0	1	0	0	1			2		
Long-footed Potoroo	2	3	3	-	3	3	2	0	2	0	0	0	0	0	0					
Smoky Mouse	2	3	3	1	2	2	2	0	1	1	0	0	0	0	0					
New Holland Mouse	2	1	3	0	1	1	0	0	1	0	0	1	0	0	0					
Spot-tailed Quoll	2	3	2	2	2	2	1	3	1	1	1	0	1	0	1					
Long-nosed Bandicoot	2	2	2	1	2	3	2	1	0	0	0	0	0	0	0					
Red-necked Wallaby	2	2	2	1	2	2	2	-	1	0	0	-	0	-	1					
White-footed Dunnart	2	2	2	0	2	2	2	0	0	0	0	0	0	0	0					
Yellow-bellied Glider	2	2	1	0	1	0	0	0	0	0	1	0	0	0	1					
Common Bent-wing Bat	1	-	-	-	-	2	0	2	0	2	-	2	1	3	0				3	
Eastern Horseshoe Bat	-	-	-	-	-	2	0	2	0	2	0	2	0	3	0				2	
BIRDS																				
Regent Honeyeater	3	2	-	2	2	1	2	-	1	-	3	-	0	-	0	1				
Swift Parrot	3	2	-	2	-	1	2	-	1	-	2	-	-	-	0	-				
Square-tailed Kite	2	2	2	1	2	0	1	-	1	-	1	-	2	2	0					
Grey Goshawk	2	2	2	1	2	0	1	2	1	-	1	1	-	2	0					
White-bellied Sea-Eagle	3	2	-	2	-	0	2	2	2	2	2	3	-	2	0	-				
Barking Owl	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0					
Powerful Owl	1	3	2	1	2	0	-	1	1	-	1	0	0	0	0					
Masked Owl	2	2	3	2	2	1	1	3	1	-	1	0	0	0	0					
Sooty Owl	1	3	2	1	2	0	-	1	1	1	1	0	0	0	0		2			
Chestnut-rumped Heathwren	2	-	2	2	2	-	1	-	0	-	-	0	0	0	1					
Azure Kingfisher	2	1	0	0	0	2	1	-	-	-	0	-	0	0	3					
Gang-gang Cockatoo	2	2	1	-	2	0	-	0	-	-	-	0	-	0	0					
Pink Robin	1	2	1	-	1	-	1	0	-	0	2	0	0	0	0		2			
Hooded Robin	2	-	2	2	2	3	2	-	-	-	2	0	0	0	0					
Cicadabird	2	2	-	0	2	0	0	0	0	0	1	0	0	0	0					
REPTILES																				
Glossy Grass Skink	3	2	1	0	1	2	2	0	1	0	0	0	0	0	2					3
Spencer's Skink	2	2	1	2	2	0	0	0	1	0	2	1	0	0	0					
Swamp Skink	3	-	-	1	-	2	2	-	1	0	0	-	0	0	2					2
Lace Monitor	3	3	2	2	2	2	1	2	1	1	2	1	1	1	0					
AMPHIBIANS																				
Giant Burrowing Frog	2	3	2	1	2	2	2	-	2	2	0	-	0	0	-					
Martin's Toadlet	-	2	2	-	2	-	-	-	2	-	-	-	-	-	-					
Tyler's Toadlet	-	2	2	-	2	-	-	-	2	-	-	-	-	-	-					
Blue Mountains Tree Frog	3	2	-	-	-	-	-	-	2	-	-	-	-	-	-					
Large Brown Tree Frog	1	2	2	1	-	-	1	1	1	1	-	-	-	-	-					
Leaf Green Tree Frog	3	2	-	-	-	2	-	-	2	-	-	-	-	-	-					
Alpine Tree Frog	-	0	-	0	-	-	3	1	1	1	0	2	-	-	-		3			
Spotted Tree Frog	1	2	-	1	--	3	2	2	2	3	0	2	--	-	2		2			
TOTAL SCORE	68	69	49	31	50	44	43	26	36	18	23	18	5	13	15					
NO. OF SPECIES AFFECTED																				
Major threat	8	7	4	0	1	4	2	3	0	1	1	1	0	2	1		1		1	1
Moderate threat	18	23	15	9	21	14	14	6	9	4	6	5	1	3	3		4	1	1	1
Minor threat	8	2	7	13	5	4	9	5	18	7	8	5	3	1	6	1				
Not a threat	0	1	1	7	1	9	6	11	7	12	15	16	24	23	22					
Unknown threat	5	6	12	10	11	8	8	14	5	15	9	12	11	10	7	2				
Total no. affected	34	32	26	22	27	22	25	14	27	12	15	11	4	6	10	1	5	1	2	2

Potentially threatening processes indirectly associated with harvesting operations include siltation, weed invasion, changes to vegetation structure and composition, habitat modification and loss of opportunity to develop habitat elements characteristic of mature and senescent forests on the coupe. These threatening processes are considered to be of moderate overall significance but can have a major impact in certain vegetation types, such as those of wetter, protected, riparian or gully environments. Edge effects are likely to be of greatest threat to EVCs that are linear and small, such as those confined to gully or stream habitats, and plant species which rely on stable, low light, high humidity, moderate temperature regimes. Species potentially affected by additional soil disturbance created by timber harvesting include small forest understorey plants and species of mountain stream margins. Frequency, intensity and length of a harvesting rotation appears to strongly influence species composition and different forest ecosystems and species respond differently to the various silvicultural systems applied.

Timber harvesting impacts upon a range of fauna species through its short-term effect of habitat removal and medium and longer-term effect of producing even-aged regrowth forests that are less suitable for some species than older forests. Threatening processes include the loss of hollow-bearing trees, the conversion of mature stands to young regrowth stands, soil disturbance and habitat fragmentation. Ecologically mature or old-growth forests are generally more structurally and floristically diverse than regrowth forests and provide a greater range of foraging substrates.

In Gippsland, timber harvesting is considered a major threat to the Spot-tailed Quoll, Sooty Owl, Powerful Owl and Lace Monitor and Long-footed Potoroo (Gippsland record is in a Conservation Reserve). Loss of hollow-bearing trees as a result of timber harvesting is considered a moderate threat to the Yellow-bellied Glider and the Gang-gang Cockatoo. The conversion of older forest to young regrowth stands can result in the loss of nesting and foraging habitat for the Regent Honeyeater, Swift Parrot, Square-tailed Kite and Grey Goshawk.

Timber harvesting activities have the potential to reduce numbers of the Spotted Tree Frog, Large Brown Tree Frog and Leaf Green Tree Frog by destroying sheltering sites, affecting prey abundance, altering micro-climates, fragmenting habitat and allowing the invasion of exotic weeds and predators. Altered stream conditions as a result of timber harvesting operations may indirectly impact on the Glossy Grass Skink and Azure Kingfisher that feed on aquatic insects and fish. Soil disturbance and loss of litter during timber harvesting operations is a potential threat to the Blue Mountains Tree Frog and Giant Burrowing Frog that are known to use habitats away from streams.

Ground-dwelling species such as the Broad-toothed Rat, Long-nosed Bandicoot and Red-necked Wallaby may be adversely affected by the reduction of shelter and foraging sites immediately following timber harvesting. White-footed Dunnart populations are unable to persist following timber harvesting due to dense regrowth making the habitat unsuitable. The availability of hypogean (underground fruiting) fungi, an important food of the Long-footed Potoroo, Long-nosed Bandicoot and Smoky Mouse, may also be affected. Loss of large trees is potentially a moderate threat for Spencer's Skink.

Timber harvesting and associated roading and burning activities are managed under the forest management planning process which includes the Code of Forest Practices for Timber Production, the Code of Practice for Fire Management on Public Land, the Mid-Gippsland Forest Management Plan (NRE in prep.), regional prescriptions and annual Wood Utilisation Plans. The Code of Forest Practices for Timber Production and Forest Management Plans are subject to periodic review with formal public consultation, while regional prescriptions and Wood Utilisation Plans are prepared in consultation with regional flora and fauna staff and community input.

The Code of Forest Practices for Timber Production provides principles and guidelines and sets minimum standards for forest operations in State forests in Victoria. It aims to ensure that environmental values and water catchments are protected, by careful operation planning, reservation of appropriate areas and vegetation corridors. Such prescriptions particularly target certain forest ecosystems (such as riparian EVCs) and the flora and fauna associated with them.

Potentially threatening processes listed under the FFG Act which may be relevant to timber harvesting are *Degradation of native riparian vegetation along Victorian rivers and streams*, *Increase in sediment input into Victorian rivers and streams due to human activities*, *The invasion of native vegetation by 'environmental weeds'*, and *Loss of hollow bearing trees in Victorian native forest*.

The Gippsland RFA region encompasses the Tambo and parts of the Central Gippsland and Wodonga Forest Management Areas (FMAs) and a forest management plan is currently being prepared for the region. Management strategies for species and threatening processes listed under the FFG Act are detailed in Action Statements and incorporated into forest management plans where relevant. Direct and indirect taking of protected flora associated with timber harvesting requires authorisation under the FFG Act. In addition to the formal reserve system already in place, Special Protection Zones will be defined and managed for conservation with timber harvesting excluded. Current prescriptions in the Tambo FMA set a minimum of 5 retained trees per 15 hectares harvested for all forest types for conservation of wildlife habitat within the timber production forest.

Clearing of Native Vegetation

Clearing of native vegetation in Gippsland occurs as part of development for agricultural, industrial, urban, recreational and utility purposes. Historically, the open forests of the lower valleys and river flats, and the Gippsland plains were among the most attractive for pastoral settlement and large areas of coastal vegetation and non-perennial swamps behind Ninety Mile Beach have been drained and cleared for agriculture. In addition clearing for snow sport and associated development of facilities is a localised but significant form of vegetation clearing in Gippsland.

Potentially threatening processes directly and indirectly associated with clearing of native vegetation include damage or loss of individuals, disturbance to soil-stored seedbanks, changes to vegetation structure and composition, spread of weed species and disturbance to, loss or modification of habitat. Within Gippsland, clearing of native vegetation is a particularly significant threat to EVCs and species dependent on plains, woodland, coastal and sub-alpine habitats. Few if any native plants can survive broadscale clearance of vegetation where the result is conversion of the land to intensive human use for urban, industrial, tourism, agricultural or other purposes. Many of the threatening processes indirectly associated with this disturbance result from fragmentation and isolation of habitat. Remnant woodland habitats on fertile soils are important food sources for mobile bird species such as the Regent Honeyeater and Swift Parrot. Loss of these habitats may deplete a food resource at a critical time of year and contribute to local or regional population declines. Loss of habitat on private land is a major threat to the White-bellied Sea-Eagle. For species which utilise woodland habitats as well as other forest types (e.g. Square-tailed Kite, Grey Goshawk, Chestnut-rumped Heathwren, Cicadabird, Gang-gang Cockatoo), clearing for agriculture is considered a moderate threat. The loss of large trees, both living and dead, is likely to have adverse effects on populations of the Lace Monitor.

Loss of habitat associated with clearing of native vegetation and draining of wetlands was identified as a threatening process for Swamp Skink and Glossy Grass Skink in Gippsland.

Habitat loss, and a reduction in litter and ground debris layers, as a result of native vegetation clearing may be deleterious to the Blue Mountains Tree Frog and the Leaf Green Tree Frog.

Further clearing of native vegetation is significantly mitigated by the implementation of native vegetation retention controls under the *Planning and Environment Act 1987*. Land holders and public authorities must apply for a permit to clear native vegetation from land greater than 0.4 ha. Permits to clear native vegetation are generally only granted for small areas with little significance or slightly larger areas of degraded native vegetation. Removal of protected flora associated with clearing requires authorisation under the FFG Act. The rate of clearing of private land is monitored by NRE through a database of clearing applications and satellite imagery, which allows detailed comparison between current and past extent of tree clearance. Since the introduction of planning restrictions on the clearing of native vegetation on private land in 1989, the rate of vegetation loss has decreased tenfold in Victoria.

Clearing of native vegetation on public land requires Ministerial or Departmental approval and major developments are usually the subject of Environment Effects Statements in which any impacts on native flora and fauna are considered.

Fuel Reduction Burning

The effects of fire on flora and fauna vary depending on the scale, frequency, intensity and season of burns. Many native terrestrial plants have evolved reproductive mechanisms in response to fire and many fauna species respond to fire with respect to shelter, food and behavioural patterns. Most fuel reduction burns are low intensity burns that aim to reduce the ground, understorey and bark fuel loadings. Fuel reduction burning is carried out in a wide range of forest types in Gippsland. It generally occurs in the vicinity of 4-6 years frequency for areas that require asset protection, and less frequently for other areas. Fuel reduction burning may affect heathy EVCs and EVCs of drier environments relatively more than other vegetation types because these EVCs burn more readily than other types. Less flammable vegetation and EVCs of wetter environments are rarely subject to fuel reduction burning.

The direct impact of a fuel reduction burn is the damage or loss of fire sensitive species as a result of the fire itself. Indirect impacts of an imposed fire regime which may differ from the “natural” (pre-European) regime can result in changes to vegetation floristics and structure. For example, the frequency, intensity or season of fire may increase competition from other native or introduced species better suited to the altered fire regime. When burning frequency is too high, species may fail to reproduce adequately before the next burn so that there are no propagules available for regeneration after subsequent burning events. This is a problem for obligate seed reproducers such as members of the Proteaceae, Fabaceae and Epacridaceae families which comprise a large proportion of heathy EVCs.

Fuel reduction burning in Gippsland is regarded as a major threat to the Long-footed Potoroo, Smoky Mouse, New Holland Mouse and Masked Owl. It is considered a moderate threat to a further 15 fauna species, a minor threat to seven species and an unknown threat to 12 species. The Smoky Mouse and New Holland Mouse appear reliant on understorey vegetation components that are strongly influenced by the frequency and intensity of fire, so inappropriate fire regimes that change floristics and structure represent a major threatening process for these species. Frequent low-intensity burns can simplify and eventually eliminate dense understorey thus reducing shelter and foraging sites for the Long-footed Potoroo, Long-nosed Bandicoot, and Chestnut-rumped Heathwren. The effect of fire on hypogean fungi, an important food resource for the Long-footed Potoroo, is unclear.

Masked Owls, which forage along the forest/farmland edge, may be negatively affected by fuel reduction burning as a result of the loss of prey.

Fire management in Gippsland is guided by the Code of Practice for Fire Management on Public Land, which outlines general principles and guidelines for fuel reduction burning and Regional Fire Protection Plans. Each fuel reduction burn undertaken on Public land, must be the subject of an approved burn plan in accordance with the Code and Regional Fire Protection Plan. Such plans must take into account prescriptions developed for the protection of threatened species.

FFG Act Action Statements include fire management prescriptions for listed species that are threatened by this process. However, for the majority of species, the effect of fuel reduction burning, particularly the effect of burning frequencies, is largely unknown. NRE is undertaking long-term research on fuel reduction burns in the Wombat State Forest, which includes vegetation types found in Gippsland.

Regeneration Burning

Regeneration burning is a standard component of forest management in most harvesting operations in Gippsland and involves the burning of debris, which may be windrowed or heaped, to create optimal conditions for the natural germination of eucalypt seed. The direct impact of the regeneration burn on flora is the damage or loss of fire sensitive species on the coupe and sometimes in the surrounding vegetation (such as in gullies). The discussion of the impacts of planned fire on fauna species is in the section on fuel reduction burning.

In circumstances where regeneration has not been fully successful, windrowing or heaping of debris can be employed. This may cause damage or loss of individuals, disturbance to the superficial structure or soil-stored seedbanks and compaction of the soil surface.

The longer-term, indirect impacts of regeneration burning include failure to reproduce adequately when intensity or season are unsuitable, absence of suitable conditions for establishment, and competition from native or introduced species better suited to the fire regime.

The Code of Forest Practices for Timber Production contains specific guidelines to prevent damage to retained (including streamside buffers, habitat trees and existing regrowth) and surrounding vegetation from regeneration burns, particularly in relation to fire sensitive riparian EVCs.

Planned Absence of Fire

The deliberate exclusion of fire is a result of successful fire prevention and fire suppression activities directed towards the protection of life, property and other assets. It also may reflect management decisions to exclude fire as much as possible (eg. in fire-sensitive vegetation such as rainforests and sub-alpine communities). The threatening processes associated with the long-term absence of fire are similar to those indirect impacts of the types of planned fire discussed above.

The EVCs most prone to structural and floristic changes in the absence of fire include EVCs that carry a high proportion of species that are dependent on fire for reproduction via resprouting and/or seedling establishment such as members of the Proteaceae, Fabaceae and Epacridaceae families (eg. heathy EVCs) and those that require fire to reduce biomass of dominant ground species so as to allow establishment of other species (eg. grasslands and grassy woodlands).

Ecological burns are undertaken in accordance with management plans or Action Statements for specific species, communities or sites.

Unplanned Fire (Wildfire)

Fire is a fundamental element of the Australian environment and is the major natural disturbance maintaining the mosaic of floristic and structural diversity within native vegetation. Wildfire may have both positive and negative outcomes for flora and fauna populations.

Effects of fire on vegetation are dependent on the frequency, intensity, and season of burn. They include changes in species composition, abundance, and physical and age structure. All species respond uniquely to the combination of fire regime, other disturbances and potentially threatening processes such as weed invasion. The intensity of a fire may determine the degree to which the vegetation is initially altered. Low intensity fires generally leave more areas of un-burned vegetation but high intensity fires can also be restricted or patchy in extent. Rainforests and vegetation in sub-alpine areas are especially sensitive to damage caused by wildfire because of a very limited growing season and slow growth rate.

Adverse effects of wildfire on animal species are related to mortality, subsequent loss of shelter and nest sites, reduction in prey availability and foraging substrate, and increased risk of predation by introduced species. Wildfire is regarded as a major threat to the Long-footed Potoroo and a moderate threat to 21 species. There are 11 species for which the effects are unknown.

The Long-footed Potoroo has a limited distribution in Gippsland and loss of habitat due to wildfire could result in population declines. The effect of fire on hypogeal fungi, an important food source for Long-footed Potoroo and Long-nosed Bandicoot, is not clear.

The Department of Natural Resources & Environment has the responsibility for prevention and suppression of fire in State forest, National Parks and reserves and all protected public land. The Code of Practice for Fire Management on Public Land and regional fire protection plans include strategies for fire prevention, preparedness, fire suppression and recovery after wildfire. Significant and sensitive natural values can be taken into account by these plans.

Grazing

Domestic stock and feral and naturalised exotic animals including rabbits, hares, deer, goats and brumbies are the main agents of grazing or browsing and trampling of native vegetation within Gippsland. On public land, licensed grazing is practised in State forest, parts of the Alpine National Park, roadside reserves and water frontages. Browsing by native herbivores is only considered as a disturbance in this review where it is significantly beyond the natural range of impact (over-browsing).

The impact of grazing will depend on the grazing species, intensity, timing, duration, stocking rate, EVC, local environmental conditions (eg. steepness, erodability, soil type) and climatic conditions. Grazing, browsing or trampling can result in direct damage to or loss of plants and reduced reproductive output. Less direct potentially threatening processes associated with grazing are habitat modification (structurally and floristically), reduction in the litter layer, soil disturbance, compaction or erosion. The ecological attributes which predispose plants to threat from grazing include palatability and occurrence in habitats which tend to be grazed more frequently or heavily, such as grassy habitats.

Habitats affected by grazing are principally the grassy and forb-rich EVCs. The historical combination of alienation, grazing and clearing has resulted in most of these EVCs being scarce on public land and are often present as degraded remnants on private land.

Lack of regeneration as a result of grazing of remnant patches of native vegetation is a significant threat to species such as the Regent Honeyeater, Swift Parrot and Hooded Robin.

Lack of regeneration of future habitat due to grazing is a potentially significant issue for White-bellied Sea-Eagle on private land. Elimination and simplification of understorey vegetation and trampling of litter accumulations as a result of grazing are threatening processes for a range of reptile species, particularly skinks including the Swamp Skink and the Glossy Grass Skink. This process also affects ground-foraging birds and mammals, such as the Broad-toothed Rat, White-footed Dunnart, Smoky Mouse and Long-nosed Bandicoot. The Long-footed Potoroo and Red-necked Wallaby rely on dense understorey vegetation for shelter. Habitat modification as a result of grazing may also adversely affect the Spotted Tree Frog.

Alpine and sub-alpine vegetation is generally slow growing and seedling establishment is rare so it is particularly sensitive to physical disturbance and modification arising from grazing and trampling. Trampling of breeding sites by cattle is a potentially significant threat to the Alpine Tree Frog which is restricted to sub-alpine environments.

Grazing on public land including State forest is permitted under licence subject to regulation under relevant legislation. Licences are issued for seven years for parts of the Alpine National Park and for some seasonal bush grazing on State forest. These licences specify the maximum number of stock that may be grazed on the licensed areas and include conditions, which can include the exclusion of cattle from areas of special conservation significance or from areas requiring rehabilitation. For public roadsides managed by local government, development of roadside management plans which address issues such as grazing are critical to ensure habitat conservation for many species.

Two of the major impacts of grazing are listed as Potentially Threatening Processes under the FFG Act. These are *The degradation of native riparian vegetation along Victorian rivers and streams* and *Soil erosion and vegetation damage and disturbance in the alpine regions of Victoria caused by cattle grazing*.

Coordinated public and private land rabbit control programs are ongoing.

Road Construction and Maintenance

Road construction and maintenance may involve the clearing of vegetation, major earthworks to form the road pavement and batters, road-widening and upgrading, works to construct bridges, culverts and drains and installation of utilities. Potentially threatening processes include direct damage or loss of plants by machinery, habitat loss and/or fragmentation, altered micro-climatic and light conditions, erosion, sedimentation, introduction of soil or gravel contaminated with weed seed or fungal spores and the facilitation of weed spread due to continual disturbance of road margins, introduction in soil on vehicles and machinery and contamination via the stream system.

Indirect impacts of road construction and maintenance include potentially threatening processes that lead to habitat modification (microclimatic changes, increase of water turbidity and alteration of hydrological regimes). These processes are most significant in the vicinity of gullies in the steeper, higher-rainfall, mountainous parts of Gippsland. Consequently species and EVCs associated with gully and riparian environments are most likely to be affected.

Roads can create barriers to movement and fragment habitat. Fauna species with limited mobility such as small mammals and skinks are particularly vulnerable. The establishment of roads through undisturbed forest may allow introduced predators to colonise new areas. White-bellied Sea-Eagles are particularly vulnerable to disturbance while nesting, and road construction and maintenance activities in the vicinity of nest sites may cause breeding pairs to abandon nests, leading to reduced breeding success.

Construction of roads and tracks can result in increased sedimentation of streams and alteration of riparian habitats. Increases in sediment load can be detrimental to the Spotted Tree Frog and Giant Burrowing Frog by affecting growth and survival of eggs and tadpoles. Alterations to hydrological regimes and increased siltation may negatively impact on Leaf Green Tree Frog, Large Brown Tree Frog, Alpine Tree Frog, Martin's Toadlet, Tyler's Toadlet, Swamp Skink and Glossy Grass Skink.

All new roads and tracks used for timber production in State forests must be built to comply with the Code of Forest Practices for Timber Production. However, many roads and tracks were built prior to introduction of the Code and do not meet these standards. In State forest attention is paid to planning the road network to avoid threatened species habitat, minimise environmental damage and provide high standard stream crossings. Management aims include the progressive improvement of the design and drainage of the road network to minimise sedimentation run-off and meet appropriate road standards.

VicRoads (the Victorian Government agency responsible for main roads and highways throughout Victoria) has recently published an environmental strategy. Local municipalities are responsible for all other public roads (and roadsides) excluding those managed by NRE. Local Government Roadside Management Plans, which incorporate guidelines for habitat management should assist in achieving conservation objectives for species dependent upon roadside vegetation in the agricultural landscape.

Degradation of native riparian vegetation along Victorian rivers and streams, Increase in sediment input into Victorian rivers and streams due to human activities and The invasion of native vegetation by environmental weeds are listed as Potentially Threatening Processes under the FFG Act.

Recreation

A wide range of recreational pursuits takes place in Gippsland, but the most significant, from a disturbance perspective, are vehicle-based activities, fishing, hunting, camping, and skiing. At stream crossing-points high levels of vehicle traffic can result in localised bank erosion and sedimentation. Vehicle use can also result in the transport of soil, potentially carrying plant diseases and weed propagules. Snow sport and associated development of facilities is a localised but significant form of recreation in Gippsland. Its impacts can include clearing, habitat fragmentation and habitat disturbance, pollution and the spread of environmental weeds.

The potentially threatening processes associated with recreation activities that directly impact on native vegetation are the direct damage or loss of individuals and habitat loss or modification.

Indirect impacts on vegetation result in overall habitat degradation which may involve disturbance to soil structure by compaction and erosion, the facilitation of spread of disease, pathogens or environmental weeds, altered soil or surface hydrology, the increase in sediment input into streams and pollution/eutrophication of wetlands and streams, including those in sub-alpine regions.

The EVCs likely to be at greatest risk from recreational activities are those associated with coastal, sub-alpine or riparian environments where recreation activities are concentrated. Species at risk include those sensitive to trampling, erosion, altered hydrology, sedimentation, weed invasion and plant pathogens.

Fauna species most vulnerable to threatening processes associated with recreational activities are those dependent on sensitive habitat types and whose distributions are restricted to areas

where recreational activities are concentrated. Recreational activity is considered a major threat to the White-bellied Sea-Eagle and a moderate threat to the Broad-toothed Rat, bats, Alpine Tree Frog and Spotted Tree Frog.

Recreational activities occur at many of the sites from which the Spotted Tree Frog has disappeared including fishing and bait collection, which may be a significant cause of Spotted Tree Frog population declines. The Gippsland coast is a stronghold of the White-bellied Sea-Eagle and recreational activities near nest sites are likely to cause population decline. Protection of these sites from disturbance is recognised as a significant factor in the conservation of this species.

Vehicle-based activities on public land are managed through the relevant management planning process (Forest Management Plan or Park Management Plans). Effort is generally made to encourage activities in appropriate zones where these activities are compatible with overall management objectives, or where impacts can be minimised. Snow sport and associated resort development and management is required to take into account a range of legislation including provisions of the FFG Act and local planning requirements.

Year-round recreational activities are allowed throughout much of the sub-alpine area most of which is included in the Alpine National Park, although certain restrictions apply, for example, horse riding is allowed only during set periods of the year. The Park is divided into a number of zones, including areas set aside as Special Protection Zones, where stricter controls on recreation apply. Recreation activities are not permitted in Reference Areas, and Wilderness Zones cater only for non-mechanised recreation. Within the Alpine National Park there are Special Protection Zones for the Broad-toothed Rat, Smoky Mouse and Spotted Tree Frog. These are areas of suitable habitat that are managed primarily to maintain, protect or enhance the special features they encompass.

Environmental Weed Invasion

Environmental weeds are widespread throughout Gippsland, occurring in all habitats and areas, and their impact varies. The most destructive environmental weeds are those which out-compete native species to the extent that their habitat can become grossly modified, with particular niches being lost altogether.

Environmental weed invasion can occur in any EVC but those EVCs and species growing in moister environments with higher soil fertility are more susceptible. These include riparian zones, relatively fertile soil types and fragmented habitats in close proximity to weed sources, such as waste disposal areas and agricultural lands. Various suites of weeds are often found in particular environments where disturbance regimes and environmental characteristics are suitable, for example Blackberry, *Rubus fruticosus* spp. agg. in riparian and gully environments. Invasion of habitats by introduced weeds contributes to habitat degradation, particularly for ground-foraging species such as the Chestnut-rumped Heathwren and Hooded Robin. These species are threatened by weed invasion as it reduces foraging habitat by limiting access to ground litter, and invasion of roadside habitats by introduced pasture species is an important cause of habitat loss for these birds. The Pink Robin may lose breeding habitat in stream-side gullies if these sites are invaded by Blackberry *Rubus fruticosus* spp. agg. Similarly, the invasion of stream-side habitat by weeds may result in the loss and degradation of habitat for the Spotted Tree Frog.

The invasion of native vegetation by environmental weeds and *The spread of Sweet Pittosporum in areas outside its natural range* are listed as a Potentially Threatening Process under the FFG Act. The management of environmental weed invasions is the responsibility of the land manager and on public land, environmental weeds and agricultural weeds are considered under the Victorian *Catchment and Land Protection Act 1994*.

The Victorian Parliament, through the Environment and Natural Resources Committee, has investigated the significance of the weed problem in general, including specific reference to environmental weeds. The Commonwealth, in consultation with State and Territory agencies, has recently completed the National Weeds Strategy (ARMCANZ & ANZECC 1997) which outlines strategies to address major issues including limited resources and a general lack of strategic planning, tactical planning, follow-up, monitoring and experimental management.

The Victorian Weeds Strategy (NRE 1998f) builds on the National Weeds Strategy and also takes account of recommendations in the Victorian parliamentary inquiry 'Report on Weeds in Victoria' (ENRC 1998). The Victorian strategy sets out a range of actions that will establish a cost-effective long-term approach to weed management in Victoria.

The distribution of environmental weeds is generally well understood as a result of their inclusion in floristic surveys conducted in Gippsland.

Introduced Fauna Species

This disturbance relates to the impact of introduced fauna on native fauna and covers predation and competition by introduced species. The impact of introduced fauna on vegetation is discussed in the section on grazing. An additional impact is the spread of weeds by the transport of propagules on their fur or within their faeces.

Foxes were found to prey heavily on the Broad-toothed Rat in Kosciuszko National Park and are considered a threat to this species in the Alpine National Park. Juveniles of the Red-necked Wallaby are also sometimes heavily preyed upon and juvenile Lace Monitors, the Swamp Skink and Glossy Grass Skink may also be threatened by predation. Bird species that forage or nest on or near the ground, such as the Hooded Robin, are vulnerable to predation by Foxes, Cats and Dogs with both individuals and eggs taken. The Common Bent-wing Bat and Eastern Horseshoe Bat are preyed upon by Cats as they leave their cave/mineshaft roosts; this predation is regarded as a moderate threat in Gippsland. Predation of Spotted Tree Frog eggs and tadpoles by Trout represents a major threat to this species in Gippsland. The impact of predation by Trout may also pose a threat to the Leaf Green Tree Frog and Blue Mountains Tree Frog. Predation also has the potential to have a significant impact on species such as Long-footed Potoroo and Smoky Mouse that have limited population distributions in Gippsland.

Competition by introduced species for food and nest hollows is recognised as a moderate threat to the Dingo and Spot-tailed Quoll and a minor threat to the Swift Parrot, Masked Owl and Regent Honeyeater. There appears to be some dietary overlap between Cats, Foxes and the Spot-tailed Quoll, and competition for prey items may potentially threaten the viability of the Quoll in Gippsland. Feral European Honey Bees are known to occupy hollow trees, and may compete for this resource and nectar with several native species such as the Regent Honeyeater and Swift Parrot. European Carp stir up bottom sediments increasing water turbidity and may significantly impact on habitat quality for the Azure Kingfisher, which may have difficulty in detecting prey in murky water.

Predation of native wildlife by the cat Felis catus, and Predation of native wildlife by the introduced Red Fox Vulpes vulpes, are listed as Potentially Threatening Processes under the FFG Act, with a published Action Statement for the Fox and an Action Statement currently under preparation for the Cat. Predation by the Cat and Fox are listed as Key Threatening Processes under the ESP Act and Threat Abatement Plans have been prepared for each.

Pest animal control measures in Gippsland include programs coordinated with adjacent landowners (Good Neighbour Program) and, where feasible, targeted programs through the region. Management plans include strategies relating to pest animal control.

Pest Control

Control of pest plants and animals potentially impacts on native fauna through non-target and secondary poisoning and food chain contamination by chemicals. This disturbance is a major threat to the Spot-tailed Quoll, Masked Owl and Dingo, and a moderate threat to a number of other species.

The Spot-tailed Quoll is especially at risk from non-target poisoning as ingestion of 1080-poisoned baits intended for Foxes and Dogs can cause death of individual animals or local populations. Similarly the Dingo, which is afforded some protection in the Alpine National Park where it is considered indigenous, is threatened by these pest control measures. Rabbits are a major prey item for the Masked Owl and Lace Monitor and reduction in Rabbit numbers due to control programs, such as poisoned-baiting and the Rabbit Calicivirus, is considered a major threat to these species. There is also a risk of secondary poisoning from consuming poisoned Rabbits or Rats to the Spot-tailed Quoll, White-bellied Sea-Eagle and the Grey Goshawk. The destruction of burrows and piles of logs and debris for Rabbit control are a potential threat for the Lace Monitor. Pesticide poisoning and loss of prey are a potential threat to most of the bats, Spotted Tree Frog and Alpine Tree Frog in Gippsland.

Overall the ecological implications for native fauna of pesticide use is unknown but is potentially significant given the importance of insects and other invertebrates as prey; this issue requires investigation. It is important that pest control programs are closely monitored for any adverse impacts on native fauna and effectiveness on the target species.

Firewood Collection

In Victoria, firewood represents one of the highest volume forest products. The direct impacts of firewood collection on flora include damage or loss of individuals, alteration of microclimatic conditions and the loss or modification of habitat. Indirect impacts of firewood collection include the facilitation of weed invasion, the spread of pathogens, fragmentation and isolation of habitat, soil compaction, increased erosion and sedimentation and disturbance to understorey by vehicles. EVCs directly affected by firewood collection are principally those on more gentle terrain, near private land or that are easily accessible by road in the foothills and the Gippsland plains. Logs, litter and debris are important microhabitats for many species such as the Spot-tailed Quoll, Lace Monitor, Spencer's Skink and the Chestnut-rumped Heathwren. The loss of old trees from woodland remnants on private land is a particularly significant threat to woodland species including the Masked Owl, Regent Honeyeater and Swift Parrot, Hooded Robin and White-bellied Sea-Eagle

Harvesting of standing trees for firewood is not permitted on public land within Gippsland. On private land harvesting of firewood for domestic use and the cutting of standing dead trees is exempt under the Native Vegetation Retention Controls. One of the major impacts of firewood collection, *Loss of hollow-bearing trees in Victorian native forests*, is listed as a Potentially Threatening Process under the FFG Act.

Firewood collection for domestic use on public land is controlled by the issue of licences which stipulate the amount of timber to be collected. Firewood collection along roadsides requires local government permission and a licence issued under the *Forest Act 1958*. Some shires have roadside management plans which may control firewood collection on roadsides, prohibiting removal of timber from certain high conservation value sites. The number of licenses issued for commercial firewood operations on public land depends on an assessment of the amount of wood available in accordance with the Wood Utilisation Plan in each Forest

Management Area. Commercial cutters must also hold a forest operators licence and operate in accordance with the Code of Forest Practices for Timber Production and local NRE prescriptions.

A large proportion of the firewood collected from within the Gippsland region is from woodland remnants on private land. The FFG Act, *Conservation, Forests and Lands Act 1987* and the *Planning and Environment Act 1987* provide some controls for firewood collection.

Illegal Collecting/Harvesting

This disturbance includes direct interference to plants and animals by humans in the form of collection or deliberate hunting, poisoning, or trapping. Deliberate collection is a significant disturbance or threat to the native orchids, particularly terrestrial orchids including *Caladenia* spp., *Diuris* spp., *Calochilus* spp. and *Prasophyllum* spp. Egg collection is potentially a significant threat to the Square-tailed Kite given the species' small population size in the region, although the extent of this activity in Gippsland is unknown.

Collection of native orchids is listed as a Potentially Threatening Process under the FFG Act. Removal of wildlife from the wild is prohibited under the *Wildlife Act 1975*, and the FFG Act requires a permit to take from the wild all listed species. Tree Fern collection is only permitted with a permit under the FFG Act.

Vandalism, or the deliberate interference to animals through human activities such as shooting and disturbance at nest and roost sites, is a major threat to the Common Bent-wing Bat and Eastern Horseshoe Bat. It is also considered a moderate threat to the Square-tailed Kite, Grey Goshawk and White-bellied Sea-Eagle, and a minor threat to the Lace Monitor.

Dieback

Dieback describes the protracted decline of health and vigour of plants and it is likely that many factors interact to lead to dieback. Possible contributing factors include insect defoliation, fungal diseases, drought, fire, altered water tables, increased salinity, nutrient imbalances as a result of applications of fertilisers, soil erosion and reduced soil aeration, land clearing, lack of regeneration and overgrazing.

The direct impact of dieback and related processes involves the damage or loss of plants. This can lead to changes in vegetation structure, composition and diversity, the alteration of microclimatic conditions and the loss or modification of habitat. Within Gippsland, dieback is attributable to a range of causes in scattered parts of the region. These include the fungal pathogen Cinnamon Fungus *Phytophthora cinnamomi* which causes dieback disease, often in heathy environments and *Chalara australis* which causes Myrtle Wilt, a disease of the dominant overstorey species of Cool Temperate Rainforest, Myrtle Beech *Nothofagus cunninghamii*. Dieback of Forest Red Gum *Eucalyptus tereticornis*, the dominant overstorey species of Plains Grassy Woodland and other depleted grassy and woodland EVCs of private land and roadsides on the Gippsland Plains, is considered a major problem.

Dieback is not a significant threat to fauna species which are mainly recorded from large blocks of forest. However, for the fauna of remnant vegetation in agricultural land, it is a significant threat. Dieback is a threat for species such as Regent Honeyeater, Swift Parrot, Hooded Robin, White-bellied Sea-Eagle, Cicadabird, Square-tailed Kite and Masked Owl. Dieback may degrade Pink Robin, Lace Monitor and Spencer's Skink habitat.

Use of Phytophthora cinnamomi-infected gravel in construction of roads, bridges and reservoirs is listed as a Potentially Threatening Process under the FFG Act. The Code of Forest Practices for Timber Production, management plans and conditions of exploration licences address this threatening process.

Mining/Quarrying

The main deposits for extractive industries in the Gippsland region are brown coal, sand, gravel and limestone. Rock, gravel, clay, sand and soil are extracted from a number of quarries within the region. Although mining/quarrying has the potential to impact on a large number of species, due to the small scale and number of operations in Gippsland, this disturbance is currently considered only a minor threat to the majority of species covered by this review.

Species and EVCs directly affected by mining and quarrying include those associated with riparian habitats. Surrounding EVCs may be indirectly affected by weed invasion. Fauna species likely to be threatened by mining include the Spotted Tree Frog, Giant Burrowing Frog, White-bellied Sea-Eagle, Common Bent-wing Bat and Eastern Horseshoe Bat. Disappearances and declines of Spotted Tree Frog populations appear to be partly linked to educator dredging activities, an activity which is now banned. Quarrying can particularly impact on vegetation of sub-alpine areas such as the sphagnum mossbed and bog communities which are slow growing and therefore sensitive to damage.

Mineral exploration, mining and extractive industries are not permitted in Reference Areas, National, State or Wilderness Parks, except where a tenement or application pre-dates the Park and the Minister responsible for the National Parks Act consents. Mining and exploration operations require a licence and work plan approved by Minerals and Petroleum Victoria before exploration or mining works can be undertaken. Similarly, extractive industries require a work plan and the consent of the relevant Minister for extractive operations.

Other Disturbances

Dams/Impoundments

Potentially threatening processes associated with dam/impoundment construction and subsequent operation include direct damage and loss of vegetation cleared, increases in sediment input to rivers and streams, modifications to natural temperature fluctuations and flow rates, degradation of adjacent native riparian vegetation and loss and fragmentation of habitat. Altered flooding regimes can affect EVCs associated with riparian and floodplain environments which are adapted to and have requirements for natural flooding regimes.

Siltation, alteration of stream flow and degradation of riparian vegetation is a major threat to Azure Kingfisher and a moderate threat to Spotted Tree Frog. Clearing and drainage of swamps and wetland habitat is a significant threat to Swamp Skink and Glossy Grass Skink populations through the disturbance or loss of habitat. The environmental impacts of dams/impoundments have been subject to numerous studies. Processes to minimise impacts include environmental flow allocations, construction of fish ladders and regulating the temperature flowing out of storages.

Mineshaft Collapse

Mineshaft collapse and mineshaft entrances becoming overgrown are recognised as a major threat to the Common Bent-wing Bat and a moderate threat to the Eastern Horseshoe Bat. These species are dependent on caves and mineshafts for roosting and breeding. Restricted access to and loss of breeding habitat due to these processes is likely to lead to a decline of population numbers in Gippsland.

Climate Change

The Enhanced Greenhouse Effect is the increase of greenhouse gases caused by human activities and the resultant warming of the atmosphere. Species living in sub-alpine areas typically exist in small isolated populations and are particularly vulnerable to environmental

change. Both flora and fauna of sub-alpine, and high montane environments are potentially under threat due to their limited habitat requirements. Climate change has been identified as a threat to Alpine Tree Frog, Spotted Tree Frog, Broad-toothed Rat, Pink Robin and Sooty Owl. An increase in ultraviolet radiation is known to cause death of frog eggs and larvae, and it is thought that this may have contributed to population declines of the Alpine Tree Frog.

Loss of Genetic Diversity

Loss of genetic diversity is a threat to small, fragmented or isolated populations or less mobile species. It is considered to be a potential threat to the Dingo.

Genetic pollution of natural populations of native flora is most likely to occur from garden escapees or as a result of the establishment of plantations of silvicultural or horticultural species closely related to native species within reproductive range. Although potentially significant, major impacts have not been revealed by research to date.

12.8 AQUATIC FAUNA SPECIES ASSESSMENT

Introduction

This section considers available information on fish and aquatic macroinvertebrates (crayfish, shrimps, large insects etc) occurring in the Gippsland rivers, streams and wetlands, reviews the range of factors which are threats to the survival of important species and describes the management actions which are in place to mitigate those threats.

The quality of aquatic habitats and the diversity of the associated fauna are influenced by activities that occur in the catchment beyond the rivers, streams or wetlands themselves. The impacts of activities such as water regulation, timber harvesting, roading, grazing, recreation and mining are expressed indirectly in the aquatic habitat through environmental changes such as degraded water quantity and quality (eg. increased sedimentation, nutrients, toxic chemicals). A significant disturbance at a single site (a source of sediment for example), can have impacts many kilometres downstream, even in areas which may have adequate local protection in place. Therefore off-site management is essential to ensure the viability of aquatic biodiversity.

The Gippsland Region is bordered on its northern edge by the ridge of the Great Dividing Range (with the exceptions of the upper Mitta Mitta and Upper Murray Rivers included in the Region and the Wonnangatta, Humffray and upper Wongungarra Rivers included in the North East RFA region). Except for the upper Mitta Mitta and Upper Murray Rivers, all rivers in the Region flow south into Bass Strait, many via the Gippsland Lakes system.

Twenty-one native freshwater fish have been recorded from the Gippsland RFA Region to date, and 15 are known or suspected to migrate as part of their life cycle. There are insufficient data to estimate the total number of aquatic macroinvertebrate species in the Gippsland Region. Sixteen species of cray are known from the Region, along with a single species of shrimp and one species of freshwater crab. The diverse nature of the freshwater cray fauna and the presence of a number of endemic species make the crayfish fauna in the Gippsland RFA Region particularly significant.

Data Review

As part of the assessment, a review was conducted of existing site-based biological data for aquatic species in Gippsland. Assessments were also made as to the adequacy of this biological data. This information was used to identify priority areas and data gaps that could be filled through additional survey work.

There is generally wide spatial coverage of sampling records across the region, although many survey sites fall into fairly restricted areas where survey intensity has been very high due to specific projects.

Fish

Intensive inventory surveys of fish assemblages in the Gippsland RFA Region have primarily been conducted by the Department of Natural Resources and Environment (NRE). Some investigations that incidentally recorded fish species were conducted by other government agencies, universities or private individuals.

The number of freshwater survey sites in the Gippsland RFA Region appears to be reasonable at 340, with 171 of these sites considered to be full surveys which provide adequate data quality. Because of the nature of individual survey objectives, 82 sites (24%) have been located in areas set aside for conservation purposes, with almost half of these (40 sites) located in the Wilsons Promontory National Park. One hundred and thirty-five sites (40%) were located in private land and other areas of public land (eg. stream frontages), and 121 sites (36%) have been located in State forest.

There are no significant data gaps in fish distributional data from the Gippsland Region following the RFA research and survey program. However, significant data gaps exist on life history and population characteristics for all priority fish species. The most significant gaps relate to spawning behaviour, including induction cues and location of egg laying sites, both within the catchment and within the stream. There is also limited data on cues for migration, preferred larval habitats, and reactions of priority fish species to disturbances, particularly increased sedimentation and turbidity.

Aquatic Macroinvertebrates

Surveys of aquatic macroinvertebrates in Gippsland have primarily been conducted by a number of Government departments. As part of the Monitoring River Health Initiative (MRHI), 52 sites are being monitored in the Gippsland RFA Region. Additional sampling at 72 sites using the same methodology as the MRHI has been conducted as part of the RFA project.

There are still considerable gaps in the knowledge of aquatic macroinvertebrates in the Gippsland RFA Region. The lack of adequate distributional and historical data makes it impossible to identify other taxa that may qualify for inclusion in a priority list. Almost no comprehensive data are available for life histories of priority aquatic macroinvertebrate taxa (and most other macroinvertebrate taxa as well).

Priority Species Information

Of the 21 native freshwater fish species recorded from Gippsland, 7 are listed as threatened fauna in Victoria (NRE 1999b), five of which are listed under the *Flora and Fauna Guarantee Act 1988*, and one of which is listed under the Commonwealth *Endangered Species Protection Act 1992*.

Eight aquatic macroinvertebrate species known from Gippsland are listed as threatened in Victoria (CNR 1995f), with two of these listed under the *Flora and Fauna Guarantee Act 1988* (Table 12.16a).

Table 12.16a: Priority Aquatic Fauna Species Occurring in Gippsland

Scientific Name	Common Name	Conservation Status*	FFG/ESP Listing
Fish			
<i>Galaxias olidus</i>	Mountain Galaxias	Data Deficient*	
<i>Galaxiella pusilla</i>	Dwarf Galaxias	Lower Risk – near threatened*	FFG/ESP
<i>Gobiomorphus australis</i>	Striped Gudgeon	Vulnerable*	
<i>Gobiomorphus coxii</i>	Cox's Gudgeon	Endangered*	FFG
<i>Macquaria australasica</i>	Macquarie Perch	Endangered*	FFG
<i>Galaxias cleaveri</i>	Australian Mudfish	Endangered*	FFG
<i>Prototroctes maraena</i>	Australian Grayling	Vulnerable*	FFG/ESP
Crayfish			
<i>Engaeus australis</i>	Lilly Pilly Burrowing Cray	Rare [#]	
<i>Engaeus phyllocerus</i>	Narracan Burrowing Cray	Rare [#]	FFG
<i>Engaeus rostrigaleatus</i>	Strzelecki Burrowing Cray	Rare [#]	
<i>Euastacus crassus</i>	Alpine Spiny Cray	Rare [#]	
<i>Euastacus neodiversus</i>	South Gippsland Spiny Cray	Rare [#]	
Other invertebrates			
<i>Hemiphysalis mirabilis</i>	Dragonfly	Vulnerable [#]	FFG
<i>Plectrotarsus gravenhorstii</i>	Caddisfly	Ins. Known [#]	
<i>Thaumatoperla timmsi</i>	Stonefly	Rare [#]	

* Conservation status is based on *Threatened Vertebrate Fauna in Victoria - 1999*.[#] Conservation status is based on *Threatened Fauna in Victoria - 1995*. Ins. Known = Insufficiently known. FFG = Flora and Fauna Guarantee Act 1988, ESP = Endangered Species Protection Act 1992.

Threatening Processes - Impacts and Management

This section reviews the current state of knowledge of threatening processes on aquatic species in Gippsland and the management actions that are in place to mitigate those threats. It aims to assist in setting priorities for management and research. The review covers priority aquatic species (Table 12.16a) in the Gippsland region and was based on existing scientific literature and expert opinion.

Impacts

A number of activities occurring within catchments have either been shown to have, or have the potential to have, serious impacts on aquatic ecosystems, and therefore on aquatic species. A list of broad disturbance categories and their major impact on aquatic ecosystems is shown in Table 12.17.

The most common environmental change caused by land use activities in the catchments is an increase in sediment input to rivers and streams. Increased levels of sediment can adversely affect all aspects of freshwater ecosystems by reducing water quality and degrading or destroying habitat. Increased turbidity or suspended sediment can have adverse physical, physiological and behavioural effects on stream-dwelling flora and fauna.

The construction and operation of dams and weirs represent a major disturbance to aquatic systems. Storage and release of water at different times also changes the natural flow regimes. Dams can also present a barrier to migratory fish species.

While the potential impacts of these activities and associated environmental changes are well established, few scientifically derived data are available that directly relate the impact of most activities to any of the priority aquatic species. Therefore, in most cases, the impact on priority species in Gippsland needs to be predicted from the results of studies conducted elsewhere. While specific data relating activities or disturbances and the impacts on priority species may not exist, sufficient information is available to adequately predict the likely impacts on priority species in the Region.

Table 12.17: Broad Disturbance Categories (Activity) with Associated Environmental Change that have Potentially Significant Impacts on Aquatic Ecosystems

Activity	Major environmental change
Clearing of vegetation	Increased stream bed and bank degradation Increased sedimentation and turbidity Increased nutrient concentrations in water Increased pesticide concentrations in water
Dams	Alteration to flow regimes Increased sedimentation and turbidity Decreased water temperature Barriers to fish passage
Fire	Increased sedimentation and turbidity Increased nutrient concentrations in water
Fire control	Increased sedimentation and turbidity Increased toxic chemical concentrations in water
Grazing of stock	Increased stream bed and bank degradation Increased sedimentation and turbidity Increased nutrient concentrations in water Reduced availability of swamp/headwater habitat
Harvesting/Collecting	Reduced population numbers
Introduced species	Increased competition with native species Increased predation on native species
Mining/Quarrying	Increased sedimentation and turbidity Increased toxic chemical concentrations in water
Pest control	Increased pesticide concentrations
Recreation	Increased stream bed and bank degradation Increased sedimentation and turbidity
Roading	Increased stream bed and bank degradation Increased sedimentation and turbidity
Timber harvesting	Increased sedimentation and turbidity Increased nutrient concentrations in water
Waste disposal	Increased nutrient concentrations in water Increased toxic chemical concentrations in water

Management

Following the Land Conservation Council's (LCC) Rivers and Streams Special Investigation (LCC 1991a), the corridors of the Mitta Mitta (above Lake Dartmouth), the Mitchell and Wonnangatta Rivers and the Thomson River (below the dam and above Cowarr weir) were declared to be Heritage River Areas under the *Heritage Rivers Act 1992* because of their significant natural, scenic, cultural heritage and recreational values. Draft management plans for these heritage rivers have been produced and include strategies to protect significant environmental values in each river.

Timber harvesting is excluded from the seven Natural Catchment Areas in the Gippsland Region (LCC 1991a) declared under the *Heritage Rivers Act 1992*.

General conservation measures to protect riparian and instream values are also key elements of the Code of Forest Practices for Timber Production and regional prescriptions.

Under the provisions of the *Flora and Fauna Guarantee Act 1988* and the Commonwealth *Endangered Species Protection Act 1992*, and as part of Park and Forest Management Plans, conservation guidelines can be developed and implemented to protect individual species and their habitats from threatening processes. Where biological information and knowledge of threatening processes is adequate, quite specific guidelines can be developed. Other priority aquatic species are afforded protection through the more general habitat protection measures of the Code of Forest Practices for Timber Production.

Specific conservation guidelines have been produced for some of the priority aquatic species. These are generally *Flora and Fauna Guarantee Act 1988* restrictions on collection, and fishing regulations, mainly bag and size limits, and closed seasons during breeding (NRE 997k). Fishing regulations also exist for *Euastacus* species in Victoria.

13. OLD-GROWTH FOREST

13.1 INTRODUCTION

Under the 1992 National Forest Policy Statement (NFPS), the Commonwealth and State Governments agreed to a strategy to conserve and manage areas of old-growth forest across Australia as a part of a comprehensive, adequate and representative forest reserve system. To clarify its objectives, national criteria were established for the conservation of old-growth forests (JANIS 1997, Section 1.1.4). This chapter includes an assessment of the extent of old-growth forest in the Gippsland region and the application of the nationally agreed reserve criteria.

The first comprehensive regional assessment of old-growth forest in Australia was completed in East Gippsland by Woodgate *et al.* (1994) and it has become the benchmark for a series of regional old-growth forest studies in Victoria. The Woodgate study developed working definitions of old-growth forest and a standard methodology for assessing and mapping forest of different age classes and 'ecological vegetation classes' (EVCs). Ecological vegetation classes are part of a hierarchy of floristic vegetation descriptions.

As part of the Gippsland Comprehensive Regional Assessment (CRA) that is required to complete a Regional Forest Agreement (RFA), the Commonwealth and Victorian Governments agreed to jointly undertake an assessment of the extent of old-growth forest in the Gippsland region.

The Characteristics of Old-growth Forest

Old-growth forests are significant to the Australian community because of their high nature conservation, aesthetic and cultural values, and lack of disturbance. The attributes of old-growth forest include:

- the presence of relatively large trees and other associated understorey species in the wetter forest types to stunted and gnarled trees in drier forest types;
- relatively old trees and other plants in terms of development stage;
- the presence of large crown gaps (in some forest types);
- presence of tree hollows and/or fallen trees;
- characteristic biotic composition;
- presence of certain growth forms for example epiphytes in some forest types;
- stable nutrient cycles and high litter (in some vegetation classes); and
- low rates of change in species, forest structure and ecosystem functioning.

Old-growth Forest Definitions

The old-growth forest study of East Gippsland (Woodgate *et al.* 1994) analysed a range of attributes and found that old-growth forests were characterised by having the oldest possible growth stage and are negligibly disturbed. The Gippsland region old-growth forest study uses the same definition:

'Old-growth forest is forest which contains significant amounts of its oldest growth stage in the upper stratum - usually senescing trees - and has been subjected to any disturbance, the effect of which is now negligible.'

This definition is consistent with the nationally agreed operational definition of old-growth forest for application in the RFA process, which is:

Old-growth forest is ecologically mature forest where the effects of disturbances are now negligible (JANIS 1997).

In applying this interpretation to a forest ecosystem within a region, the following principles will apply:

- ecological maturity is defined by the characteristics of the older growth stages;
- if data are available on the structural, floristic and functional qualities that would be expected to characterise an ecologically mature forest ecosystem, these data should be used in the assessment of the significance of disturbance effects; and
- negligible disturbance effects will be evident in most forests by a significant proportion of trees with age-related features and a species composition characteristic of the ecologically mature forest ecosystem.

Old-growth National Reserve Criteria

The following National Reserve Criteria have been established for the conservation of old-growth forests (JANIS 1997).

Where old-growth forest is rare or depleted (generally less than 10 per cent of extant distribution) within a forest ecosystem, all viable examples should be protected, wherever possible. In practice, this would mean that most of the rare or depleted old-growth forest would be protected. Protection should be afforded through the range of mechanisms outlined in the National Reserve Criteria.

For other forest ecosystems, 60 per cent of the old-growth forest identified at the time of assessment would be protected, consistent with a flexible approach where appropriate, increasing to the levels of protection necessary to achieve the following objectives:

- the representation of old-growth forest across the geographic range of the forest ecosystem;
- the protection of high quality habitat for species identified under the biodiversity criterion;
- appropriate reserve design;
- protection of the largest and least fragmented areas of old-growth; and
- specific community needs for recreation and tourism.

13.2 ASSESSMENT METHODOLOGY

The old-growth forest survey methodology for the Gippsland region essentially followed that developed by Woodgate *et al.* (1994) for East Gippsland and subsequently used for the Central Highlands and North East studies (NRE 1996d, NRE 1998g). This methodology was independently assessed by a joint Commonwealth/State Scientific Advisory Group, which considered that it is an appropriate and effective means of identifying old-growth stands in eucalypt forests.

Woodgate *et al.* (1994) identified attributes that contribute to the forest description, and disturbances that influence the state of old-growth forest. These are discussed in the following section.

The characteristics and extent of old-growth forest attributes in the Gippsland region were gathered using the following methods:

- assessing relative forest age from aerial photographs and field observation;
- analysing historic data within archival records;
- mapping and assessing the nature and degree of disturbance since European settlement;
- mapping and classifying EVCs using aerial photographs, floristic survey and field inspection for all lands; and

- modelling old-growth values for public native vegetation using digital spatial analysis techniques.

All data collected for this project were captured digitally. Information such as floristic vegetation, forest type, land tenure, land systems and land use (including records on the occurrence of historic and contemporary timber harvesting, grazing and agricultural clearing, mining and fire) are stored in an NRE geographic information system (GIS) database.

Results of the old-growth analysis are reported only for public land. Most freehold land in Gippsland has been extensively disturbed through agricultural clearing, timber harvesting or fire. Accordingly, freehold land and lands leased or licensed for plantation purposes was not considered as part of the Gippsland region old-growth study.

Ecological Vegetation Classes

Vegetation in the region was classified into EVCs. EVCs consist of one or a number of floristic communities that appear to be associated with a recognisable environmental condition. Each EVC was described through a combination of floristics, lifeform and reproductive strategy profiles.

In the Gippsland region, 101 EVCs on public land were identified and of these, 45 were eucalypt dominated. Twelve EVC mosaics and five EVCs were not recorded in the public land vegetation mapping of the region. These generally occur on private land which has been largely cleared for agriculture or urban development.

Forest Age

Introduction

For a particular site and vegetation class, old-growth forests are deemed to have attained their oldest, naturally achievable growth stage. Growth stage refers to the developmental stage of the tree based on its physical form. Distinctive features of tree crowns at different growth stages allow key growth stages to be identified from aerial photographs. The oldest growth stage is usually the senescing growth stage and to qualify as old-growth forest, this stage must be present as a substantial component of the stand.

The eucalypt forests, which are the dominant forest type in the Gippsland region, were assessed for the presence of senescing growth stage using aerial photograph interpretation supported by field validation. Crown form characteristics of trees were used to establish growth stage categories for forest stands. The growth stage category was used as a surrogate for the age of forest stands.

Crown Form, Growth Stage and Crown Cover Projection

Crown cover and crown form were mapped from aerial photographs and were used to determine the forest growth stages. Forest growth stage is a term initially described by Jacobs (1955) and is now related to the Statewide Forest Resource Inventory (SFRI, see NRE 1999c for details) crown form (Figure 13.1).

The Gippsland old-growth assessment considers that eucalypt forests pass through three growth stages:

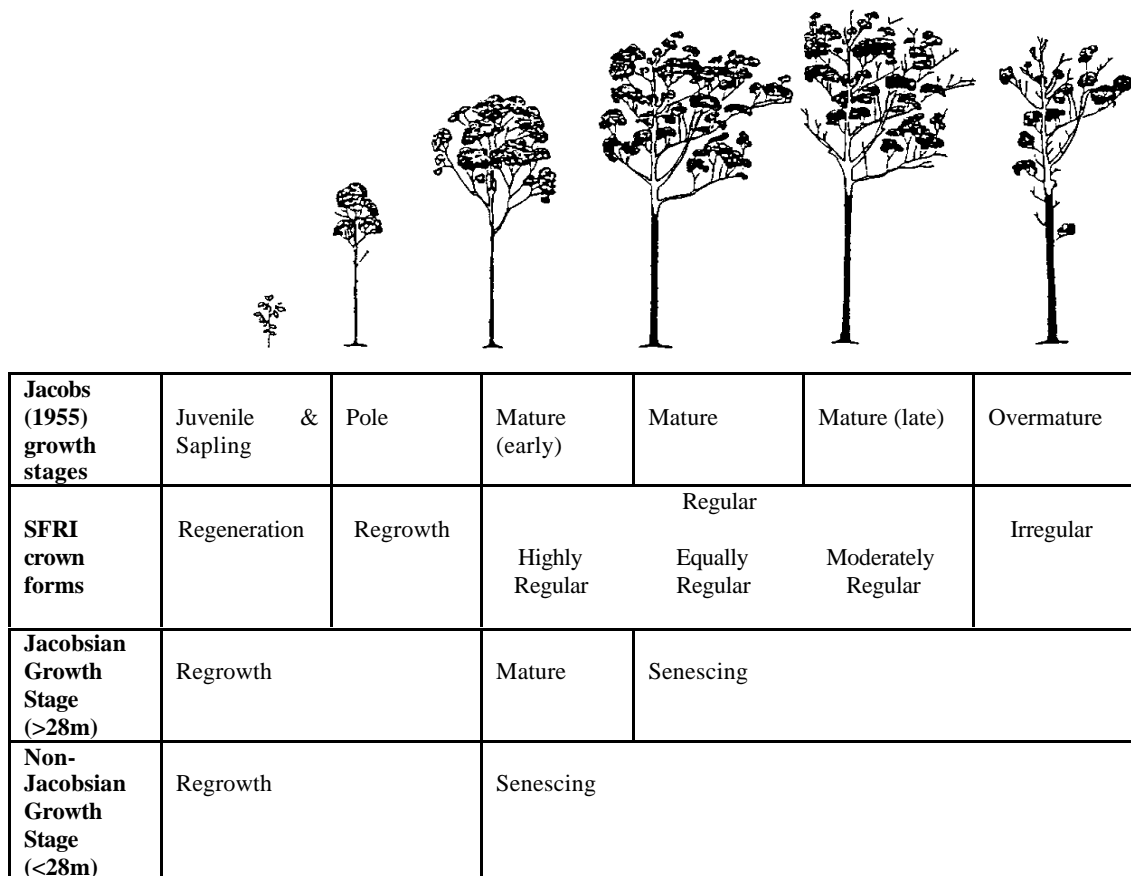
- regrowth;
- mature; and
- senescing.

In forest stands on high environmental quality sites (fertile sites), the crown forms were consistent with the growth stages described by Jacobs and could be readily mapped from aerial photographs.

However, not all eucalypt and non-eucalypt species conform to the typical Jacobsian growth habit. For some species on low quality sites, the characteristics of a senescing crown were not detectable from aerial photographs (for example *Eucalyptus polyanthemos* and *E. goniocalyx*). For other species, the regular crown form is characterised by a healthy crown but represents the final growth stage before death (for example *E. macrorhyncha* and *E. dives*).

All eucalypt stands were classified as Jacobsian or non-Jacobsian by using potential stand height, mapped from aerial photographs, and whether they occurred on high or low quality sites. This was defined at <28m for low site quality (non-Jacobsian) and >28m for high site quality (Jacobsian). The SFRI crown form and the forest growth stages used for the old-growth analysis is presented in Figure 13.1.

Figure 13.1: Relationship between the Typical Eucalypt Growth Stages Described by Jacobs (1955) and those Considered by the Gippsland Old-Growth Study



The equally regular crown form class defined by SFRI contains approximately equal proportions of the highly regular and moderately regular crown forms, and can only be defined for a forest stand. However, this category contains sufficient moderately regular trees to be classified as senescing under the old-growth forest definition.

Tree Ageing

Limited investigations were conducted to determine the ages of forest growth stages by using dating techniques. Ring counting studies on trees felled as a part of the Statewide Forest Resource Inventory (SFRI) growth and yield study provided age information for ash and mixed species eucalypt forests in the Gippsland region. The study found that most of the forest was 60 – 100 years old, and that the remaining mature ash and mixed species forest

were in two distinct age groups - with one group aged between 160 to 190 years and the other between 260 to 280 years. The oldest *E. delegatensis* sampled in the Gippsland region was 271 years old, and the oldest tree from mixed species forest was 235 years old.

Sampling of mature *E. sieberi* in East Gippsland found mature trees to be aged from 158 to 171 years; similarly in the North East, mature trees were found to be in the range of 160 to 170 years old. In the Central Highlands, dating results for *E. regnans* exhibited a broad age range up to 500 years.

Forest Disturbance

Introduction

Forest disturbance mapping was undertaken to identify the presence and scale of disturbance in Gippsland forests, and whether or not the effect of past and present disturbance events is now negligible.

Human settlement and land-use has been an important factor in shaping the current distribution and condition of the native vegetation in the study area. Most clearing of the natural vegetation on the plains and foothills has been for agriculture, but some has also been cleared for urban and industrial purposes, roads, recreation and other uses. Private land in the study area is predominantly agricultural. Public land has generally retained a cover of native vegetation, which has been disturbed to a greater or lesser extent.

Disturbance is a primary characteristic which diminishes, or detracts from, old-growth forest status. Significant disturbance renders a forest ineligible as old-growth. The many disturbances known to alter the primary attributes, such as floristics, structure or growth stage, of the forests in the region were investigated and quantified. Disturbances were described according to their cause - either natural disturbance such as wildfire, or unnatural disturbance such as human induced agricultural clearing or timber harvesting. The location of disturbances through occupation by indigenous people before European settlement is unknown but has been regarded as being natural for the purposes of the old-growth forest assessment.

Research covering historical and contemporary records was undertaken to delineate and map the extent and severity of these disturbances.

The effect of disturbance varied from one vegetation class to another. The significance of each disturbance was classified according to the following levels:

- areas with no record of disturbance were described as ‘undisturbed’
- ‘negligible disturbance’ was defined as a disturbance for which there is an authentic record, but which is unlikely to have altered the structure of the usual composition of species for that EVC; or, if a disturbance did occur in the past, its effect is no longer significant
- ‘significant disturbance’ was defined as a disturbance regime for which there is an authentic record and which is likely to have altered the growth stage ratios or crown cover projection of the usual floristic composition of that EVC, and which is detectable at the time of the survey.

Agricultural Clearing

Agricultural settlement was a key factor in the clearing of Gippsland’s forests. It dramatically altered the landscape of the region. Information about those areas of agricultural clearing within the Gippsland region that are now classified as public land was extracted from archival files. Data on the location, extent and approximate period of clearing for each selection were recorded.

Grazing

Historical and current data on the location and extent of grazing licences were extracted from maps, parish plans, files and archival records. Data recorded included extent and period of licence. The earliest grazing licences, and the pastoral (or squatting) runs were excluded from this study because of inconsistency of available information or poor quality of data relating to the location of the runs.

The impact of grazing varies for each vegetation class. It is unlikely to have an appreciable long-term effect on EVCs with vegetation unpalatable to livestock, which tended only to be grazed during periods of severe drought. Unpalatable EVCs were considered negligibly disturbed. However, grazing in areas that contained 'palatable' vegetation classes was considered to be a significant disturbance. Thirty-nine palatable EVCs were identified on public land in Gippsland including, for example, Herb-rich Foothill Forest, Wetland Formation and Treeless Sub-alpine Mosaic. Therefore the grazed areas, palatability of the grazed EVC and the period over which it was grazed were key factors in determining the level of disturbance.

Furthermore, field inspections revealed that the intensity of grazing activities and the resultant disturbance appeared to be associated with a slope threshold of 20°. Slopes of less than 20° were considered to have significant un-natural disturbance, and areas with a slope of greater than 20° were considered to be negligibly disturbed.

Wildfire

Eucalypt forests are extremely fire-prone and major bushfires are a feature of Gippsland. Major fires occurred in the region in 1851, 1875, 1898, 1900, 1908, 1926, 1944, 1951-52, 1965 and 1998.

Since 1945, the Forests Commission of Victoria and subsequent forest management agencies have mapped the outer boundaries of wildfires. The areal extent of contemporary and historic wildfires was recorded from existing documentation.

Where aerial photograph interpretation confirmed significant disturbance to the growth stage or canopy within these areas, this was classified as significant natural disturbance.

Fuel Reduction Burning

Since the mid-1920s, fire has been used to reduce the amount of flammable material on the forest floor and reduce the risk of intense wildfire. Fuel reduction burns differ from wildfires. They are deliberately ignited on days that produce a cool burn.

Records of fuel reduction burning varied in quality, accuracy and completeness. Areas recorded for each fuel reduction burn were considered as an indication of its extent. In areas where crown cover and growth stage mapping from aerial photographs revealed no damage, fuel reduction burning was classified as a negligible unnatural disturbance.

Mining

The location and extent of disturbances associated with mining were identified from archival records and aerial photographs. Disturbance due to mining was determined by a buffer of differing sizes around particular mining activities, dependent on the assumed extent of the activity.

Timber Harvesting

Detailed information on the geographic extent of timber harvesting was obtained from historical records and maps and, for more recent harvesting, from aerial photographs. Sawlog

allocation records of the Forests Commission covering the period 1936 to 1980 were also used to determine the extent of historic timber harvesting, both clearfelling and selective harvesting. When these mapped sources of disturbance were confirmed by the crown cover or growth stage mapping, the disturbance level was classified as significant and unnatural.

Other Disturbances

Conifer plantations, hardwood plantations and cleared/severely disturbed land (where weeds constituted >50 per cent of cover or 50 per cent of species by composition) were also identified. Native forest and other vegetation cleared or otherwise disturbed for the establishment of softwood and hardwood plantations were identified and mapped from plantation map records. Other disturbances including clearing of power easements were also mapped. Such areas were not included in the analysis to identify old-growth and were classified as significant un-natural disturbance.

13.3 ANALYSIS OF DATA AND RESULTS

Introduction

The objective was to identify areas of old-growth forest in the Gippsland region by using the data gathered from the assessment of growth stage, the collection of disturbance data, field assessment and expert knowledge. Through a process eliminating areas of forest with significant disturbances using these datasets, areas of undisturbed or insignificantly disturbed forest dominated by their older growth stages, or old-growth forest, were identified.

Old-growth Database

Each forest stand was assessed and ranked for old-growth status. Crown cover projection, crown form, vegetation classes and disturbances were all compiled and entered into a GIS database. The resource data utilised were:

- EVCs grouped into Jacobsian or non-Jacobsian growth characteristics;
- forest growth stage grouped into three classes according to the proportions of crown form;
- structural vegetation based on tree height and grouped as above or below 28 metres; and
- disturbance level categories.

Wherever possible, datasets were validated against other datasets using rules to eliminate possible errors.

Assignment of Old-growth Forest Status

Using the forest growth stage class, disturbance and EVC datasets, old-growth forest status was identified according to the old-growth forest definition. That is, old-growth forest was identified as forest which:

- contains senescing trees present in the upper canopy (at least 10 per cent of total crown cover for the stand);
- has regrowth present in sparse proportion (less than 10 per cent of crown cover); and
- has negligible or no disturbances identified.

Younger forest dominated by mature growth stages with a lower proportion of old-growth forest structural characteristics, but which had negligible evidence of disturbance, was recognised as a separate class - 'negligibly disturbed forest'.

Disturbance data collected during the study did not account for the significant disturbance observed during field inspection along the public-private land interface. To take into account this disturbance, a buffer was applied to the public-private land interface, or to public land

adjoining plantation or the Cleared/ Severely Disturbed EVC. The distance of this buffer was based on the presence or absence of forest on the private land and the steepness of slope (20° threshold) on the adjoining public land. Within the buffer, the vegetation classes were considered to be disturbed.

Extent of Old-growth Forest

The Gippsland region covers approximately 1.44 million hectares of public land, of which 209 000 hectares, or 14.5 per cent, has been identified as old-growth forest (Map 4).

Old-growth forest occurs in 39 EVCs within the region. Seventy-five per cent of all old-growth identified in the Gippsland region occurs within seven EVCs:

- Heathy Dry Forest
- Shrubby Dry Forest
- Grassy Dry Forest
- Herb-rich Foothill Forest
- Damp Forest
- Montane Dry Woodland
- Shrubby Damp Forest.

Information on the area of negligibly and significantly disturbed forest will be provided in the Biodiversity Assessment Report.

Old-growth Reservation Levels

Table 13.1 provides information on the reservation status of the old-growth forest in each EVC. This Table shows the amount of old-growth in legislated parks and reserves (conservation reserves), State forest and other public land.

Table 13.2 sets out the area of old-growth forest in each of the Geographic Representation Units (GRUs). The area figure in this Table represents the total area of old-growth forest for each vegetation class in each GRU. The corresponding protection figure refers to the proportion of that area in dedicated conservation reserve Table 13.1: Representation and Reservation of Old Growth

Table 13.1: Representation and Reservation of Old Growth

Ecological Vegetation Class (EVC) (i)	Area of EVC (ha) (ii)	%EVC as Old Growth (iii)	Area of Old Growth	Conservation Reserves		State Forest		Other Parks & Reserves (iv)		Other Public Land	
				Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Damp Sands Herb-rich Woodland	14 310	0.1	15	10	57.1	5	6.8	-	-	5	36.1
Limestone Box Forest	750	5.8	45	-	-	15	30.2	30	69.8	-	-
Lowland Forest	116 680	2.1	2 400	1 170	48.9	1 000	41.9	190	7.9	30	1.3
Riparian Forest	9 010	2.9	260	130	49.1	130	49.7	5	0.5	-	-
Heathy Dry Forest	85 020	23.7	20 120	7 640	38.0	11 850	58.9	570	2.8	30	0.2
Shrubby Dry Forest	263 830	28.0	73 970	26 970	36.5	46 290	62.6	640	0.9	30	0.0
Grassy Dry Forest	33 370	30.4	10 130	3 810	37.6	5 940	58.6	360	3.6	5	0.0
Herb-rich Foothill Forest	116 610	10.6	12 370	8 030	64.9	4 110	33.2	215	1.7	-	-
Blackthorn Scrub	7 380	37.1	2 740	560	20.5	2 170	79.4	-	-	0	0.1
Rocky Outcrop Shrubland	1 810	46.5	840	280	32.9	560	66.8	-	-	-	-
Damp Forest	106 060	14.2	15 030	2 870	19.1	11 780	78.4	365	2.4	20	0.1
Wet Forest	68 450	6.9	4 700	1 460	31.0	3 230	68.6	15	0.3	-	-
Tableland Damp Forest	11 030	9.2	1 020	130	12.7	890	87.3	-	-	-	-
Montane Dry Woodland	131 620	12.6	16 570	9 170	55.4	7 190	43.4	200	1.2	5	0.0
Montane Grassy Woodland	29 950	9.0	2 700	440	16.3	2 100	77.9	50	1.8	105	3.8
Montane Damp Forest	104 140	6.7	7 000	3 720	53.1	3 250	46.4	20	0.3	10	0.1
Montane Wet Forest	11 610	18.2	2 120	1 270	59.9	830	39.4	15	0.7	-	-
Montane Riparian Woodland	2 760	1.1	30	15	49.4	15	50.6	-	-	-	-
Montane Riparian Thicket	2 650	12.7	340	50	15.0	280	81.9	10	3.0	-	-
Sub-alpine Woodland	38 390	17.0	6 510	5 320	81.7	770	11.8	-	-	430	6.5
Shrubby Foothill Forest	36 890	7.5	2 775	510	18.5	2 250	80.9	15	0.5	-	-
Valley Grassy Forest	3 110	1.8	60	35	61.8	15	22.8	10	15.1	-	-
Heathy Woodland	34 510	23.9	8 260	5 240	63.4	2 790	33.8	-	-	200	2.4
Granitic Hills Woodland	3 980	30.2	1 200	1 200	100.0	-	-	-	-	-	-
Rocky Outcrop Shrubland/Herbland Mosaic	9 390	5.9	550	460	82.1	100	17.6	5	0.2	-	-
Riverine Escarpment Scrub	8 640	3.1	270	70	27.8	190	72.2	-	-	-	-
Valley Heathy Forest	1 130	45.1	510	-	-	510	100.0	-	-	-	-
Plains Grassy Forest	19 780	8.3	1 640	300	18.1	1 310	79.8	-	-	10	0.6
Dry Valley Forest	18 850	4.0	750	150	20.2	600	79.7	-	-	-	-
Grassy Woodland	13 980	1.7	240	120	48.5	80	33.8	40	17.2	-	-
Valley Slopes Dry Forest	1 840	44.4	820	260	31.4	560	68.3	-	-	-	0.1
Riparian Scrub	3 900	5.0	195	95	48.6	100	50.2	-	-	-	1.2
Montane Rocky Shrubland	3 260	5.3	170	165	96.8	5	3.2	-	-	-	-
Shrubby Wet Forest	2 250	11.0	250	5	1.3	245	98.6	0	0.1	-	-
Shrubby Foothill Forest/Damp Forest Complex	7 710	2.6	200	20	8.4	170	85.0	15	6.6	-	-
Shrubby Damp Forest	68 160	13.5	9 210	2 030	22.1	7 030	76.3	150	1.6	-	-
Montane Herb-rich Woodland	22 420	8.9	1 980	840	42.2	1 150	57.8	-	-	-	-
Grassy Dry Forest/Heathy Dry Forest Complex	500	5.3	30	30	100.0	0	-	-	-	-	-
Lowland Herb-rich Forest	20 440	2.1	430	25	5.5	350	81.4	55	12.8	0	0.1

Notes: For the old-growth analysis in the Gippsland region, it was considered that old-growth only occurs on public land, due to the generally high levels of disturbances on private land. Areas are rounded to the nearest 10 ha if over 100 ha, or nearest 5 ha if under 100 ha. (i) Only those EVCs that contain old-growth are shown in this table. (ii) The total area of each EVC includes extant forest on both public and private land. (iii) The proportion of old-growth in each EVC has been derived using the total area of extant forest on both public and private land. (iv) Includes 'Other Parks and Reserves' area available for timber harvesting, for example Grant Historic Area.

Table 13.2: Area of Old-growth Forest in each of the Geographic Representation Units

Ecological Vegetation Class	Aberfeldy Foothills		Avon Foothills		Cobungra Mountains		Dargo Mountains		Fish Creek Coastal		Haunted Mountains		King Coastal Plains		Latrobe Foothills		Latrobe Valley		Macalister Mountains		
	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	
3 Damp Sands Herb-rich Woodland													3	100							
15 Limestone Box Forest																					
16 Lowland Forest	49	6	148	9			0	-	8	97	162	-			326	0			4	87	
18 Riparian Forest	36	29	32	33	33	74	33	40			9	-			12	8			34	63	
20 Heathy Dry Forest	2,554	13	1,573	57	3,140	55	319	28			1,090	-			61	42			2,039	67	
21 Shrubby Dry Forest	8,185	32	23,04	32	731	100	8,862	24			4,457	-			185	39			12,15	68	
22 Grassy Dry Forest	179	8	3,326	68	3	79	1,830	26			1,249	-			238	8			1,113	70	
23 Herb-rich Foothill Forest	460	47	1,474	89	1,267	89	1,407	26			484	-							3,273	75	
27 Blackthorn Scrub			3	71			458	23			776	-									
28 Rocky Outcrop Shrubland	1	-			351	48	6	95			15	-							2	100	
29 Damp Forest	2,156	3	2,205	41	1,007	93	2,206	4			2,703	-			258	2	2	-	631	11	
30 Wet Forest	505	1	344	8	17	100	392	2			828	-			11	-			166	11	
35 Tableland Damp Forest	14	8	287	35			30	-			401	-							3	-	
36 Montane Dry Woodland	451	21	1,095	100	1,981	55	2,056	31			1,725	1							3,442	82	
37 Montane Grassy Woodland			27	100	1,055	11	463	-			194	-									
38 Montane Damp Forest	126	12	215	81	1,198	83	849	39			539	1							421	87	
39 Montane Wet Forest	130	0	10	96	923	97					130	-							1	-	
40 Montane Riparian Woodland			0	-	12	14					0	-									
41 Montane Riparian Thicket					99	12	10	-			126	17							2	100	
43 Sub-alpine Woodland	39	30	206	100	2,609	79	769	81			38	6							194	98	
45 Shrubby Foothill Forest	231	5	639	31	42	99	270	7			695	-			63	6			127	2	
47 Valley Grassy Forest			9	100			2	5			12	-							27	100	
48 Heathy Woodland													172	100			45	26			
72 Granitic Hills Woodland																					
73 Rocky Outcrop Shrubland/Herbland Mosaic	17	26	116	71			80	77			2	-							218	88	
82 Riverine Escarpment Scrub	65	22	91	27	0	100	21	13			25	-			6	98			4	100	
127 Valley Heathy Forest			107	-															39	-	
151 Plains Grassy Forest																					
169 Dry Valley Forest	74	20	393	26			69	-			34	-			5	87			35	68	
175 Grassy Woodland	2	-	124	47	1	20	8	50			46	-							10	100	
177 Valley Slopes Dry Forest	457	26	210	20	0	42	24	1			6	-			76	77			0	-	
191 Riparian Scrub															52	-					
192 Montane Rocky Shrubland			22	100			9	78											50	93	
201 Shrubby Wet Forest	142	-	10	29			34	-			30	-							30	0	
315 Shrubby Foothill Forest/Damp Forest Complex	108	5	14	76											56	2			26	-	
316 Shrubby Damp Forest	787	34	3,224	38	0	100	1,739	8			1,477	-							282	33	
319 Montane Herb-rich Woodland					212	56	16	-													
320 Grassy Dry Forest/Heathy Dry Forest Complex																					
877 Lowland Herb-rich Forest	1	-	146	11							5	-									
Ecological Vegetation Class	Matlock Mountains		Mullungdung Coastal		Nunniong Mountains		Strzelecki Foothills		Taylor Foothills		Upper Murray Mountains		Wellington Coastal Plains		Wellington Mountains		Wilsons Promontory		Total Area Old Growth		
	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	Area (ha)	Prot %	
3 Damp Sands Herb-rich Woodland			6	82									7	12			0	100		11	
15 Limestone Box Forest					13	-			30	-										4	
16 Lowland Forest			453	31	57	1	15	-	181	4			0	100			996	100	2,391		
18 Riparian Forest	5	-			14	-			8	16					30	99	17	100	26		
20 Heathy Dry Forest	311	-			3,347	15			141	0	4,962	43			580	100			20,11		
21 Shrubby Dry Forest	1,631	-			3,354	3			7,181	25	40	-	12	-	4,129	91			73,96		
22 Grassy Dry Forest	0	-			1,755	-			164	0	3	-			274	100			10,13		
23 Herb-rich Foothill Forest	235	-			835	9					846	50			2,089	91			12,37		
27 Blackthorn Scrub					1,026	11			455	71									2,731		
28 Rocky Outcrop Shrubland					40	69					425	17							84		
29 Damp Forest	160	-	52	58	2,727	2	6	97	126	3	138	63			5	17	649	100	15,03		
30 Wet Forest	103	-			918	-	254	91	0	-	8	-			28	100	1,125	100	4,691		
35 Tableland Damp Forest					259	-					26	100			1	100			1,021		
36 Montane Dry Woodland	298	12			400	10					2,092	20			3,030	96			16,561		
37 Montane Grassy Woodland					146	3					691	27			119	89			2,691		
38 Montane Damp Forest	78	6			339	-					2,023	30			1,213	99			7,00		
39 Montane Wet Forest	21	0			182	0					695	50			24	49			2,111		
40 Montane Riparian Woodland											9	45			9	100			2		
41 Montane Riparian Thicket											52	5			48	26			33		
43 Sub-alpine Woodland	237	87			82	98					1,483	75			852	98			6,50		
45 Shrubby Foothill Forest	2	-			491	5			0	-							215	100	2,77		
47 Valley Grassy Forest			7,328	63	8	-			95	-	18	-			403	66			5		
48 Heathy Woodland																	195	100	8,251		
72 Granitic Hills Woodland																	1,203	100	1,20		
73 Rocky Outcrop Shrubland/Herbland Mosaic					0	-			12	68	3	-			90	100	16	100	55		
82 Riverine Escarpment Scrub					30	6			21	87	2	100							26		
127 Valley Heathy Forest					365	-													51		
151 Plains Grassy Forest			1,642	18															1,64		
169 Dry Valley Forest	0	-			61	1			72	2	0	-			3	100			74		
175 Grassy Woodland					6	-					27	100			19	100			24		
177 Valley Slopes Dry Forest					6	-			37	97									81		
191 Riparian Scrub			43	48					26	-							74	100	19		
192 Montane Rocky Shrubland															88	100			17		
201 Shrubby Wet Forest	2	-															3	100	24		
315 Shrubby Foothill Forest/Damp Forest Complex																			20		
316 Shrubby Damp Forest					1,080	1														9,21	
319 Montane Herb-rich Woodland					627	37			345	8	1,129	43			278	97			1,98		
320 Grassy Dry Forest/Heathy Dry Forest Complex	3	100									23	100			0	100			2		
877 Lowland Herb-rich Forest					208	-			72	11										43	

14. WILDERNESS

14.1 INTRODUCTION

The assessment of wilderness in the Gippsland region has been undertaken in the wider regional context of the forests of Eastern Victoria, given their broad similarity. The report *Wilderness Assessment of the Eastern Victorian Forests* (VicRFASC 1996d) analyses wilderness quality across four CRA regions, namely Central Highlands, East Gippsland, North East and Gippsland. Reference should be made to this report if further detail is required.

14.2 DATA

The data used in the analysis were those used in the National Wilderness Inventory (NWI) and come from many sources. The distance related indicators (settlement, access and apparent naturalness) are essentially current AUSLIG digital mapping data updates with additional information in the detailed study areas. The disturbance information, that provides the base data for the biophysical naturalness indicator, is of variable quality and lineage across the region studied in this project.

In East Gippsland and the Central Highlands, the disturbance information was that used in the detailed old-growth surveys of the region, with a currency of April 1993 and December 1993 respectively. For North East and Gippsland, the best available systematic disturbance data at the time of the analysis was most recently updated in 1986 and this should be taken into account when interpreting the outputs.

14.3 METHODS

The concept of wilderness embraces measures of remoteness, naturalness and lack of disturbance. The National Forest Policy Statement (Commonwealth of Australia 1992b) states on page 11 that 'forested wilderness areas will be protected by means of reserves developed in the broader context of protecting wilderness values of all lands'. Consistent with this, non-forest vegetation types have been included where they form a mosaic within largely forested wilderness identified in this current assessment.

The approach taken in the eastern Victorian forests wilderness assessment was to first identify and delineate areas of high wilderness quality, and then calculate the percentage of these areas within the existing reserve system.

The NWI methodology developed by Lesslie and Maslen (1995) produces a database of 'wilderness quality' across the region. This is achieved by measuring the variation in wilderness quality across the landscape using four wilderness quality 'indicators' that represent the two essential attributes of wilderness: remoteness and naturalness (see *Wilderness Assessment of the Eastern Victorian Forests* (VicRFASC 1996d)).

To identify areas with high wilderness quality, the criteria used in this assessment were areas with a NWI wilderness quality of at least 12 and an area larger than 8000 ha. In the case of the East Gippsland and Central Highlands regions and Wilsons Promontory analyses, thresholds were also applied to the four wilderness quality indicators.

Boundaries were delineated around areas that satisfied these criteria. Wherever possible, the boundaries which were adopted followed catchment divides or other topographic features. Where such features did not prove suitable, boundaries were drawn that reflected the influence of nearby features affecting wilderness quality, such as roads.

14.4 RESULTS

This assessment of the Eastern Victorian forests identified 18 areas that met the threshold requirements (see Table 14.1). Four of these areas (MacAlister, Avon, Wilsons Promontory and Mt Darling/Snowy Bluff) are located within the Gippsland RFA region. Both the total area and the area included within the existing legislated reserve system were calculated and are presented in Table 14.1. Those areas included within the existing legislated dedicated reserve system were considered to be protected.

14.5 CONCLUSION

Four areas of high wilderness quality have been delineated within the Gippsland region. All of these areas are fully contained within the dedicated reserve system. In total, 95 per cent of the total area delineated as significant for high wilderness quality in the Eastern Victorian forests region is protected. The National Reserve criteria (JANIS 1997) specify that 90 per cent (or more, if practicable) of the area of high quality wilderness that meets the minimum area requirements should be protected in reserves.

Table 14.1: Summary of Protection of Areas of High Wilderness Quality within the Eastern Victorian Forests

Area	Total Hectares	Reserve Status	Hectares Reserved
Cape Howe	7 120	Full	7 120
Sandpatch	28 540	Part	17 150
Petrel	10 960	Full	10 960
Tamboon	5 000	Full	5 000
Coopracambra	28 050	Part	25 460
Upper-Brodribb	5 310	Part	4 850
Tingaringy	25 250	Part	25 060
Snowy	54 560	Full	54 560
Buchan	12 580	Full	12 580
Avon	39 650	Full	39 650
Mt Darling/Snowy Bluff	40 400	Full	40 400
Razor/Viking	15 700	Full	15 700
Wabba	19 700	Full	19 700
Indi Addition to Pilot and Davies Plain	24 300	Full	24 300
MacAlister	33 300	Full	33 300
Yarrarabulla Creek ^{a)}	13 000	Full	13 000
Dartmouth	26 950	Part	20 370
Wilsons Promontory	33 228	Full	33 228
Totals	423 688		402 388

a) Yarrarabulla Creek Area. Part of this area is not included in a legislated reserve but is covered by an Order in Council requiring its protection as a Remote and Natural Area.

15. NATIONAL ESTATE

15.1 INTRODUCTION

Background

The Register of the National Estate is a national register of places in Australia which have national estate heritage value. Heritage values are features which have cultural or natural significance to the national, regional or local community as defined in section 4 of the *Australian Heritage Commission Act 1975*.

Many forest areas are listed in the Register of the National Estate. The Commonwealth Government, in making decisions concerning forests, such as the granting of licences to export woodchips, must consider the possible effect of these decisions on the National Estate.

A regional assessment model for identifying the National Estate was developed in 1991-92 by the Australian Heritage Commission (AHC), in cooperation with the Western Australian Department of Conservation and Land Management (CALM), for the Southern Forest Region of south-west Western Australia, (AHC and CALM 1992). The model was refined and applied in the Victorian East Gippsland and the Central Highland Regional Forest Agreement (RFA) process. The RFA process is consistent with the statutory requirements of the *Australian Heritage Commission Act 1975*.

The Gippsland National Estate assessment commenced in 1996 and is currently being finalised.

The objectives of the national estate study are to:

- assess the representation of national estate values in the existing nature conservation reserve system and other protective land tenures where appropriate;
- identify those areas in Gippsland which merit listing in the Register of the National Estate; and
- provide management guidelines on the protection and maintenance of national estate values.

The Gippsland National Estate report will be released for public comment in the coming months.

The methodology used for the national estate assessment followed the methods developed and reviewed for the East Gippsland, Central Highlands, North East Victoria and Tasmanian RFAs. The methods are outlined in the reports:

- *Method Papers: Central Highlands National Estate Assessment, Volume One - Natural values.* (AHC and CNR 1994b)
- *Method Papers: East Gippsland and Central Highlands Joint Forest Projects, Volume Two ¾- Cultural Values.* (AHC and CNR 1994c)
- *Tasmania-Commonwealth Regional Forest Agreement, National Estate Report. Background Report Part H.* (Tasmanian Public Land Use Commission 1997); and
- *National Estate Identification and Assessment in the North East Region of Victoria.* (Vic RFA SC 1999).

Approach to the National Estate Assessment

The national estate study involves distinct phases: the identification phase, the protection analysis phase and, the development of conservation principles.

The **identification** phase involves assessing the available information against the National Estate sub-criteria to determine areas of value and delineate indicative national estate places. Details on the AHC's criteria and sub-criteria will be outlined in the forthcoming National Estate report. The major components of this phase were: determining the appropriate methods; analysing existing data; undertaking further gap-filling studies; applying the sub-criteria to the data available; and applying thresholds of significance.

The **protection analysis** phase involves an assessment of each national estate value and its sensitivity, resilience and/or robustness to various types of disturbance. Most cultural heritage places are sensitive to disturbance, although for many cultural places their significance is linked with continuing human interaction. In contrast, old-growth forest values are considered sensitive to disturbance such as harvesting, roading or wildfire.

The **conservation principles** phase involves consideration of the sensitivity to disturbance of each value, as well as current international 'best practice' in natural and cultural heritage conservation and the design of nature conservation reserves.

Management and protection of many national estate values are undertaken through a range of mechanisms which can be included in the Forest Management Plan for Gippsland and as set out in the Code of Forest Practices for Timber Production (Rev No 2) (NRE 1996a). Forest Management Plans can address the conservation principles of many national estate values, which will assist in their management. Statewide guidelines for the management of cultural heritage values in the forest, parks and reserves are to be prepared once all the Victorian RFAs are completed. Until such time as the statewide guidelines are completed, *Guidelines for the Management of Cultural Heritage Values in the Forests, Parks and Reserves of East Gippsland* (NRE 1997j) will function as an interim guide. Measures to guide Aboriginal heritage protection and management are being developed with the Aboriginal communities of the Gippsland region. These measures include a proposed study for a sensitivity-zoning plan for the region using the model for Aboriginal cultural heritage management currently being developed for the Victorian forest regions.

15.2 DATA REVIEW

Much of the data for national estate analysis is derived from extensive data sets assembled by NRE over many years. These are analysed and supplemented by consultancies, special projects, and input from the community. Where possible, one source of data is used to complement or confirm another to ensure that the most robust data sets were compiled.

Eight broad types of data and information are used in the assessment:

- existing scientific (natural and cultural heritage) studies and reports;
- site-specific data obtained from field research;
- data collected from mapping, usually aerial photo interpretation;
- existing databases of cultural heritage places;
- information derived from models, using limited ground data;
- studies conducted by consultants;
- community information; and
- information from experts.

The data being used in the national estate study include:

- ecological vegetation class mapping;
- disturbance mapping from old-growth assessment;
- the National Wilderness Inventory database;
- the NRE Flora Information System;
- the Atlas of Victorian Wildlife;
- the forest growth stage data set;

- the NRE Historic Places Section Database;
- the NRE visual management system;
- the Register of the National Estate;
- data assembled at heritage workshops conducted with local communities and major stakeholder groups;
- published and unpublished scientific data;
- specific historic thematic studies, including research and field surveys for sawmill and tramway sites, selected historic themes, and forest activity sites;
- aesthetic value assessment study;
- social value assessment study;
- the Aboriginal Affairs Victoria site register database;
- the Aboriginal Affairs Victoria Aboriginal historical places database; and
- geological and geomorphical data.

These data sources will be summarised in the forthcoming National Estate report.

15.3 CONSULTATION PROCESS FOR NATIONAL ESTATE ASSESSMENT

The main objectives of the consultation process are to:

- involve the community in the identification of its heritage;
- inform all sectors of the community about the national estate study (i.e. local people and organisations, recreation groups, industry groups, conservation organisations and unions);
- be open and transparent about process, methods and decisions;
- encourage a better understanding of heritage, the AHC's role and processes; and
- encourage a stronger understanding of management and conservation measures.

Key Stakeholders

Peak conservation and industry groups were briefed on the national estate study as part of the public briefings, at the local community heritage workshops and at the stakeholders' heritage workshop in Melbourne. Community heritage workshops were conducted at Bruthen, Churchill, Dargo, Foster, Heyfield, Omeo, and Sale. Community heritage data compiled at the community heritage workshops were made available for review and comment. A further opportunity for comment will follow the release of the National Estate report.

Aboriginal Communities

Six Aboriginal community organisations were identified in the Gippsland region. These are Moogji Aboriginal Council East Gippsland Incorporated, Lake Tyers Aboriginal Trust, Ramahyuck District Aboriginal Corporation, Central Gippsland Aboriginal Health and Housing Co-operative Ltd, and Gippsland and East Gippsland Aboriginal Co-operative Ltd. Meetings were held with these groups in November 1998 to discuss the RFA process. A workshop with cultural heritage officers was held at the Gippsland and East Gippsland Aboriginal Co-operative Ltd, Bairnsdale in May 1999 as the first stage in developing an Aboriginal heritage management system. Mirimbiak Nations Aboriginal Corporation has been contacted in order to make contact with all Native Title claimants in the region. A second stage of consultation is planned.

15.4 SUMMARY OF THE NATIONAL ESTATE ASSESSMENTS

The assessment of national estate natural and cultural values of the forests of the region will be summarised in the National Estate report.

More detailed information on cultural value assessments is available in the following consultants' reports:

- Marshall, B. and Jones, R. (1997). *Victorian Cultural Heritage Data Audit and Analysis for the RFA Regions: Gippsland*

- Graeme Butler & Associates (1999). *A Study of Places Relating to Selected Historic Forest Themes in the Gippsland Forest Region Victoria*
- Context Pty Ltd (1999). *Identification and Assessment of Community Heritage Values in the Gippsland Forest Region, Victoria: Workshop Overview Report*
- Context Pty Ltd (1999). *Identification and Assessment of Community Heritage Values in the Gippsland Forest Region, Victoria: Social Value Assessment Report*
- Context Pty Ltd (1999). *Identification and Assessment of Community Heritage Values in the Gippsland Forest Region, Victoria: Inventory of Community Heritage Places*
- Robin Crocker & Associates (1999). *Identification and Assessment of Aesthetic Value in the Gippsland Forest Region Victoria*
- Bannear, D. (1999). *A Study of Historic Forest Activity Sites in the Gippsland Forest Region, Victoria*
- Evans, P. (1999). *A Study of Historic Sawmill and Tramway Sites in the Gippsland Forest Region, Victoria*

16. WORLD HERITAGE

16.1 METHODOLOGY

In accordance with the Commonwealth/Victoria Scoping Agreement and the Commonwealth's obligations under the World Heritage Convention, there is a commitment by both governments to identify and assess World Heritage values in the Gippsland region as part of the RFA.

Places on the World Heritage List are defined as those that have outstanding universal value. The methodology used to identify and assess places that may have this level of value is based on a thematic approach. This assesses significance by developing themes of outstanding universal value, and then testing places against these themes.

The methodology involves the use of an Expert Panel and provides a systematic means of identifying a list of places that meet the criteria and operational guidelines of the World Heritage Convention.

The first step (Step A) of the methodology involves the Expert Panel providing advice to Governments on themes of outstanding universal value relevant to Australia. These themes are then used in the second step (Step B) to develop a list of places that might include those that best represent the identified themes in a global context.

These potential places are then further examined against the Operational Guidelines for the World Heritage Convention to determine whether they have World Heritage value. They are tested using a series of sieves where the places identified at Step B are assessed for authenticity and integrity (Step C), and adequacy of management and legal protection (Step D), prior to formal assessment against the World Heritage criteria in the final step (Step E). Places that do not meet the tests are eliminated at each step of the assessment process.

Details of this methodology are included in the *East Gippsland Environment and Heritage Report* (VicRFASC 1996a).

16.2 ASSESSMENT

An Expert Panel was established to implement Step A and Step B of the methodology for Victoria. Members of the Expert Panel were drawn from amongst Australia's foremost specialists in disciplines relevant to the World Heritage natural and cultural criteria. The panel met in Melbourne on 13-14 June 1996.

Details of the membership of the panel and the formal record of its meeting are included in the *East Gippsland Environment and Heritage Report* (VicRFASC 1996a).

Step A of the methodology required the Expert Panel to:

- provide advice on the identification of significant themes relating to World Heritage natural values (flora, fauna, geological and geomorphological) or cultural values (Aboriginal and European) for all terrestrial areas of Australia;
- assess these themes in their global context in order to provide advice to Governments on which themes are of outstanding universal value; and
- identify those outstanding universal themes that are relevant to forested areas in Australia.

The Expert Panel was then asked to undertake Step B of the methodology for places in Victoria and to:

- determine which, if any, of the outstanding universal themes for forested areas identified in Step A are relevant to Victoria, as well as to Australia as a whole; and
- provide advice on whether there are places in Victoria which best express the themes and which therefore need to be further investigated as part of the CRA process.

16.3 OUTCOMES

The outcomes of the Expert Panel's work are summarised in Table 16.1 below.

The panel identified five potential sub-themes in Victoria, which warrant further investigation. Three of these sub-themes are potentially relevant to the Gippsland region. The relevant sub-themes are:

- areas with outstanding examples of *Eucalyptus*-dominated vegetation associated with the Eastern Forests of Victoria; parts of the Australian marginal swells associated with the Eastern Highlands; and Cretaceous fossils (as exemplified by a site in the Leongatha region).

The Expert Panel in its deliberations on Victoria made the following statement clarifying the nature of the *Eucalyptus* theme:

A strong nomination focussed on Eucalyptus evolution and diversity would include a wide variety of Eucalyptus types from a variety of environments. An excellent representative sample of these can be found in south east Australia, centred on East Gippsland, encompassing a range of habitats from the sea to the alpine herbland, and then to the inland plains. This sample would not be found in a single, contiguous area but would comprise several large areas, most of which could be expected to already have protected area status.

The expression of these sub-themes is not contained entirely within the Gippsland region as they extend to other Victorian RFA regions and areas beyond Victoria. Any assessment of potential World Heritage values (Steps C-E of the methodology) would need to be undertaken in this broader context. The Commonwealth and Victoria remain committed to carrying out such an assessment in this broader context in cooperation with all states involved.

Table 16.1: Summary of World Heritage themes, subthemes and places in Victoria warranting further investigation

STEP A			STEP B	
AUSTRALIA			VICTORIA	
All Terrestrial Areas			Australian Forested Areas	Victorian Forested Areas
Australian Themes of Outstanding Universal Value	Australian Sub-themes/ Exemplars	Explanatory Sentence	Australian Forest Sub-themes/ Exemplars	Potential places in Victoria warranting further investigation
NATURAL				
Ancient records of life and landforms.	Ancient landforms and fossils	Australia has outstanding examples of the earliest known records of life and early physiographic features		
Origin and development of biota and landforms as a result of Gondwana plate tectonics and more recent stability and long isolation.	Passive continental margins	Marginal swells are characteristic of all passive continental margins. The Australian marginal swells are outstanding and exceptional in having volcanics to allow the process to be dated.	Passive continental margins.	Parts of the Australian marginal swells associated with the Eastern Highlands (only partly represented in Victoria).
	Paleoplains	Australia has outstanding examples of ancient soil forms in its ancient laterites and duricrusts.		
	Paleo-drainage systems	Australia has outstanding examples of Mesozoic and older river systems extant in its landscapes.		
	Fossils	Cretaceous fossil sites in Victoria (particularly including fossil remnants of dinosaurs, fish and birds) are the best examples of southern high latitude Cretaceous faunas known.	Fossils.	Fossil sites at the Otway Coast (Cape Otway), Koonwarra (Leongatha region) and the Bunurong Marine Park (Inverloch region).
	Refugia, Relicts	Australia has outstanding examples of relict biota reflecting ancient Gondwana biota.	Refugia, Relicts.	
	Rainforest.	Australian rainforests are an outstanding example of ecosystems from which modern biota are derived. These rainforests are exceptionally rich in primitive and relictual species, many of which are similar to fossils from Gondwanaland.	Rainforest.	

Australian Themes of Outstanding Universal Value	Australian Sub-themes/ Exemplars	Explanatory Sentence	Australian Forest Sub-themes/ Exemplars	Potential places in Victoria warranting further investigation
NATURAL continued				
Evolution of landforms, species and ecosystems under conditions of stress.	Scleromorphy.	The Australian flora includes outstanding examples of the evolution of a diverse range of scleromorphic characteristics in response to low nutrient soils and a highly variable climate.	Scleromorphy.	
	Arid landscapes and adaptations.	Australia, as the most arid, non-polar continent on earth, has outstanding examples of arid landforms and arid-adapted biota in its sandy deserts, including the longest longitudinal dune systems in the world.		
	<i>Eucalyptus</i> -dominated vegetation.	<i>Eucalyptus</i> -dominated vegetation in Australia is an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus. This vegetation has evolved under stress, including conditions of high climatic variability, nutrient deficiency, and high fire frequency.	<i>Eucalyptus</i> -dominated vegetation.	Areas with outstanding relevant examples of <i>Eucalyptus</i> -dominated vegetation associated with the Eastern Forests of Victoria.
	Alpine.	Australia has outstanding examples of globally unusual vegetation that has developed in response to maritime conditions and poor soils.		
Climate change and its impacts.	Records of past climates.	Australia has outstanding and globally significant records of past climates preserved in the sediments of a number of its lake systems.	Records of past climates.	Lakes with climatic sequences in their sediments, including a number of Western Victorian volcanic lakes.
CULTURAL				
Traditional human settlement and land use.	Complex persistence of a hunting- and-gathering society on a single continent.	Australia provides the only example of where the hunting-and-gathering way of life has dominated an entire continent up until modern times. This way of life continues to play a significant role in the occupation of the continent, particularly in its northern and central sections.	Complex persistence of a hunting- and-gathering society on a single continent.	

Australian Themes of Outstanding Universal Value	Australian Sub-themes/ Exemplars	Explanatory Sentence	Australian Forest Sub-themes/ Exemplars	Potential places in Victoria warranting further investigation
CULTURAL continued				
Artistic expression.	Rock art.	Australia has Aboriginal art sites that represent a unique artistic achievement, as well as providing an outstanding record of human interaction with the environment over tens of thousands of years.	Rock art.	
Religious expression.	Dreaming sites.	Australia provides an outstanding example of where the religious system of hunting-and-gathering societies is embodied in the landscape.	Dreaming sites.	
Encounter between cultures.		Australia provides examples of the encounter between hunting-and-gathering societies and 19th Century European societies.		
European expansion of the 18th and 19th centuries.	Forced migration: - a major way in which the expansion took place.	Convict transportation to Australia is an outstanding example of how European powers initiated the occupation of an entire continent.	Forced migration: - a major way in which the expansion took place.	
	Integration of an economic system and the resources of a continent into the global economy.	The Australian goldrushes are an outstanding example of the global migrations associated with the 19th Century goldrushes.	Integration of an economic system and the resources of a continent into the global economy.	Goldrush sites associated with the Central Goldfields of Victoria.
Masterpiece of human creative genius.				
Outstanding example of a type of building/ technological ensemble or landscape.				

17. ECOLOGICALLY SUSTAINABLE FOREST MANAGEMENT

This chapter has been prepared in two parts:

Part 1 Summary of the independent Statewide assessment of ecologically sustainable forest management (ESFM) in Victoria published as part of the Comprehensive Regional Assessments for Central Highlands (VicRFASC 1997b) and a statement on ecologically sustainable forest management for the Gippsland Region.

Part 2 Response of the Commonwealth and Victoria to the Statewide ESFM assessment reported in the Central Highlands Directions Report (VicRFASC 1997c).

PART 1 INDEPENDENT ESFM ASSESSMENT

The following is a summary of an independently assessed report on ecologically sustainable forest management in Victoria.

The report is only part of the overall assessment of ecologically sustainable forest management and together with community input, provides a starting point for Commonwealth and State consideration and determination of sustainable forest management in Victorian Regional Forest Agreements.

The report examines and assesses the systems and processes underpinning the delivery of ESFM in Victoria. The report adopts a 'systems' approach rather than seeking to catalogue specific on-ground practices. An analysis of the overall management system and the process elements was undertaken because there are no established performance indicators or benchmarks for ecologically sustainable forest management.

Given that the report is based on the findings of an independent panel which completed a review and assessment of ESFM in East Gippsland, and an assessment of Statewide practices which was independently peer reviewed, the views contained in this summary and the full report are not necessarily those of the joint Commonwealth and Victorian RFA Steering Committee (the RFA Steering Committee) or of the Commonwealth or Victorian Governments.

17.1 INTRODUCTION

Ecologically sustainable forest management is a key element of current forest policy and underpins the objectives articulated in the National Forest Policy Statement. ESFM can be operationally defined as the management of forest on all land tenures to maintain the overall capacity of forests to provide goods, protect biodiversity, and protect the full suite of forest values at the regional level (VicRFASC 1996b).

The National Forest Policy Statement proposes to give effect to ecologically sustainable forest management through:

- integrated planning processes and management systems;
- Codes of Practice and environmental prescriptions;
- management plans incorporating sustainable yield harvesting practices; and
- management of native forests outside the reserve system complementing the objectives of nature conservation reserve management (Commonwealth of Australia 1992b, p.12).

Following completion of the Independent Advisory Group's work on ESFM for East Gippsland, it was recognised that the information and assessments arising from that work related largely to management systems and processes that are relevant in a Statewide context,

not just East Gippsland. Consequently, the Commonwealth and Victoria agreed to the development of a Statewide ESFM report and assessment, using as much of the information as possible from the East Gippsland work as a basis for the Statewide report, and to fill any gaps as required.

A brief description is provided below outlining:

- the methodology used in the Statewide assessment;
- a statement on ecologically sustainable forest management for the Gippsland RFA Region. The complete Statewide assessment report was published as part of the Comprehensive Regional Assessments for Central Highlands (VicRFASC 1997a);
- a description of the environmental management system framework used for the assessment;
- a summary of the outcomes of the assessment based on five environmental management system components in relation to the ecologically sustainable management criteria; and
- an overall appraisal of Victoria's forest management systems and processes.

The Commonwealth and Victoria have considered the Statewide ESFM assessment and the comments made by the Expert Advisory Group and Professor Ian Ferguson. Part 2 outlines the response of the Commonwealth and Victoria to the Statewide ESFM assessment, as well as the current status of actions in regard to the responses.

17.2 METHODOLOGY

Assessment of Statewide Forest Management Systems and Processes in Victoria

The assessment focuses on the effectiveness of management systems and processes in delivering ecologically sustainable forest management according to a set of principles and criteria (Table 17.1).

Preparation of the Statewide ESFM report was undertaken by a Project Management Group consisting of Commonwealth and Victorian officials under the guidance of the RFA Steering Committee. Descriptions and assessment of Statewide management systems and processes were either adapted from systems and processes described for East Gippsland having relevance to the whole State or, in the case of systems and processes not covered in the East Gippsland Report, prepared by the Project Management Group.

The final report was independently reviewed by Professor Ian Ferguson, the chair of the East Gippsland Ecologically Sustainable Forest Management Expert Advisory Group in accordance with the following terms of reference:

The consultant is required to review and report on a description and assessment of Ecologically Sustainable Forest Management systems and processes in Victoria in relation to ESFM principles and environmental management criteria with particular attention to:

- 1. new descriptions and assessments of Statewide management systems and processes not covered in the East Gippsland Report;*
- 2. whether the assessments of Statewide management systems and processes properly reflect the East Gippsland Report; and*
- 3. an overall appraisal of the Statewide report and identification of the strengths and weaknesses of Victoria's forest management systems and processes.*

Table 17.1: Management System Structure and Criteria for Assessment of Ecologically Sustainable Forest Management.

ASSESSMENT CRITERIA	CRITERIA* DESCRIPTION
System design to meet national principles of ecologically sustainable forest management	<p>The planning and management of native forests should:</p> <ol style="list-style-type: none"> 1. Maintain the full suite of forest values for present and future generations. 2. Maintain and enhance long -term multiple socio-economic benefits to meet the needs of societies. 3. Protect and maintain biodiversity. 4. Maintain the productive capacity and sustainability of forest ecosystems. 5. Maintain forest ecosystem health and vitality. 6. Protect soil and water resources. 7. Maintain forest contribution to global carbon cycles. 8. Maintain natural and cultural heritage values. 9. Utilise the precautionary principle for prevention of environmental degradation. <p><u>Notes</u></p> <ol style="list-style-type: none"> 1. These principles should be interpreted and applied in the context of the National Forest Policy Statement and other existing policy documents. 2. Definitions contained in the National Forest Policy Statement apply to these principles. 3. Planning and management of plantations should be consistent with the Ministerial Council for Forest Fisheries and Aquaculture document: Forest Practices Related to Wood Production in Plantations: National Principles. <p>* <i>These criteria need to be applied at the appropriate ecological scales.</i></p>
Public transparency	<p><u>Scrutiny</u>: Type and level of scrutiny - parliamentary, administrative.</p> <p><u>Consultation</u>: Opportunity for public comment, individual stakeholder and group submissions, advisory group involvement in the process, information exchange, provision for feedback in consultation process.</p> <p><u>Access to information</u>: Process for access to information.</p> <p><u>Public involvement</u>: Opportunity for individual stakeholder or community groups to be involved in the decision-making process.</p> <p><u>Reporting</u>: Mechanism for reporting of processes and outcomes for all system criteria.</p>
Monitoring	<p><u>Trend measurements</u>: Process for assessment of change.</p> <p><u>Monitoring regimes</u>: Process for regular monitoring of indicators.</p> <p><u>Standards</u>: Process for designation of quantifiable measures against which the quality or performance of a characteristic or attribute is assessed.</p> <p><u>Performance targets</u>: Process for designation of specified goals.</p> <p><u>Performance verification</u>: Process for ensuring achievement of standards and targets</p>
Compliance	<p><u>Audit arrangements, penalties, incentives</u>: Processes that ensure compliance with stated goals or objectives.</p>
Scientific and technical basis	<p><u>Mechanism</u> for assessing adequacy of information (for example scientific/peer review); <u>Process</u> for incorporation of information into decision making process.</p>
Review	<p><u>Mechanism</u> for review, feedback and continual improvement, internal/external, periodicity.</p>

Description of the Environmental Management System Framework used for the Assessment

The International Standards Organisation (ISO) 14004 (Standards Australia 1995) environmental management system framework provided guidance for developing the structure for the assessment of Victoria's forest management systems and processes (Table

17.2). The ISO 14000 series environmental management system operates at an organisation¹ level, and has the potential to contribute to an internationally acceptable system for certification of forest management and labelling of forest products in the future. Victoria's forest management systems and processes were classified into five components for the assessment of ecologically sustainable forest management.

Commitment and Policy Framework

The commitment of the Commonwealth and Victorian Governments, their Departments and relevant business units to ecologically sustainable forest management was assessed in terms of the development and application of appropriate legislation, policies, conventions and agreements which contribute to achieving ESFM. The process for coordination of Commonwealth and State forest related policies and legislative requirements was also treated under this heading.

Planning

A major focus of the assessment was whether management practices were supported by principles of environmental care, guidelines and minimum standards, and the basis (quantitative, qualitative and expert opinion) for application of guidelines and minimum standards within codes for specific management practices, and transparency of the planning process. Focus was also given to legal requirements, environmental aspects of forest management practices, allocation of values to particular planning zones, planning processes for minimising environmental impacts of management practices, and appropriateness of plans, and their scale and scope in relation to environmental objectives and targets.

Implementation

The capacity and capabilities of governments and their agencies to deliver ESFM through adequate accountability and responsibility, resourcing, operational controls, documentation, records keeping and reporting, communication, education and knowledge, and skills and training were assessed.

Forest Information, Monitoring and Evaluation

The assessment considered Victoria's systems for monitoring and evaluating environmental performance of the implementation of forest management plans, and the condition of the forest in relation to requirements for ecologically sustainable forest management.

Gippsland Forest Management Systems and Processes

As part of the CRA for Gippsland, the forest management systems applicable to that region were reviewed, against the Statewide ESFM report (VicRFASC 1997a) to identify any issues or systems that are specific to Gippsland. It is considered that the Statewide review of ESFM is applicable to Gippsland.

The Statewide ESFM report indicates an intention to prepare a forest management plan for Gippsland. Where a forest management plan is not in place, such as in Gippsland, State forest is managed according to approved LCC recommendations and NRE policy and guidelines. The proposed Mid-Gippsland Forest Management Plan will be released for public comment prior to its finalisation. It will be an integrated management plan developed with assistance from the community in the area. The plan will propose a framework for the future management of the State forests of Gippsland and will commit the Department of Natural

¹ An organisation can be Commonwealth and State Government organisations or statutory authorities, Governments, private or non-government organisations. For the purpose of the ecologically sustainable forest management assessment, Governments and their administrative structures have been assessed. Private organisations are not included in this assessment.

Table 17.2: Forest Management Systems and Processes in Victoria

<p>1. LEGISLATION AND POLICIES</p> <p>International Treaties, Conventions and Initiatives Commonwealth Government Legislation National Policies State Legislation State Policies</p> <p>2. PLANNING</p> <p><i>Strategic Planning</i></p> <p>Regional Forest Agreements Land Use Planning - Public land</p> <p><i>Forest Management Planning - Public Land</i></p> <p>Forest Management Plans (State Forest) Victorian Code of Forest Practices Regional Prescriptions Sustainable Yield Wood Utilisation Plans Forest Coupe Plans Log Grading</p> <p><i>Park Planning</i></p> <p>Park Plans</p> <p><i>Private Land</i></p> <p>Land Use Plans Education and Cooperative Programs Native Vegetation Retention Controls Code of Forest Practices for Private Land Waters of Victoria State Environment Protection Policy Flora and Fauna Guarantee Plantation Management Private Forestry Strategy</p> <p><i>Fire Management Planning</i></p> <p>Code of Practice for Fire Management Regional Fire Protection Plans</p> <p><i>Flora and Fauna Planning</i></p> <p>Flora and Fauna Guarantee Recovery Plans</p>	<p>2. PLANNING (continued)</p> <p><i>Cultural Values</i></p> <p>Aboriginal Places Historic Places</p> <p><i>Exploration and Mining</i></p> <p>Environmental Effects Statements Planning Permits Work Plans Environmental Review Committees</p> <p><i>Other Plans</i></p> <p>3. IMPLEMENTATION</p> <p><i>Accountabilities and Responsibilities</i></p> <p><i>Resourcing of Implementation Programs</i></p> <p><i>Operational Controls over Implementation Programs</i></p> <p>Control of Timber Harvesting in State Forests Control of Fire Management Operations Control of Other Activities in State Forest Control of Operations in National Parks Control of Other Operations on Public Land Control of Activities on Private Land</p> <p><i>Documentation and Records Keeping</i></p> <p><i>Communication and Education</i></p> <p><i>Knowledge, Skills And Training</i></p> <p>4. INFORMATION MONITORING AND EVALUATION</p> <p><i>Forest Information</i></p> <p><i>Monitoring Implementation of Plans and Programs</i></p> <p><i>Monitoring and Evaluating Condition of the Forest Environment</i></p> <p><i>Auditing of Compliance with Regulations and Controls</i></p> <p><i>Corrective Action</i></p> <p>5. REVIEW AND IMPROVEMENT</p> <p>Review of the Environmental Management System Research and Development</p>
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Resources and Environment (NRE) to the completion of specific management actions to enhance the conservation and production roles of State forest.

The process for auditing components of the management system and corrective actions to determine system performance was also assessed. Assessment of audit processes was based

on their objectivity and impartiality, and whether they were conducted by properly trained personnel (Standards Australia 1995).

Review and Improvement

Processes for review which lead to continuous improvement of the management system and environmental performance were assessed. These included:

- processes for improvement of the management system which can lead to improved performance;
- application of review findings and research and development at policy, management and planning levels; and
- effectiveness of research and development processes.

Ecologically Sustainable Forest Management Assessment Criteria

ESFM has been assessed against nine principles for ecologically sustainable forest management and the five environmental management system criteria namely: public transparency; monitoring; compliance; scientific and technical basis; and review (Table 17.1).

The nine principles have been developed for national application from the Montreal Process, Forest Stewardship Council Principles and Australian Forestry Council Principles for Environmental Care in Native Hardwood Logging.

Principle 1 Maintain the full suite of forest values for present and future generations

This principle addresses the issue of intergenerational equity, that is, that forests be managed to meet present needs without compromising the ability of future generations to meet their own needs (Young 1993). It provides the context in which principles 2-9 must be considered.

Principle 2 Maintain and enhance long-term multiple socio-economic benefits to meet the needs of societies

The basis of this principle is the promotion of forest related economic activity which is consistent with the maintenance of the environment and satisfaction of the socio-economic requirements for income, employment, goods and services. Implicit in this principle is the optimum use of the forest economy's capital stock (human, man-made and natural resource capital) through management so as to maximise the long-term welfare or benefit of society in terms of goods and services it requires. The forest economy covers timber and other forest products and uses, water supply, minerals, grazing, recreation and tourism.

Principle 3 Protect and maintain biodiversity

The maintenance of biodiversity is fundamental to achieving ecologically sustainable forest use (ESDWG 1991, Commonwealth of Australia 1992b). Incorporated into the concept of biodiversity is variation at the ecosystem, species and genetic levels.

Principle 4 Maintain the productive capacity and sustainability of forest ecosystems

Sustained production of biomass by forest ecosystems is essential to the well-being of all living things. The productive capacity of a forest can be influenced through the silvicultural regime and other management activities. Implicit in the term sustainability is the understanding that irreversible damage through resource use is not imposed on the capacity of the forest to supply goods or services to present and future generations (Ferguson *et al.* 1996).

Principle 5 Maintain forest ecosystem health and vitality

This principle reflects the concept of ecological integrity whereby the health and vitality of an ecosystem is maintained under changing environmental conditions. Structural and functional

changes can occur in ecosystems as a result of threatening processes, such as land clearing, fire, pollution, pests and diseases. These can cause significant shifts in species composition, loss of key biological components, or the degradation of ecosystem processes. Consideration of ecological integrity means determining thresholds of environmental change whereby each threshold results in a reorganisation of the ecosystem to a different but appropriate level. The properties and processes of forest ecosystems over management periods become important considerations for maintaining ecological integrity over time.

Principle 6 Protect soil and water resources

Forests contribute significantly to the maintenance and conservation of the soil resource; they afford water catchment protection, and maintain the quality and quantity of water.

Principle 7 Maintain forest contribution to global carbon cycles

Carbon is stored in Australian forests as living plant and animal biomass and dead organic matter in the form of forest debris. As a general rule, carbon is accumulated and stored in forests that are growing and which, as a consequence, contribute positively to carbon storage. Forests in which carbon is accumulated through photosynthesis but offset by the loss of carbon resulting from biomass decomposition or death are carbon neutral. Generally, forests that make a negative contribution to carbon storage are those that are regularly burnt, harvested on short rotations, or subject to heavy soil disturbance.

Principle 8 Maintain natural and cultural heritage values

Heritage encompasses archaeological sites, historic places and customs (cultural heritage), and natural values or objects (natural heritage) that are of aesthetic and social value and passed down to the present generation from past generations.

Principle 9 Utilise the precautionary principle for prevention of environmental degradation

In applying the precautionary principle, public and private decisions should be guided by:

1. careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and
2. an assessment of the risk-weighted consequences of various options.

In interpreting this principle, particular attention was paid to processes based on 'risk assessment' and 'risk management' strategies. Such processes are important to minimise environmental impacts and avoid serious or irreversible damage to the environment.

17.3 SUMMARY OF ASSESSMENT

The following is a summary of the 1997 assessment of Victoria's forest management systems and processes in relation to the ESFM principles and environmental management system criteria above. It should be noted that some action has been undertaken on these items and this is set out in Part 2.

Commitment and Policy Framework

Legislation and National and State policies for the forests of Victoria provide a comprehensive framework for ensuring that all forest values are considered, assessed and afforded protection. In general, all the principles of ecologically sustainable forest management are met. On public land, legislation requires strategic land-use planning at the State/regional level through to legally enforceable Codes of Practice at the operational level (e.g. Code of Forest Practices for Timber Production - the Code). On private land, the legislation requires regional level planning, adherence to the Code and control of, for example, the clearance of native vegetation. In a number of instances, these arrangements are

reinforced by legislation designed to safeguard particular values (e.g. Flora and Fauna Guarantee Act).

Revision of Commonwealth Acts such as the *Australian Heritage Commission Act 1975* and the *Environment Protection (Impact of Proposals) Act 1974* should be considered in the light of current RFA processes to improve coordination of forest management, and especially to develop a jointly agreed approach to identifying and assessing heritage values that minimises the overlap and differences between Commonwealth and Victorian legislation. Duplication in the application of Commonwealth and State Acts relating to the protection of endangered flora and fauna should be addressed.

Statutory land-use planning and management processes for public land in Victoria involve a precautionary approach in determining the need, level and mechanisms for protecting important environmental values. On private land, environmental protection, including requirements for retention of native vegetation, is achieved through planning scheme provisions under the *Planning and Environment Act 1987* and is identified in Catchment Management Strategies under the *Catchment and Land Protection Act 1994*.

There is a legislative requirement to review sustainable sawlog yields every five years. The transparency of the review process could be improved. Yields are legislated and industry licence volumes are allocated on the basis of regional sustainable yield.

Potential socio-economic benefits are currently being foregone in Victoria by lack of utilisation of residual logs as a result of Commonwealth restrictions on export of woodchips. Harvest and export of pulpwood throughout Victoria would also have benefits for silviculture and fire management provided environmental values are protected.

Legislation was passed by the Victorian Parliament in 1997 to replace the Land Conservation Council with a new body called the 'Environment Conservation Council' whose task will be to conduct investigations into the balanced use or development of public land within the State.

Planning

Principle 1 Maintain the full suite of forest values for present and future generations

The planning processes in Victoria span all the levels required for achieving ecologically sustainable forest management. Land Conservation Council (LCC) studies have collected and assessed available information thoroughly, provided significant opportunities for public input, and ensured a balanced allocation of forested public land between resource use and conservation on a broad regional scale. The allocation of public land achieved through Land Conservation Council processes addresses all assessment criteria and provides a sound basis for ecologically sustainable forest management.

Preparing effective strategic plans for ESFM requires methods for dealing with the often complex trade-offs necessary between competing ecological and socio-economic values. There is a strong need for sophisticated modelling approaches and data for dealing with these trade-offs, and this is being addressed.

Forest Management Plans, the Code and associated prescriptions applied within the land-use framework established by the Land Conservation Council, provide a strong basis for achieving ecologically sustainable forest management. The plans specifically address parks and State forests but take account of all tenures in their attempt to balance resource use with other conservation and management requirements. Where forest management plans are not in place, the forest is managed according to approved LCC recommendations and the Department of Natural Resources and Environment (NRE) policy and guidelines. In such areas, the preparation of the Wood Utilisation Plan assumes a more important role. Wood

Utilisation Plans are prepared by a multi-disciplinary team and must take account of all available information on timber, flora, fauna, catchment, land protection and cultural values. The monitoring of implementation of Wood Utilisation Plans occurs, however this is hampered by the lack of an adequate coupe recording and tracking system.

The Department of Natural Resources and Environment needs to develop a system for monitoring implementation of plans, commence reporting on plan implementation, and make the information publicly available, along with actions intended to address any identified deficiencies. For national parks, major issues include setting clear and strategic goals for the conservation of biodiversity (or other express purposes of reservation) that are realistic in relation to available resources and against which the success of management can be judged, and consideration of the collective contribution of individual parks to regional conservation (or other express purposes of reservation) in the planning processes.

The Native Vegetation Retention Controls, Flora and Fauna Guarantee and the Code provide mechanisms for protecting environmental and other values on private land. Strategic regional plans which address flora and fauna conservation issues are required to ensure their implementation is coordinated and directed towards clear conservation goals or other relevant goals. Catchment Management Strategies may fulfil this role but are not yet well-developed.

The environmental effects statements (EES) and planning processes for assessing exploration and mining applications provide opportunities for consideration of socio-economic, environmental and cultural values, and for public participation. The incorporation of the former Department of Minerals and Energy into NRE should facilitate communication between formerly separate agencies and help produce more timely and balanced outcomes. NRE is however still refining its internal processes for assessment of exploration and mining applications. Work Plans provide mechanisms for the setting of suitable licence conditions. The local government planning process for assessment of mining applications is slow and often more adversarial than the EES process. The EES process is more objective and rigorous, providing better opportunities for consideration of scientific evidence and differing views on the relative merits of a proposal.

At the strategic planning level there are major opportunities for public input to forest management in Victoria. Public confidence in forest management planning could be increased by development of a more comprehensive set of performance indicators against which implementation of the plan can be assessed, and setting of some more explicit targets against which the effectiveness of plans can be measured.

Principle 2 Maintain and enhance long-term multiple socio-economic benefits to meet the needs of societies

The Flora and Fauna Guarantee Act and the Land Conservation Act have clear requirements for involvement of scientific experts, community consultation and consideration of socio-economic issues. These issues could be considered more thoroughly in preparing forest management plans where necessary. Current policy and programs are principally directed at improving and extending the plantation estate on private land, and the economic returns and environmental and social benefits provided by plantations and trees on farms.

There is a need for better links between forest management plans, local government planning and cross border regional planning for industry, tourism, recreation and catchment management. Significant changes in industry opportunity (e.g. value-adding, pulpwood utilisation, and tourism) should trigger re-examination of forest management plans.

Principle 3 *Protect and maintain biodiversity*

Planning for protection of biodiversity in Victoria involves a hierarchy of strategic and operational plans which assess the need for reservation or special management at all scales from region to coupe, and puts in place regional and local prescriptions designed to limit the impacts of timber harvesting and other activities on flora and fauna and other values. The reserve system established by the Land Conservation Council land-use planning process is supplemented by a complementary zoning scheme in State forests which provides special prescriptions for conservation of Ecological Vegetation Classes, old-growth forests, and threatened flora and fauna. Overall, these planning processes make a major contribution to meeting the requirements for protecting and maintaining biodiversity and complementary management of 'off-reserve' areas. Once the boundaries of the National Reserve System are determined, mechanisms need to be developed to accommodate long-term changes in landscape dynamics through removal, exchange, or addition of areas on or near the boundaries. These mechanisms for periodic changes should seek to maintain adherence to the reserve criteria and the level of the sustainable yield, but provide sufficient flexibility to accommodate new information.

The effectiveness of Action Statements and Recovery Plans for flora and fauna need to be better assessed, based on monitoring and research. While Action Statements and Recovery Plans have been completed for numerous species, they have not been completed for communities and threatening processes. Additionally the overarching Flora and Fauna Guarantee Strategy has yet to be completed. These elements of the Flora and Fauna Guarantee should be implemented to ensure a coordinated approach to flora and fauna conservation.

Strategic regional plans are required to ensure that mechanisms for protecting biodiversity on private land are coordinated and directed towards clear flora and fauna conservation goals.

Principle 4 *Maintain the productive capacity and sustainability of forest ecosystems*

The adequacy of the existing Statewide process for estimating sustainable yield in those areas with a forest management plan has been reviewed as part of the East Gippsland RFA process (VicRFASC 1996b). Procedures and data for achieving these estimates are coarse at present, but uncertainties are accounted for by making conservative estimates of sustainable yield.

The process should continue to be as transparent as possible within restrictions relating to commercial confidentiality. It should continue to seek input of the best available specialist expertise from within and outside the Department of Natural Resources and Environment, and include regular reviews as legislated in relation to monitoring indicators of ecological sustainability.

The fact that formal review of sustainable yield is a separate process to preparation of Forest Management Plans is seen by some community groups as a potential impediment to achieving ecologically sustainable forest management. It should be recognised, however, that the five-yearly review of sustainable yield takes account of changes in the land base for timber production to meet conservation needs. Greater explanation of the procedure for estimating sustainable yield and making the methodology and data used publicly available at an earlier stage than has occurred previously would raise public confidence in this process. Sustainable yield and actual hardwood sawlog supply levels should be routinely reported and be publicly available.

Principle 5 *Maintain forest ecosystem health and vitality*

Wildfires pose a significant threat to resources, property and forest values on both public and private lands. Potential losses are considered in planning. Clearly established planning guidelines under the Code of Practice for Management of Fire on Public Land and strategic

and operational plans provide a sound basis for integrated and effective management and control of fire in Victoria. The current practice of ensuring that fauna and flora officers have input to fire management plans is an important part of minimising risks to biodiversity. On private lands, the processes and planning mechanisms adopted by the Country Fire Authority provide a logical and accountable basis for strategic and operational planning for prevention and control of wildfires. While most issues are appropriately dealt with through strategic and additional plans, the overall effectiveness of pest management is limited by the lack of strategic plans for pest plant and animal control that cover all tenures. Operational planning processes should provide continuing programs for training and updating field staff and access to support materials.

Principle 6 Protect soil and water resources

For State forests, the Code of Forest Practices and supporting local management prescriptions provide guidelines for protection of soil and water values. The guidelines given in the Code are designed as Statewide minimum standards and therefore cannot address regional variation. The development of regional prescriptions that build on the Code standards to take account of local factors such as soil types and climatic conditions is required and should continue, as should research into the development of indicators of soil damage caused by harvesting machinery.

Areas of high soil erosion risk are often excluded from harvesting and may be placed in the Special Protection Zone as part of a Forest Management Area plan. The management of these and other erosion-prone areas in reserves is based on exclusion or careful management of fire and other activities to maintain vegetation and litter cover. Inclusion of targets in forest management plans for soil and water quality should be considered.

Catchment Management Authorities have played an important role in analysing threats and beneficial uses and must continue to do so to provide appropriate strategies to protect soil and water at the sub-catchment level.

Principle 7 Maintain forest contribution to global carbon cycles

Victoria aims to progressively increase its total forest cover through programs such as Landcare and the Tree Victoria Action Plan. There is a judgement by forest managers that conversion of mature forest to regrowth will maintain carbon storage, and that management burning will have a neutral long-term effect on forest carbon budgets. Little information is available to test these judgements at a regional scale. The areas of greatest uncertainty are the pattern of carbon re-accumulation in forest biomass after harvesting, the effects of harvesting and fire regimes on changes in the soil carbon store, and the residence time of carbon in harvested forest products.

Principle 8 Maintain natural and cultural heritage values

A suite of legislation protects all archaeological sites (Aboriginal and historic), significant historic sites, and aesthetic values. They are recognised at the strategic forest management level and in a range of management plans. More detailed strategies for the identification and protection of cultural heritage values, including Aboriginal sites, are required.

Deficiencies at the operational planning level need to be addressed through improved liaison with Aboriginal Affairs Victoria to implement the Aboriginal and Archaeological Relics Act, and increased participation of Aboriginal communities in Aboriginal site identification and management. A systematic approach to Aboriginal site impact assessment through appropriate ongoing identification of values (through consultation with communities and field survey) is required.

Principle 9 *Use the precautionary principle for prevention of environmental degradation*

A precautionary approach to forest management is adopted through a range of planning processes including a conservation reserve and zoning system, reservation of Ecological Vegetation Classes based on rarity and other indicators of risk, application of management prescriptions to ameliorate threatening processes in forests managed for timber harvesting and in sustainable yield.

Areas for improvement include:

- recognition in Forest Management Plans of the contribution of all forest areas to regional conservation goals e.g. General Management Zone;
- development of a formal approach to risk assessment at the commencement of the planning process and at periodic reviews to give greater confidence in the measures taken to ameliorate risk and to better identify the need for research into new types of information; and
- development of flexible corridor networks to accommodate changes in habitat where necessary.

Implementation

The accountabilities and responsibilities for delivery of each element of ecologically sustainable forest management are clearly established. The high level of public ownership and land management by one Department provides a good basis for a coordinated approach to ecologically sustainable forest management and minimises overlap and duplication between government agencies. Service delivery is facilitated by a departmental structure with both centralised control and strong decentralised components. The creation of Parks Victoria as a provider of park management services to NRE is new. It is unclear whether policy and regulatory functions can be clearly and effectively separated and maintained by the Parks Program within NRE, and whether the protocols and other planning measures concerning coordination across these and other bodies within NRE and Parks Victoria will be effective in fire and other management activities. These aspects merit review and continued improvement.

The program and budgeting process of NRE generally reflects National Forest Policy Statement initiatives to improve public forestry accounting systems. In this way, the performance of both commercial activities and community service obligations can be clearly evaluated. A strength of the business unit structure is that it should allow all costs and benefits relating to ESFM to be fully identified. Uniform treatment of all business units and activities is acknowledged to be difficult and ongoing refinements are needed. Particular attention is needed to identify costs on a regional basis and to separate costs of commercial and non-commercial activities. The level of funding to an individual region should be linked to the requirements for effectively implementing the strategic and annual plans for ecologically sustainable forest management in that region. Maintenance of a strategic focus for research into ESFM also needs a continuing commitment to funding. For sustainable fire management, it is important to ensure that levels of skilled staff for fire-planning and suppression activities are maintained at least at current levels.

The process for control of forest operations to achieve compliance with the Code of Forest Practices and Coupe Plans is transparent and accountable. There is clear responsibility for control for each stage of timber harvesting from supervision of the implementation of the Coupe Plan to the signing of a Coupe Completion certificate following satisfactory compliance with the plan, including draining of major snig tracks and rehabilitation of landings. A major strength in managing timber harvesting operations is the Forest Operator Licensing System. The indicator point system provides a strong basis for the regulation of harvesting activities conducted by independent contractors to ensure they conform with the

Code of Forest Practices. The process of control to achieve compliance with the Code of Fire Management on Public Lands is transparent and accountable. Country Fire Authority requirements for supervision by trained staff of all fire prevention and control operations, and a permit system for prescribed burning by private landholders provides an accountable basis for control of fire operations on private land. Improvement is needed in the forthcoming reviews of Fire Protection Plans to ensure that specialist peer review is generally undertaken. The lack of auditing processes for other Departmental operations is a weakness which should be addressed. In particular, there is a need to audit the extent of compliance of strategic and operational plans. An area for improvement is the supervision of forest operations where protection of archaeological or heritage values is important.

Statewide guidelines and procedures for parks and reserves provide guidance and a consistent approach across the State for a variety of field operations and park management issues. Supervision of contractors by field staff, ranger patrols to ensure visitor compliance with regulations, and leases and licences provide further operational control.

Private landholders are responsible for controlling activities on their land. Native Vegetation Retention Controls, Flora and Fauna Guarantee and the Code provide mechanisms for protecting environmental values on private land, however, their implementation lacks coordination. It is important to ensure this is coordinated and directed towards clear flora and fauna conservation goals. Development of further practical guides, and other information material describing good forest practice, especially to assist small plantation owners, would be helpful. Greater consistency in the interpretation of the Native Vegetation Retention Controls for plantation development is required.

Timber Harvesting Plans which conform to the Code and the S13 amendment to the planning scheme must be lodged for timber harvesting operations on private land with the responsible authority. This is usually local government which is then responsible for ensuring compliance with the provisions of the plan. These can be enforced through formal enforcement orders and subsequent recourse to the Administrative Appeals Tribunal. Local government often does not have the expertise to implement Native Vegetation Retention Controls, to assess cultural and heritage values, or to monitor compliance with permit conditions. Continued improvement in this area is necessary. Expansion of the trial in Gippsland using accredited forestry personnel to ensure harvesting plans comply with the Code, if successful, should be encouraged.

For exploration and mining, the on-ground presence of NRE staff is designed to ensure that monitoring of compliance with licence conditions occurs and that progressive rehabilitation of mine sites is satisfactory. Rehabilitation bonds provide a further incentive for compliance.

Most documents comprising the environmental management system are published or are made publicly available. Greater attention should be paid to ensuring that up-to-date copies of key documents, for example, management prescriptions, are readily available to staff and other relevant parties. There is a need for a computerised database system to record forest operations, in particular, timber harvesting. This is important to ensure that old-growth forest and forest resource inventory information is regularly updated. Archival material of particular interest to ESFM, including historical records of fire, storm, settlement, timber harvesting, is not properly catalogued and stored. There is a need for retaining and transmitting the corporate knowledge base. This requires documentation of procedures, regular training and effective induction.

While NRE and Parks Victoria have training programs in place, there is room for improvement in a number of areas. Effective operational planning depends on, for example, identification of critical values at the local (coupe) scale (e.g. habitat requirements in Special Management Zones and soil erodibility).

On-ground assessments are made by Forest Officers and Park Rangers, and a wide range of skills are required to make competent professional judgements. Current planning processes need to better emphasise the importance of adequate technical training of field staff and access to support materials.

Forest Information, Monitoring and Evaluation

The development of flora and fauna databases covering all land tenures and the development of data gathering programs directly linked to strategic planning requirements are a strength of NRE's planning process and also provides a basis for strategic long term monitoring of forest change. There are parallel databases for natural and cultural heritage places in forests. The joint Australian Heritage Commission/Department of Natural Resources and Environment studies have utilised existing databases and established new databases for many layers of site-based values. The Department's operational planning systems could be improved significantly through access to and regular updating of data concerned with Aboriginal sites.

Areas for improvement in forest information include:

- gathering and storage of socio-economic data for consideration in strategic plans;
- development of a Statewide computerised site, site management and visitor statistics database in national parks to improve the management process;
- systematic surveys of plant pest location and density and the development of a specific strategic plant and animal pest protection plan (similar to the fire protection plan) identifying priority control zones;
- making the GIS available to staff in the more remote areas of the State as well as Melbourne and major regional centres; and
- implementation of the Integrated Forest Planning System as new data from SFRI becomes available electronically.

While recent strategic plans include mechanisms to monitor their implementation, this is a relatively new process and implementation reports are yet to become available. It is essential that NRE complete the system for monitoring implementation of park plans, commence reporting on plan implementation on all land tenures, and make the information publicly available, along with actions intended to address any identified deficiencies. Monitoring of implementation of Wood Utilisation Plans is hampered by the lack of an adequate coupe recording and tracking system. The Department's monitoring process provide a sound basis for ensuring forest regeneration, however, assessment of other sustainability indicators could be undertaken during regeneration assessments to monitor the effects of forest operations.

NRE has a large body of information on the forest environment and a number of specific monitoring programs, however, the development of sustainability indicators is essential to assess whether stated forest management objectives are being met. While many indicators are implicit in current management plans, specific indicators and programs are required for monitoring biodiversity, health and vitality of forest ecosystems, soil and water resources, and social and cultural heritage values. Monitoring is required to assess whether prescriptions, such as habitat tree retention, linear reserves and streamside buffers, achieve their desired objectives in the longer term. The monitoring of road and track condition on public land is inadequate, leading to risks to soil and water quality. This is especially the case for those pre-dating the Code of Forest Practices. Indicators need to be sensitive to, and representative of, ecological change at strategic and operational scales. The applicability of presently held data for this purpose will need to be assessed.

Reference Areas have the potential to be valuable for monitoring long-term changes in forest ecosystems. A detailed inventory of the Reference Area system is required including an assessment of its representativeness, extent of replication and the degree to which it provides reliable examples of forests unaffected by humans.

There are no formal processes for routine and regular audit of compliance with some Departmental policies and plans. Periodic audits are recommended. Auditing for compliance of components of Victoria's management system with the Code and exploration and mining licences is internally based and appropriate. Auditing applies to coupe planning, timber harvesting operations, log grading, fire operations, exploration and mining, and record-keeping. A strength of the auditing system in State forests is that a summary of results is made public and that substantial penalties are possible for breaches. NRE's internal audit of timber harvesting and log grading operations is an appropriate and effective means for assessing compliance with the Code and prescriptions. The use of staff from outside the region subject to audit is a strength of the process. Consideration should be given to increasing the transparency of audits by making the results of audit processes publicly available along with measures taken to address deficiencies and by increasing the independence of the audit teams. Log grade audit results should be published. Consideration should be given to independent log grading procedures, perhaps related to the audit of the Code outlined above. The number of coupes audited may be too small to adequately sample the full range of environmental conditions under which problems may occur. Code audits should cover both public and private land, including plantations.

Corrective actions result from reviews of operational prescriptions and procedures, audit findings and results of regeneration performance, reports on Annual Service Agreements, supervision of field operations, and enforcement patrols to detect unauthorised activities in Parks or State forest. To improve transparency, NRE should better document corrective actions taken.

Review and Improvement

A process for reviewing the forest management system components has not been formally developed by NRE. A process with appropriate reporting mechanisms, such as a 'state of the forests report' is required to ensure continuous review and improvement of the management system. This would be in keeping with developments in forestry organisations throughout the world. The scientific basis of those parts of forest management which generate greatest environmental risk or are subject to contrary scientific interpretations, together with those where scientific knowledge is advancing rapidly, should be subject to more frequent peer review.

NRE's research program clearly links to providing information for improving strategic planning and reducing environmental risks in forest management. A stronger commitment to the timely completion, appropriate peer review and publication of scientific research would improve public confidence and the scientific basis of forest management. A well defined long-term research and development program in which critical areas for research and development are identified is needed.

17.4 OVERALL APPRAISAL

The appraisal below was prepared by Professor Ian Ferguson as part of his independent review of the Statewide ESFM report (terms of reference are given in 17.1). This appraisal was made in addition to a number of comments incorporated into the Statewide report, and it should be read in that context. Given that it was an independent peer review, the views contained in this appraisal are not necessarily those of the RFA Steering Committee or of the Commonwealth or Victorian Governments.

Victoria has all of the major elements in place for appropriate systems and processes for ecologically sustainable forest management. Having said that, however, there is still considerable scope for further improvement. Forest related legislation needs review to bring some aspects up-to-date and to make it more comprehensible to the public. Land-use planning processes need refinement in the light of changes in

bureaucratic structures and current needs. Closer attention needs to be paid to strategic planning of the integration of reserve and off-reserve management. The purchasers of stumpage need to recognise the importance of competition in determining the price of publicly-owned native timber, and the role of contestable but renewable and transferable rights to timber supply from that forest. More training is needed to ensure that staff are adequately prepared for planning and management under ecologically sustainable forest management. More research is needed to assist in the resolution of various issues.

These are not major or exceptional requirements: they are the measures required for continuing improvement in management systems. The extent and rapidity of adoption will be dictated by

- *the economic viability of the commercial activities and the capacity to fund improvements in forest management through productivity gains,*
- *the resources available for improvements in non-commercial management activities,*
- *the support that the public at large gives to the economic, environmental and social outcomes, and*
- *the commitment of Governments, the timber industry, and the bureaucracy to the process.*

In an era when resources for non-commercial activities are becoming scarcer and more competitive, there are concerns about the capacity for the system to fund adequately the improvements needed for management of an extended National Reserve System and the better integration of reserve and off-reserve management for all forest values. The formation of Parks Victoria may provide a basis for improved productivity that will enable existing resources to stretch further but the division of responsibilities between it and the NRE is still unclear. The additional resources required should not be underestimated.

Victoria is in a good position to deal with these issues providing it remains adaptive and accepting that sustainable forest management is a goal to be pursued vigorously, not an antique to be admired.

PART 2 RESPONSE TO STATEWIDE ESFM ASSESSMENT

The Commonwealth and Victoria have considered the Statewide ESFM assessment and the comments made by the Expert Advisory Group and Professor Ferguson as summarised in Part 1 of this chapter. The discussion below outlines the response of the Commonwealth and Victoria to the Statewide ESFM assessment as reported in the Central Highlands Directions Report (VicRFASC 1997c). It is important to note when reading this response that some of the improvements suggested by the Expert Advisory Group have already been addressed through commitments made in the East Gippsland and Central Highlands RFAs, while others are not considered sufficiently significant to justify an adjustment to the systems and processes already in place. Each of the issues (or suggested improvements) in the Statewide ESFM report are briefly described below with a page reference, together with a response from the Commonwealth and Victoria. The issues are grouped according to the five environmental management system components described in the Statewide ESFM report.

In addition, since the release of the Central Highlands Directions Report the following actions, as reported in the following discussion as planned actions, have been completed:

- review of Commonwealth legislation dealing with the environment (Commonwealth of Australia 1998). Federal Parliament passed the *Environment Protection and Biodiversity Conservation Act 1999*;

- Parks Victoria has been established under the *Parks Victoria Act 1998* to provide management services to the State for parks, reserves and other Crown land;
- Forestry Victoria has been established to enable clearer environmental accountability and an improved commercial focus for logging activity in State forests;
- the East Gippsland Forest Management Plan Amendment (NRE 1997g) has been completed in accordance with the East Gippsland RFA;
- regional prescriptions for timber production have been completed;
- Biodiversity Strategy, previously referred to as the Flora and Fauna Guarantee strategy, has been published (NRE 1997i);
- the internal audit of the compliance with the Code of Forest Practices for Timber Production for 1997 and 1998 have been published (NRE 1997c, NRE 1998c);
- Guidelines for the Management of Cultural Heritage Values in Forests, Parks and Reserves in East Gippsland (NRE 1997j) have been published and it is intended to prepare Statewide guidelines during 1999;
- completion of SFRI for the North East (Benalla-Mansfield, Wangaratta and Wodonga FMAs) (NRE 1999c); and
- a pilot program in municipalities in the Gippsland region to trial the accreditation of forestry professionals relating to planning for forest operations on private land has been completed and a report has been prepared.

Commitment and Policy Framework

Issue: Review of the Victorian Forests Act. (p40)

Response: As a result of commitments given in the National Competition Policy Agreement and through the Victorian Legislative Review Committee, a review of the *Forests Act 1958* is scheduled to be completed by 1999.

Issue: Review of Commonwealth Acts dealing with the environment. (p40).

Response: The Commonwealth will formally initiate a review of Commonwealth environmental law by publishing a discussion paper canvassing possible reforms by the end of 1997.

Issue: The need to address the duplication of processes associated with the Commonwealth Endangered Species Protection Act and the Victorian Flora and Fauna Guarantee Act. (p40)

Response: This issue has been addressed through commitments agreed in the East Gippsland RFA.

Issue: The need to address the duplication in application of Commonwealth and State heritage legislation. (p40)

Response: Avoidance of duplication is being addressed through State-Commonwealth initiatives to standardise criteria and assessment processes. The review of Commonwealth environmental legislation may also address this issue in part.

Planning

Issue: Flexibility with respect to the boundaries of the CAR Reserve System is necessary to accommodate long-term changes. (p42)

Response: This issue is addressed in commitments made in the East Gippsland RFA and will be implemented according to the guidelines in the amendment to the East Gippsland Forest Management Plan. It is envisaged that similar provisions will also apply in future RFAs.

Issue: The need for more thorough treatment of socio-economic factors in forest management plans. (p47)

Response: This requirement would only be considered in the event that significant social and economic implications are likely to arise from a forest management plan. However, this is unlikely given the current RFA processes. Major changes to land use and consequently, potentially significant socio-economic implications have usually been addressed in Land Conservation Council investigations and these have been accompanied by detailed socio-economic studies.

Issue: The need for formal risk assessment at the commencement of planning processes and at periodic reviews to guide new research. (p47)

Response: A systematic identification and assessment of risk and threatening processes is already undertaken at the commencement of forest planning processes. Those risks that are of particular significance are given greatest attention. For example, the potential risk to a range of forest-dependent species such as large forest owls and the Long-footed Potoroo in East Gippsland was identified early in the planning process and resulted in the development of detailed strategies to ameliorate the potential risk. The process of risk assessment will be addressed at the time of reviews to identify changes in factors affecting risk management.

Issue: The contribution of all forest areas to regional conservation goals needs to be recognised. (p48)

Response: This concept is a fundamental component of the National Forest Reserve Criteria and will be taken into account in the development and design of the CAR Reserve System in each region.

Issue: The need for performance indicators to monitor forest management plan implementation. (p48)

Response: Management plans already include a set of specific actions against which implementation can be assessed. There is also a requirement for an annual report on the implementation of the plans and these will establish timelines for priority actions attached to the approved service agreement.

Issue: The need to include specific targets for soil and water quality in plans. (p48)

Response: There is already a commitment in the East Gippsland RFA to develop indicators of sustainability, including appropriate protection of soil and water values that are relevant to particular regions.

Issue: More detailed strategies are required to identify and protect cultural heritage values. (p48)

Response: This issue is being addressed through the development of cultural heritage guidelines and improved arrangements in relation to consultation with Aboriginal communities. It is envisaged that guidelines and provisions similar to those prepared for the East Gippsland Region will be prepared for the remainder of the State.

Issue: Better links between the range of forest management planning processes within and across regional boundaries and the requirement that significant changes in forest management or condition should provide a trigger to review plans. (p48)

Response: There are already considerable linkages between relevant planning processes which ensure that activities operating across tenures and regions are properly coordinated and planned, and the need for major improvement is not considered necessary at this time. Major changes in the planning area, such as wildfire or major changes in land use, have resulted in major reviews in the past and will continue to do so.

Issue: More research is required to strengthen the scientific basis of the Code of Forest Practices, especially soil protection, and monitoring to confirm the effectiveness of prescriptions as a basis for their improvement. Further work is required to develop regional prescriptions that build on the Code to take account of local factors such as soil types and climatic conditions. (p48)

Response: Further research to underpin the Code of Forest Practices (NRE 1996a) is underway including a program to develop ecologically sustainable development indicators for soil and develop and evaluate long term soil monitoring programs. A field guide is being developed to assist staff in dealing with soil erosion hazard and soil permeability, and potential for overland flow in accordance with the Code. Further information on research is contained in the Compendium of Forest Research (BRS 1998b) (see review and improvement section below). Work is also progressing such that regional prescriptions for all Forest Management Areas will be completed by the end of 1997.

Issue: Greater explanation of the procedure for estimating sustainable yield is required, as well as the need to make information on the methodology and data used available at an earlier stage. Sustainable yield and sawlog supply levels should be routinely reported and be publicly available. (p49)

Response: Victoria will continue to publish the methodology, including reviews and improvements of methods, and data sources used in estimating sustainable yield at the time of each review, and to make this publicly available as soon as possible, recognising that the Minister is required to seek parliamentary approval of sustainable yield levels in each Forest Management Area following the Review. Victoria already provides public reporting of sustainable yield levels through the *Forests Act 1958* (Schedule 3), while sawlog supply levels for Victoria are provided in the Department's annual reports.

Issue: There is a need to set clear and strategic goals for the conservation of biodiversity (or other express purposes of reservation) in parks and reserves that are realistic in relation to available resources and against which the success of management can be judged. This would involve a procedure for monitoring implementation of plans. The contribution of parks to regional conservation should also be considered. (p50)

Response: Recent park plans contain specific implementation actions with respect to biodiversity conservation and other express purposes for reservation against which plan implementation can be monitored. The specified actions are prioritised and must be included in relevant service agreements which identify funding levels associated with their implementation. Each park plan is prepared with the parks regional context in mind, including its contribution to the regional conservation goals and the recreational and tourism opportunities. The Commonwealth and Victoria consider that the new plan approach meets the suggested requirements outlined in the ESFM report. There is a commitment to complete all plans across the State by the end of 1998 and this approach will be adopted in these plans. Park managers, including Parks Victoria, are developing a complementary framework for monitoring the condition of the parks and reserves estate. This framework should be achieved by 1999. The contribution of all land tenures, including parks, is considered in determining the CAR Reserve System for RFAs.

Issue: Wider use should be made of Reference Areas for long-term comparative studies on the impacts of human disturbance in other forested areas. (p50)

Response: The Commonwealth and Victoria support the use of reference areas as baseline research sites as long as that use is consistent with the objectives of reference areas.

Issue: The implementation of processes to protect environmental values on private land require improved coordination, and the expertise of local government to implement the controls and to assess values or monitor compliance needs to be improved. (p53)

Response: Better coordination of actions on private land is a stated objective of the new Catchment Management Authorities through the implementation of strategic regional plans and the Native Vegetation Retention controls. The Commonwealth and Victoria agree that local government requires improved expertise in monitoring compliance with permit conditions and in assessing environmental values on private land. A pilot program is underway to identify accredited experts who can be utilised by local government to address these issues.

Issue: The implementation of consistent approaches to auditing of compliance with the Code of Forest Practices on both public and private land is needed, as is the development of further practical guides and other material describing good forest practice, especially to assist small forest growers. Greater consistency is required in the interpretation of the Native Vegetation Retention Controls for plantation development. (p54)

Response: Victoria is not currently intending to require audits of compliance with the Code of Forest Practices on private land. It should be recognised that forest activity is the only private land use currently subject to a Code of Practice. Both the Commonwealth and Victoria are involved in the development of practical information and guidance relating to plantation establishment on private land. These initiatives will continue and funding arrangements are in place to promote private forest industry development over the next few years. Both the Commonwealth and Victoria consider that the issue of consistency in the interpretation of Native Vegetation Retention Controls will be facilitated by the information being collected as part of the RFA process, such as standard vegetation mapping across the State. Vegetation information should assist in identifying important vegetation types that are in particular need of protection in a regional context. Auditing of compliance with the Code of Forest Practices on public land is dealt with under 'Implementation' below.

Issue: There is a need to strengthen the scientific basis of fire management plans through research in order to better balance protection of life and property with conservation of biodiversity, soil and water. (p58)

Response: The Victorian Code of Fire Practice for Public Land requires that the Department undertake, participate in, or support research programs aimed at improving: firefighter safety; understanding of fire behaviour; prediction of threat of wildfire to life, assets and values; the effects and effectiveness of preparedness actions; and firefighting methods, including knowledge of their impact on environmental values. The East Gippsland RFA identifies further research on fire management as a high priority and in 1997-98 Victoria will spend more than \$300 000 on fire research which is directly related to strengthening the scientific underpinning of fire management. This research will include impacts on flora, invertebrates, bats and birds as well as investigating prescribed burning prescriptions for heathlands. This will facilitate the continued improvement of the scientific basis of fire management and protection measures.

Issue: While Action Statements under the Flora and Fauna Guarantee Act have been completed for numerous species, they have not been completed for communities and threatening processes. The Flora and Fauna Guarantee Strategy has yet to be completed. The

effectiveness of Action Statements and Recovery Plans needs to be better assessed, based on monitoring and research. (p59)

Response: Victoria is committed to the completion of Action Statements for threatened communities and threatening processes, but it must be recognised that this work needs to be prioritised with other Action Statements required under the Flora and Fauna Guarantee Act. Action Statements are currently in preparation for several communities and threatening processes. Victoria is also committed to the completion of the Flora and Fauna Guarantee Strategy and this is scheduled to occur by the end of 1997. Action Statements already include provisions for monitoring and research, and a standardised method of monitoring their implementation is in place. An example of the process for developing and implementing Action Statements, including provision for monitoring, is provided by past and continuing work on Leadbeater's Possum. Victoria has committed in the East Gippsland RFA to a Quality Assurance Program (QAP). This will identify feedback loops between the components of the forest management system.

Issue: There is a need for a systematic approach to the ongoing identification of Aboriginal cultural values, collaboration with Aboriginal communities to facilitate and increase their participation in natural resource management, improved liaison between Aboriginal Affairs Victoria (AAV) and the Department of Natural Resources and Environment in implementing the Aboriginal and Archaeological Relics Act, and improved consultation with local Aboriginal communities in the preparation of Wood Utilisation Plans (WUPs) and the proposed siting of forest operations. (p60)

Response: The assessment work completed as part of the RFA process has provided good information on sites of Aboriginal cultural significance and this information has been included in an existing database maintained by AAV. Victoria has committed in the East Gippsland RFA to manage Aboriginal cultural heritage in accordance with a set of guidelines agreed between the governments and the Aboriginal communities and this should facilitate better communication and participation in natural resource management. The guidelines include a strategy for targeted survey of archaeological sites and a procedure for checking existing site data bases for archaeological values as part of forest planning. Forest Management Plans and Park Management Plans also commit the Department to better communication with local Aboriginal communities and this is already occurring in East Gippsland, particularly in relation to the development of WUPs and other forest operations. Regular meetings of the local communities, Departmental staff and AAV staff have been established.

Issue: Local government planning processes for assessing mining applications is slow and often more adversarial than the Environmental Effects Statement (EES) process, which tends to be more objective and rigorous, providing better opportunities for consideration of scientific evidence and differing views on the relative merits of a proposal. (p63)

Response: While the governments do not necessarily agree with this view, it is noted that major proposals in Victoria usually require an EES before they can proceed. The East Gippsland RFA also requires that an EES must be completed prior to any mining activity in the CAR Reserve System. It is envisaged that similar provisions will also apply in future RFAs.

Issue: The overall effectiveness of pest management is limited by the lack of strategic plans for pest plant and animal control that cover all tenures. Operational planning should provide for ongoing training and updating of field staff, and access to support materials. (p64)

Response: Strategic programs for pest plant and animal control covering all land tenures currently exist. For example, strategic rabbit control plans for the release of rabbit calici-virus

(RCD) and follow-up control works using other methods; Statewide Good Neighbour Programs which coordinate pest plant and animal control on private property and adjoining public land; and pest plant and animal control programs within parks are developed in a regional context and in accordance with parks procedures. In relation to staff training, the Department has a comprehensive and individually based training program for its staff, especially in key areas such as fire protection and suppression, forest and park operations pest, plants and animal control, and flora and fauna management. These programs will continue.

Implementation

Issue: The Expert Group was unclear about whether the policy and regulatory functions associated with the management of parks and reserves can be separated between the parks program in the Department and the new Parks Victoria entity. (p67)

Response: The Victorian Government has established Parks Victoria as a service agency for the provision of park management services in Victoria. New legislation which clearly establishes the separate roles and functions of that organisation and the Department is in preparation. Fire management responsibilities will also be clearly defined in the new legislation.

Issue: Particular attention is needed to identify costs on a regional basis and to separate the costs of commercial and non-commercial activities. A focus on research into ESFM requires an ongoing commitment to funding. (p68)

Response: Departmental budgets are already prepared on a regional basis taking into account regional priorities and needs. Further separation into commercial and non-commercial activities or projects is achieved through allocation of funds to the head office business units. The Department commits significant funding to support ongoing research into land management. As part of this, the Forests Service has developed a three year rolling program of research (with a budget of \$1.5 million for 1997-98) focussed on ESFM in order to provide stability for projects extending beyond one year.

Issue: Better supervision of forest operations where protection of archaeological or heritage values is important. (p71)

Response: The Commonwealth and Victoria do not consider there is sufficient evidence to warrant this conclusion. Provisions currently exist to audit compliance with the Code of Forest Practices in relation to the protection of cultural values, and audits have not shown any significant problems. Cultural heritage experts within the Department are also involved in the development of WUPs and the establishment of appropriate buffers to protect identified values. The development of Guidelines for the protection of Cultural Heritage values should also assist in overcoming communication issues associated with cultural site protection and help avoid damage to sensitive sites.

Issue: Improvement is needed in the forthcoming review of fire protection plans to ensure that specialist peer review is generally undertaken. (p71)

Response: The Code of Practice for Fire Management on Public Land specifies that when preparing each fire protection plan 'the Department must involve its specialists in flora, fauna, parks, forestry, land and water protection and fire management'.

Issue: The lack of auditing processes for other Departmental operations is a weakness which should be addressed. In particular, there is a need to audit the extent of compliance of strategic and operational plans. (p72)

Response: The Commonwealth and Victoria consider that the key activities on public land are already subject to audit processes. An audit of the Code of Fire Practices on Public Land (CNR 1995d) is to be introduced. The implementation of strategic and operational plans such as the forest and park plans is already subject to regular review and reporting.

Issue: Up-to-date copies of key documents, for example, management prescriptions should be readily available to staff and other relevant parties. There is a need for a computerised database system to record forest operations in particular, to enable maintenance and updating of important datasets. (p72)

Response: A range of documents, including reports and management plans are readily available to staff and others on the Department's site on the internet. Additional documentation is located at offices. Much of the information collected as part of the RFA process and the Statewide Forest Resources Inventory (SFRI) is stored in GIS format and can be readily used in future planning and management. The establishment of GIS systems in regional centres, which will enable forest records to be stored digitally and be spatially referenced, is occurring progressively as resources and data collection permit. The RFA and Forest Management Planning processes provide significant opportunities for this program to be accelerated.

Issue: Staff training, especially in key areas such as fire planning and suppression activities, and in the area of cultural heritage protection is important. Long-term training strategies for individual staff and the retention and transmittal of corporate knowledge through ongoing documentation of procedures are very important as available resources decline. (p73)

Response: Both the Commonwealth and Victoria agree that these are important issues and resources are being committed to them to ensure that valuable information and expertise is retained or can be purchased from the private sector. Minimum standards for staff competencies have been established in key areas such as fire management and there is a focus on the preparation of important documents containing critical procedures, such as regional prescriptions. See additional comments in the Planning section above regarding staff training.

Issue: There is a need to promote good forestry practice on private land. (p74)

Response: This issue is already addressed in the Planning section above.

Information, Monitoring and Evaluation

Issue: Data collection, storage and updating of forest information needs to be improved in specific areas. (p78)

Response: These issues are being addressed through the RFA and SFRI processes in particular, and further information will be derived from the development and monitoring of sustainability indicators. The issue of socio-economic information has been addressed above. A database of visitor statistics is currently available for parks and priority reserves, and it is intended to extend this program and its scope as time and resources permit. Systematic surveys of pest plants and animals are undertaken in priority areas across the State and these provide input to the development of regional control programs. Updating of datasets concerned with Aboriginal and National Estate values will occur as new information becomes available. The Commonwealth and Victoria are both committed to maintaining databases for which they have responsibility. The SFRI and IFPS programs are being progressively implemented across the State and are scheduled for completion by the year 2000. As indicated above, GIS capacity in regional centres is being introduced progressively as resources permit. The Governments have also agreed to the development of a Data Agreement which is

intended to address storage and updating of datasets, and to maintain them in the corporate NRE library.

Issue: Monitoring of implementation of park plans should commence as soon as possible and should be publicly available, along with actions to address any identified deficiencies. The monitoring of implementation of WUPs is hampered by the lack of an adequate coupe recording and tracking system. (p79)

Response: Implementation of park plans is undertaken through the development of Regional Action Plans which are prepared annually by Parks Victoria and are maintained in Regional offices. These are reviewed annually to ensure that implementation is proceeding in accordance with the specified outcomes. Coupe recording and tracking systems currently vary across the State. The Department is currently pursuing the development of a tool for delineating coupes on a GIS and ensuring consistency across the State, with the intention to introduce it progressively across Victoria from 1998.

Issue: There is a need to develop sustainability indicators in order to assess whether stated forest management objectives are being met. A detailed inventory of the Reference Area system is required, including an assessment of its representativeness, extent of replication and the degree to which it provides reliable examples of forests unaffected by humans. (p80)

Response: Both the Commonwealth and Victoria are committed to the development and implementation of sustainability indicators for the forested regions of Victoria. This commitment was made in the East Gippsland RFA. Research into key aspects of the forest management system, including the efficacy of buffers on streams, is currently underway. An inventory of the Reference Area system was undertaken by the Land Conservation Council as part of its Statewide Review of Public Land Use (LCC 1988) which was completed in 1988. That report is publicly available and covers the issues raised by the Expert Group.

Issue: There are no formal processes for auditing of compliance with some Departmental policies and plans. Periodic audits are necessary for these. Consideration should be given to increasing the transparency of audits by making the results publicly available, along with measures to address deficiencies, and by increasing the independence of the audit teams. Log grade audits should be published and consideration should be given to independent log grading procedures. Code audits should cover both public and private land. (p82)

Response: The issue of further audits of Departmental processes is dealt with earlier, as has the issue of Code audits on private land. Victoria has committed to publish future reports of internal audits of compliance with the Code of Forest Practices for Timber Production (NRE 1996a) as part of the East Gippsland RFA. Audit teams are drawn from people who are actively involved in the day-to-day implementation of the Code and are stationed outside the Region being audited. The Department currently has in place several procedures to ensure the independence and accuracy of log grading, including spot checks of logs in the forest and at sawmills. Other mechanisms are also being considered.

Review and Improvement

Issue: A process for reviewing the forest management components has not been formally developed. A process with appropriate reporting mechanisms, such as the 'State of the Forests Report' is required to ensure continuous review and improvement of the management system. Key elements of the system should be subject to more frequent peer review. (p83)

Response: The Commonwealth and Victoria consider that review and improvement mechanisms do exist in some areas of the management system, e.g. the Code of Forest Practices for Timber Production which has just been independently reviewed and adjustments

made in the light of new information. In addition, the ESFM assessment conducted in Victoria for the RFA process used an environmental management system approach against which to report. Victoria considers that this framework is a useful model for subsequent reporting when used in conjunction with sustainability indicators consistent with the Montreal criteria.

Issue: In relation to research, there is a need for a stronger commitment to timely completion, appropriate peer review and publication. External peer review of research should be routinely sought and funding should be based on assessment of environmental threats. Formal processes are required to ensure that the most recent relevant research is used to assist in management decisions. A well-defined long term research program is needed. The Expert Group outlined the most critical areas for research and development. (p85)

Response: The basis of this issue is related to comments made by some groups in the community that the Department is not publishing some of its research because it has implications for current management. In fact, most of the documents of concern to community groups have not been published because they were in draft form and had not been reviewed by appropriate experts, both within and outside the Department. External peer review of research in the Department is regularly undertaken in order to ensure that research methodology and interpretation of results is appropriate and scientifically based. It would be very difficult for the Department to ignore published research when making management decisions, especially if the Department had conducted the research. The Forests Service within the Department develops a three-year rolling plan of research matched by appropriate funding in order to provide certainty for projects beyond the current financial year. The research program is developed with input from a range of experts and is geared toward the improvement of forest management, consistent with ESFM goals. The Commonwealth and Victorian Governments are committed to research in key areas as part of the East Gippsland RFA and the next three-year rolling research plan will reflect those commitments. The areas of research are also consistent with those outlined by the Expert Group. The details of the research plan are publicly available and are accessible on the Department's internet site.

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APPENDIX 1. KEY LEGISLATION

The following list describes major legislation relevant to the Regional Forest Agreement. It is not intended to be an exhaustive list. A full list of legislation and international conventions relating to the RFA process is contained in the Victoria statewide assessment of ecologically sustainable forest management (VicRFASC 1997a).

COMMONWEALTH LEGISLATION*

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

This Act has a 1987 amendment, which applies directly to Victoria. It stipulates that all places of significance to Aboriginal communities, including places covered by the Victorian Archaeological and Aboriginal Relics Preservation Act, are to be protected. Such places may only be damaged or destroyed with the express permission of the relevant local Aboriginal communities.

Australian Heritage Commission Act 1975

The Australian Heritage Commission has a statutory obligation under this Act to identify the National Estate. The Commonwealth has an obligation to take into account the effect of its actions on the National Estate.

Endangered Species Protection Act 1992

This Act provides a legislative basis for Commonwealth responsibilities with regard to the conservation of endangered and vulnerable species and endangered ecological communities, and the amelioration of the processes that threaten them.

Environment Protection (Impact of Proposals) Act 1974

All Governments in Australia have statutory requirements for environment impact assessments. This Act requires Commonwealth decision-makers to refer to the Minister for the Environment decisions or actions likely to affect the environment to a significant extent.

Export Control Act 1982

Regulations under this Act provide the Commonwealth with a mechanism with which to impose environmental conditions on harvesting operations for the export of unprocessed wood and woodchips. In addition, it allows for the assessment of the potential for domestic processing.

World Heritage Properties Conservation Act 1983

This Act provides for the protection and conservation of those properties in Australia and its external territories that are of outstanding universal natural or cultural value. Such properties are those which:

- are inscribed in the World Heritage List; or
- are nominated for inscription on the World Heritage List; or
- are subject to an inquiry established by a law of the Commonwealth whose purpose is to consider whether the property forms part of the natural or cultural heritage; or
- form part of the natural or cultural heritage, and are declared so by regulation.

* Note: The objects of the *Environment Protection and Biodiversity Conservation Act 1999* are met through the Regional Forest Agreement process for each region. Accordingly, the Act does not apply to forestry operations in RFA regions except where such operations are in a property included in the World Heritage list or in a wetland designated under the Ramsar Convention or are incidental to another purpose other than forestry.

The Act authorises the Commonwealth to prevent the damage or destruction of a property through the prohibition by regulation of prescribed activities. It does not enable the Commonwealth Government to assume responsibility for the management of a property.

VICTORIAN LEGISLATION

Archaeological and Aboriginal Relics Preservation Act 1972

This Act requires that all Aboriginal, archaeological and historic sites are protected. It is administered by Aboriginal Affairs Victoria, which maintains a register of known sites within Victoria.

Catchment and Land Protection Act 1994

This Act establishes an administrative framework for advising Government on the integrated management and protection of catchments on all land tenures across the State. It establishes processes to encourage and support community participation in the management of land and water resources through the establishment of a State-wide Catchment and Land Protection Board, ten regional Catchment and Land Protection Boards, and a Pest Animal Advisory Committee. The Act consolidates functions relating to the identification, proclamation and management of water supply catchments previously performed under the Land Conservation Act and its predecessor, the *Soil Conservation and Land Utilisation Act 1958*.

Conservation, Forests and Lands Act 1987

This Act formally transferred the responsibilities of a number of former statutory bodies to the (then) new Department of Conservation, Forests and Lands resulting from machinery of Government changes. This single, integrated public land management agency (and its successors) is responsible for the management and protection of the State's public lands including State forests (both native and exotic), National Parks and reserves, wildlife (including commercial fisheries) and other public lands, in addition to private land catchment protection functions.

The Act provides legislative backing for Codes of Practice which govern activities on public and private lands, under which the Code of Forest Practices for Timber Production and Code of Practice for Fire Management on Public Land have been developed. It also provides for the establishment of 'conservation covenants' on private land titles in order to protect important environmental values.

Country Fire Authority Act 1958

This Act consolidates the law relating to the Country Fire Authority and confers on the Authority a responsibility to prevent and suppress fire on all land (urban and rural), other than unoccupied Crown Land, outside the Melbourne Metropolitan Fire District.

Crown Land (Reserves) Act 1978

This Act provides for the reservation of Crown land for a variety of public purposes including flora and fauna conservation.

Environment Conservation Council Act 1997

The *Environment Conservation Council Act 1997* came into operation on 1 July 1997. This Act established the new Environment Conservation Council (ECC) and replaced the *Land Conservation Act 1970* and the Land Conservation Council (LCC).

The role of the ECC is to advise the Government on public land use planning and the balanced use or development of public land or any flora, fauna or minerals on, above or under that land or water flowing over that land. The new Council has a wider role than the former LCC, being able to advise on all natural resource matters, taking into account relevant issues that may impact on use of resources.

Previous recommendations made by the Land Conservation Council, most of which were approved by government, continue to have effect under the new Act.

Environment Effects Act 1978

This Act provides for the assessment of potential environmental impacts of proposed developments on land of all tenures. Major instruments and control mechanisms are Environment Effects Statements and ministerial Assessment Reports.

Environment Protection Act 1970

This Act establishes the Environment Protection Authority as an independent statutory body and provides it with powers, duties and functions on lands of all tenures concerning the protection of receiving environments (air, land and water), control of noise and pollution.

Extractive Industries Development Act 1995

The aim of this Act is to facilitate and streamline the planning and approvals processes on public and private lands for the removal of extractive materials (eg stone). Specifically, the purpose of the Act includes providing for a coordinated assessment and approvals process for extractive industries, and ensuring that operations are carried out with safe operating standards and in a manner that ensures the rehabilitation of quarried land to a safe and stable landform.

Fisheries Act 1995

The *Fisheries Act 1995* was fully proclaimed on 1 April 1998 and repeals the 1968 Act. This Act covers the Commonwealth/State management of fisheries, fishery management plans, regulation of commercial and recreational fishing, aquaculture, protected aquatic biota, noxious aquatic species, fisheries reserves, fisheries co-management, enforcement and legal proceedings. Under this Act, a licence is required to fish in inland waters including within forested catchments; and all public authorities must have regard to fishery management plans.

Flora and Fauna Guarantee Act 1988

This Act provides a legislative basis for the conservation of Victoria's flora and fauna on all land tenures. Major instruments include the listing of threatened species and communities and threatening processes, the development of Action Statements, controls over the taking, trading and keeping of native species, and the use of Interim Conservation Orders for the urgent protection of areas facing immediate threats.

Forests Act 1958

This Act provides for the management of State forests, protection of these and other public and private lands from fire, development of working plans and the licensed sale of forest produce. Through its licensing provisions and regulations, the Act also provides for control of the use of State forest. Under its powers for the making of regulations, the Timber Harvesting Regulations and associated forest operator accreditation and licensing have been implemented. These regulations provide the legislative basis on which provisions in the Code of Forest Practices for Timber Production (NRE 1996a) are implemented. The Forests Act requires that proper and sufficient work be carried out for prevention and suppression of fire in State forest, national parks and protected public land.

Forests (Wood Pulp Agreement) Act 1996

This Act guarantees AMCOR Plantations Pty. Ltd. with a supply of pulpwood for its pulp and paper mill at Maryvale until 2030. Logs are drawn from State forest in a supply zone that falls within Central Gippsland, Dandenong and Central Forest Management Areas. The annual

supply level is well within the forecast yields of residual logs resulting from sustainable sawlog harvesting in these areas.

Heritage Act 1995

This Act aims to provide for the protection and conservation of places and objects of cultural heritage significance and the registration of such places and objects. The Act establishes a Heritage Council and Victorian Heritage Register. The main function of the Heritage Council is to advise the Minister for Planning and Local Government on the state of Victoria's cultural heritage resources and to determine which heritage places and objects are added to the Victorian Heritage Register. Only items of special significance to the history and development of Victoria are added to the Register.

The Act also establishes the Heritage Inventory, which is a listing of all known historical archaeological sites in Victoria regardless of their level of significance.

Heritage Rivers Act 1992

This Act establishes a number of Heritage Rivers and Natural Catchment Areas on public land, where significant nature conservation, recreation, scenic or cultural heritage values have been identified. The Act specifies activities that are not permitted in these areas and requires that a management plan be prepared for each area.

Land Act 1958

This Act governs the alienation and use of unreserved Crown land, other than State forest, including the issuing of licences and leases for occupational use.

Land Conservation (Vehicle Control) Act 1972

The Act controls the movement of private motor vehicles on public lands, to prevent soil erosion and other environmental damage.

Land Titles Validation Act 1994

The purpose of this Act is to validate, in accordance with the *Native Title Act 1993* of the Commonwealth, past acts that are invalidated because of the existence of native title. It also provides for compensation rights for the holders of native title, which have been affected by past acts attributable to the State and to confirm certain existing rights.

Mineral Resources Development Act 1990

This Act aims to encourage an economically viable Victorian mining industry which makes the best use of mineral resources in a way compatible with the State's economic, social and environmental objectives. It provides for the granting of licences to explore and extract minerals. Three categories of public land have varying levels of exemption from mining activity.

National Parks Act 1975

This Act provides for the declaration and protection of national, wilderness, State and other parks. Its objectives are to protect the natural and cultural values of the State's system of parks, and to provide the community with opportunities for enjoyment, recreation, education and research. It also provides administrative procedures for the licensing and control of activities in parks, the preparation of management plans and creates the statutory office of Director of National Parks.

Planning and Environment Act 1987

This Act establishes a framework for integrating policies and environmental considerations into planning decisions affecting private lands across the State. It establishes a system of planning schemes with local, regional and State sections into which appropriate controls for the use, development and protection of land can be incorporated through instruments such as planning permits and landowner agreements.

The objectives of the Act include provision for the protection of natural resources and the maintenance of ecological processes and genetic diversity, and to conserve places of scientific, aesthetic or special conservation value. It requires 'responsible authorities' to administer and enforce planning schemes, under which applications for planning permits may be referred to other relevant authorities to stipulate permit conditions or the grounds for permit refusal.

Reference Areas Act 1978

This Act provides for the setting aside and management of 'Reference Areas' on public land. These are areas of special ecological and scientific interest or significance, which could serve as a baseline for comparative assessment of impacts of land uses elsewhere. Their use is largely confined to scientific study. A Reference Areas Advisory Committee advises the Minister on how the areas should be protected, controlled and managed. The aim is to ensure that ecological processes within them continue unhindered.

Victorian Conservation Trust Act 1972

This Act establishes the Trust for Nature (Victoria) to encourage and assist the preservation of areas of private land, which are of significant conservation value, and to assist in flora and fauna conservation. It provides for the establishment of 'conservation covenants' on private land titles in order to protect important environmental values.

Victorian Plantations Corporation Act 1993

This Act confers operational and administrative powers on the Victorian Plantation Corporation, a statutory corporation established under the *State Owned Enterprises Act 1992*. The Corporation is responsible for the management and protection of State-owned plantation timber resources, both hardwood and softwood.

Water Act 1989

This Act (and amendments) establishes rights and obligations in relation to water resources, provides mechanisms for the allocation of water resources (including to the environment), governs the statutory powers and functions of water authorities outside the metropolitan area and provides for integrated management of water resources for environmental and consumer protection.

Wildlife Act 1975

This Act provides for the establishment and management of State wildlife and nature reserves, licences, research and management, wildlife management cooperative areas, prohibited areas and sanctuaries, declaration of noxious wildlife, offences, enforcement and legal proceedings.

APPENDIX 2. MEMBERSHIP OF COMMITTEES

JOINT COMMONWEALTH-VICTORIA STEERING COMMITTEE

Victoria

Gerard O'Neill (co-chair)	Department of Natural Resources and Environment (NRE)
Ian Miles	NRE
Michonne van Rees	NRE
Athena Andriotis	Department of Premier and Cabinet

Commonwealth

Belinda Robinson (co-chair)	Department of Prime Minister and Cabinet (PM&C)
Catharine Masters	PM&C
Rhondda Dickson	Environment Australia (EA)
Tom Aldred	Agriculture Fisheries and Forestry – Australia (AFFA)

JOINT COMMONWEALTH-VICTORIA TECHNICAL COMMITTEE

Victoria

Andrew Maclean (co-chair)	NRE, Forests Service
Sue Houlden	NRE, Forests Service
Rod Anderson	NRE, Parks, Flora and Fauna
Chris Ashe	NRE, Parks, Flora and Fauna
Alison Boak	NRE, Gippsland Region
Daniel Catrice	NRE, Parks, Flora and Fauna
David Clarke	Aboriginal Affairs Victoria
David Parkes	NRE, Parks, Flora and Fauna
Phil Roberts	NRE, Minerals and Petroleum
Michael Sutton	NRE, Forests Service
Kylie White	NRE, Forests Service

Commonwealth

Geoff Dyne (co-chair)	EA, Environment Forests Taskforce
Dougal Morrison (co-chair)	AFFA, Forest Assessment Branch
Peter Connell	AFFA, ABARE
Vanessa Hill	AFFA, Forest Assessment Branch
Yanis Miezitis	Department Industry, Sciences and Resources, Australian Geological Survey Organisation
Juliet Ramsey	EA, Environment Forests Taskforce
Pam Robinson	AFFA, Community Coordinator
Felix Schlager	EA, Environment Forests Taskforce
Ray Spencer	AFFA, BRS Forestry
Steve Watts	PM&C, Forests Taskforce

APPENDIX 3. DEFINITION OF SAWLOG GRADES

In Victoria all hardwood sawlogs other than River Red Gum and box-ironbark species must be graded in accordance with hardwood sawlog grading instructions and interpretations. The Hardwood Sawlog Grading Card (Jeremiah and Roob 1992) defines sawlogs by grades (A to D) as described below, and allows for some variation between grades by relative changes between diameter, number of defective quarters and size of pipe defect.

DEFINITION OF SAWLOG:

A sawlog is defined as any length of a log of merchantable species which:

- is at least 2.7 m in length
- has a small end diameter (measured under bark) of 25 cm or greater
- does not have sweep or crook which exceeds one-fifth of the diameter along a 2.4 m straight edge
- is of grade D standard or better

DEFINITION OF SAWLOG GRADE:

A Grade

Any sawlog with a minimum small end diameter under bark of 50 cm which has no defective quarters and maximum defects on exposed ends of:

- one-quarter diameter lengths of all gum vein or gum pockets
- light stain

In addition:

- maximum angle of sloping grain of 1:10 along the length of the sawlog

B Grade

Any sawlog with a minimum small end diameter under bark of 35 cm which has maximum allowable defects on exposed ends of:

- one quarter diameter length of loose gum veins/pockets and shakes
- one diameter length of tight gum vein more than 3 mm in width
- two diameters length of tight gum vein less than 3 mm in width
- light stain

In addition:

- 1:10 angle of sloping grain along the sawlog axis
- a maximum of one defective quarter along the length of the sawlog
- a maximum of 105 cm squared of pipe in an exposed end.

C Grade

Any sawlog with a minimum small end diameter under bark of 30 cm which has maximum allowable defects on exposed ends of:

- one diameter length of loose gum veins/pockets and shakes
- seven diameters length of tight gum vein more than 3 mm width
- unlimited lengths of tight gum veins less than 3 mm width
- dark stain

In addition:

- maximum sloping grain angle of 1:8 along the length of the sawlog
- maximum of two defective quarters
- maximum of 112 cm square of pipe in an exposed end

D Grade

Any sawlog with a minimum small end diameter under bark of 25 cm which has maximum allowable defects on exposed ends of:

- two diameters length of loose gum veins/pockets or shakes
- 10 diameters length of tight gum vein more than 3 mm width
- unlimited length of tight gum vein less than 3 mm width
- dark stain

In addition:

- maximum sloping grain angle of 1:8 along the length of the sawlog
- maximum of three defective quarters
- maximum of 120 cm square of pipe on exposed ends

(NRE 1996e)

APPENDIX 4. GEOLOGICAL AND MINERALISING EVENTS

Table 1a: Tabberabbera and Melbourne Zones - Summary of geological and mineralising events

Geological Time Scale	Age (Ma)	Sedimentation and associated volcanics	Magmatism	Major geological events	Main mineralisation events	
PALAEZOIC	Permian			Erosion of landscape		
	Carboniferous			Kamuhlan deformation		
		35.4	Manfield Group Redbeds	Caldera volcanism rhyolite, ignimbrite granitoid intrusion		
	Devonian			Granitoid Intrusion Woods Point dyke swarm	Tabberabbera deformation Mount Wellington & Kaituma Fault Zone	Red bed sediment hosted copper uranium Tin veins Tin greisens Tungsten - moly veins Epithermal gold Copper - gold porphyry
	Silurian	410	Marine sedimentation Melbourne Trough mudstone, sandstone, minor conglomerate			
Ordovician	434			Berambran deformation		
Ordovician		Deep marine sedimentation sandstone, mudstone (*turbidity current deposits) black shale, chert, siltstone				
Cambrian	490					
Cambrian	545	Greenstones mafic volcanics chert volcaniclastics			Epithermal gold Chromite Copper in basic volcanics Volcanic massive sulphide	
Precambrian						

(Ma) Million years ago

Table 1b: Omeo Zone and Gippsland Basin - Summary of geological and mineralising events

Geological Time Scale	Age (Ma)	Sedimentation and associated volcanics	Magmatism	Major geological events	Main mineralisation events		
MESOZOIC	Quaternary	Recent stream deposits			Pincer gold		
	Tertiary	Shallow water non-marine basin, swamps, Sandstone, mudstone, greywacke, brown coal	Older basalt	Basin subsidence, rift faulting, Lantrobe Valley Depression	Brown coal (very thick seams), placer gold, heavy mineral sands		
	Cretaceous	Sandstone (Strzelecki Group)			Sandstone hosted uranium, black coal (thin seams)		
	Jurassic		Mount Leinster Complex volcanics, syenite	Erosion of landscape			
	Triassic						
	Permian						
	PALAEOZOIC	Lower Carboniferous	Avon River (Gp. Mt Timbo Gp. conglom., sst, red mudstone)	Wellington rhyolite	Kaunibahn deformation	Vein gold, silver Red beef sediment hosted copper uranium	
		Upper Devonian		Tabberabbera dyke swarm Granite intrusion	Tabberabbera deformation	Granite related tin, tungsten, gold	
		Lower Devonian		Shallow marine shelf limestone			
				Silicic volcanism (Snowy River Volc & Mt Elizabeth Caldera Volc's)	Granitoids of Mount Elizabeth & Snowy River volcanics	Bachan Rift	Carbonate hosted base metal Nowa Nowa Ironstone Epithermal gold, silver Poppley copper Granite-related gold
Upper Silurian				Bindian deformation	Vein gold, silver		
Lower Silurian			Graben filled with felsic volcanics, marine sedimentation limestone	Felsic volcanics Granite intrusion	Limestone/Wombat CK Grabens	VMS base metal (Penamban)	
			Deep marine sedimentation sandstone, siltstone		Quilonggan deformation, metamorphism	Poppley copper, Vein gold, silver	
Ordovician			Deep marine sedimentation sandstone, mudstone, black shale, chert, siltstone (turbidity current deposits)		Beunbryan deformation		

(Ma) Million years ago

APPENDIX 5. POTENTIAL MINERAL RESOURCES ASSESSMENT SUMMARY

Deposit type	Summary description of mineral tracts
Slate belt gold	The tracts are based on the distribution of Ordovician to Devonian turbidites and their metamorphic equivalents (in places overlain by younger sediments). The tract also incorporates dyke swarms (Woods Point; Mitta-Mitta, Tintalra-Cudgewa, Walwa, and other smaller dyke swarms in the Benambra gold province) and low to moderately magnetic responses which are interpreted to be associated with dyke swarms (Maier <i>et al.</i> 1997). The tract contains most of primary gold occurrences and a large number of alluvial deposits. The highest levels of potential are in the fault corridors along the Woods Point and the Kiewa Fault structures.
Disseminated gold	The tract is based on the distribution of the same rock suites as for slate belt gold. These rocks are favourable for hosting slate-belt vein gold mineralisation with a potential to form haloes of disseminated and stockwork gold mineralisation around mineralised veins.
Epithermal gold and silver	The highest levels of potential include volcanic, volcanoclastic and sedimentary rocks of the Snowy River Volcanics in the Buchan Rift and the Mount Elizabeth Caldera, and the Devonian granodioritic bodies in the Caldera. All of these rocks host mineral occurrences with epithermal type alteration characteristics. Lower levels of mineral potential are defined by the Cambrian volcanics in the north-northwest trending Barkly River Greenstone Belt in the south western part of the region and by Devonian subaerial felsic volcanic and volcanoclastics such as the Sheevers Spur Rhyodacite.
Porphyry copper-gold	The tract is based on the distribution of I and S-type, relatively magnetic and oxidised granitoids of Devonian and Silurian age in the eastern part of the region. The adjacent country rocks are also included where the aeromagnetics suggest that magnetic granitoids are present at shallow depths.
Volcanic massive sulphide base metal and gold silver deposits	This tract of highest mineral potential delineate areas of Cambrian metabasalts, gabbro and sediments in the Mt Wellington Fault Zone and the Gibsons Folly Formation and other rocks in the Limestone Creek Graben that have potential for volcanogenic base metal and gold/silver deposits. Two deposits of this type are known in the graben and mineral occurrences and prospects are also known in the greenstones. Tract of lower potential include Silurian and Devonian marine volcanic and sedimentary rocks in the Wombat Creek Graben and the Snowy Creek Volcanics of the Buchan Rift.
Irish style base metals	The tract of high potential for this type of deposit is confined to the Buchan Group limestones in the Bindri Rift.
Tin veins	These tracts includes reduced, felsic and fractionated granites (includes Numiong, Angler's Rest and Lilly Pilly granites). The tracts also incorporates a 5 km buffer around the granites and captures most of the known tin vein occurrences.
Tin greisens	These tracts are defined by the extent of known tinfields that relate to apatite-pegmatite dyke swarms (the southern extension of the Mitta Mitta dyke swarm). The abundance of apatite-pegmatite dykes and numerous greisen style occurrences within the dykes indicate that primary sources of tin were present over a wide area and processes of greisenisation were commonly in action. The tracts also include Granitoids which are, felsic, fractionated, non-magnetic, S-type or I-type, and have greisen tin deposits/prospects. Greisenised dykes north-east of Mount Pinnibar, and Silurian 'fault rock' granitoid north-east of Falls Creek are included in this tract.
Brown coal	The tract of high potential consists of large areas of Late Tertiary and Quaternary sediments that overlie extensive coal seams. The tract is based on geological parameters derived from drill hole and other data regarding the quality, depth and overburden ratio of brown coal seams. For regions where resources have a minimum seam thickness of three metres, an overburden:coal ratio of 2:1 or better, and a maximum depth of 300 metres. The tract of moderate to high potential includes the remainder of the onshore Gippsland Basin Tertiary sediments. There is evidence from drilling that brown coal is widespread throughout the Tertiary sediments of the Gippsland Basin. Where at least one of the three criteria (a minimum seam thickness of three metres, an overburden:coal ratio of 2:1 or better and a maximum depth of 300 metres) is not met, a mineral potential of moderate to high has been assigned.

There is also potential for other deposit types as follows:

- alluvial gold deposits in Tertiary and Quaternary sediments with potential for deep lead gold near primary slate belt and disseminated gold deposits.
- tungsten-molybdenum vein deposits in fractionated but relatively oxidised granitoids and adjoining sediments;
- tungsten skarn deposits in calcareous sediments near granitoids;
- nickel-copper deposits in the Woods Point Dyke Swarm;
- sediment hosted copper and sandstone uranium deposits in reduced redbed sequences of the Macalister, Avon River and Mitchell River Basins and for sandstone type deposits in the Strzelecki Group;
- dimension stone in various granitoids and other rock types in the region;
- residual kaolin deposits in weathered feldspar rich rocks and transported kaolin in areas of Tertiary and Quaternary sediments;
- bauxite deposits in deeply weathered tholeiitic and alkaline basalts; and
- construction materials where suitable rock materials occur within viable transport distances of population centres and transport routes.