Murrindindi Shire Land Capability Analysis and Environmental Values

August 2002

CLPR Research Report No. 1

State Government Victoria
Department of Natural Resources and Environment

Victoria
The Place To Be

Published by the Department of Natural Resources & Environment, 2002
Agriculture Victoria – Bendigo – CLPR
Cnr Midland Highway and Taylor St
Epsom Vic 3551

Website: http://www.nre.vic.gov.au/clpr

The National Library of Australia Cataloguing-in-Publication entry:
Murrindindi Shire land capability analysis and
environmental values.

Bibliography.
ISBN 1 74106 187 3
1. Land use – Victoria – Murrindindi. 2. Land use –
Environmental aspects – Victoria – Murrindindi. I. Centre
for Land Protection Research (Vic.). (Series : CLPR
research report series ; no. 1).

333.73099453

ISSN 1447-1043

Executive Summary

The Murrindindi Shire Council is located to the north-east of Melbourne with much of the shire located within one and a half hours drive from the northern and eastern suburbs of Melbourne.

Murrindindi Shire is similar to other areas in close proximity to Melbourne in attracting commuters, weekend residents and many tourists. While these activities provide economic benefits within the region, they place greater pressure on the shire for subdivision and development.

The rural lands in the Murrindindi Shire are coming under increasing pressure for development and subdivision, especially those around the Kinglake and Flowerdale district. This is of primary concern due to the loss of high quality agricultural land and the environmental, infrastructure and service implications of these developments.

The Murrindindi Shire Council is currently reviewing and updating their Planning Scheme. With emerging issues of subdivision and development the council has shown considerable foresight by identifying the need for natural resource information to support land use planning and the decision making process. Future subdivision and development options will be weighed up against the requirement to protect the better quality agricultural land (which is generally the most versatile and productive). The protection of high quality agricultural land is an objective under the State Planning Policy Framework (SPPF) and provisions can be made in the local planning schedule regarding appropriate zones and lot sizes.

This study has resulted in the preparation of land capability data and a range of other environmental datasets to support the development of strategic directions, policy zones and overlays. Zones and overlays are integral tools for administering land use directions and natural resource management at the local planning level.

The objectives of this study are:

1. To undertake a detailed land capability assessment of the Murrindindi Shire, including land characteristics (land systems, landform and soil types).
2. To identify areas of high quality agricultural land.
3. To identify natural resource areas and environmental constraints, including environmentally significant areas, and areas with hazards (or limitations) and erosion potential.
4. To provide the Murrindindi Shire with digital copies of the land capability information.
5. To incorporate this land resource information into the Murrindindi Shire Council's Geographic Information System (GIS).

The land resource data has been standardised to generate a consistent layer across the shire. Table 2 details the criteria from which a land capability assessment is then derived. Land capability differentiates between highly capable agricultural land and land with low capability, and is useful for the development of local planning policies and definition of zones and overlays.

To assist the Murrindindi Shire in the development of their zones, overlays and planning policies, other digital map products were generated in the preparation of this report. These digital maps include:

1. Environmental information such as Environmental Vegetation Classes (EVCs), stream and drainage line buffer zones, and wetlands.
2. Remnant vegetation taken from the Department of Natural Resources and Environment's (NRE's) tree cover layer.
3. Erosion risk, which is once again derived from the standard land resource unit layer and is based on criteria for erosion susceptibility.
4. Significant ridgelines and viewscapes which were mapped by Murrindindi Shire Council staff onto base maps and subsequently digitised into GIS.
5. Potential Dieldrin contamination areas. This has been mapped to a broad area around Kinglake based upon anecdotal information from NRE staff.

The land resource information contained in this publication and the associated digital soil landform data has been derived from a number of studies previously carried out within the Murrindindi Shire. These previous studies have been completed at varying scales, thus product enhancement techniques have been necessary to present the data at 1:40 000 scale. Flora information and fauna habitat areas have been derived from environmental vegetation class (EVC) mapping at 1:100 000 scale. The data presented within this report is therefore suitable only for regional planning purposes and is not site specific in detail.

The precision of mapped boundaries is affected by the scale of the map. Any enlargement of the map will result in distortion of the information and is unlikely to improve its accuracy. The authors strongly advise that further detailed investigation be carried out prior to any new development proceeding.

The digital map themes associated with this report have been forwarded to the Murrindindi Shire Council who are able to produce hard copy map products. Hard copy maps are not provided with this publication.

The digital map products, the base data layers and this report have been packaged and forwarded to the Murrindindi Shire in digital form to be incorporated into the shire's GIS to support their Planning Scheme review.

Please note that this study has been prepared by the Centre for Land Protection Research (CLPR) for the Murrindindi Shire Council. The Centre for Land Protection Research is a research institute of Agriculture Victoria, Department of Natural Resources and Environment. However NRE reserves the right to comment freely on any strategic plans or planning scheme amendments prepared as a result of this study.

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Keywords: land capability, soil and landform units, Ecological Vegetation Classes (EVCs), Geographic Information Systems (GIS), planning scheme, zones, overlays, erosion

1 Introduction

The Murrindindi Shire Council is located to the north-east of Melbourne and stretches from Kinglake and Narbethong in the south to the granite plateau of the Strathbogie Ranges (Highlands) to the north, and from Strath Creek in the west to Lake Eildon in the east. Much of the shire is located within one and a half hours drive from Melbourne.

The rural lands in the Murrindindi Shire are coming under increasing pressure for development and subdivision, especially those closest to Melbourne, around the Kinglake and Flowerdale district. This is of primary concern due to the loss of high quality agricultural land and the environmental, infrastructure and service implications of these developments, particularly when they are inappropriately sited. There are also differing expectations within the community concerning development, which has resulted in confusion as to development entitlements, environmental outcomes and appropriate land management practices.

The Murrindindi Shire Council is currently reviewing and updating their Planning Scheme. With emerging issues of subdivision and development the council have shown considerable foresight by identifying the need for natural resource information to support land use planning and the decision making process. All development should be based on a sound knowledge of the natural resource base, in conjunction with environmental constraints and social and economic information, to give a holistic and sustainable set of outcomes. This study has resulted in the preparation of land capability data and a range of other environmental datasets to support the development of strategic directions, policy zones and overlays. Zones and overlays are integral tools for administering land use directions and natural resource management at the local planning level.

Land capability information is derived from an understanding of the nature of the land, the condition of the land, the limitations inherent within the landscape for more varied land use, and the degree of management likely to be required to maintain a particular use. Although not always definitive due to the many management systems that can be imposed for any particular land use, land capability information will provide planners with an indication of the likely performance of land under a particular land use or land management system.

The information from this study will be used by the Murrindindi Shire Council in the development of strategic directions, policies, zoning and overlay changes in the Murrindindi Planning Scheme and to further guide the use and development of rural land in the shire. This information will assist day-to-day decision making about land uses for both landowners and Murrindindi Shire Council.

2 Purpose of the study

The background and purposes of this study arise from the preparation and review of the Murrindindi Shire Planning Scheme including the Municipal Strategic Statement (MSS) that sets land use directions and policies for the municipality

Murrindindi Shire is similar to other areas in close proximity to Melbourne in attracting commuters, weekend residents, and many tourists. While these activities provide economic benefits within the region, they place greater pressure on the shire for subdivision and development. Future subdivision and development options must be weighed up against the requirement to protect the better quality agricultural land (which is generally the most versatile and productive). The protection of high quality agricultural land is an objective under the State Planning Policy Framework (SPPF) and provisions can be made in the local planning schedule regarding appropriate zones and lot sizes.

The Murrindindi Shire Council recognises the importance of agriculture to the shire's economy, the need to protect high quality agricultural areas, and encouragement of agricultural diversity. Land capability mapping for the rural areas of the shire will produce information about high quality agricultural land, agricultural industry suitability, landform, soil types, natural resources, environmental constraints and opportunities. It will be an integral component of the shire's Planning Scheme Review and will guide the use and development of rural land in the shire.

The review is also pertinent due to the changing nature of agriculture in the region, with new agricultural industries emerging in some areas, for example, intensive horticultural crops. It can be argued that much of the land in the Murrindindi Shire will support some form of agricultural development given sufficient input and management. The additional costs associated with the management of marginal land will ultimately determine the economic feasibility of any new development. It is possible to identify landforms and soil types that are highly advantageous for agricultural production, and ensure these areas are protected from competitive land uses.

This study has mapped high quality agricultural land. Table 3 provides a guide to the range of agricultural enterprises that may be pursued. A summary of all key landform and soil descriptions can be found in Section 5, and a glossary of soil terms is contained in the Appendix.

In addition, this report refers to Ecological Vegetation Class (EVC) mapping. The use of pre-1750 EVC information is referred to in Section 4. Using pre-1750 data gives a reliable baseline and is considered to be relevant even in areas where vegetation has been altered since settlement. Components of original EVCs often remain despite conversion to agriculture and there is potential for biodiversity gains from land restoration activities if original EVCs are taken into account.

All the above information can be used to direct planning policy and decisions, and encourage new agricultural investment opportunities. These objectives are stated below.

2.1 Objectives

1. To undertake a detailed land capability assessment of the Murrindindi Shire, including land characteristics (land systems, landform and soil types).
2. To identify areas of high quality agricultural land.
3. To identify natural resource areas and environmental constraints, including environmentally significant areas, and areas with hazards (or limitations) and erosion potential.
4. To provide the shire with digital copies of the land capability information.

5. To incorporate this land resource information into the Murrindindi Shire Council's Geographic Information System (GIS).

3 Methodology

The Murrindindi Shire has a wide range of land types which support various forms of land use. Due to the increasing pressure for development and subdivision, the shire has sought information about the agricultural potential of rural lands within its area. This study has identified land units, provided a land capability assessment of the agricultural potential of the different units, and identified limitations and constraints to agricultural productivity. This information is being used to inform the review of the Murrindindi Planning Scheme.

The assessment of land capability for agriculture in the Murrindindi Shire has primarily been a 'desktop' study. Existing sources of information, historical surveys and GIS modelling techniques have been utilised to determine the land units (predominantly based on soil and landform characteristics).

Environmental protection has also been considered to ensure that development will not result in a net loss in biodiversity (consistent with State Government policies) or cause land or water degradation. To achieve this aim a range of environmental information and maps has been prepared. Council may use this information to consider options for the following overlays within its Planning Scheme:

- Erosion Management Overlay (EMO)
- Vegetation Protection Overlay (VPO)
- Environmental Significance Overlay (ESO)
- Significant Landscape Overlay (SLO)

The provision of natural resource information for the Murrindindi Shire Council has been achieved using a range of existing land resource information. This land resource information has been standardised as much as possible, and is presented at a scale of 1:40 000 for planning purposes. It will have limitations with regard to the precision of mapped boundaries, survey intensity, and the quantity and quality of data collected. This information is therefore suitable for broadscale planning rather than detailed site selection.

3.1 Land (soil landform) units

For the purposes of this study a land unit is defined as an area of common landform in association with a dominant soil type and within a broad climatic range. Landform has been defined into categories based on relative relief such as plains, low hills and mountains. These comply with national standards as set out in the *Australian Soil & Land Survey Field Handbook* (McDonald et al. 1990). Different landforms were further distinguished by the make-up of their lithology (geology). Soil types are also described to national standards from field soil surveys and soil cores, and are compared on the basis of their attributes and classification, using *The Australian Soil Classification* (Isbell 1996).

For this project, development of the land units has been an exercise in collating existing information from historical surveys completed for different parts of the shire. These surveys were performed at different times, by different agencies, at a range of scales and to varying standards, which made the provision of a consistent dataset of land attributes the major task for the development of land units. The relevant surveys used to access existing data are listed in Table 1.

Table 1. Soil and land surveys within the Murrindindi Shire

Title	Author	Year	Organisation	Reference locality	Scale
Goulburn Broken Dryland Regional Development Project	Hocking, Rees and Robinson	2000	Centre for Land Protection Research	Goulburn Broken Catchment Management Authority	1:100 000
A Land Capability Study of the Cathedral Range - Archeron River Valley	Lorimer	1977	Soil Conservation Authority	Cathedral Ranges	1:25 000
City of Whittlesea, Land Capability Analysis Technical Report No. 54	Bluml and Feuerherdt	1999	Centre for Land Protection Research	Kinglake area	1:25 000
A Study of the Land of the Upper Yarra Valley and Dandenong Ranges	Howe and Van der Graaf	1976	Soil Conservation Authority	Upper Yarra River	1:56 000

Approximately 90% of the Murrindindi Shire area is contained within the Goulburn Broken River catchment. As the Goulburn Broken Dryland Regional Development Project (Hocking et al. 2000) provides the broadest coverage of the shire area, the information contained within this project was used as the basis for developing detailed land units. However, this survey was carried out at 1:100 000 scale and the Murrindindi Planning Scheme requires data layers suitable at 1:40 000 scale. A detailed digital elevation model (DEM) was developed at the Centre for Land Protection Research (CLPR) and integrated with the existing land units from the Goulburn Broken Dryland Regional Development Project to refine the landform component. This generated a land unit layer that has landform components suitable at 1:40 000 scale, and soils information at 1:100 000 scale.

Once the land unit layer had been developed, the more detailed data from the other surveys could then be standardised and incorporated within that layer. Around the Kinglake area, land units were incorporated from the City of Whittlesea Land Capability study (Bluml & Feuerherdt 1999), while the Cathedral Ranges study (Lorimer 1977) was incorporated into the base data layer thus capturing more detailed land units. The Upper Yarra Valley Land systems (Howe & Van der Graaf 1976) were also integrated into small areas to the south of the shire.

The precision of the final land units is dependent upon the accuracy of base geological mapping (1:100 000 scale), slope classes which have been constructed from 1:25 000 digital elevation modelling, and the level of detail and accuracy of previous soil and land surveys (1:100 000 – 1:25 000 scales). Subsequently, the land unit mapping and information is considered suitable for broadscale planning and policy decisions only. Specific on-farm or on-site development requires more detailed assessment as enlargement of the map will not improve the precision of data, and could be misleading to the user.

The land units and their properties are described in detail in Section 5.

3.2 Land capability assessment for agriculture

Once a uniform soil and landform dataset has been generated, each land unit is assigned a land capability class for agricultural potential. The capability classes have been determined using specific land capability assessment tables containing landform and soil parameters which influence the ability of the land to sustain the desired land use. In this study the term ‘versatility’ has been used interchangeably with that of ‘capability’.

Capability classes are determined by comparing the parameters outlined in the land capability assessment table (Table 2) against the specific landform and soil conditions present in a land unit. The overall land capability class is then determined by identifying the most limiting factor (MLF) in each land capability assessment table. This procedure is repeated for each land unit in the study area.

Table 2. Land capability criteria to determine agricultural quality classes for Murrindindi Shire study (1:40 000 scale)

	Land capability classes				
	1	2	3	4	5
Climate-rainfall (mm)	Watersupply <1200	>500 & <1200	>500 & <1200	<500 or >1200	<300 or >1200
Slope range (%)	0-3	3-10	10-20	20-32	>32
Surface texture	Loams, Sandy Loams	Silty Loams, Sandy Clay Loams, Clay Loam	Clay Loam, Fine Sandy Loams	Light Clays	Heavy Clays, Sands
Drainage	Well	Moderately Well	Rapid, Moderately Well	Imperfect	Poor
Soil colour	Red, Brown	Red, Brown	Brown, Grey, Yellow		
Friability	Yes	Partial	No	No	No
Soil aggregate stability (A horizon)	Highly stable (E6-8)	Stable (E4-5)	Mod stable (E3)	Unstable (E2)	Very Unstable (E1)
Depth to hard rock	>100	>100	>50	>50	<50
Base nutrient status	Eutrophic (>15)	Mesotrophic (5-15)	Mesotrophic (5-15)	Dystrophic (<5)	Dystrophic (<5)
Subsurface permeability	Moderate	High to slow	High to slow	High to slow	Very High to very Slow
pH	>6	5-6	<5		
Soil type *	DE AA, KA AA, CH AA DE/KA/CH AB where friable	DE AA/AB, KA AA/AB, CH AA/AB, SO AA, VE, TE, KU AA. OR	DE AB, AD, KA AB, AD, CH AB, AD,SO AB, AD/AE	DE AC/AD, KA AC/AD, CH AC/AD, SO AB/AC/AD	RU, SO,TE, HY, SO AB/AC/AD

* refer to Appendix 1 for Australian Soil Classification definitions

Table 2 has been developed from local and regional data to provide a general assessment of land capability. The assessment does not provide sufficient information for site specific evaluation. Additional site specific factors that would require consideration prior to development may include site size and layout, availability of supplementary water supply, winter-spring flooding, frost risk, and soil factors such as sub-surface textures, soil profile structure, organic matter content and sodicity.

Land capability is defined by five separate classes in order to differentiate between highly capable agricultural land (generally high land quality) and land with low capability (generally severe limitations) for agricultural productivity. These classes are represented on the land capability maps as green (very good) to yellow (moderate) through to red (very poor). Definitions for these classes are contained in Table 3.

Detailed site assessment is required before proceeding with any new development.

3.3 Environmental information

The land capability analysis has considered natural resources throughout the study area, identifying environmental constraints and opportunities. The information forms a useful set of background data for both council and the community to make broad land use decisions. When applicable, the information may be used as a basis for planning scheme overlays. The use of a range of environmental overlays

within the planning scheme ensures that development opportunities and environmental protection can be considered in unison.

The natural resource and environmental datasets have been sourced from existing survey work and GIS layers held within the Department of Natural Resources and Environment (NRE) Corporate Geospatial Data Library.

Flora and fauna records have been sourced from NRE's Victorian Flora Information System and the Atlas of Victorian Wildlife. The database records have been filtered to show Australian Rare and Threatened Species (AROTS), Victorian Rare and Threatened Species (VROTS), Flora and Fauna Guarantee Act (1988) (FFG) listed species, China-Australia Migratory Birds Agreement (CAMBA) listed species and Japan-Australia Migratory Birds Agreement (JAMBA) listed species. Species lists for these categories are given in Appendices 2 and 3. The conservation status of Ecological Vegetation Classes (EVCs) in the Central Victorian Uplands bioregion is listed at Appendix 5.

The following datasets have also been sourced to present information and maps:

- Remnant vegetation – tree cover (NRE Geospatial Data Library 2002)
- Ecological Vegetation Classes (EVCs) (NRE Geospatial Data Library 2002)
- Wetlands (NRE Geospatial Data Library 2002)
- Streams buffers (CLPR 2002)
- Erosion susceptibility (CLPR 2002)
- Significant Ridgelines and Viewscapes (mapping provided by Murrindindi Shire Council 2002)

The natural resource and environmental information has been prepared from a range of existing datasets outlined above. This information has been provided to the Murrindindi Shire in digital form for use in their GIS system. Hard copy maps have also been generated for display throughout the public consultation phase. In many cases the scale of the natural resource and environmental layers is 1:100 000. If this data is considered and adopted within the Murrindindi Planning Scheme, the level of accuracy is compromised by utilising it at the Planning Scheme scale of 1:40 000. This must be considered when utilising this data for decision making.

The specific natural resource and environmental layers are discussed in Section 4.2.

4 Sustainable development in the rural zone

4.1 Planning considerations

The State Planning Policy Framework (SPPF) requires the following objectives to be addressed in developing the Planning Scheme:

- the protection of high quality productive land;
- recognition that land capability is a fundamental consideration;
- encouragement of sustainable land use and agriculture;
- that subdivision not detract from the long-term productivity of high quality agricultural land; and
- recognition of the compatibility of development with existing uses.

The local planning policy framework (LPPF) of the Murrindindi Planning Scheme also gives direction for agricultural land and environmental resources. The Goulburn Broken Catchment Management Authority (CMA) has also issued a policy statement that there should be double the production from half the land in its area. The Goulburn Broken CMA is also currently reviewing its regional catchment

strategy. Although agriculture is important, relevant land management authorities recognise there are many areas of marginal agricultural land use with severe limitations. The land capability (versatility) assessment has been used to identify these. This raises the question regarding the future use of land that is considered to be of low capability for agriculture. To further inform these planning and catchment frameworks, there is a need to provide basic information upon which to base broad land use decision making. The mapping that is associated with this report provides this information.

4.2 Land capability (versatility) assessment

Map 1 (refer to accompanying CD) essentially identifies agricultural quality and versatility. The assessment of land capability provides a guide to the type of agriculture that can be supported by a specific land unit. As the capability of the land increases, so will the opportunities for agricultural diversification (versatility). Therefore, areas of high capability are most valued as they can provide greater flexibility for landholders seeking alternative agricultural enterprises.

Due to the complex interactions between soil, landscape and climate, purely objective assessments of land can sometimes be misleading. To this extent, agricultural capability as determined in this report, provides a general guide to the capability of land for agriculture and is useful in protecting what is considered to be high quality agricultural land. This information is desirable for the development of local planning policies and the identification of zones and overlays.

In assessing the capability of land for various forms of agriculture, the study has considered a number of key questions:

1. *Climate* What forms of agriculture are suited to the climatic conditions present?
2. *Landscape* Will the landscape and soil conditions present result in drainage problems and impede machinery operations or management for different forms of agriculture? Will different forms of agriculture result in unacceptable land and water degradation?
3. *Soil* Are the inherent soil conditions capable of supporting different forms of agriculture?

The land capability criteria outlined in Table 2 has been developed to address these questions. The table has five capability classes that are related to five enterprise groupings (Table 3). The enterprise groupings are distinguished by characteristic soil and landform properties. Therefore, the capability class is determined by comparing the existing soil and landform conditions, with the growing conditions required for each of the enterprise groups. Where no limiting conditions are present, the land has a high capability and will support many forms of agriculture. Where few or many limitations exist, the land has a moderate to low capability and will support fewer forms of agriculture.

These enterprise groupings not only reflect the landform and soil limitations that impact on the various forms of agriculture, but also highlight areas with the flexibility to diversify into new and competitive industries. Definitions for the five capability classes and enterprise groupings are contained in Table 3. It is important to note that the enterprise groups listed for the five capability classes are not restricted to one of the five capability classes, but are listed as typical land uses that could occur within the limitations of each class. Activities listed in higher capability classes may be suitable for low capability classes with correct land management, engineering works and higher inputs, for example, fertiliser.

Table 3. Definitions for agricultural capability classes

Capability class		Description	Enterprise groups
1	Very high	High to very high productivity mostly on alluvial floodplain. Suited to a wide variety of horticultural and cropping applications. Note: Flooding risk needs to be considered in floodplain areas.	Irrigated horticulture, irrigated broadacre cropping, dairying, broadacre cropping, broadacre grazing, viticulture
2	High	Moderate to high productivity on the wider alluvial plain. Generally suited to grazing, viticulture and opportunistic cropping. Note: Waterlogging is an issue on the wider alluvial plain.	Broadacre cropping, broadacre grazing, viticulture, forestry
3	Moderate	Moderate to low productivity on moderate to gentle slopes. Commonly suited to grazing and viticulture.	Broadacre grazing, viticulture, forestry
4	Low	Low to moderate productivity on steep to moderate slopes. Typically utilised for forestry and marginal grazing.	Forestry and marginal grazing
5	Very low	Very low productivity or severe landform constraints exist (e.g. very steep slopes, rock outcrop). Considered unsuitable for agriculture and forestry.	Not suitable for agriculture or forestry production

The land capability classes (1 - very high to 5 - very low) provide an indication of the estimated risks associated with development. It is generally acceptable to steer development to land classed as very high to moderate capability. Within these classes, few to no landform and soil limitations exist for development. Subsequently, standard design and management techniques can safely be used to develop the land without the risk of failure. Therefore, lower maintenance costs and land management skills are required to manage the land and minimise on-site and off-site environmental impacts.

It is not acceptable to guide development to land classed as low to very low capability. Significant landform and soil limitations exist which require substantial investigation and specialist design to overcome (where possible). Under these circumstances, land uses such as effluent disposal, gravel roads and farm dams can be expected to fail. This may result in a marked increase in infrastructure and maintenance costs. In addition, landowners would require a much higher skill level to cope with the associated on-site and off-site land management issues.

4.3 Environmental considerations

The long-term protection and conservation of the natural environmental is important for a number of reasons, including maintaining biological diversity, provision of a healthy living environment, and the minimisation of land and water degradation.

The need to protect biological diversity has been identified at all levels of government. *Victoria's Biodiversity Strategy* (NRE 1997) recognises the need to protect all native habitat where species of national, state and regional significance are depleted or threatened. The planning system is one means by which commonwealth, state and local biodiversity objectives can be implemented. Effective planning policies and controls in planning schemes are important mechanisms for achieving biodiversity objectives, especially on private land. Local government's key role in conserving biodiversity is recognised in *Victoria's Biodiversity Strategy (NRE 1997)* and also in the *National Biodiversity Strategy* (Commonwealth of Australia 1996) and the *National Local Government Biodiversity Strategy* (Australian Local Government Association 1999).

Ensuring positive outcomes for formally recognised rare or threatened species and their habitat is one step to ensuring biodiversity values are maintained and enhanced. Status, key vegetation classes and

habitat components for key flora and fauna species and communities that occur in the Murrindindi Shire are given in Table 4. Detailed notes and pictures of Australian rare or threatened species (AROTS) and selected *Flora and Fauna Guarantee Act 1988* (FFG) listed species is given in Appendix 2. A full list of flora and fauna species that have international, national or state significance is given in Appendix 3.

Communities of flora and fauna may be listed at national level under the *Environmental Protection and Biodiversity Conservation Act* (EPBC) or at state level under the FFG Act. Grassy White Box Woodland is listed under the EPBC Act and remnants of this community still exist in the Murrindindi Shire. A good example is council owned land immediately south of McKenzie Flora Reserve, on the outskirts of Alexandra township.

A summary of these acts can be found in Appendix 4.

Table 4. Notes on Australian Rare or Threatened Species (AROTS) and selected species listed under the *Flora and Fauna Guarantee Act 1988* which occur in Shire of Murrindindi

Species/communities	Status*	Key EVCs in which key habitat occurs	Key habitat components
Threatened fauna and habitats			
Regent honeyeater *Xanthomyza phrygia*	EPBC (E) FFG (AS-41)	Grassy Dry forest Valley Grassy Forest Grassy Woodland Plains Grassy Woodland	Large trees (nectar)
White-bellied sea-eagle *Haliaeetus leucogaster*	CAMBA FFG (AS-60)	Floodplain Riparian Woodland	Large trees (nesting) Floodplain wetlands and open water (feeding) Dead emergent trees in Lake Eildon
Swift parrot Lathamus discolor	EPBC (E) FFG	Grassy Dry Forest Valley Grassy Forest Grassy Woodland Plains Grassy Woodland	Large trees (nectar)
Powerful owl *Ninox strenua*	FFG (AS-92)	Herb–rich Foothill Forest Damp Forest Valley Grassy Forest	Large trees (hollows)
Spot-tailed quoll *Dasyurus maculatus*	EPBC (E) FFG (AS-15)	Can occur in most forest types.	Large trees (hollows) Large (hollow log) on ground litter Often associated with rock outcrop and escarpment terrain
Leadbeater's possum Gymnobelideus leadbeateri	EPBC (E) FFG (AS-62)	Montane Wet Forest Montane Riparian Thicket Wet Forest	Large trees (hollows) Wattles in mid-storey
Southern bent-wing bat *Miniopterus schreibersii* southern form	EPBC (CD) FFG	Can occur (forage) in most forest types.	Caves/mine shafts (breeding/roosting)
Brush-tailed phascogale *Phascogale tapoatafa*	FFG (AS-79)	Grassy Dry forest Damp Forest Valley Grassy Forest Grassy Woodland Plains Grassy Woodland	Large rough barked eucalypts (including the base of species such as red gum) for nesting and feeding
Eastern horseshoe bat *Rhinolophus megaphyllus*	FFG	Can occur (forage) in most forest types.	Caves/mine shafts (breeding/roosting)
Striped legless lizard *Delma impar*	EPBC (V) FFG (AS-17)	Plains Grassy Woodland Grassy Woodland	Native grassland
Spotted tree frog *Litoria spenceri*	EPBC (E) FFG (AS-112)	Riparian Forest	Mountain streams
Southern bell frog *Litoria raniformis*	EPBC (V) FFG	Floodplain Riparian Woodland	Permanent fresh waterbodies with well vegetated margins
Barred galaxias *Galaxias fuscus*	EPBC (E) FFG (AS-65)		Mountain streams
Macquarie perch Macquaria australasica	EPBC (E) FFG	Riparian zones of streams containing populations of Macquarie Perch	Floodplain (tributaries)
Hemiphlebia damsel fly *Hemiphlebia*	FFG (AS-46)	Floodplain Riparian Woodland	Floodplain (wetlands)
Cattle egret	CAMBA	Floodplain Riparian Woodland	Floodplain (wetlands)
Great egret	CAMBA	Floodplain Riparian Woodland	Floodplain (wetlands)
Lathams snipe	CAMBA	Floodplain Riparian Woodland	Floodplain (wetlands)
Painted snipe	CAMBA	Floodplain Riparian Woodland	Floodplain (wetlands)
Threatened flora and habitats			
Buxton gum Eucalyptus crenulata	EPBC (E) FFG (AS-01)	Swampy Riparian complex	Acheron valley at Buxton
Grassy white box woodland	EPBC (E)	Grassy Woodland Plains Grassy Woodland	White box in over-storey, grassy under-storey

*AS = Action Statement, E = endangered, V = vulnerable, EVC = Ecological Vegetation Class.

NOTE: Action Statements are available at http://www.nre.vic.gov.au/ -plants and animals – native plants and animals – Flora and Fauna guarantee Act – Action Statements

Identification of key habitat components for rare or threatened species provides a useful filter in the identification of major values that contribute to biodiversity in the local landscape. Key components identified in the Murrindindi Shire include large trees, floodplain wetlands, caves and mine shafts, native grassland and on-ground large woody debris. Large hollow-bearing trees are a key habitat component for many species and fauna records held by NRE are able to identify species that are dependent on tree hollows and those that often use hollows.

Although there are a diverse range of habitat types in the region, many of these are degraded. Parts of many of the ecological vegetation communities (EVCs) that existed prior to European settlement have been removed or substantially altered through agricultural and urban development. Wetlands have also suffered considerable losses through alteration, drainage and declining water quality.

Specific mapping of the extent and degree of vegetation change would be difficult, time consuming and costly. The most appropriate, available base line information is pre-1750 EVC maps. Data has been collected at the bioregion level and depletion rates calculated. These are outlined in the *Goulburn Broken Native Vegetation Management Strategy* (GBCMA 2001), and the *Forest Management Area Plan for the Central Highlands* (NRE 1998). Conservation status has been allocated based on rarity and degree of depletion. Some adjustments have been made to bioregion boundaries and there are likely to be minor adjustments to currently available data. Conservation status, which is unlikely to change with adjusted figures, are presented in Appendix 5. The Shire of Murrindindi lies, geographically, within the Central Victorian Uplands and Highlands Northern Fall bioregions.

The natural resource and environmental information provides a picture of the key conservation areas, key habitat linkages and threats to biodiversity. The natural resource and environmental information should be used in conjunction with the land capability analysis to identify zoning conflicts, particularly where rural residential development or rural living may result in the destruction or fragmentation of significant vegetation or habitat. These conflicts could then be reduced through the application of appropriate land use management and planning scheme strategic directions and implementation tools.

An outline of the natural resource and environmental information for the Murrindindi Shire is given below.

Ecological vegetation classes (EVCs), streams, drainage lines and wetlands

Map 2 (refer to accompanying CD) displays vulnerable, endangered and depleted ecological vegetation classes, stream and drainage lines including 30 metre buffer zones, and wetlands.

Wetlands within the study area have been mapped from existing information held by the Department of Natural Resources and Environment (NRE). Although there are still a number of wetlands that exist, primarily in the alluvial plain and floodplain zones, many have undertaken significant degradation through habitat alteration, salinity, drainage and declining water quality.

Consideration should be given to protection of wetlands through the provision of buffer areas and protection of upstream water quality.

Stream buffers have been highlighted for each of the major creeks and associated drainage lines. This allows the recognition of land where inappropriate clearing, siting of water storages and poor land management may lead to deterioration in water quality, or a considerable reduction in environmental flows.

Map 2 displays a 30 metre buffer zone around streams and drainage lines. The provision for a 30 metre buffer zone is incorporated within Clause 15.01, *Protection of Catchments, Waterways and Groundwater* of the *Victorian Planning Provisions* (Government of Victoria 1997). These planning provisions state that ‘Planning and responsible authorities should consider the impact of catchment

management on downstream water quality and freshwater, coastal and marine environments, and where possible should encourage:

- the retention of natural drainage corridors with vegetated buffer zones at least 30 metres wide along waterways to maintain the natural drainage function, stream habitat, and wildlife corridors and landscape values, to minimise erosion of stream banks and verges, and to reduce polluted surface runoff from adjacent land uses.'

Threatened EVCs provide useful information for land management and land use planning decision making. There is an opportunity for further scientific investigation and discussions with the community and relevant agencies as to how this information is incorporated into future land use and planning decisions.

Remnant vegetation

Agriculture and residential development have resulted in the depletion of many vegetation communities throughout the study area. Much of the remnant vegetation is now restricted to state forest. Environmentally significant stands of remnant vegetation still occur on private land. These remnants are particularly important for maintaining biodiversity within the region.

Areas of remnant vegetation to one hectare in size have been identified from 1:25 000 scale satellite imagery analysed by NRE. An assessment of the tree density cover has been made to classify the tree cover into three categories as follows:

i. Dense

ii. Moderate

iii. Sparse.

These classes are highlighted on the remnant vegetation map (Map 3 – see accompanying CD).

Erosion risk

The protection of soil and water quality is a major consideration in achieving biodiversity objectives. Any erosion mapping should identify areas susceptible to erosion, where the loss of top soil would contribute a greater amount of sediment to rivers and streams. The areas of erosion susceptibility were once again defined by applying criteria to the land units and generating an erosion susceptibility layer. The criteria are outlined in Table 5 below. The criteria are primarily based upon a combination of soil dispersibility, soil depth, rainfall and slope factors.

Table 5. Criteria used to assign erosion susceptibility classes

	Susceptibility to erosion classes				
	1	2	3	4	5
Soil aggregate stability * (A horizon)	Highly stable (E6-8)	Stable (E4-5)	Moderately stable (E3)	Unstable (E2)	Very unstable (E1)
Depth to hard rock (cm)	30-200	0-30, >200			
Slope (%)	0-1	1-3	3-10	10-32	>32
Climate (rainfall mm)	>650	<400	400-650		

* Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8

The criteria outlined in Table 5 have been applied to the soil landform units to classify the erosion susceptibility classes. It is considered that classes 4 and 5 relate to high and severe erosion susceptibility. They both exhibit dispersive subsoils on moderate to steep slopes. The dispersive nature of the subsoil limits the agricultural potential of that area. If the subsoil is exposed to the surface due to

cultivation, or some other practice, it is likely to erode rapidly in the event of significant rainfall. This will be exacerbated on steeper slopes where only a thin mantle of soil cover remains.

Class 4 areas, especially on the lower slopes, may be managed productively and sensitively to reduce erosion susceptibility, whereas management of class 5 areas, being on steep slopes, would require far greater attention and inputs to contain its erosion potential. Class 4 areas may be considered to exhibit a general erosion risk, whereas class 5 areas exhibit a severe erosion risk. These areas are highlighted on the erosion risk map (Map 4 – see accompanying CD).

Significant ridgelines and viewscapes

The Murrindindi Shire is an area of great natural beauty, with a number of scenic attractions to entice tourists to the region. The shire recognises the need to preserve the aesthetic nature of the area by not allowing unsuitable or inappropriate developments to detract from highly visible scenic areas.

The classification of significant landscapes is a difficult task, due mainly to the subjective definition of a significant landscape with no established classification criteria. With GIS and suitable software it would be possible to model these landscapes using a View Shed modelling procedure, however this task was not within the scope of this project. The procedure adopted was for shire staff, with knowledge of the local environment, to identify and mark on to base maps areas of known significant ridgelines and viewscapes. The areas marked were then digitised into the GIS and included in this map (Map 5 – see accompanying CD).

The significant ridgelines and viewscapes map has been developed to show:

- significant ridgelines from all declared main roads in the Murrindindi Shire;
- significant ridgelines surrounding major towns;
- significant ridgelines in the environs of the major tourist precincts of Lake Eildon and the Goulburn River; and
- landscapes that have been classified by the National Trust of Australia (Victoria) in the Trawool Valley and Cathedral Ranges areas.

Potential Dieldrin residue areas

Areas of potential Dieldrin residue have been defined from anecdotal information provided by NRE regional staff. Their knowledge is based upon the extent of historical potato growing agriculture in the Kinglake area.

The area defined as potential Dieldrin residue does not necessarily indicate the presence of dieldrin within that locality, but it identifies locations requiring more detailed investigation prior to any development, or change in existing land use. These areas are highlighted in Map 6 (see accompanying CD).

5 Land capability classes, landform and soil descriptions

This section of the report presents the land capability classes for each land component. A summary of geological, landform and soil information that is relevant to the assessment of land capability is also provided. This information should be viewed in conjunction with the land capability map (Map 1 – see accompanying CD) associated with this report.

The information presented here has been sourced from existing surveys

Table 6. Land Capability Classes for sedimentary and metamorphic terrain (Palaeozic metasediments) with high mean annual rainfall (>1000 mm)

Component	1	2	3	4	5	6	7
			Land attributes				
Terrain type	level	gently undulating	undulating	gently rolling	rolling	steep	crest
Slope (%)	0-1	1-3	3-10	10-20	20-32	>32	-
Capability Class	1	1	2	3	4	5	1
			Dominant soils and attributes				
Description	Red, structured gradational (earth), generally strongly acidic	Red, structured gradational (earth), generally strongly acidi	Red, structured gradational (earth), generally strongly acidi	Red, structured gradational (earth), generally strongly acidi	Red, structured gradational (earth), generally strongly acidi	Red and Brown structured gradational (earth), generally strongly acidic	Red structured gradational (earth), generally strongly acidi
ASC[1]	Red Dermosols	Red Dermosols	Red Dermosols	Red Dermosols	Red Dermosols	Red and Brown Dermosols	Red and Brown Dermosols
PPF[2]	Gn3.11, Gn4.11	Gn3.11, Gn4.11	Gn3.11, Gn4.11	Gn3.11, Gn4.11	Gn3.11, Gn4.11	Gn3.11, Gn4.11, Gn4.31, Gn3.21	Gn3.11, Gn4.11, Gn4.31, Gn3.21
Depth	Deep	Deep	Deep	Deep	Deep to moderately deep	Shallow to deep	Shallow to deep
	>1 m	>1 m	>1 m	>1 m	>1 m and 0.5-1 m	0.25-0.5 m and >1 m	0.25-0.5 m and >1 m
Surface texture	Sandy loam or silty loam	Sandy loam or silty loam	Fine sandy loam or silty loam	Silty loam and sandy loam	Silty loam and sandy loam	Silty loam and sandy loam	Silty loam and sandy loam
Drainage	Well drained	Well drained	Well drained	Well drained	Well drained	Well drained, rapid	Well drained
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3
Nutrients[4]	mesotrophic/ dystrophic	mesotrophic/ dystrophic	mesotrophic/ dystrophic	mesotrophic/ dystrophic	mesotrophic/ dystrophic	dystrophic	dystrophic

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Table 6 continued

Component	1	2	3	4	5	6	7
			Subdominant soils and attributes				
Description	Red, apedal/ weakly structured gradational (earth), generally acidic	Red, apedal/ weakly structured gradational (earth), generally acidic; red whole coloured structured texture contrast soil	Red, apedal/ weakly structured gradational (earth), generally acidic red whole coloured structured texture contrast soil	Red, apedal/ weakly structured gradational (earth), generally acidic red whole coloured structured texture contrast soil	Red, apedal/ weakly structured gradational (earth), generally acidic red whole coloured structured texture contrast soil	Red, apedal/ weakly structured gradational (earth), generally acidic red whole coloured structured texture contrast soil	Red, apedal/ weakly structured gradational (earth), generally acidic red whole coloured structured texture contrast soil
ASC[1]	Red Kandosol	Red Kandosol Red Chromosol	Red Kandosol Red Chromosol	Red Kandosol Red Chromosol	Red Kandosol Red Chromosol	Red Kandosol Red Chromosol	Red Kandosol Red Chromosol
PPF[2]	Gn2.11	Gn2.11, Dr2.11	Gn2.11, Dr2.11	Gn2.11, Dr2.11	Gn2.11, Dr2.11	Gn2.11, Dr2.11	Gn2.11, Dr2.11
Depth	Deep >1 m	Deep >1 m	Deep and moderately deep >1 m and 0.5-1 m	Deep and moderately deep >1 m and 0.5-1 m	Deep and moderately deep >1 m and 0.5-1 m	Shallow and deep 0.25-0.5 m and >1 m	Shallow and deep 0.25-0.5 m and >1 m
Surface texture	Sand loam or silty loam	Silty loam and sandy loam	Silty loam and sandy loam	Silty loam and sandy loam	Silty loam and sandy loam	Silty loam and sandy loam	Silty loam and sandy loam
Drainage	Well drained	Imperfect	Imperfect to moderate	Imperfect to moderate	Imperfect to moderate	Well drained, rapid	Well drained
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3
Nutrients[4]	mesotrophic/dystrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic	dystrophic	dystrophic

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

Table 7. Land Capability Classes for sedimentary and metamorphic terrain (Palaeozoic metasediments) with high to very high mean annual rainfall (>1000 m)

Component	1	2	3	4	5	6	7
			Land attributes				
Terrain type	level	gently undulating	undulating	gently rolling	rolling	steep	crest
Slope (%)	0-1	1-3	3-10	10-20	20-32	>32	
Capability Class	4-5	4	4	4-3	4	5	5
			Dominant soils and attributes				
Description	Yellow, mottled, texture contrast soils with bleached A2 horizons, often sodic	Yellow, mottled, texture contrast soils with bleached A2 horizons, occasionally sodic	Yellow and brown,generally mottled texture contrast soils with bleached A2 horizons	Yellow gradational soil(earths) with bleached A2 and grey, sodic texture contrast soils	Grey, texture contrast soils and Yellow gradational soil with bleached A2 horizons	Brown and yellow gradational soils often stony, occasional A2 horizon	Shallow, stony loams and earths (gradational)
ASC[1]	Yellow Sodosol Yellow Chromosol	Yellow Chromosol. Yellow Sodosol	Yellow and Brown Chromosols	Yellow Dermosol Grey Kurosol	Grey Kurosol Yellow Dermosol	Brown and Yellow Dermosols	Leptic Rudosol. Brown and Yellow Dermosols
PPF[2]	Dy3.41	Dy3.41	Dy3.41	Gn3.04, Dy2.11	Dy2.11, Gn3.04	Gn4.51, Gn3.04	Um1, Uc2.12, Gn4.6
Depth	Deep >1 m	Deep >1 m	Deep >1 m	Deep >1 m	Deep to moderately deep .1 m to 0.5-1 m	Shallow to moderately deep 0.25-0.05 m and 0.5-1 m	Very shallow to shallow 0.025 m and 0.25-0.5 m
Surface texture	Silty loam	Silty loam	Fine sand loam or silty loam	Sitly loam and sandy loan	Sandy loam and silty loan	Silty loam	Sandy loam and loam fine sandy
Drainage	Poor to imperfect	Imperfect to poor	Imperfect to poor	Imperfect to moderate	Moderate to imperfect	Moderate	Well drained
Aggregate stability[3] A/B	E3/E5	E3/E5	E3/E5	E3/E5	E3/E5	E3/E5	E7
Nutrients[4]	mesotrophic	mesotrophic	mesotrophic	mesotraphic	mesotrophic	mesotrophic	mesotrophic

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Table 7 continued

	Subdominant soils and attributes					
Description	Yellow,often mottled gradational soil with A2 horizon sometimes bleached	Yellow,often mottled gradational soil with A2 horizon, sometimes bleached and grey apedal/weak structured gradational soil	Brown often mottled gradational and yellow often mottled texutre contrast soils with A2 horizons	Yellow texture contrast soil with bleached A2 and Brown gradational soils	Yellow texture contrast soil with bleached A2 and Brown gradational soils	Brown texture contrast,grey apedal gradational and uniform textured soils
ASC[1]	Yellow Dermosols	Yellow Dermosols Grey Kandosols	Brown Dermosols Yellow Sodosols	Yellow Chromosols Brown Dermosols	Yellow Chromosols Brown Dermososls	Brown Chromosols Grey Kandosols
PPF[2]	Gn3.04	Gn3.04, Gn2.94	Gn4.64, Dy3.41	Dy3.41, Gn4.64	Dy3.41, Gn4.64	Dy2.41, Gn4.51
Depth	Deep >1 m	Deep and moderately deep >1 m and 0.5-1 m	Deep and moderately deep >1 m and 0.5-1 m	Deep and moderately deep >1 m and 0.5-1 m	Deep and moderately deep >1 m and 0.5-1 m	Shallow to moderately deep 0.25-05 m and 0.5-1 m
Surface texture	Silty loam	Silty loam or Sandy loams	Silty loam or Sandy loam	Silty loam or Sandy loam	Silty loam or Sandy loam	Silty loam
Drainage	Imperfect	Imperfect	Imperfect to moderate	Imperfect to moderate	Imperfect to moderate	Moderate
Aggregate stability[3] A/B	E3/E5	E3/E5	E3/E5	E3/E5	E3/E5	E3/E5
Nutrients[4]	mesotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

Table 8. Land Capability Classes for sedimentary and metamorphic terrain (Palaeozoic metasediments) with moderate mean annual rainfall (800-1000 mm)

Component	1	2	3	4	5	6	7
			Land attributes				
Terrain type	level	gently undulating	undulating	gently rolling	rolling	steep	crest
Slope (%)	0-1	1-3	3-10	10-20	20-32	>32	-
Capability Class	4-3	4-3	3-5	4	4	5	-
			Dominant soils and attributes				
Description	Yellow and brown, mottled, texture contrast soils with bleached A2, often sodic	Yellow, mottled, texture contrast soils with bleached A2, occasionally sodic	Yellow and brown, generally mottled, texture contrast soils with bleached A2, occasionally sodic	Yellow gradational earths with bleached A2 Grey, sodic texture-contrast soils	Grey, texture contrast soils.Yellow gradationa soils with bleached A2	Brown and yellow gradational soils often stony, occasional A2	Gradational shallow, stony loams and earths
ASC[1]	Yellow Sodosols Yellow and Brown Chromosols	Yellow Chromosols Yellow Sodosols	Yellow and Brown Chromosols Yellow Sodosols	Yellow Dermosols Grey Kurosols	Grey Kurosols Yellow Dermosols	Brown and Yellow Dermosols	Leptic Rudosols Brown and Yellow Dermosols
PPF[2]	Dy3.41	Dy3.41	Dy3.41	Gn3.04, Dy2.11	Dy2.11, Gn3.04	Gn4.51, Gn3.04	Um1, Uc2.12, Gn4.6
Depth	Deep	Deep	Deep	Deep	Deep and moderately deep	Shallow to moderately deep	Very shallow to shallow
	>1 m	>1 m	>1 m	>1 m	>1 and 0.5 -1 m	0.25-0.5 and 0.5-1 m	0-0.25 and 0.25-0.5 m
Surface texture	Silty loam	Silty loam	Fine sandy or silty loam	Silty or sandy loam	Sandy or silty loam	Silty loam	Sandy loam Loam, fine sandy
Drainage	Poor to imperfect	Imperfect to poor	Imperfect to poor	Imperfect to moderate	Moderate to imperfect	Moderate	Well drained
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3
Nutrients[4]	mesotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic

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Table 8 continued

	Subdominant soils and attributes						
Description	Yellow, often mottled, gradational soil with A2 sometimes bleached	Yellow, often mottled gradational soil with A2 sometimes bleached. Grey apedal/weakly structured gradational soil	Brown often mottled gradational and yellow often mottled texture contrast soils with A2	Yellow texture contrast soil with bleached A2. Brown gradational soils	Yellow texture contrast soil with bleached A2 and Brown gradational soils	Brown texture contrast. Grey apedal gradational and uniform soils	Nil
ASC[1]	Yellow Dermosols	Yellow Dermosols Grey Kandosols	Brown Dermosols Yellow Sodosols	Yellow Chromosols Brown Dermosols	Yellow Chromosols Brown Dermosols	Brown Chromosols Grey Kandosols	-
PPF[2]	Gn3.04	Gn3.04, Gn2.94	Gn4.64, Dy3.41	Dy3.41, Gn4.64	Dy3.41, Gn4.64	Dy2.41, Gn4.51	-
Depth	Deep	Deep and moderately deep	Deep and moderately deep	Deep and moderately deep	Deep and moderately deep	Shallow and moderately deep	-
	>1 m	>1 and 0.5-1.0 m	>1 and 0.5-1.0 m	>1 and 0.5-1.0 m	>1 and 0.5-1.0 m	0.25-0.5 and 0.5-1.0 m	-
Surface texture	Silty loam	Silty or sandy loam	Silty or sandy loam	Silty or sandy loam	Silty or sandy loam	Silty loam	-
Drainage	Imperfect	Imperfect	Imperfect to moderate	Imperfect to moderate	Imperfect to moderate	Moderate	-
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	-
Nutrients[4]	mesotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic	mesotrophic	-

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

Table 9. Land Capability Classes for granitic terrain (Devonian granitoids) with high and very high mean annual rainfall (>1000 mm)

Component	1	2	3	4	5	6	7
			Land attributes				
Terrain type		gently undulating	undulating	gently rolling	rolling	steep	crest
Slope (%)		1-3	3-10	10-20	20-32	>32	
Capability Class		3	4	3	4	5	5
			Dominant soils and attributes				
Description		Shallow stony loam around rock outcrop	Grey, mottled texture contrast soils often with bleached A2 horizons	Brown and grey texture contrast soils often with bleached A2 horizons	Brown texture contrast soils often with bleached A2 horizons	Brown texture contrast soils, occasional mottled bleached A2 horizon	Pale sands and Yellow gradational soil, often stony, occasional A2 horizon
ASC[1]		Leptic Rudosol	Grey Kurosols	Brown and Grey Chromosols	Brown Chromosols	Brown Chromosols	Bleached-Leptic Tenosols and Yellow Kandosols
PPF[2]		Uc1	Dy3.41	Dy3.41, Dy2.41	Dy3.41, Dy2.41	Dy2.11, Dy3.41	Uc2.21, Gn1.84
Depth		Very shallow to shallow	Deep	Deep	Moderately deep to deep	Shallow to moderately deep	Shallow to moderately deep
		0-0.25 m and 0.25-0.5 m	>1 m	>1 m	0.5-1 m and >1 m	0.25-0.5 m and 0.5-1m	0.25-0.5 m and 0.5-1 m
Surface texture		Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Coarse loamy sandy
Drainage		Moderately well drained	Imperfectly drained	Moderately well drained	Moderately well drained	Rapid to moderately well drained	Rapid
Aggregate stability[3] A/B		E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3
Nutrients[4]		mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic

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Table 9 continued

	Subdominant soils and attributes		
Description	Coarse pale sandy soils, occasionally stony	Pale sands and Yellow gradational soil, often stony, occasional A2 horizon	Pale sands and Yellow gradational soil, often stony, occasional A2 horizon
ASC[1]	Bleached-Leptic Tenosols	Bleached-Leptic Tenosols and Yellow Kandosols	Bleached-Leptic Tenosols and Yellow Kandosols
PPF[2]	Uc2.21	Uc2.21, Gn1.84,	Uc2.21, Gn1.84
Depth	Moderately deep to deep 0.5-1m and >1 m	Shallow to moderately deep 0.25-0.5m and 0.5-1m	Shallow to moderately deep 0.25-0.5 m and 0.5-1 m
Surface texture	Light sandy clay loam, loamy sand	Sandy loam	Sandy loam
Drainage	Well drained	Well drained	Rapid
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3
Nutrients[4]	mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

Table 10. Land Capability Classes for granitic terrain (Devonian granitoids) with high and very high mean annual rainfall (>1000 mm)

Component	1	2	3	4	5	6	7
Land attributes							
Terrain type		gently undulating	undulating	gently rolling	rolling	steep	crest
Slope (%)		1-3	3-10	10-20	20-32	>32	
Capability Class		3	4	3	4	5	5
Dominant soils and attributes							
Description		Shallow stony loam around rock outcrop	Grey, mottled texture contrast soils often with bleached A2 horizons	Brown and grey texture contrast soils often with bleached A2 horizons	Brown texture contrast soils often with bleached A2 horizons	Brown texture contrast soils, occasional mottled bleached A2 horizon	Pale sands and yellow gradational soil, often stony, occasional A2 horizon
ASC[1]		Leptic Rudosol	Grey Kurosols	Brown and Grey Chromosols	Brown Chromosols	Brown Chromosols	Bleached-Leptic Tenosols and Yellow Kandosols
PPF[2]		Uc1	Dy3.41	Dy3.41, Dy2.41	Dy3.41, Dy2.41	Dy2.11, Dy3.41	Uc2.21, Gn1.84
Depth		Very shallow to shallow	Deep	Deep	Moderately deep to deep	Shallow to moderately deep	Shallow to moderately deep
		0.25 m and 0.25-0.5 m	>1 m	>1 m	0.5-1 m and >1 m	0.25-0.5 m and 0.5-1 m	0.25-0.5 m and 0.5-1 m
Surface texture		Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Coarse loamy sand
Drainage		Moderately well drained	Imperfectly drained	Moderately well drained	Moderately well drained	Rapid and moderately well drained	Rapid
Aggregate stability[3] A/B		E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3
Nutrients[4]		mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic

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Table 10 continued

	Subdominant soils and attributes		
Description	Coarse pale sandy soils, occasionally stony	Pale sands and Yellow gradational soil, often stony, occasional A2 horizon	Pale sands and Yellow gradational soil, often stony, occasional A2 horizon
ASC[1]	Bleached-Leptic Tenosols	Bleached-Leptic Tenosols Yellow Kandosols	Bleached-Leptic Tenosols and Yellow Kandosols
PPF[2]	Uc2.21	Uc2.21, Gn1.84	Uc2.21, Gn1.84
Depth	Moderately deep to deep	Shallow to moderately deep	Shallow to moderately deep
	0.5-1m and >1 m	0.25-0.5 m and 0.5-1 m	0.25-0.5 m and 0.5-1 m
Surface texture	Light sandy clay loam or loamy sand	Sandy loam	Sandy loam
Drainage	Well drained	Well drained	Rapid
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3
Nutrients[4]	mesotrophic/eutrophic	mesotrophic/eutrophic	mesotrophic/eutrophic

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

Table 11. Land Capability Classes for colluvial terrain (Cainozoic colluvium) with high to very high mean annual rainfall (>1000 mm)

Component	1	2	3	4	5	6	7
			Land attributes				
Terrain type	level	gently undulating	undulating	gently rolling	rolling	steep	
Slope (%)	0-1	1-3	3-10	10-20	20-32	>32	
Capability Class	4, 3	4, 3	3, 4, 5	3	4	5	
			Dominant soils and attributes				
Description	Yellow, mottled, weak to strongly structured gradational soil (earth) with a bleached A2 horizon	Yellow, mottled, weak to strongly structured gradational soil (earth) with a bleached A2 horizon	Yellow and brown, mottled texture contrast soil with bleached A2 horizon, often sodic	Brown and yellow, generally mottled textur contrast soil with bleached A2 horizons and some (yellow) are sodic	Brown texture contrast soils, occasionally mottled, bleached A2 horizon and stony loam soils	Stony loam soils	
ASC[1]	Yellow Dermosol	Yellow Dermosol	Yellow Sodosol Brown Kurosol	Brown Chromosol Yellow Sodosol	Brown Chromosols	Leptic Rudosols	
PPF[2]	Gn3.84	Gn3.84	Dy3.41, Dy2.41	Dy3.42, Dy3.41	Dy3.41	Um	
Depth	Deep	Deep	Deep	Deep	Moderately deep to deep	Shallow to moderately deep	
	>1 m	>1 m	>1 m	>1 m	0.5-1 m and >1 m	0.25-0.5 m to 0.5-1 m	
Surface texture	Silty loam	Silty loam	Silty loam or sandy clay loam	Loam fine sandy to light sandy clay loam	Loam fine sandy to silty loam	Loam fine sandy	
Drainage	Poor	Poor	Moderately well drained to imperfect	Moderately well drained to imperfect	Rapid to moderately well drained	Rapid	
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	
Nutrients[4]	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	

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Table 11 continued

	Subdominant soils and attributes					
Description	Yellow, brown and grey mottled texture contrast soil with bleached A2 horizon (yellow & grey) sometimes sodic (grey)	Yellow, brown and grey mottled texture contrast soil with bleached A2 horizon (yellow & grey) sometimes sodic (grey)	Yellow, mottled, weak to strongly structured gradational soil (earth) with a bleached A2 horizon	Yellow, mottled, weak to strongly structured gradational soil (earth) with a bleached A2 horizon and brown, sometimes mottled gradational (earth) and stony loam soil	Yellow to red texture contrast soil with coarse gravel with an A2 horizon	Brown texture contrast soils, occasionally mottled, bleached A2 horizon
ASC[1]	Yellow Sodosol Grey and Brown Chromosols	Yellow Sodosol Grey and Brown Chromosols Brown Kurosols	Yellow Dermosol	Brown and Yellow Dermosols Orthic Tenosol	Red Chromosol	Brown Chromosols
PPF[2]	Dy3.41, Dd2.42, Dy2.12	Dy3.41, Dd2.42, Dy2.12, Dy2.41	Gn3.84	Gn3.71, Gn3.84	Dy3.21	Dy3.41
Depth	Deep	Deep	Deep	Moderately deep to deep	Moderately deep to deep	Shallow to moderately deep
	>1 m	>1 m	>1 m	0.5-1m and >1 m	0.5-1 m and >1 m	0.25-0.5 m and 0.5-1 m
Surface texture	Silty loam or sandy loam	Silty loam or sandy clay loam	Silty loam	Light sandy clay loam or loamy sand	Loam fine sandy	Silty loam
Drainage	Moderately well drained to imperfect	Moderately well drained to imperfect	Poor to imperfect	Moderately well to well drained	Well drained	Moderately well drained
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3
Nutrients[4]	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

Table 12. Land Capability Classes for colluvial terrain (Cainozoic colluvium) with moderate mean annual rainfall (800-1000 mm)

Component	1	2	3	4	5	6	7
			Land attributes				
Terrain type	level	gently undulating	undulating	gently rolling	rolling	steep	
Slope (%)	0-1	1-3	3-10	10-20	20-32	>32	
Capability Class	4, 5	4, 3	4	4	4	5	
			Dominant soils and attributes				
Description	Yellow, mottled texture contrast soil with bleached A2 horizon, generally sodic	Yellow, mottled texture contrast soil with bleached A2 horizon, generally sodic	Yellow, mottled texture contrast soil with bleached A2 horizon, generally sodic	Brown and yellow, mottled texture contrast soil with bleached A2 horizons and some (yellow) are sodic	Brown texture contrast soils, occasionally mottled, bleached A2 horizon	Brown texture contrast soils, occasionally mottled bleached A2 horizon	
ASC[1]	Yellow Sodosol	Yellow Sodosol	Yellow Sodosol	Brown Chromosol Yellow Sodosol	Brown Chromosol	Brown Chromosol	
PPF[2]	Dy3.41	Dy3.41	Dy3.41	Dy3.42, Dy3.41	Dy3.41	Dy2.11, Dy3.41	
Depth	Deep	Deep	Deep	Deep	Moderately deep to deep	Shallow to moderately deep	
	>1 m	>1 m	>1 m	>1 m	0.-1 m and >1 m	0.25-0.5 m and 0.5-1 m	
Surface texture	Silty loam or sandy clay loam	Silty loam or sandy clay loam	Silty loam or sandy clay loam	Loam fine sandy or light sandy clay loam	Loam fine sandy or light sandy clay loam	Sandy loam	
Drainage	Moderately well drained to imperfect	Moderately well drained to imperfect	Moderately well drained to imperfect	Moderately well drained to imperfect	Moderately well drained to imperfect	Rapid to moderately well drained	
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	
Nutrients[4]	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	

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Table 12 continued

	Sub dominant soils and attributes					
Description	Yellow, mottled, weak to strongly structured gradational soil (earth) with a bleached A2 horizon	Yellow and brown, mottled, weak to strongly structured gradational (earth) and texture contrast soils with bleached A2 horizons	Yellow and brown, mottled texture contrast and weak to strongly structured gradational (earth) soils with bleached A2 horizons	Brown, sometimes mottled gradational (earth) and a stony loan soil	Yellow to red texture contrast soil with coarse gravel with an A2 horizon	Yellow, sometimes mottled structureless gradational (earth) and bleached sandy soil can be shallow and gritty/gravelly
ASC[1]	Yellow Dermosol	Yellow Dermosol Brown Kurosol	Brown Kurosol Yellow Dermosol	Brown Dermosol Orthic Tenosol	Red Chromosol	Bleached-leptic Tenosol Yellow Kandosols
PPF[2]	Gn3.84	Gn3.84, Dy2.41	Dy2.41, Gn3.84	Gn3.71, Um	Dy3.21	Uc2.21, Gn1.84
Depth	Deep	Deep	Deep	Moderately deep and deep	Moderately deep and deep	Shallow and moderately deep
	>1 m	>1 m	>1 m	0.5-1 m and >1 m	0.5-1 m and >1 m	0.25-0.5 m and 0.5-1 m
Surface texture	Silty loam	Silty and fine sandy loam	Fine sandy loam and silty loam	Light sandy clay loam and loamy sand	Loam fine sandy	Sandy loam
Drainage	Poor	Poor to moderate	Poor to moderate	Well drained	Well drained	Rapid
Aggregate stability[3] A/B	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3	E3/E3
Nutrients[4]	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic	mesotrophic/dystrophic

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

Table 13. Land Capability Classes for alluvial terrain (Quaternary alluvium) with high mean annual rainfall (>1000 mm)

Component	1	2	3
	Land attributes		
Terrain type	level	gently undulating	undulating
Slope (%)	0-1	1-3	3-10
Capability Class	3	3	3
	Dominant soils and attributes		
Description	Yellow and brown, mottled gradational (earth) soils, some with bleached A2 horizons (yellow)	Yellow and brown, mottled gradational (earth) soils, some with bleached A2 horizons (yellow)	Yellow and brown, mottled gradational (earth) soils, some with bleached A2 horizons (yellow)
ASC[1]	Yellow Kandosol Brown Dermosol	Yellow Kandosol Brown Dermosol	Yellow Kandosol Brown Dermosol
PPF[2]	Gn4.66, Uc6.34	Gn4.66, Uc6.34	Gn4.66, Uc6.34
Depth	Deep >1 m	Deep >1 m	Deep >1 m
Surface texture	Fine sandy loam or silty loam	Fine sandy loam or silty loam	Fine sandy loam or silty loam
Drainage	Imperfect	Imperfect	Imperfect
Aggregate stability[3] A/B	E2/E5, E3/E2	E2/E5, E3/E2	E2/E5, E3/E2
Nutrients[4]	eutrophic/eutrophic	eutrophic/eutrophic	eutrophic/eutrophic

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Table 13 continued

	Subdominant soils and attributes		
Description	Grey and black gradational (earths) soils and uniform bleached (A2) sands	Grey and black gradational (earths) soils and uniform bleached (A2) sands	Grey and black gradational (earths) soils and uniform bleached (A2) sands
ASC[1]	Grey Dermosol	Grey Dermosol	Grey Dermosol
PPF[2]	Gn3.91, Um4, Uc2.21	Gn3.91, Um4, Uc2.21	Gn3.91, Um4, Uc2.21
Depth	Deep >1 m	Deep >1 m	Deep >1 m
Surface texture	Fine sandy loam or silty loam	Fine sandy loam or silty loam	Fine sandy loam or silty loam
Drainage	Imperfect	Imperfect	Imperfect
Aggregate stability[3] A/B	E3/E3, E5/E5	E3/E3, E5/E5	E3/E3, E5/E5
Nutrients[4]	eutrophic/eutrophic	eutrophic/eutrophic	eutrophic/eutrophic

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

Table 14. Land Capability Classes for alluvial terrain (Quaternary alluvium) with moderate mean annual rainfall (800-1000 mm)

Component	1	2	3
		Land attributes	
Terrain type	level	gently undulating	undulating
Slope (%)	0-1	1-3	3-10
Capability Class	3	3, 4	4, 3
		Dominant soils and attributes	
Description	Yellow and brown, mottled gradational (earth) soils, some with bleached A2 horizons (yellow)	Yellow and brown, mottled gradational (earth) soils, some with bleached A2 horizons (yellow)	Yellow and brown, mottled gradational (earth) soils, some with bleached A2 horizons (yellow)
ASC[1]	Yellow Kandosol Brown Dermosol	Yellow Kandosol Brown Dermosol	Yellow Kandosol Brown Dermosol
PPF[2]	Gn4.66, Uc6.34	Gn4.66, Uc6.34	Gn4.66, Uc6.34
Depth	Deep >1 m	Deep >1 m	Deep >1 m
Surface texture	Fine sandy loam or silty loam	Fine sandy loam or silty loam	Fine sandy loam or silty loam
Drainage	Imperfect	Imperfect	Imperfect
Aggregate stability[3] A/B	E2/E5, E3/E2	E2/E5, E3/E2	E2/E5, E3/E2
Nutrients[4]	eutrophic/eutrophic	eutrophic/eutrophic	eutrophic/eutrophic

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Table 14 continued

	Subdominant soils and attributes		
Description	Yellow and grey mottled and brown (some mottled) and black gradational (earths) soils and Uniform bleached (A2) sands	Yellow and grey mottled and brown (some mottled) and black gradational (earths) soils and Uniform bleached (A2) sands	Yellow and grey mottled and brown (some mottled) and black gradational (earths) soils and Uniform bleached (A2) sands
ASC[1]	Brown, Grey and Yellow Dermosols Yellow Kandosol	Brown, Grey and Yellow Dermosols Yellow Kandosol	Brown, Grey and Yellow Dermosols Yellow Kandosol
PPF[2]	Gn3.91, Gn4.64, Um4, Uc6.14, Uc2.21	Gn3.91, Gn4.64, Um4, Uc6.14, Uc2.21	Gn3.91, Gn4.64, Um4, Uc6.14, Uc2.21
Depth	Deep >1 m	Deep >1 m	Deep >1 m
Surface texture	Fine sandy loam or silty loam	Fine sandy loam or silty loam	Fine sandy loam or silty loam
Drainage	Imperfect	Imperfect	Imperfect
Aggregate stability[3] A/B	E3/E3, E5/E5, E2/E2	E3/E3, E5/E5, E2/E2	E3/E3, E5/E5, E2/E2
Nutrients[4]	eutrophic/eutrophic	eutrophic/eutrophic	eutrophic/eutrophic

[1] ASC = Australian Soil Classification (Isbell 1996)

[2] PPF = Principal Profile Form (Northcote 1979).

[3] Soil aggregate stability is based upon Emmerson dispersion classes from E1 to E8; in these tables they have been calculated separately for the A horizon (upper part of the soil profile) and the B horizon (the lower part of the soil profile)

[4] refer to Appendix 1 (base status) for definition of nutrient classes

6 Recommendations

The land resource information contained in this publication and the associated digital soil landform data has been derived from a number of studies previously carried out within the Murrindindi Shire. These previous studies have been completed at varying scales, thus product enhancement techniques have been necessary to present the data at 1:40 000 scale. Flora information and fauna habitat areas have been derived from environmental vegetation class (EVC) mapping at 1:100 000 scale. It is therefore recommended that the data presented within this report is suitable only for regional planning purposes and should not be used for site specific detail.

The precision of mapped boundaries is affected by the scale of the map. Any enlargement of the map will result in distortion of the information and is unlikely to improve its accuracy. The authors strongly advise that further detailed investigation be carried out prior to any new development proceeding.

It is recommended that the land capability and environmental maps (see accompanying CD) and report be considered in the review of the Murrindindi Planning Scheme, including the review and development of strategic directions, policies, zones and overlays.

Acknowledgements

Grant Scale	Murrindindi Shire Council
Karen Girvan	Murrindindi Shire Council
Steve Smith	NRE, Alexandra Office
Rob Chaffe	NRE, Alexandra Office
Kerri Goshnick	NRE, Alexandra Office
Sue Berwick	NRE, Benalla Office
Russell Whelands	Goulburn Broken CMA

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Appendices:

Appendix 1. Glossary of soil terms

Alluvium: Material such as sand, silt and clays which have been deposited on land by waterflow.

Australian Soil Classification (ASCs):

Australian Soil Classification Order and Description

ASC Soil Order	Code	Description
Anthroposol	AN	Man made soils
Calcarosol	CA	Lacking strong texture – contrast plus calcareous throughout
Chromosol	CH	Strong texture-contrast plus pH > 5.5 in B horizon
Dermosol	DE	Lacking strong texture-contrast plus structured B horizon
Ferrosol	FE	Lacking strong texture-contrast plus high free Fe in B horizon
Hydrosol	HY	Prolonged seasonal saturation
Kandosol	KA	Lacking strong texture-contrast plus massive B horizon
Kurosol	KU	Strong texture-contrast plus pH < 5.5 in B horizon
Organosol	OR	Organic soil material
Podosol	PO	Bs, Bh, or Bhs horizons
Rudosol	RU	Negligible pedological organisation
Sodosol	SO	Strong texture-contrast plus sodic B horizon
Tenosol	TE	Weak pedological organisation
Vertosol	VE	Clay > 35%, cracks, slickensides

ASC Sub Orders - colour codes

Sub Order	Code
Red	AA
Brown	AB
Yellow	AC
Grey	AD
Black	AE

Base status: This refers to the sum of exchangeable basic cations (Ca^{2+}, Mg^{2+}, K^{+} and Na^{2+}) expressed in cmol (+) kg^{-1} clay. This sum is obtained by multiplying the sum of the reported basic cations (which are determined on a soil fine earth basis) by 100 and dividing by the clay percentage of the sample. Where clay percentage is not available it may be approximated from the field texture (refer *soil texture*). Three classes are defined:

Dystrophic – the sum is less than 5, low nutrient value;

Mesotrophic – the sum is between 5 and 15 inclusive, moderate nutrient value, and;

Eutrophic – the sum is greater than 15, high nutrient value.

Colluvium: Rock fragments and soil which are deposited at the base of a slope by gravity and erosion by water.

Drainage: Drainage is a term used to summarise local soil wetness conditions. It is affected by internal attributes which include soil structure, texture, porosity, hydraulic conductivity, water holding capacity, and external attributes such as evapotranspiration, gradient and length of slope and position in the landscape. Categories are as follows:

Very poorly drained: Free water remains at or near the surface for most of the year. Soils are usually strongly gleyed. Typically a level or depressed site and/or a clayey subsoil.

Poorly drained: All soil horizons remain wet for several months each year. Soils are usually gleyed, strongly mottled and/or have orange or rusty linings of root channels.

Imperfectly drained: Some soil horizons remain wet for periods of several weeks. Subsoils are often mottled and may have orange or rusty linings of root channels.

Moderately well-drained: Some soils may remain wet for a week after water addition. Soils are often whole coloured, but may be mottled at depth and of medium to clayey texture.

Well-drained: No horizon remains wet for more than a few hours after water addition. Soils are usually of medium texture and not mottled.

Rapidly drained: No horizon remains wet except shortly after water addition. Soils are usually of coarse texture, or shallow, or both, and are not mottled.

Duplex profile form: A Primary Profile Form of the Northcote (1979) classification. It describes a soil where there is a sharp contrast in the texture between the A and B horizons (often sandy or loamy surface horizons with a sharp to clear boundary to clay subsoils).

Electrical conductivity (EC): A measure of the conduction of electricity through water or a water extract of soil. It can be used to determine the soluble salts in the extract and hence soil salinity. The unit of electrical conductivity is the siemens and soil salinity is usually expressed as millisiemens per centimetre at 25^{o}C.

Erosion and deterioration: Determined from observation of soil performance under a range of land uses in the study area.

Floodplain: A level plain adjacent to a river or stream which is subject to flooding.

Flood risk: Flood risk provides an estimation of flooding frequency. Flood frequency has been determined from observations of landform, catchment geometry, and soil types.

Flooding class	Estimated return period (years)
Nil	>100
Low	25-100
Moderate	5-25
Frequent	1-5
Very High	<1

Land capability assessment: A systematic and rational method of determining the relative ability of different areas of land to sustain a specific land use under a nominated level of management without being degraded or causing any long-term off-site degradation.

Land slip potential: This is related to slope and soil type. Land slip risk increases where deep permeable soils with low wet strengths are encountered.

Land slip class	Definition
Nil	No evidence of landslip
Low	Some evidence of landslip
Moderate	Common evidence of landslip
High	Frequent evidence of landslip

Land system: An area of land, distinct from surrounding terrain, that has a specific climatic range, parent material and modal slope. Made up of a recurring sequence of land elements or components, e.g. sedimentary rolling hills.

Land units or components: An area of land, distinct from adjacent units or components because of specific slope, soil, or geomorphological characteristics, e.g. crest, gentle slope, drainage depression.

Perched watertable: The watertable of a saturated layer of soil which is separated from an underlying permanent watertable by an unsaturated soil layer.

Permeability: The characteristic of a soil, soil horizon or soil material which governs the rate at which water moves through it. It is a composite expression of soil properties and depends largely on soil texture, soil structure, the presence of compacted or dense soil horizons and the size and distribution of pores in the soil.

Value range (m^2/day)	Interpretation
<2	Very slow
2-5	Slow
5-15	Moderately slow
15-50	Moderate
50-200	Moderately Rapid
200-500	Rapid
>500	Very Rapid

Plain: Any flat area, large or small, having few if any prominent surface features.

Plateau: An elevated plain, limited on at least one side by an abrupt descent.

Principal Profile Form (Northcote 1979): A soil classification system used in Australia that groups soils into recognisable profile forms. These are based on visible morphological properties and simple chemical properties and simple chemical properties of a soil and are labelled used an alphanumeric code.

Rock outcrop: Any exposed area of rock that is inferred to be continuous with the underlying parent material.

Salinity: A measure of the total soluble salts in a soil. A saline soil is one with an accumulation of free salts at the soil surface and/or within the profile affecting plant growth and/or land use. It is generally attributed to changes in land use or natural changes in drainage or climate that affects the

movement of water through the landscape. Salinity levels of soil or water can be tested using Electrical Conductivity (see EC).

Seasonal watertable: Saturated soil horizon which inhibits the downward movement of water.

Waterlogging class	Definition
Nil	Watertable drops below 1 m after 24 hours
Temporarily ponded	Local areas of ponding persist for several days after heavy rain
Temporarily waterlogged	Watertable perches on an impermeable soil layer which may persist for a week after heavy rain
Seasonally waterlogged	Watertable within pasture root zone up to one month after heavy rain, surface ponding common
Watertable seasonally at surface	Water at soil surface for several months during winter

Shrink swell potential: Relates to the amount of swelling clays present in a soil. These clays swell on wetting and shrink on drying and can severely effect foundations and earthworks.

Shrink swell	Potential linear shrinkage
Low	less than 4%
Moderate	4 to 12%
High	12 to 12%
Very high	>20%

Slope: Landform element that is neither a crest nor a depression and that has an inclination greater than 1%. Slope can be broken up into the following categories:

Slope range (%)	Interpretation
< 1%	Level
1 - 3%	Very gentle slope
4 - 10%	Gentle slope
10 - 20%	Moderate slope
20 - 35%	Moderately steep slope
> 35%	Steep slope

Soil profile: A portion of a soil exposed in a vertical section, extending usually from the land surface to the parent material. In very general terms, a profile is made of three major layers designated A, B and C horizons. The A and B horizons are those modified by soil development. The C horizon is weathering parent material that has not yet been significantly altered by soil forming processes.

Soil texture: The relative proportions of sand, silt and clay particles in a sample of soil. The field assessment of texture is based on the characteristics of a bolus of wetted soil moulded by hand. Six main soil texture groups are recognised

Texture group	Approx. clay content (%)
1. Sands	< 10
2. Sandy loams	10 - 20
3. Loams	20 - 30
4. Clay loams	30 - 35
5. Light clays	35 - 40
6. Heavy clays	> 45

Soil texture groups: The topsoil and subsoil texture classes were grouped according to Northcote (1979).

S Sand, loamy sand, clayey sand

SL Sandy loam, fine sandy loam, light sandy clay loam

L Loam, loam fine sandy, silt loam, sandy clay loam

CL Clay loam, silty clay loam, fine sandy clay loam

LC Sandy clay, silty clay, light clay, light medium clay

MHC Medium heavy clay, medium clay, heavy clay

Uniform profile form: A Primary Profile Form of the Factual Key Classification (Northcote 1979). These soil profiles have little, if any texture change throughout the profile. There is generally no textural boundary found within the profile, except for possibly a surface crust.

Unified soil group: Engineering classification based on soil texture and plasticity which indicates the likely stability of soils for construction of roads, foundations and embankment.

Appendix 2. Notes on nationally significant flora and fauna species known to occur in Murrindindi Shire

Threatened species in the Murrindindi Shire
(photographs from Fauna Information System 2001)

REGENT HONEY EATER 1500 individuals in single sub-population, probably still *decreasing (Action Plan for Australian birds 2000).* In Victoria mainly in box-ironbark forests to north eg. Chiltern. Murrindindi nesting records from Gobur and Glenburn. Movements in non-breeding period poorly understood. They may utilise dry forest areas within the Murrindindi Shire in non-breeding period. White box and yellow box particularly important nectar source. Insects essential for breeding. Key habitat components include large flowering eucalypts and an intact mid-storey for nesting and to provide insects for nestlings. KEY RISKS/THREATS Loss of large nectar-producing eucalypts	 Photo: B.Shepherd/NRE
WHITE-BELLIED SEA-EAGLE Birds form pairs for life and are mostly sedentary once a home range has been established, although immature birds can disperse. Nests are usually near water, in tall live or dead trees. Occurs mainly along eastern coast, Murray River and some inland water-bodies. Birds within the Murrindindi Shire have been present and breeding on Lake Eildon for a number of years and numbers appear to be increasing. Potential for pairs to establish along Goulburn River floodplain. Key habitat components include large live or dead trees for breeding and open water to hunt for fish. KEY RISKS/THREATS Loss of large dead and live trees and disturbance at nest sites during breeding season	 Photo: John Seebeck/NRE
SWIFT PARROT Migratory species that passes nothward through Victoria, including records in Murrindindi Shire during autumn, following spring breeding in Tasmania. Total number of breeding birds estimated at 2000 and *decreasing (Action plan for Australian Birds 2000).* On mainland Swift parrots live in eucalypt forest and woodland. Key habitat components include large flowering eucalypts. KEY RISKS/THREATS Loss of large nectar-producing eucalypts. KEY ZONES & EVCs North & west of line joining Eildon–Buxton–Molesworth–Toolangi.	 Photo: Mike Carter

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Appendix 2 continued

POWERFUL OWL Number of records including nesting within the Murrindindi Shire. Known territories range from dry to damp forest types. Home-range of powerful owls typically 800 to 1000 hectares**.** Pairs tend to 'farm' their favourite prey of possums and gliders within their large territories. Key habitat includes large trees for nesting and habitat suitable to maintain their food sources, particularly possums and gliders. KEY RISKS/THREATS Loss of large hollow bearing trees. KEY ZONES & EVCs Whole of shire	 Photo: Ben Kefford
SPOT-TAILED QUOLL Patchy distribution across southern and eastern Victoria. Occupies a range of forest habitats. Very low number of records (average 6–7) each year across Victoria. No recent confirmed records. Past records from Lake Mountain and Black Range and more recent anecdotal sightings in Highlands, Gobur 'escarpment' areas and wetter forest on Blue Range south of Alexandra. Very recent record from Kinglake area. Quolls are susceptible to 1080 poisoning with most standard commercial baits having sufficient rates to provide lethal dose. Protocols can be followed to minimise risk of non-target poisoning. Key habitat components include old hollow-bearing trees and large hollow logs on ground litter. Often associated with rock outcrop and escarpment terrain. KEY RISKS/THREATS 1080 poisoning and loss of 'old growth' habitat components. KEY ZONES & EVCs Most likely to still occur in Highlands/Strathbogie escarpment and forests of Blue Range, Black Range, Toolangi and Kinglake areas.	 Photo: NRE
BARRED GALAXIAS Small native fish confined to streams above 400 m in the Goulburn River catchment. Only survives where natural barriers have stopped access to trout. A few populations have been protected and stream habitat increased by construction of barriers and removal of trout. All except one population remote from private property. KEY RISKS/THREATS Introduced predatory fish, Sedimentation KEY ZONES & EVCs Riparian zones along streams greater than 400 m ASL KEY HABITAT COMPONENTS The Barred Galaxias (*Galaxias olidus var. fuscus*), is restricted to upland streams above 400 m in elevation where it is often the only native fish species present. Streams are usually well vegetated with large quantities of large in stream debris such as logs.	 Photo: NRE

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Appendix 2 continued

LEADBEATER'S POSSUM

One of Victoria's faunal emblems. Restricted to mountain ash forests of central Victoria with a few small outlier populations in other habitats. First discovered about 100 years ago in low-land forest in Gippsland (since cleared) and then 'lost' to science until rediscovered in 1961 near Marysville. Leadbeater's possum occurrence is mainly in the ash eucalypt forest on public land in the southern portion of Murrindindi Shire but there are records from private land in the Buxton area on the fringes of ash forest and in snow gum forest at Lake Mountain. Leadbeater's possums live in family groups which usually occupy a territory of 1 to 3 ha.

KEY RISKS/THREATS

Loss of hollow bearing trees and wattle in foraging areas.

KEY ZONES & EVCs

South and east of line joining Eildon–Buxton–Molesworth–Toolangi.

KEY HABITAT COMPONENTS

Large hollow bearing trees. Wattles in mid-storey.

Photo: NRE

SOUTHERN BENT-WING BAT

Widely distributed across southern and eastern Victoria but requires suitable caves or shafts for roosting. Only two main breeding caves known, in Gippsland and in the Western District. Banding indicates that at least some over-wintering individuals at Eildon use the Nowa Nowa maternity cave in Gippsland for breeding.

KEY RISKS/THREATS

Disturbance or destruction of roosting sites

.KEY ZONES

Whole of shire. Any cave or old mine shaft.

KEY HABITAT COMPONENTS

Cave / mine shaft roosts

Photo: Lindy Lumsden/NRE

BRUSH-TAILED PHASCOGALE

An animal of the mainly drier forests and woodlands. It has a very large home range (up to 100ha) and all males die at about one year old. This is the largest mammal with such a breeding strategy. Very dependent on large trees with suitable hollows and large trunks to supply large invertebrates for food. Carnivorous and will take larger prey including birds. Spasmodic reporting mainly from Eildon area, Highlands and Gobur. Many pre 1970's records from Taggerty, Thornton but few recent records. Currently a State-wide monitoring project includes one site within the Murrindindi Shire (Eildon N.P.) but survey results have been poor. Many records submitted following cat predation.

KEY RISKS/THREATS

Loss of large trees important for feeding and breeding. Cat and fox predation.

KEY ZONES & EVCs

North & west of line joining Eildon–Buxton–Molesworth–Toolangi.

KEY HABITAT COMPONENTS

Large rough barked eucalypts (including the base of species such as Red Gum) for nesting and feeding.

Photo: Peter Robertson

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Appendix 2 continued

EASTERN HORSESHOE BAT

Found only in east Gippsland and part of the eastern highlands in Victoria. All sites in the eastern highlands are in disused mine-shafts and as there are probably no suitable natural caves in this area, it is possible that it has extended it's range from east Gippsland since European settlement. Only three maternity caves known, all in Gippsland although heavily pregnant females at Eildon suggest there is an eastern highlands site.

KEY RISKS/THREATS

As for Bent-wing Bat.

KEY ZONES

As for Bent-wing Bat.

KEY HABITAT COMPONENTS

As for bent-wing bat.

Photo: Lindy Lumsden/NRE

STRIPED LEGLESS LIZARD

This cryptic lizard is at home in and under native grassland and grassy woodland. Until recently conservation efforts were centred around plains grasslands such as the Western Basalt Plains and grasslands around Canberra. The Murrindindi Shire area has been added to the efforts after discovering that local remnants of grassland/grassy woodlands also provide habitat. One 1960s museum record was the only lead to this discovery.

Recently discovered in a range of sites in Murrindindi mainly associated with remnant native grassland and relatively undisturbed history of use. Occurs at some sites where there would have been previously Grassy woodland. Much of the over-storey has been removed but many elements of the original grassland component persist. Currently subject of a World Wildlife funded project with local Landcare groups. The National Recovery Plan identifies the Murrindindi area as a key 'cluster' to secure conservation of the species.

KEY RISKS/THREATS.

Clearing and/or gross disturbance to habitat eg. ploughing, over grazing, removal of on ground debris. Over-grazing and too frequent fire.

KEY HABITAT COMPONENTS

Native Grassland (usually with history of little disturbance and still containing some surface material such as rock or fallen timber). Soils suitable to allow animals to shelter underground.

Photo: Peter Robertson

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Appendix 2 continued

SPOTTED TREE FROG

Critically endangered species occurring in about a dozen fast flowing mountain streams between Eildon and Mt Kosciusko. All known populations are monitored annually for numbers and health. These frogs are day-time baskers, so bright sunny days are the ideal time to conduct surveys.

Twelve populations have been located in Victoria; these occur in the catchments of 17 streams. One population in the Murrindindi Shire occurs in Taponga River catchment on public land. Not likely to occur on private land. Every known population monitored annually in addition to comprehensive research program. Very low survival rate for tadpole to metamorph stage of life-cycle.

KEY RISKS/THREATS

Predation by introduced fish. Sedimentation of interstitial spaces in rocky stream substrates with particular risk from road drainage systems.

KEY ZONES

Only known population in Murrindindi is in Taponga River catchment.

KEY HABITAT COMPONENTS

Spotted Tree Frogs inhabit naturally vegetated, rocky, swift-flowing upland streams in dissected mountainous country, between 280 and 1110 metres above sea level. Frog populations are generally in areas with limited access and disturbance. Distribution along streams is patchy, most individuals being associated with loose rock substrates, rocky banks and rapids. Adjacent streamside vegetation is also used for sheltering and basking. Eggs are deposited under large in-stream boulders, and tadpole development occurs within the stream.

Photo: Peter Robertson

SOUTHERN BELL FROG

This is the frog that many local people of the Murrindindi Shire remember as the 'big green bull-frog' from the time 'when they were kids'. This frog occurred along the Goulburn floodplain. The formal records dried up about the 1970's and this is generally the time locals stopped seeing them. This decline has occurred all across Victoria. They are known to survive in a couple of back paddock dams within the Murrindindi Shire. There is potential to manage permanent freshwater natural and artificial sites to encourage their return.

KEY RISKS/THREATS

Predation by introduced fish. Wetland drainage and destruction of edge vegetation by stock.

KEY HABITAT COMPONENTS

Well vegetated permanent freshwater.

Photo: Graeme Gillespie/NRE

MACQUARIE PERCH

Naturally occurring north of the great divide in tributaries of the Murray River including the Goulburn River. Where populations persist they are in fast flowing waters with rocky or gravelly bottoms and deep, sheltered holes.

KEY HABITAT COMPONENTS

Deep sheltered pools. Riffle sections with gravel/rocky bottoms.

KEY RISKS/THREATS

Sedimentation. Predation by introduced fish.

No Photo available

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Appendix 2 continued

HEMIPHLEBIA DAMSEL FLY The Hemiphlebia Damselfly (*Hemiphlebia mirabilis Selys 1868 Odonata: Hemiphlebiidae*), is a small insect with a wingspan of approximately 22 mm and length of 24 mm. It is bright metallic green with white anal appendages. It has been described as a 'living fossil'. The first Victorian records came from floodplain lagoons in the Goulburn Valley at Alexandra and in the middle to upper course of theYarra River at the turn of the century. Searchers failed to find it on the Goulburn River floodplain in the late 1970s. By this time, the original habitat had been largely degraded by agriculture, in particular, the effects of livestock and changed drainage patterns. It also occurs at Wilsons Promontory. In January 1992, the Hemiphlebia Damselfly was rediscovered in central Victoria in a billabong on private property beside the Yea River at Yea. Subsequent searches of the area showed the species also survives on the Goulburn River floodplain near Alexandra (FFG Action Statement No. 46). KEY EVCs Floodplain Riparian Woodland KEY HABITAT COMPONENTS Ephemeral swamps and billabong margins with intact native wetland vegetation. KEY RISKS/THREATS Wetland drainage. Loss of native wetland vegetation.	No Photo available

Appendix 3. List of fauna species recorded in the Murrindindi Shire which have international, national or state significance

COMMON NAME	SCIENTIFIC NAME	VROTS	AROTS	FFG	EPBC	CAMBA
Alpine tree frog	*Litoria verreauxii alpina*	X				
Australasian shoveler	*Anas rhynchotis*	X				
Barking owl	*Ninox connivens*	X		X		
Barred galaxias	*Galaxias fuscus*	X	X	X	X	
Bar-tailed godwit	*Limosa lapponica*					X
Blue-billed duck	*Oxyura australis*	X		X		
Broad-toothed rat	*Mastacomys fuscus*	X				
Brown quail	*Coturnix ypsilophora*	X				
Brush-tailed phascogale	*Phascogale tapoatafa*	X		X		
Caddisfly (5008)	*Archaeophylax canarus*	X		X		
Cattle egret	*Ardea ibis*					X
Common bent-wing bat	*Miniopterus schreibersii*	X		X		
Damselfly	*Hemiphlebia mirabilis*	X		X		
Fork-tailed swift	*Apus pacificus*					X
Glossy ibis	*Plegadis falcinellus*	X				
Glossy ibis	*Plegadis falcinellus*					X
Golden perch	*Macquaria ambigua*	X				
Golden sun moth	*Synemon plana*	X		X		
Great egret	*Ardea alba*	X		X		X
Grey goshawk	*Accipiter novaehollandiae*	X				
Hardhead	*Aythya australis*	X				
Leadbeater's possum	*Gymnobelideus leadbeateri*	X	X	X	X	
Lewin's rail	*Rallus pectoralis*	X				
Little bittern	*Ixobrychus minutus*	X				
Little button-quail	*Turnix velox*	X				
Little egret	*Egretta garzetta*	X				
Macquarie perch	*Macquaria australasica*	X		X	X	
Masked owl	*Tyto novaehollandiae*	X		X		
Mountain galaxias	*Galaxias olidus*	X		X		
Murray cod	*Maccullochella peelii peelii*	X		X		
Murray spiny cray	*Euastacus armatus*	X				
Musk duck	*Biziura lobata*	X				
Nankeen night heron	*Nycticorax caledonicus*	X				
Pied cormorant	*Phalacrocorax varius*	X				
Powerful owl	*Ninox strenua*	X		X		
Regent honeyeater	*Xanthomyza phrygia*	X	X	X	X	
River blackfish	*Gadopsis marmoratus*	X				

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List of fauna species recorded in the Murrindindi Shire which have international, national or state significance. continued..

COMMON NAME	SCIENTIFIC NAME	VROTS	AROTS	FFG	EPBC	CAMBA
Royal spoonbill	*Platalea regia*	X				
Smoky mouse	*Pseudomys fumeus*	X				
Sooty owl	*Tyto tenebricosa*	X		X		
Southern myotis	*Myotis macropus*	X				
Speckled warbler	*Chthonicola sagittata*	X				
Spot-tailed quoll	*Dasyurus maculatus*	X	X	X	X	
Spotted tree frog	*Litoria spenceri*	X	X	X	X	
Square-tailed kite	*Lophoictinia isura*	X				
Striped legless lizard	*Delma impar*	X	X	X	X	
Swift parrot	*Lathamus discolor*	X	X	X	X	
Tree goanna	*Varanus varius*	X				
Turquoise parrot	*Neophema pulchella*	X		X		
Warty bell frog	*Litoria raniformis*	X	X	X	X	
White-bellied sea-eagle	*Haliaeetus leucogaster*	X		X		X
White-throated needletail	*Hirundapus caudacutus*					X

List of flora species recorded in the Murrindindi Shire which have international, national or state significance.

COMMON NAME	SCIENTIFIC NAME	VROTS	AROTS	FFG	EPBC	CAMBA
Alpine cudweed	*Euchiton fordianus*	X				
Alpine wattle	*Acacia alpina*	X				
Baw Baw berry	*Wittsteinia vacciniacea*	X				
Baw Baw daisy	*Brachyscome obovata*	X				
Blue-leaf tussock-grass	*Poa sieberiana var.*	X				
Blunt-leaf pomaderris	*Pomaderris helianthemifolia* ssp. *minor*	X				
Brittle bladder-fern	*Cystopteris tasmanica*	X	X			
Broad-tip diuris	*Diuris X palachila*	X				
Buxton gum	*Eucalyptus crenulata*	X	X	X	X	
Cliff cudweed	*Euchiton umbricola*	X				
Clover glycine	*Glycine latrobeana*	X	X	X	X	
Cobra greenhood	*Pterostylis grandiflora*	X				
Creeping grevillea	*Grevillea repens*	X	X			
Crimson spider-orchid	*Caladenia concolor*	X	X	X	X	
Dwarf sickle-fern	*Pellaea nana*	X				
Fir clubmoss	*Huperzia australiana*	X				
Forest sedge	*Carex alsophila*	X				
Forest weft-moss	*Thuidium laeviusculum* s.s.	X				

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List of flora species recorded in the Murrindindi Shire which have international, national or state significance, continued.

Glaucous flax-lily	*Dianella longifolia var.*	X				
Golden pomaderris	*Pomaderris aurea*	X				
Green scentbark	*Eucalyptus fulgens*	X				
Hairy anchor plant	*Discaria pubescens*	X	X	X		
Hickory wattle	*Acacia penninervis* var. *penninervis*	X				
Highland bush-pea	*Pultenaea williamsonii*	X	X			
Lake mountain grevillea	*Grevillea monslacana*	X				
Lanky buttons	*Leptorhynchos elongatus*	X				
Large-fruit fireweed	*Senecio macrocarpus*	X	X	X	X	
Lilac berry	*Trochocarpa clarkei*	X				
Long pink-bells	*Tetratheca stenocarpa*	X	X			
Moss	*Fissidens strictus*	X				
Moss	*Distichophyllum*	X				
Moss	*Trachyloma planifolium*	X				
Moss	*Hampeella alaris*	X				
Mountain coral heath	*Epacris microphylla* var. *rhombifolia*	X				
Netted daisy-bush	*Olearia speciosa*	X				
River leafless bossiaea	*Bossiaea riparia*	X				
Round-leaf pomaderris	*Pomaderris vacciniifolia*	X				
Royal grevillea	*Grevillea victoriae* ssp. *victoriae*	X				
Ruddy bent	*Agrostis rudis*	X				
Silky browntop	*Eulalia aurea*	X				
Silky golden-tip	*Goodia lotifolia* var. *pubescens*	X				
Silver stringybark	*Eucalyptus alligatrix*	X				
Silver stringybark	*Eucalyptus alligatrix* ssp. *alligatrix*	X	X			
Sky lily	*Herpolirion novae-zelandiae*	X				
Slender beard-orchid	*Calochilus gracillimus*	X				
Slender tick-trefoil	*Desmodium varians*	X				
Snow heath	*Epacris petrophila*	X				
Snow speedwell	*Derwentia nivea*	X	X			
Snow-berry	*Gaultheria hispida*	X				
Snowdrop wood-sorrel	*Oxalis magellanica*	X				
Spinning gum	*Eucalyptus perriniana*	X				
Strawberry buttercup	*Ranunculus collinus*	X				
Subalpine baeckea	*Baeckea latifolia*	X				
Summer fringe-sedge	*Fimbristylis aestivalis*	X				

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List of flora species recorded in the Murrindindi Shire which have international, national or state significance, continued.

Swamp billy-buttons	*Craspedia paludicola*	X				
Tough scurf-pea	*Cullen tenax*	X		X		
Tree geebung	*Persoonia arborea*	X				
Tuft-rush	*Oreobolus oxycarpus* ssp.	X				
Victorian richea	*Richea victoriana*	X				
Western golden-tip	*Goodia medicaginea*	X				
Wiry bossiaea	*Bossiaea cordigera*	X				
Woodland leek-orchid	*Prasophyllum validum*	X	X		X	

Appendix 4. Existing legal obligations and government policy

The following is a summary of existing obligations that remain and must continue to be met within the Municipal Planning Scheme. Local government has the capacity via planning schemes to adopt stricter codes but is obligated to administer or abide by over-arching international, national and state law and policy.

Victoria is a signatory to several national agreements and strategies including: *Intergovernmental Agreement on the Environment (IGAE); National Strategy for Ecologically Sustainable Development; National Strategy for the Conservation of Australia's Biological Diversity.*

International obligations

Jamba/Camba (Japanese/Chinese Australian Migratory Bird Agreements.) See http://www.austlii.edu.au/au/other/dfat/treaties/1981/6.html

The agreement contains a commitment to 'establish sanctuaries' and 'preserve and enhance habitat' of listed species.

National obligations

Environment Protection & Biodiversity Conservation Act (EPBC) (http://www.ea.gov.au/epbc)

The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), came into force on 16 July 2000.

Under the assessment and approval provisions of the EPBC Act, actions that are likely to have a significant impact on a matter of 'national environmental significance' are subject to a rigorous assessment and approval process. An action includes a project, development, undertaking, activity, or series of activities. The Act currently identifies matters of national environmental significance including listed threatened species and ecological communities and listed migratory species.

State obligations

Victoria's Biodiversity Strategy (http://www.nre.vic.gov.au)

The Victorian Government endorses this landmark strategy for the conservation of biodiversity in the state. The Biodiversity Strategy will encourage Victorians to better understand and appreciate our rich and diverse flora and fauna and ecosystems, and to take an active part in their conservation and management for future generations. Individuals, community groups, industry, and government agencies all have a vital role to play.

Flora and Fauna Guarantee Act 1988 (FFG) (http://www.nre.vic.gov.au)

This act, proclaimed in 1988, provides the main legal framework for the protection of Victoria's biodiversity, our native plants and animals and ecological communities on land and in water. It provides the framework for State Government and community action in relation to biodiversity. The aim is to ensure that our native flora and fauna survive, flourish and retain their potential for evolutionary development in the wild.

Processes within the act include listing of species, communities and potentially threatening processes. Over 100 Action Statements have been prepared to date.

Native vegetation retention regulations. ***Planning and Environment Act 1987***

The Native Vegetation Retention (NVR) Controls were introduced in 1989 to reduce the degree of broadscale clearing of native vegetation while allowing regulated minor clearing of vegetation for normal agricultural and domestic purposes to continue.

Native vegetation is defined in all planning schemes as 'plants that are indigenous (locally native) to Victoria, including trees, shrubs, herbs and grasses'. All native vegetation is valuable and of concern under the NVR Controls.

Native vegetation plays an important role in the achievement of environmental, economic and social objectives.

Native vegetation is essential for the maintenance of biodiversity, ecology, water quality, the productive capacity of land and provides valuable shade and shelter for stock.

The controls operate by stating that a permit is required to remove, destroy or lop native vegetation on any land holding of 0.4 hectare or greater in size. However, to avoid excessive paper work some permit exemptions exist to enable nominated vegetation removal activities associated with already established land management practices.

Appendix 5. Ecological Vegetation Classes (EVCs) and conservation status in the Central Victorian Uplands bioregion

EVC	CONSERVATION STATUS
Alluvial Terraces Herb-rich Woodland	E
Alluvial Terraces Herb-rich Woodland/Creekline Grassy Woodland Mosaic	E
Blackthorn Scrub	
Box Ironbark Forest	V
Clay Heathland	
Cool Temperate Rainforest	V
Creekline Grassy Woodland	E
Damp Forest	
Damp Sands Herb-rich Woodland	E
Floodplain Riparian Woodland	E
Floodplain Riparian Woodland/Plains Grassy Woodland Mosaic	E
Gilgai Plain Woodland/Wetland Mosaic	E
Granitic Hills Woodland	E
Granitic Hills Woodland/Rocky Outcrop Shrubland/Herbland Mosaic	E
Grassy Dry Forest	D
Grassy Dry Forest/Rocky Outcrop Shrubland/Herbland Mosaic	V
Grassy Woodland	E
Grassy Woodland/Valley Grassy Forest Complex	X
Heathy Dry Forest/Shrubby Granitic-outwash Grassy Woodland Complex	X
Heathy Dry Forest	D
Heathy Woodland	
Herb-rich Foothill Forest	D
Lateritic Woodland	
Lowland Forest	
Montane Damp Forest	
Montane Dry Woodland	
Montane Riparian Thicket	
Montane Rocky Shrubland	
Montane Wet Forest	
Perched Boggy Shrubland Complex	E
Plains Grassy Wetland	E
Plains Grassy Woodland	E
Plains Grassy Woodland/Creekline Grassy Woodland Mosaic	E
Plains Grassy Woodland/Plains Grassland/Plains Grassy Wetland Mosaic	E
Riparian Forest	V

continued next page….

Appendix 5 continued

EVC	CONSERVATION STATUS
Riparian Forest/Creekline Grassy Woodland Mosaic	E
Riparian Forest/Swampy Riparian Woodland Mosaic	E
Riparian Forest/Swampy Riparian Woodland/Riparian Shrubland Complex	E
Riparian Scrub Complex	D
Riparian Shrubland	E
Riparian Shrubland/Swampy Riparian Woodland Mosaic	E
Riparian Thicket	
Riverine Escarpment Scrub	E
Rocky Outcrop Shrubland/Herbland Mosaic	V
Shrubby Dry Forest	
Shrubby Foothill Forest	
Shrubby Granitic-outwash Grassy Woodland/Plains Grassy Woodland Complex	X
Shrubby Wet Forest	
Slopes Box Grassy Woodland/Box Ironbark Forest Complex	E
Spring Soak Woodland	E
Sub-alpine Woodland	
Swampy Riparian Complex	E
Swampy Riparian Woodland	E
Swampy Riparian Woodland/Perched Boggy Shrub-land Mosaic	V
Swampy Riparian Woodland/Spring Soak Woodland Mosaic	E
Unclassified Foothill Forest	
Valley Grassy Forest	V
Valley Grassy Forest/Box Ironbark Forest Complex	V
Valley Grassy Forest/Plains Grassy Woodland Complex	E
Valley Grassy Forest/Slopes Box Grassy Woodland Complex	E
Valley Heathy Forest	E
Wet Forest	
Wetland Formation	E

Note:

V = Vulnerable (10-30% pre European extent exists)

E = Endangered (<10% pre European extent exists)

X = Presumed Extinct (probably no longer present in the region)

D = Depleted ((>30% and up to 50% pre European extent exists)