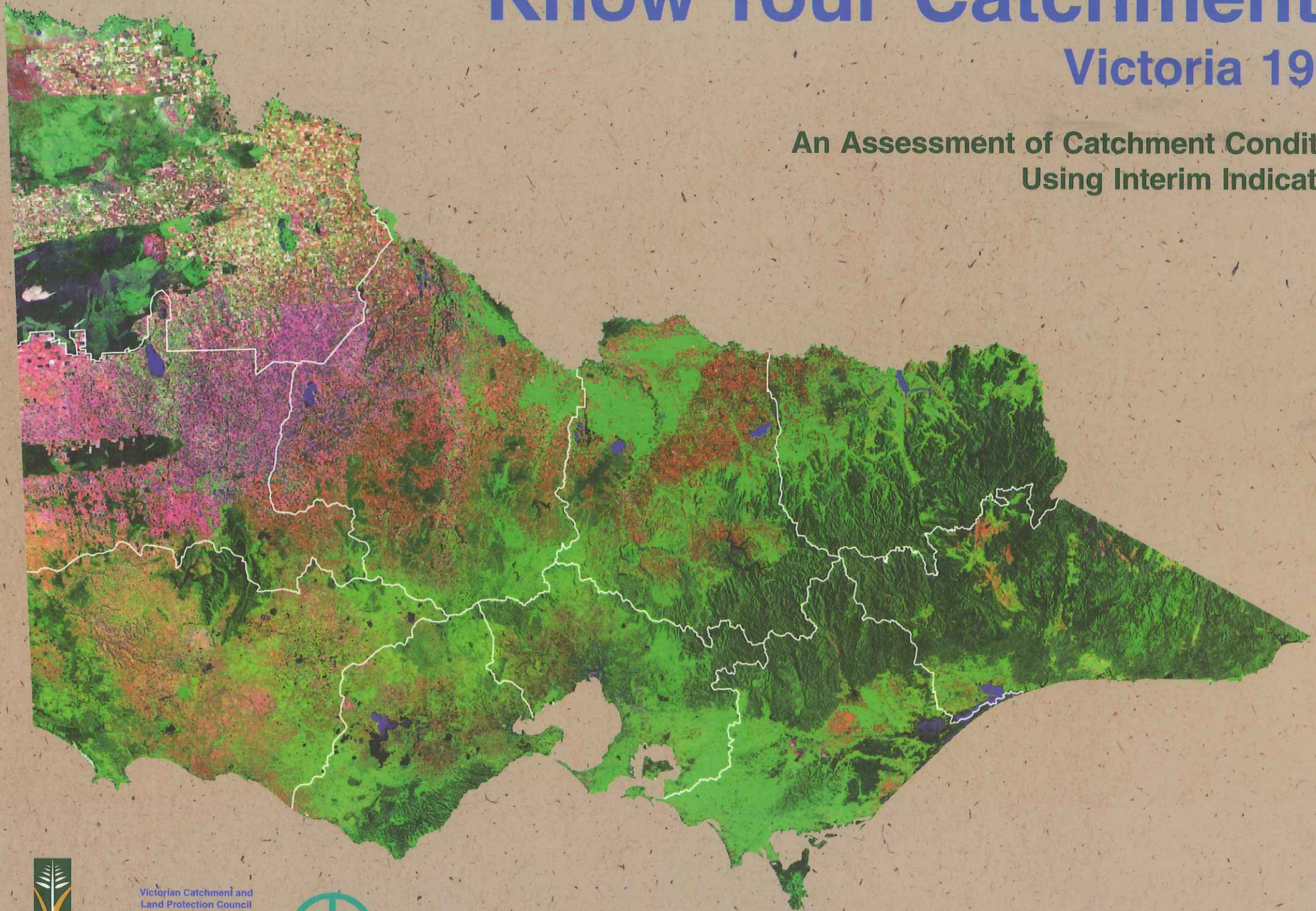


Know Your Catchments

Victoria 1997

An Assessment of Catchment Condition
Using Interim Indicators



Victorian Catchment and
Land Protection Council



Satellite Image

The satellite image shows Victoria's land mass in 1993, using Landsat 5.

The image is a mosaic of seventeen Landsat satellite Thematic Mapper images taken from 750 kilometres above the earth. The Thematic Mapper records wavelengths of reflected and radiated light from the earth's surface, in seven different bands. These bands range from the visible blue through to the mid infra red portion of the light spectrum.

This image shows the visible blue, the near infra red and the mid infra red bands. These are shown in the blue, green and red colour guns respectively. Although the image is a false colour image, this combination of bands and colours provides an approximation of true colour.

- *The near infra red, displayed in the green colour gun, highlights chlorophyll in vegetation. Forest and other vegetation cover appears as dark green and slightly brown, while irrigated pasture and crops appear as light green.*
- *The mid infra red, displayed in the red colour gun, also highlights vegetation as well as ground and soil reflectance. Hence, dry pastures and crops are characterised by the various shades containing red such as the browns, oranges and pinks.*
- *The visible blue band, displayed in the blue colour gun, highlights water bodies and can provide an indication of their relative depth. Deep bodies of water appear almost black, while shallow bodies are a much lighter blue.*

The dates of the seventeen images range from January 1993 to February 1993. All have been recorded in summer months when the maximum differences between forest and other land covers can best be discriminated.

Some areas of particular interest in this image include:

- *the distinctive broad acre cropping patterns in the north west of the state*
- *the natural fire scar patterns observed in the Wyperfeld National Park and the Big Desert Wilderness Park in the north west*
- *the geological structures in the Grampians National Park in the south west*
- *the channels and waterways of the Corner Inlet Marine and Coastal Park, in south Gippsland*

The satellite imagery was captured by the Australian Centre for Remote Sensing (ACRES). All image processing, enhancement and mosaicing was undertaken by Natural Resource Systems.

Boundaries of the Catchment and Land Protection (CALP) Regions are overlain on the image. These Regions are named on Map 1.

Know Your Catchments

Victoria 1997

**An Assessment of Catchment Condition
Using Interim Indicators**

**Department of Natural Resources and Environment
Victorian Catchment and Land Protection Council
Environment Protection Authority**

October 1997

Errata

The following points require correction or clarification.

Page 6 ~ Contributors

Streams and Wetlands:

Should include *Brett Light, Water ECOscience*.

Page 18 ~ Population

Graphs 7 and 8:

The ninth town is *Echuca*.

Page 26 ~ Change in Soil pH

Note:

The assessment of soil pH refers to surface soils. Samples from the top 10 or 15 cms were analysed.

Page 28 ~ Lime Applied to Crops and Pastures

Graph 21:

The weight of lime applied in Corangamite CALP Region should read *21,500* tonnes.

Page 36 ~ Soil Tillage Methods

Background, paragraph 1:

Should read "Minimum Tillage refers to less than *two* workings prior to sowing."

Background, paragraph 2 and Results, paragraph 1:

Should read "Conventional Tillage is generally the sowing of the crop after *two* or more cultivations."

Page 62 ~ Algal Blooms

Note:

Not all blooms of blue-green algae are toxic. However, other effects (from both blue-green algae and true algae) such as discolouration of water, pungent tastes and odours and unsightly scums can also render water unfit for human use.

Page 65 ~ Streams Protected from Livestock

Graph 38:

Wimmera, total stream length should read *1,160* kms

Glenelg, total stream length should read *5,600* kms.

Page 67 ~ Saltwatch and Waterwatch

Graph 39 (e) ~ Corangamite:

May 1997 should read *45* groups.

Page 70 ~ Salinity and Watertables

Summary, point 1:

Should read "Around *2,200,000* ha of perennial pastures were resown in 1993/94".

Pages 78 and 79 ~ Irrigation Management Practices

Page 78, Graph 47:

i) Fifth year in Legend should read *1991/92*.

ii) Tragowel Plains, 2nd column (1991/92) should read *\$2,262,000*.

Page 79, Graph 46 (j):

Should read Campaspe *West*.

Page 94 ~ Appendix 1: Resource Management Units

Reference:

Resource Management Units (RMUs): A framework for state and regional planning, D.B. Rees and L.D. Russell, 1997, Centre for Land Protection Research, unpublished report, DNRE.

Contact:

David Rees, Centre for Land Protection Research, DNRE.

Contacts

- General enquiries,
- Contact phone numbers of Contributors, or
- Copies of the Background Report

Contact Jodie Cray, DNRE, Bendigo 0354 304 475.

Preface

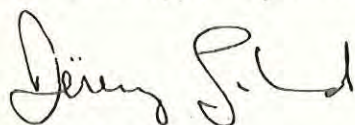
The Victorian Catchment and Land Protection Council was established in November 1994 to advise the Government on catchment management and land protection matters and, among other things, to report on the condition and management of land and water resources.

The Council's first two annual reports highlighted the need for an integrated and co-ordinated monitoring and assessment program in Victoria which would facilitate efficient and meaningful reporting against key indicators.

The Deputy Premier and Minister for Agriculture and Resources, Pat McNamara, and the Minister for Conservation and Land Management, Marie Tehan made a firm commitment in October 1996 to a strategy for integrated monitoring and assessment of the State's natural resources.

Know Your Catchments provides a benchmark which will stimulate and focus discussion productively on the finalisation of agreed indicators: a critical step in this strategy.

I commend those involved in the production of the publication, particularly the Council Resource Assessment and Monitoring Committee convened by Professor Barry Hart of Monash University, staff of DNRE and EPA who were closely involved in its management and the provision of information, and staff of CMSA and CLPR, Bendigo, who were assigned to draft the bulk of the report and provide technical expertise.



Jeremy Gaylard
Chairperson

Foreword

The condition of our catchments underpins the wellbeing of all Victorians. We rely on healthy catchments for water supply, food, fibre and timber production, the conservation of flora and fauna, tourism and recreation. Significant wealth is generated from our land and water resources and Victoria's soil, water, vegetation and climate provides distinct competitive advantages for all rural industries. Sustainable use and protection of our catchments natural resources requires careful management to maintain the environmental integrity of the resource and protect Victoria's reputation as a clean green producer.

Working in partnership with the Victorian Government, the Catchment and Land Protection Council commissioned *Know Your Catchments* to report on the condition and management of the catchments' natural resource, economic and social base. The publication of *Know Your Catchments* comes as a milestone in the implementation of the Integrated Catchment Monitoring and Assessment Strategy for Victoria. The Strategy is a key component for the integrated management of our land and water resources that addresses long term issues through the development and implementation of management solutions. The end result is the sustainable development of resources and the protection of the environment for all Victorians.


Monitoring and assessment of our catchments allows us to understand how their condition is changing and is the key information base of good catchment management. *Know Your Catchments* has distilled the significant information resources of DNRE and EPA to provide an overview at both the statewide and Catchment Management Authority Level. It is a trial of potential indicators for future continued monitoring and the inclusion of social and economic indicators reflects the importance of viable rural enterprises in achieving sustainable catchment management.

The benefits of monitoring and assessment allow us, as land and catchment managers, to see where achievements are, and also where further work is required. Through the partnership between community and the government, some of the achievements in catchment management include;

- the formation of over 870 Landcare groups and 550 groups involved in the Waterwatch programme
- approximately 7.6 million trees planted on private land between 1993 and 1995,
- over the last twenty years, a majority of areas in Victoria showing no change in soil pH or an increasing trend in pH
- the majority of Salinity Management Plans are either exceeding or meeting their on-ground works targets.

Know Your Catchments provides an opportunity for all people interested in catchment management to understand the condition and trends occurring within and across catchments, and how this information can enable improved catchment planning and management in the future. This report provides a significant base of information for future reporting and challenges all Victorians to consider their activities in light of the current condition of the catchments.

We welcome this report and commend the efforts of the Catchment and Land Protection Council, DNRE and EPA in producing *Know Your Catchments* in such a short time frame. We encourage all natural resource managers to use this information within the bounds for which it was intended and to assist in targeting our efforts in sustainable natural resource management.



Hon. Marie Tehan, MP
Minister for Conservation
and Land Management



Hon. Patrick McNamara, MP
Deputy Premier
Minister for Agriculture and Resources

Maps

Maps Compiled and Created by '1997 Catchment Condition Atlas Team'

Project Management: Peter Forbes (NRMA); John Williamson (CLPR).

Project Team: Jodie Cray, Hetty Verspay, Glen MacLaren, Stephen Page (Natural Resources Monitoring and Assessment Team, CMSA); Steve Williams, Sara Hill (Catchment Information Systems Unit, CLPR, Bendigo):

Cartography by Wayne Harvey (CLPR)

Data Processing by Steve Williams (CLPR)

Satellite Image by Natural Resource Systems

Technical Assistance from Jodie Cray, Ruth Lourey (NRMA), Angela Smith, Judith Henschke, Julie Gequillana, Keith Reynard (CLPR).

All maps are produced in VICMAP Projection (Transverse Mercator, AGD 66)

Background layers extracted from the DNRE Corporate Geospatial Data Library (L500)

locn500	main towns	basin100	river basins
road500	main roads	hydro500	main streams & lakes
lga100	shires	landusc250	land use
parish500	parishes	landmmt100	public land
calp100	Catchment and Land Protection Regions		
smp250	Salinity Management Plan Areas		
ibra500	Interim Biogeographic Regionalisation of Australia		
rmu250	Resource Management Units		
lsys250	Geomorphologic Units		
Landsat	1993 Satellite Image		

***Know Your Catchments* was commissioned and overseen by the Resource Monitoring and Assessment Steering Committee of the Victorian CALP Council**

Barry Hart (Chair), Christine Forster (CALP Council); Clive Lyle (CMSA); Chris Bell (EPA)

Interim Indicator list developed by Resource Monitoring and Assessment Steering Committee,
with Jodie Cray, Hetty Verspay and Peter Forbes (NRMA)

Edited, Designed and Produced by Stephen Page

Text Editing by Stephen Page, Peter Forbes, Jodie Cray (NRMA), Angela Smith, John Williamson (CLPR)

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World Wide Web Site

Know Your Catchments, Victoria 1997 is available on the World Wide Web. Visit us via the DNRE Web Site:

<http://www.nre.vic.gov.au/catchmnt/conditn>

Background Report

The text accompanying the maps in this atlas is necessarily brief. Generally we have tried to describe the Limitations which apply to interpreting the data and drawing conclusions. Some general discussion of the results is also included.

For more detailed explanation of the collection and analysis of the data presented on each map, see the accompanying Background Report.

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For Further Information contact

Dept. of Natural Resources and Environment, Box 2500,
Bendigo Mail Centre, Vic. 3554.

Phone: 0354 304 444

Contents

Preface	1
Foreword	1
Introduction	7
Determining the Interim Indicators	9
Report Structure	9
Catchment Management Authorities, 1997	11

Catchment Communities 12

Land Use and Tenure	14
Water Use	16
Population, 1991 - 1996	18
Income and Value of Production	20
Landcare-type Groups, 1996	22

Soils 24

Change in Soil pH, 1973/83 - 1984/94	26
Lime Applied to Crops and Pastures, 1994/95	28
Change in Soil Fertility, 1973/83 - 1984/94	30
Soil Structure Decline, 1989 - 1994	32
Stubble Management, 1994/95	34
Soil Tillage Methods, 1994/95	36
Fallowing	38
Awareness of Soil Erosion, 1988 - 1997	40

Pest Plants and Animals 42

Rabbit Calicivirus Disease, August 1997	44
Agricultural Weeds, 1996	46
Agricultural Weeds, 1996	48
Weeds Awareness, 1997	50

Streams and Wetlands 52

Stream Total Phosphorus	54
Stream Turbidity	56
Stream Electrical Conductivity (EC)	58
Stream Health, 1994 - 1996, using macroinvertebrates	60
Algal Blooms	62
Streams Protected from Livestock	64
Saltwatch and Waterwatch, 1987 - 1997	66
Awareness of Rivers and Catchments, 1988 - 1997	68

Salinity and Watertables 70

Trends in Watertable Depth, 1997	72
Dryland Salinity, 1997	74
Perennial Pasture Established, 1993/94	76
Irrigation Management Practices, 1990 - 1996	78
Salinity Awareness, 1988 - 1997	80

Vegetation and Wildlife Habitat 82

Trees Planted on Farmland, 1993/94 - 1994/95	84
Land for Wildlife, 1997	86
Native Vegetation Protected from Livestock, 1993/94	88
Biological Diversity Awareness, 1998 - 1997	90

Appendices 92

Appendix 1. Resource Management Units, 1997	94
Appendix 2. Biogeographic Regions, 1997	95
Glossary	96
Notes	98
Your Comments	99

List of Maps, Graphs and Tables

Catchment Management Authorities, 1997

Map 1 Catchment and Land Protection Regions, 1997

Catchment Communities

Land Use and Tenure

Map 2 Land Use

Graph 1 Area of Horticulture, Broadacre Cropping and Pasture, 1993/94

Graph 2 Area of Land Use Types, 1993/94

Graph 3 Area of Dryland and Irrigated Agriculture, 1993/94

Water Use

Map 3 Water Use by Rural Water Authorities, 1996/97

Map 4 Water Use by Urban Water Authorities, 1996/97

Graph 4 Environmental Flows Negotiated under the Bulk Entitlement (BE) Conversion

Program, 1996/97

Population, 1991 - 1996

Map 5 Change in Population, 1991-96

Graph 5 Population of Regional Centres >20,000 People, 1996

Graph 6 Change in Population of Regional Centres >20,000 People, 1991-96

Graph 7 Population of Regional Centres 7,000 to 20,000 People, 1996

Graph 8 Change in Population of Regional Centres 7,000 to 20,000 People, 1991-96

Income and Value of Production

Graph 9 Regional Per Capita Income as a Proportion of Victorian Average, 1976-91

Graph 10 Agricultural Gross Value Product, by CALP Region, 1994/95

Graph 11 Agricultural Gross Value Product, by Industry, 1994/95

Graph 12 Fisheries - Value of Production, 1995/96

Graph 13 Forestry - Value of Production, 1996/97

Graph 14 Gold Mining - Value of Production, 1995/96

Graph 15 Manufacturing - Value of Production, 1993/94

Graph 16 Tourism - Value of Production, 1995/96

Landcare-type Groups, 1996

Map 6 Landcare-type Groups, by Postcode Areas, 1996

Graph 17 Landcare-type Groups Formed per Year, 1960-96

Graph 18 Full Time and Part Time Farmers in Landcare-type Groups, 1996

Graph 19 Salinity and Landcare Articles in Melbourne Major Daily Newspapers, 1987-95

Graph 20 Salinity and Landcare Articles in Sydney Major Daily Newspapers, 1987-95

Diagram 1 Density of Landcare-type Groups, 1996

Diagram 2 Average Size of Landcare-type Groups, 1996

Soils

Change in Soil pH, 1973/83 - 1984/94

Map 7 Soil pH 1973/94, showing Change in Soil pH, 1973/83 - 1984/94

Lime Applied to Crops and Pastures, 1994/95

Map 8 Lime Applied to Crops and Pastures, by Parish, 1994/95

Graph 21 Lime Applied to Crops and Pastures, 1994/95

Change in Soil Fertility, 1973/83 - 1984/94

Map 9 Soil Potassium Fertility, 1973/94, showing Change in Fertility, 1973/83 - 1984/94

Map 10 Soil Phosphorus Fertility, 1973/94, showing Change in Fertility, 1973/83 - 1984/94

Soil Structure Decline, 1989 - 1994

Map 11 Soil Structure - Aggregate Slaking and Dispersion, 1989-94

Stubble Management, 1994/95

Map 12 Stubble Area Burnt, by Parish, 1994/95

Graph 22 Area of Stubble Burnt and Retained, 1994/95

Table 1 Area and Farmers with Various Stubble Management Practices, 1994/95

Soil Tillage Methods, 1994/95

Map 13 Tillage Area under Direct Drilling, by Parish, 1994/95

Map 14 Tillage Area under Conventional Tillage, by Parish, 1994/95

Graph 23 Crop Area under Various Tillage Methods, 1994/95

Table 2 Cropped Area under Various Tillage Methods, 1994/95

Fallowing

Map 15 Landscape Fallow, by Parish, 1994/95

Table 3 Measures of Fallow Usage, 1991/92 and 1994/95

Soil Erosion Awareness, 1988 - 1997

Graphs 24 (a to j) Public Awareness of Soil Erosion, 1988-97

Pest Plants and Animals

Rabbit Calicivirus Disease, August 1997

Map 16 Distribution and Impact of RCD on Rabbit Numbers, from Release Sites and Natural Spread, August 1997

Agricultural Weeds, 1996

Map 17 Reported Incidence of Blackberry, 1996

Map 18 Reported Incidence of Horehound, 1996

Map 19 Reported Incidence of Paterson's Curse, 1996

Map 20 Reported Incidence of St. John's Wort, 1996

Graph 25 Incidence of Four High Priority Agricultural Weeds on Public Land, 1996

Graph 26 Incidence of Four High Priority Agricultural Weeds on Private Land, 1996

Graph 27 Incidence of Four High Priority Agricultural Weeds on Roadsides, 1996

Agricultural Weeds, 1996

Map 21 Reported Incidence of 1-leaf Cape Tulip, 1996

Map 22 Reported Incidence of Ragwort, 1996

Map 23 Reported Incidence of Serrated Tussock, 1996

Map 24 Reported Incidence of 2-leaf Cape Tulip and Cape Tulip, 1996

Graph 28 Incidence of Five High Priority Agricultural Weeds on Public Land, 1996

Graph 29 Incidence of Five High Priority Agricultural Weeds on Private Land, 1996

Graph 30 Incidence of Five High Priority Agricultural Weeds on Roadsides, 1996

Photo Serrated Tussock Infestations, July 1997

Weeds Awareness, 1997

Graphs 31 (a to h) Public Awareness of Environmental Weeds, 1997

Graphs 32 (a to h) Public Awareness of Weeds on Farmland, 1997

Graph 33 Public Awareness of 'Good Neighbour' Program, 1997

Streams and Wetlands

Stream Total Phosphorus

Map 25 Median Stream Total Phosphorus

Graph 34 Sites with Stream Total Phosphorus Levels in each Category

Stream Turbidity

Map 26 Median Stream Turbidity

Graph 35 Sites with Stream Turbidity Levels in each Category

Stream Electrical Conductivity (EC)

Map 27 Median Stream Electrical Conductivity (EC)

Graph 36 Sites with Stream EC Levels in each Category

Stream Health, 1994-96, using macroinvertebrates

Map 28 Stream Health, 1994-96, as determined by AUSRIVAS, using macroinvertebrates

Table 4 AUSRIVAS Score Categories for Observed / Expected Macroinvertebrate Families

Algal Blooms

Map 29 Algal Blooms Reported, 1928-95

Graph 37 Algal Blooms Reported, 1951-96

Streams Protected from Livestock

Map 30 Stream Frontage Protected from Livestock, by Parish, March 1995

Graph 38 Streams Protected from Livestock, at March 1995

Saltwatch and Waterwatch, 1987 - 1997

Graphs 39 (a to k) Groups Participating in Saltwatch, 1987-97

Graph 40 Groups Participating in Saltwatch and Waterwatch, 1987-97

Graph 41 Groups Participating in Waterwatch Snapshot Program, 1997

Awareness of Rivers and Catchments, 1988 - 1997

Graphs 42 (a to j) Public Awareness of Degraded Rivers and Catchments, 1988-97

Salinity and Watertables

Trends in Watertable Depth, 1997

Graphs 43 (a to u) Rising, Falling and Stable Trends in Watertable Depth, 1997

Map 31 Salinity Management Plan Areas, 1997

Dryland Salinity, 1997

Map 32 Dryland Secondary Salinity Discharge Sites, 1997

Table 5 Accurately Mapped Dryland Salinity, by CALP Region, 1997

Perennial Pasture Established, 1993/94

Map 33 Perennial Pasture Resown, by Parish, 1993/94

Graph 44 Perennial Pasture Resown, 1993/94

Graph 45 Perennial Pasture Resown as a Proportion of Total Pasture, 1993/94

Irrigation Management Practices, 1990 - 1996

Graphs 46 (a to p) Irrigation Management Practices Adopted under Salinity Management

Plans, 1990-96

Graph 47 Irrigation Salinity Management Plan Budgets, 1990/91 - 1995/96

Salinity Awareness, 1988 - 1997

Graphs 48 (a to j) Public Awareness of Salinity, 1988-97

Vegetation and Wildlife Habitat

Trees Planted on Farmland, 1993/94 - 1994/95

Map 34 Trees Planted on Farmland, by Parish, 1993/94-1994/95

Graph 49 Trees Planted on Farmland, 1993/94-1994/95

Land for Wildlife, 1997

Map 35 Distribution of Land for Wildlife Properties, August 1997

Graph 50 Habitat Area and Property Area of Land for Wildlife Properties, 1981-97

Graph 51 Habitat Area and Property Area of Land for Wildlife Properties, by CALP Region, 1997

Graph 52 Habitat Types on Land for Wildlife Properties, 1997

Table 6 Total Area of Retained and Restored Habitat on Land for Wildlife Properties,

August 1997

Table 7 Increase in Area of Two Targeted Habitats on Land for Wildlife Properties, 1994-97

Native Vegetation Protected from Livestock, 1994

Map 36 Native Vegetation Protected from Livestock, by Parish, March 1994

Graph 53 Native Vegetation Protected from Livestock, at March 1994

Biological Diversity Awareness, 1988 - 1997

Graphs 54 (a to j) Public Awareness of Extinction of Plants and Animals, 1988-97

Appendices

Appendix 1 Resource Management Units, 1997

Appendix 2 Biogeographic Regions, 1997

Contributors

Catchment Communities

Hetty Verspay	CMSA, DNRE
Paul Bennett	CMSA, DNRE
John Williamson	CMSA, DNRE
Ruth Lourey	CMSA, DNRE
Komala Karunaratne	CMSA, DNRE
Mal Brown	CMSA, DNRE

Soils

Doug Crawford	SCL, DNRE
Austin Brown	SCL, DNRE
Jodie Cray	CMSA, DNRE
Komala Karunaratne	CMSA, DNRE
Neil Barr	CMSA, DNRE
John Williamson	CMSA, DNRE

Pest Plants and Animals

Steven Burke	CMSA, DNRE
Brad Shields	CMSA, DNRE
Jim Backholer	KTRI, DNRE
Mal Brown	CMSA, DNRE

Streams and Wetlands

Michael Shirley	Water Ecoscience
Lisa Dixon	EPA
Ross Perry	CMSA, DNRE
Jodie Cray	CMSA, DNRE
Mal Brown	CMSA, DNRE

Salinity and Watertables

Anthony Brinkley	SKM
Mark Reid	CLPR, DNRE
Sara Hill	CLPR, DNRE
Jodie Cray	CLPR, DNRE

Vegetation and Wildlife Habitat

Jean Edwards	PFF, DNRE
Felicity Nicholls	PFF, DNRE
Jodie Cray	CMSA, DNRE
Neil Barr	CMSA, DNRE

Public Awareness

Neil Barr	CMSA, DNRE
Mal Brown	CMSA, DNRE

Production Assistance

Amy Hill	Kerry Garrett Graphics
Scott Garrett	Dots Per Inch, Shepparton
Lisa Maw	Dots Per Inch, Shepparton
Tracy Tymensen	Dots Per Inch, Shepparton

Victorian Catchment and Land Protection Council

The major roles of the Catchment and Land Protection Council are:

- to advise on statewide priorities for catchment management and land protection;
- to advise on funding bids from a statewide viewpoint, through the State Assessment Panel;
- to oversee statewide reporting on the condition and management of land and water resources;
- to promote investigation into and research on any matter relating to catchment management or land protection;
- to promote community awareness and understanding of issues relating to catchment management and land protection; and
- to facilitate the operation of regional Catchment and Land Protection Boards and monitor their effectiveness.

Abbreviations

CALP Council	Victorian Catchment and Land Protection Council
CALP Region	Catchment and Land Protection Region
CLPR	Centre for Land Protection Research, DNRE, Bendigo
CMA	Catchment Management Authority
CMSA	Catchment Management and Sustainable Agriculture Division of DNRE
DNRE	Department of Natural Resources and Environment
EPA	Environment Protection Authority
GIS	Geographic Information System
ML	Megalitre
NRMA	Natural Resources Monitoring and Assessment Team, CMSA, DNRE
PFF	Parks, Flora and Fauna Division of DNRE
RCD	Rabbit Calicivirus Disease
RMU	Resource Management Unit
SCL	State Chemistry Laboratory, DNRE
SD	Statistical Division
SKM	Sinclair Knight Merz
SLA	Statistical Local Area

Introduction

In Victoria the management of natural resources within catchments occurs via a partnership between government and the community. Since the development of the Catchment and Land Protection Act, the government and rural communities have progressively built a partnership in catchment management. The formation of the nine regional Catchment Management Authorities (CMAs) in July 1997 consolidates this partnership.

The Catchment and Land Protection Council is required to report on the condition of Victoria's land and water resources on an annual basis. To date, the report has been included as part of the Council's annual report. *Know Your Catchments* aims to make information more accessible to catchment managers, and integrate CALP annual reporting as part of a larger monitoring programme. To report on the condition of the catchments, a set of indicators was chosen to represent issues identified in each of the CMA strategic objectives. Indicators were chosen for their

- applicability for statewide assessment
- usefulness for management
- availability of data, and
- the ability to analyse trends

This report satisfies the legislative requirement of the CALP Council. It also forms part of a strategic integrated monitoring and assessment programme that will improve catchment management through the implementation of Regional Catchment Strategies. As part of this strategy, this report forms a development stage of identifying and implementing an agreed set of indicators for catchment condition. As a result, the indicators presented in this report are considered interim. The next stages of development will be to review the suitability of the interim indicators, agree on a final set and develop and implement programmes for data capture and regular reporting.

Assessment of the condition of our land and water resources forms a component of Victoria's response to a number of future monitoring requirements including State of the Environment, the Land and Water Audit, and further reporting for the Catchment and Land Protection Council. The use of interim indicators has allowed Victoria to 'road test' what will be useful and meaningful indicators for the future. To assist with this process, feedback is invited from interested parties on this

report, and the relevance and usefulness of the indicators used. A form is included at the rear of the report to help guide responses.

The information presented in this report has come from a wide range of sources with the aim of providing a statewide snapshot of the contemporary condition of the catchments, and where possible, trend information to show change in condition over time. Information presented is predominantly focused on the environment, however critical economic and social condition information is also presented in order to provide a more holistic overview.

It is recognised that not all indicators of catchment condition have been included in this report. The brief was to provide an overview using a manageable number of indicators. The report attempts to achieve a balance across the areas of land, water, vegetation, economics and social issues, capturing those indicators that are likely to be robust now and into the future.

Much of the information presented in *Know Your Catchments* is based on as yet incomplete information. The maps have attached text providing an interpretation of what conclusions can be drawn, and the limitations to the data. More detailed descriptions and limitations to the data are contained in the accompanying Background Report.

Know Your Catchments therefore provides both an insight into the condition and management of land and water, and also provides a useful review of the status and adequacy of our current monitoring efforts. The information will be useful to Catchment Management Authorities, the Catchment and Land Protection Council, and all those interested in sustainable catchment management. It is from this base that a robust and effective integrated monitoring programme can grow so that our ability to report on condition and trends can be advanced.

Determining the Interim Indicators

In 1996, each of Victoria's Catchment and Land Protection Boards produced Regional Catchment Strategies. Within these Strategies, objectives detail what each Board intends to achieve within their catchment. These objectives formed the basis of a set of interim performance indicators to measure the health and condition of Victoria's catchments.

The CALP Board objectives were broadly classified according to the range of natural resource issues identified in the *Manual for Ranking Regional Impacts of Land and Water Degradation Issues*, compiled by the Natural Resources Planning Team of DNRE.

To identify the issues that could be reported on for the CALP Council's *Know Your Catchments* report, it was necessary to determine for which issues data is currently available. This formed the basis of a set of proposed indicators of catchment condition. These indicators are a compromise between the priorities of the CALP Boards and what can currently be reported on effectively.

In many cases, information on changes in biophysical condition is not readily available. These changes are often difficult to assess, requiring a long term commitment to expensive data collection and analysis. In these cases, indicators of management and community actions can provide a valuable insight into biophysical condition.

Indicators were culled from the list if they could not be reported upon consistently across the state, or where data could not be prepared within the time and cost constraints of the project.

During the compilation of this report a number of the indicators were modified, removed or replaced, as the true availability of data was identified.

The indicators presented vary in their ability to describe catchment condition and management. Some simply give a snapshot of present condition, others show trends through time and others actually explain and interpret these trends. Ultimately, all indicators should report on trends over time and we would have available the information needed to interpret why changes had occurred.

Report Structure

Know Your Catchments, Victoria 1997 aims to provide an overview of the available information. Therefore, only brief descriptions and interpretation are provided. More detailed information on the indicators and data analysis is available in the Background Report.

The report was commissioned to fulfil the CALP Council's legislative requirement to assess the condition and management of the land, water and biodiversity of Victoria's catchments. Because of the interconnectedness of these three themes, we have organised the indicators into the following sections:

- Catchment Communities
- Soils
- Pest Plants and Animals
- Streams and Wetlands
- Salinity and Watertables
- Vegetation and Wildlife Habitat

These subdivisions are strongly interconnected, and should be viewed in the context of integrated catchment management.

Not all the presented indicators reflect catchment condition. However, all are related to catchment management. The indicators can be loosely divided into 3 types, providing a framework for interpretation.

Empowerment Indicators

Empowerment activities provide knowledge, ability and motivation for people to act on an issue. Awareness of an issue or attendance at a course or workshop are examples of empowerment activities. Without empowerment, it is difficult or impossible for people to act to change the condition of natural resources. Indicators of empowerment allow us to measure either the output, (eg. attendance at a course) or the outcome, (eg. changed knowledge base).

Implementation Indicators

These are activities undertaken by people that change the condition of the natural resource base. Fencing off watercourses, the application of lime, and planting of trees are all examples of implementation activities. Generally, implementation cannot happen without empowerment. In many cases, implementation activities can affect the condition of a number of resource issues. For example, the adoption of conservation tillage practices can improve soil structure, reduce soil erosion and reduce groundwater recharge.

Condition Indicators

Condition relates to the state of the natural resource base. Condition can be compared to known or desired levels (benchmarks) or compared over time to provide a measurement of change (trend). Natural resource management is aimed at empowering people to implement actions that will change the condition of the resource in a desirable way. The condition of the resource is the final outcome of our actions, and condition indicators are often the most difficult to measure. Natural processes such as climate, wildfire and flora and fauna impact upon the condition of natural resources. Where possible these should be isolated from human induced impacts, although often this is not possible. Often it is the combined effect of human and natural impacts that result in a change in the condition of the natural resources.

Catchment Management Authorities

In July 1997, nine Catchment Management Authorities (CMAs) were formed to facilitate implementation of the Regional Catchment Strategies in nine of the existing rural Catchment and Land Protection (CALP) Regions. These CMAs combine the roles of a range of existing groups:

- Catchment and Land Protection Boards
- River Management Authorities
- Salinity Implementation Groups
- Water Quality Groups
- Sustainable Regional Development Committees

The role of the CMAs includes:

- to ensure the sustainable development of natural resource based industries
- to maintain and where possible improve the quality of land and water resources
- to conserve natural and cultural heritage
- to involve the community in decisions relating to natural resource management within their Region
- advise on matters relating to catchment management and land protection and the condition of land and water resources in the Region
- to promote community awareness and understanding of the importance of land and water resources, their sustainable use, conservation and rehabilitation

The existing Port Phillip CALP Board retains responsibility for the Port Phillip CALP Region.

Port Phillip

Vasey Houghton
Marshall Baillieu
Linda Bennison
Gordon Buller
Paul Crock
Ingrid Duncan
Tim Ealey
Mick Lumb
John Ower
Eric Sharkey
Alistair Urquhart
James Viggers
David Young

YARRA GLEN
BEACONSFIELD
MOOROODUC
WARBURTON
MELBOURNE
DARRAWIT GUIM
KANGAROO GROUND
MIDDLE PARK
MICKLEHAM
BACHUS MARSH
RICHMOND
YARRA GLEN
KEW

Mallee

Gerald Leach
Dorothy Brown
Rodney Hayden
Adrian Kidd
Barrie MacMillan
Steve Smith
Richard Wells
Reginald Wilkinson
Stan Pickering

Wimmera

Lance Netherway
Joan Bennett
Joanne Bourke
Lyle Driscoll
Ross Haby
Barry Hall
Colin Hall
Jim Kilpatrick
Ken Sleep

Glenelg

David Koch
Brian Learmonth
Michael Murphy
Lynn Murrell
Ian Ross
Basil Ryan
Bill Sharp
Richard Walter
Peter Dark

North Central

Drew English
John Brooke
David Clark
Ted Gretgrix
Goff Letts
Terry Simpson
Frank Smith
Mostyn Thompson
Gordon Weller

Corangamite

Robert Carrail
Claire Barber
Andrew Boyle
David Fiskin
Kevin Knight
John McDonald
Robert Missen
Harry Peeters
Cliff Tann

WALPEUP
UNDERBOOL
PIAGIL
MILDURA
MILDURA
MERBEIN
MERBEIN
YARRARA
MERBEIN

HORSHAM
NHILL
RUPANYUP
STAWELL
HORSHAM
EDENHOPE
STAWELL
GREAT WESTERN
JEPARIT

COLERAINE
COLERAINE
MORTLAKE
PORTLAND
TELANGATUK EAST
GRASMER
BRANXHOLME
HAMILTON
MIRANATWA

KERANG
PYRAMID HILL
WAUBRA
HUNTLY
VIA STAWELL
ST ARNAUD
SWAN HILL
WOODEND
TENNYSON

NEWTOWN
SHELFORD
MORIAC
BALLARAT
LINTON
WHEELERS HILL
BEEAC
BATESFORD
KAWARREN

Goulburn Broken

John Dainton
Huw Davies
Craig Madden
Athol McDonald
Dianne McPherson
Tom Perry
Peter Ryan
John Gray
Ailsa Fox

West Gippsland

Greg Pullen
Trevor Andrews
Barbara Fulton
Angus Hume
Ken Lamb
Gerard McRae
John O'Brien
Patrick O'Shaughnessy
Doug Treasure

North East

Ken Gaudion
Terry Hillman
Lindsay Jarvis
Mac Paton
Simon Penfold
Christine Prendergast
David Sexton
Noelene Wallace
Ken Whan

East Gippsland

Duncan Malcolm
Peter Allard
Marlene Battista
Shaun Beasley
Geoff Robertson
Geoff Russell
Chris Shearer
Doug Stevenson
Norman Wilkinson

MOOROPNA
YEA
AVENAL
GIRGARRE
ORRVALE
TATURA
DOOKIE COLLEGE
TOOLAMBA
MERTON

WARRAGUL
MORWELL
MAFFRA
LEONGATHA
HEYFIELD
MIDDLE TARWIN
COWWARR
CROYDON
STRATFORD

BOWEYA
LAVINGTON
KERGUNYAH
TALLANGATTA
MYRTLEFORD
BRIGHT
ALBURY
WODONGA
TAMINICK

BOISDALE
WAMGARABELL
LAKES ENTRANCE
STRATFORD
BAIRNSDALE
NICHOLSON
PAYNESVILLE
BAIRNSDALE
DARGO

Catchment Management Authorities, 1997



Catchment Communities

Overview

It is almost impossible to consider the condition of catchments without considering how people interact with them. People live, work and play within catchments, and the land and water resources within the catchment are utilised to the benefit of Victoria's economy. Just as the activities of people influence the condition of our catchments, catchment condition will influence the living standards of the Victorian community.

In this section we take a look at how our land and water resources are allocated to different uses, and what value of production is obtained from these uses. Population change and income distribution are also examined to provide some indication of the health of the communities within our catchments.

Finally, the growth of organised landcare type activities is examined, to give some indication of the level of community activities promoting healthier catchments.

Summary

- Agricultural land constitutes 57% of Victoria.
- Approximately 4,500,000ML of water was consumed in 1996
- Agricultural production is the largest natural resource based wealth generator with total value of production between \$330m and \$850m for most CALP Regions.
- All non metropolitan areas have lower than average real per capita income.
- Over 15 years, the average real per capita income for most non metropolitan regions has increased slightly.
- Since 1991, the population of Victoria has been increasing by an average of 0.63% per annum.
- In 1996, the population of Melbourne was 72% of the total Victorian population.
- Victoria has eleven regional centres with populations of greater than 20,000. All increased in population between 1991 and 1996, apart from those in the LaTrobe Valley.
- Victoria has seventeen regional centres with populations between 7,000 and 20,000. Of these, twelve recorded decreases in population between 1991 and 1996.
- Victoria has 862 Landcare or Landcare-type groups. In addition there are 268 Coastcare groups, 20 regional Landcare networks, ten farm forestry networks and 20 Salinity Management Plan implementation groups.



Catchment Communities

Land Use and Tenure

Water Use

Population, 1991 - 1996

Income and Value of Production

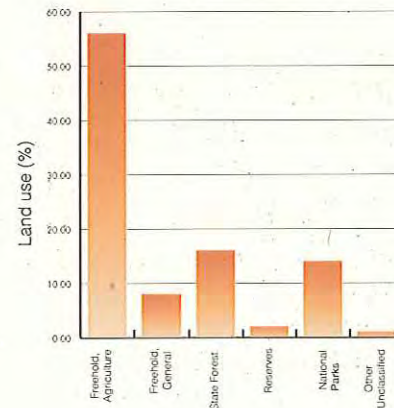
Landcare - type Groups, 1996

Land Use and Tenure

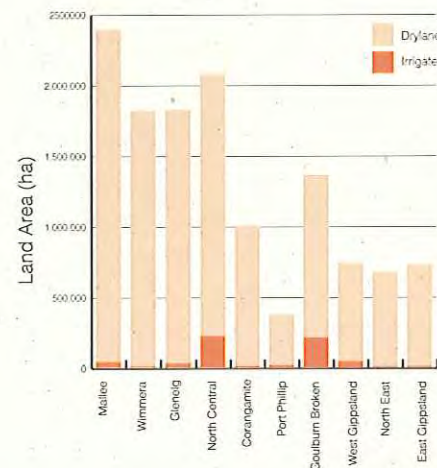
Background

An understanding of the use of the land, and the management practices within a land use category, provides valuable information about the reasons for change in the condition of our natural resources.

Victoria has a wide variety of land uses which place differing levels of human pressure on the environment. For example, land uses such as reserves and national parks have a low level of human pressure. Therefore change in the natural resource base is slow, being dictated by other pressures such as climate, fire and wildlife. Agricultural land use, on the other hand, places significant human pressure on the natural resource base which, in combination with climate, can lead to change in its condition.



Graph 2: Area of Land Use Types, 1993/94



Graph 3: Area of Dryland and Irrigated Agriculture, 1993/94

Results

- Approximately 34% of Victoria is public land comprising State Forest, National Parks and other reserves.
- Freehold agricultural land constitutes 57% of the state.
- The major agriculture type in Victoria is dryland farming constituting 95% of the agricultural land. All CALP Regions have irrigated agriculture, North Central and Goulburn Broken Regions having the highest area under irrigation.

- The major agricultural land use in all CALP Regions is pasture production. Pasture production includes dryland and irrigated pasture, and ancillary agricultural land uses such as laneways and buildings.
- Broadacre cropping is the second highest agricultural land use and is a significant industry in the Mallee, Wimmera and North Central CALP Regions.
- Horticulture is the smallest agricultural land use but constitutes 27,000 ha in the Mallee, 18,000 ha in Port Phillip and 13,000 ha in Goulburn Broken. All other CALP Regions have less than 5,000 ha of land under horticulture.

Map 2 shows the spatial distribution of land use in Victoria, at 1991.

Land Use Categories

The distribution of land uses in Victoria is broadly categorised as:

Freehold, agriculture

- Broadacre cropping and pasture
- Horticulture
- Pasture, irrigated
- Pasture, dryland

Freehold, general non-farmland

- Other private land including urban and rural residential and commercial lands, private softwood forestry and land managed by semi-government organisations such as water authorities.

State Forest, Reserves & National Parks

- Remnant native vegetation and public softwood forestry

Other unclassified

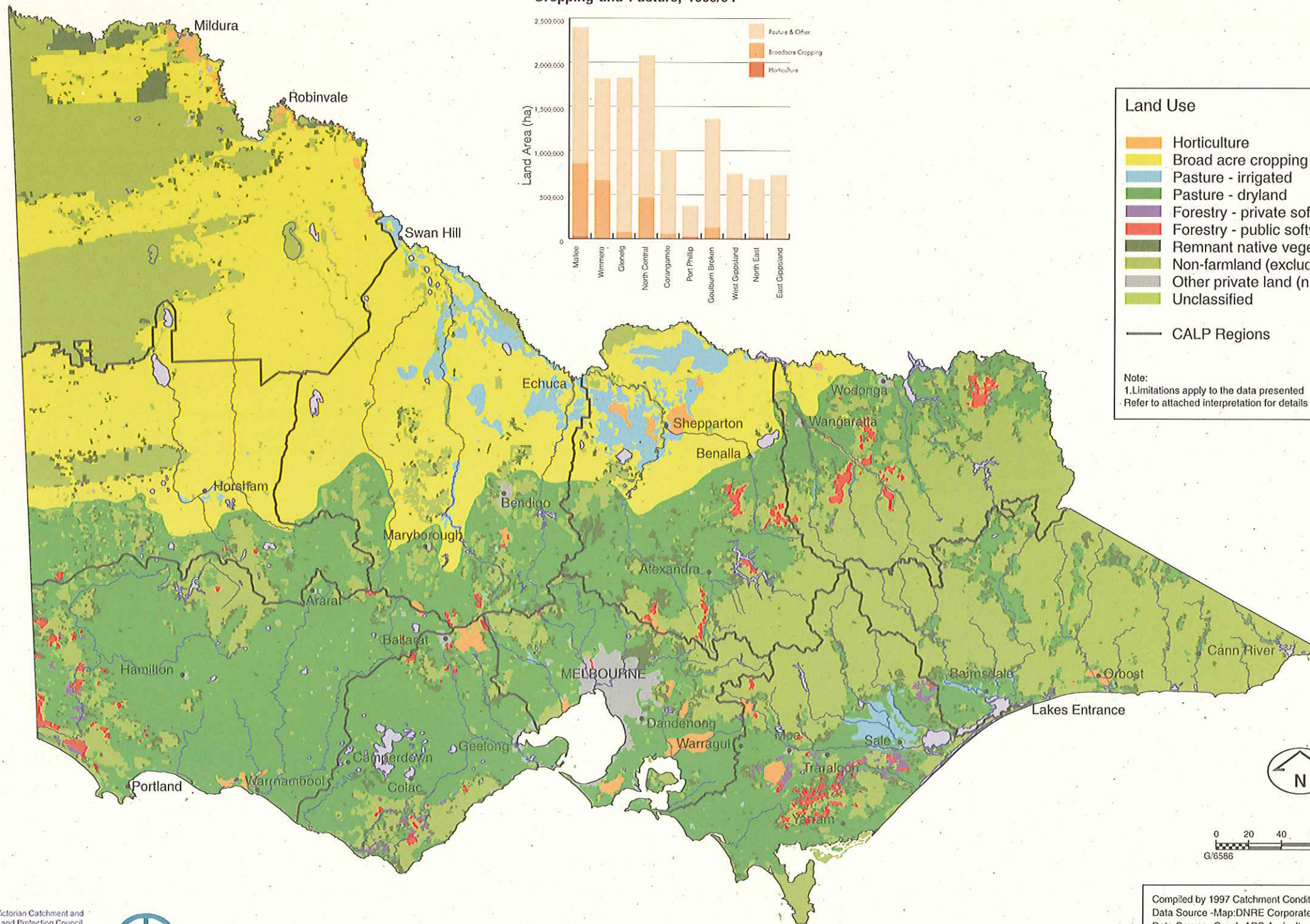
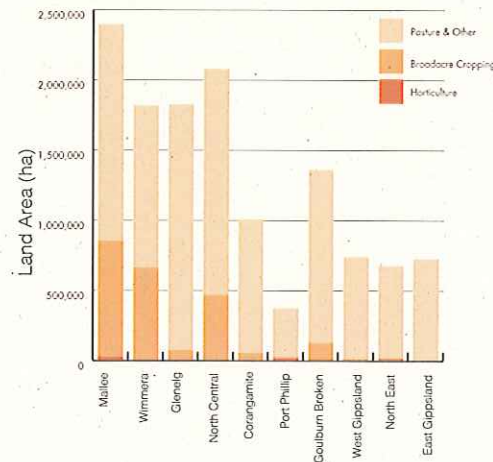
- Unclassified

Data Collection and Analysis

The land use data presents land use categories as determined from 1991 remote sensing data, sourced from the Land Management 100 layer of the DNRE corporate geospatial database. Agricultural land use has been sourced from the 1993/94 Australian Bureau of Statistics Agricultural Census.

Land Use and Tenure

Graph 1: Area of Horticulture, Broadacre Cropping and Pasture, 1993/94



Land Use

- Horticulture
- Broad acre cropping and crop pasture
- Pasture - irrigated
- Pasture - dryland
- Forestry - private softwood
- Forestry - public softwood
- Remnant native vegetation
- Non-farmland (excluding remnant vegetation)
- Other private land (non-farmland)
- Unclassified

— CALP Regions

Note:
1. Limitations apply to the data presented
Refer to attached interpretation for details



0 20 40 60 80 100
Kilometres
G/6586

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source - Map: DNRE Corporate Geospatial Data Library
Data Source - Graph: ABS Agricultural Census, 1993/94
September 1997

Map 2 Land Use



Natural Resources
and Environment

Victorian Catchment and
Land Protection Council



ENVIRONMENT
PROTECTION
AUTHORITY

Water Use

Background

Water is diverted from rivers and streams to provide for irrigation, stock, domestic, and industry use. These water users compete for the limited available resource, and with the requirement for stream flows to maintain environmental qualities.

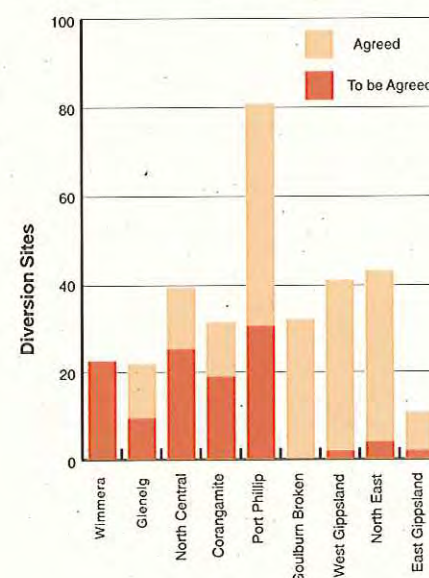
Environmental Flows

Environmental flows are allocated to maintain and improve the health of Victoria's rivers, streams and wetlands. These are currently being reviewed through the Bulk Entitlement Conversion Programme. This program is redefining access rights to water through bulk entitlements (BEs), capping further diversions of water and defining remaining water as environmental flows, for all diversion sites across the state. This process of review to negotiate and define bulk entitlements and environmental flows involves water users, environment groups and DNRE and is the first stage of the Environmental Flow Program.

Stage two will review rivers and diversions where additional efforts are required to ensure the long term sustainability of rivers.

The Bulk Entitlement Conversion Programme conforms with the objectives of the interim cap on diversions from the waterways of the Murray-Darling Basin. A final cap will be put in place following the establishment of bulk entitlements and stream flow management plans.

Graph 4: Environmental Flows Negotiated under the Bulk Entitlement (BE) Conversion Program, 1996-97



Maps 3 and 4 show annual water consumption (in megalitres) for Rural and Urban Water Authority regions, for 1996/97.

Data Limitations

Water consumption fluctuates each year as a result of climatic and other factors. Therefore 1996/97 consumption values provide a snapshot of approximate water use.

Data Collection and Analysis

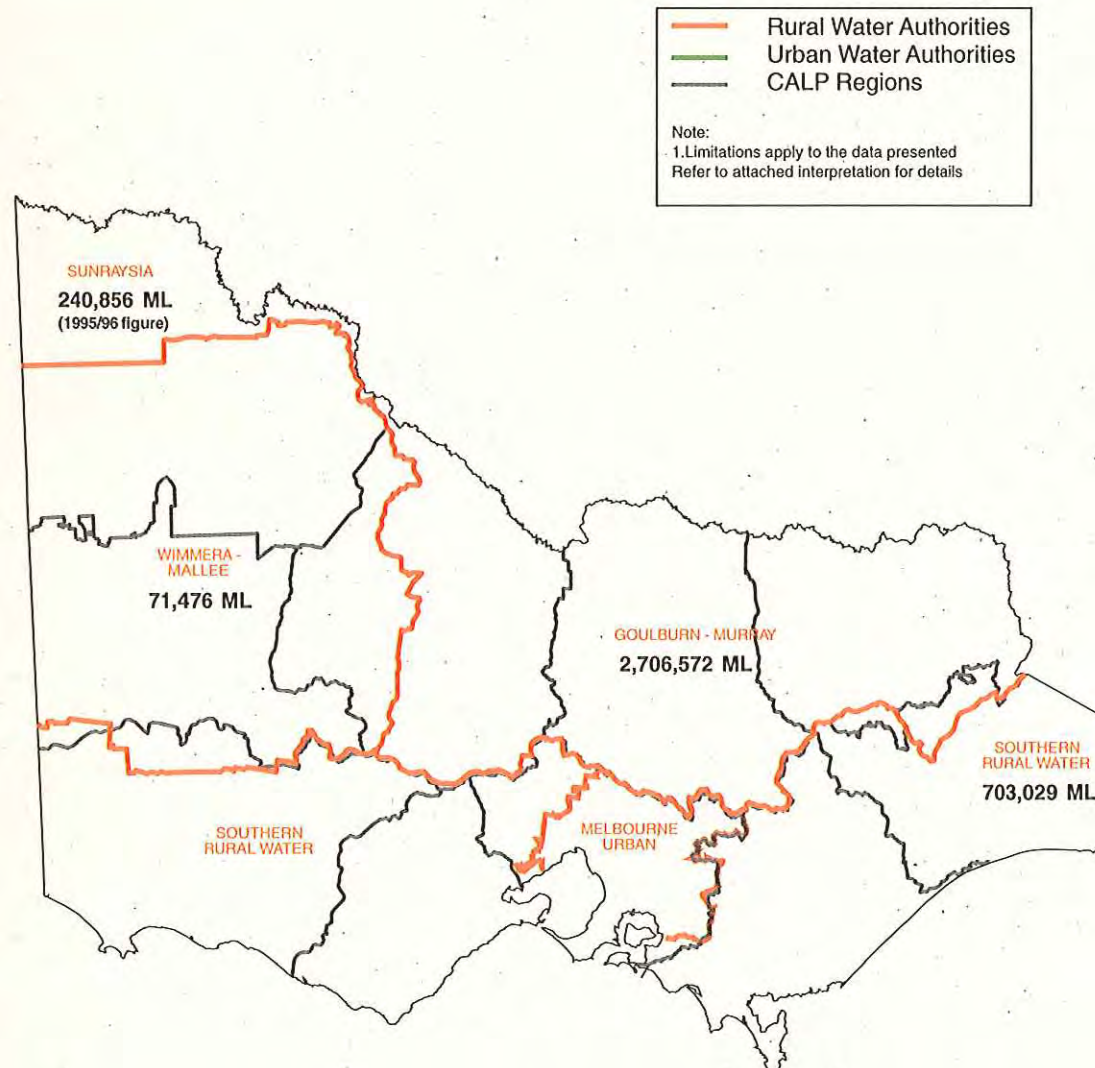
Information on water consumption was provided by each of the 20 Rural and Urban Water Authorities. All water managed and released by the water authorities was included in the consumption records.

The collection of data used in environmental flow negotiations was coordinated by the DNRE Catchment and Water Resources Branch.

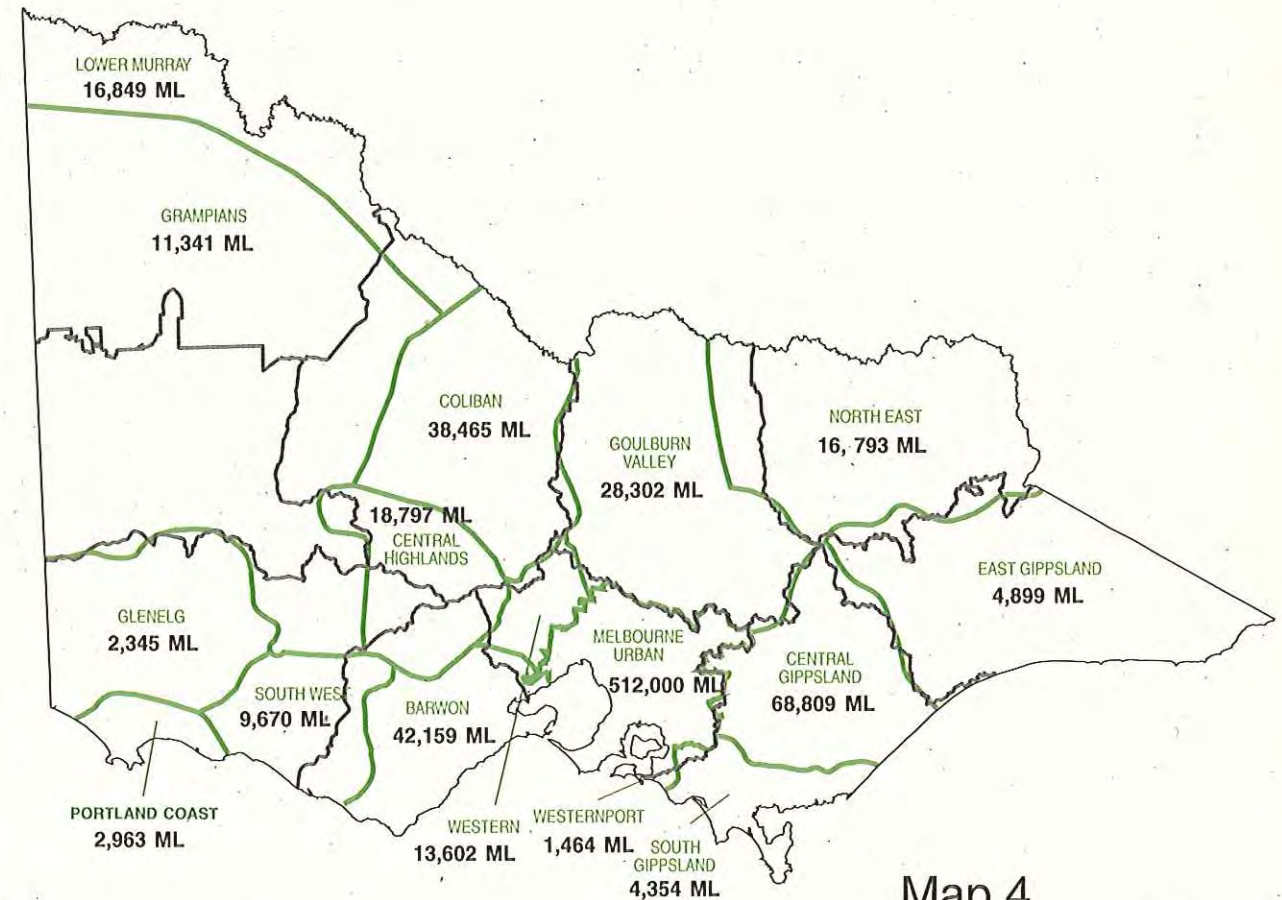
Results

- Total water consumption in 1996 is estimated at 4,472,000 megalitres (ML).
- Approximately 72% of water is used for irrigation purposes.
- The review and negotiation of bulk entitlements (BEs) and environmental water flows has commenced in all CALP Regions except the Wimmera. Negotiations in the Goulburn River are close to being completed.

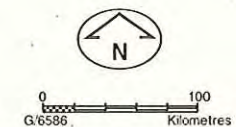
To date approximately 200 diversion sites have been reviewed. Of these reviews, 90% have resulted in some increase in environmental water flows. However, in many cases, further environmental flow increases are required. These will be negotiated under Stage 2 of the Environmental Flow Program.



Map 3
Water Use by Rural Water Authorities, 1996/97

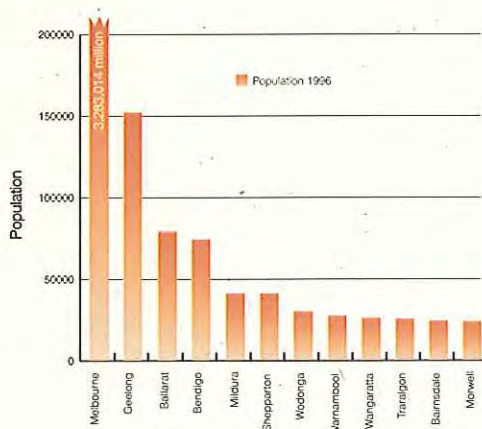


Map 4
Water Use by Urban Water Authorities, 1996/97

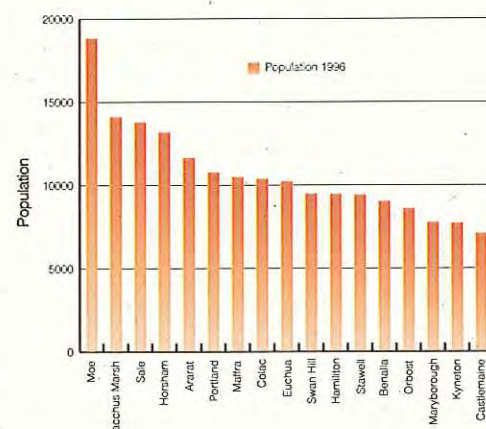


Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
 Data Source: Urban & Rural Water Authorities, 1997
 September 1997

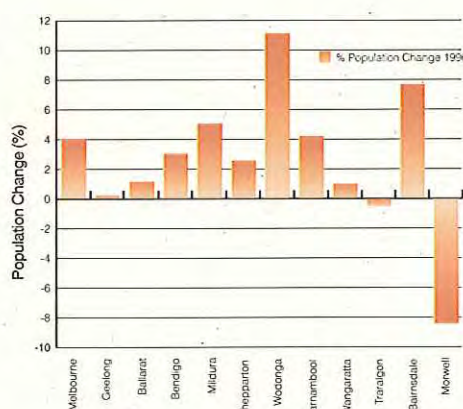
Population, 1991 - 1996



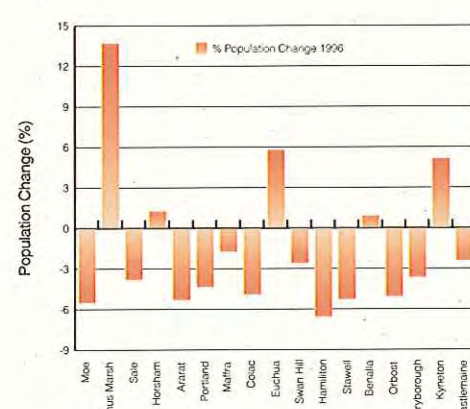
Graph 5: Population of Regional Centres > 20,000 People, 1996



Graph 7: Population of Regional Centres 7,000 to 20,000 People, 1996



Graph 6: Change in Population of Regional Centres > 20,000 People, 1991-96



Graph 8: Change in Population of Regional Centres 7,000 to 20,000 People, 1991-96

Results

Regionally: Victoria has eleven regional centres with populations of greater than 20,000 people, representing 12.3% of the population. All of these centres showed an increasing population trend between 1991 and 1996 except for Traralgon and Morwell. The decrease in population in Traralgon and Morwell are presumed to be linked to the restructuring of the electricity industry in the La Trobe Valley.

Seventeen regional centres have populations between 7,000 and 20,000 people, constituting 3.4% of the Victorian population. Of these, twelve centres showed a decreasing trend in population between 1991 and 1996. Centres with populations

between 7,000 - 20,000 that are within commuting distance of larger centres, provide other lifestyle benefits or have expanding industries, showed an increasing population trend. Bacchus Marsh, Kyneton, Echuca and Benalla are examples.

The changes experienced between 1991 and 1996 highlight the reduced role of smaller centres in servicing farming communities, in favour of larger regional centres. The maintenance of population is likely to remain a challenge for centres with populations of less than 15,000 people.

The remainder of Victorians (12.4%) live either in rural urban centres of less than 7,000 people, or away from urban centres.

Map 5 shows the change in population density (%) between 1991 and 1996, based on Statistical Local Areas.

Data Limitations

Regional centre populations are based on SLA divisions. For some of the smaller population centres, the area represented by an SLA may be greater than the town centre itself. However, it can be assumed that the demographic processes impacting on towns will be similar to the processes impacting on adjacent local areas.

Data Collection and Analysis

Data was collected and supplied by the Australian Bureau of Statistics from the 1991 and 1996 Census. Data presented is aggregated to Statistical Local Areas (SLA).

Results

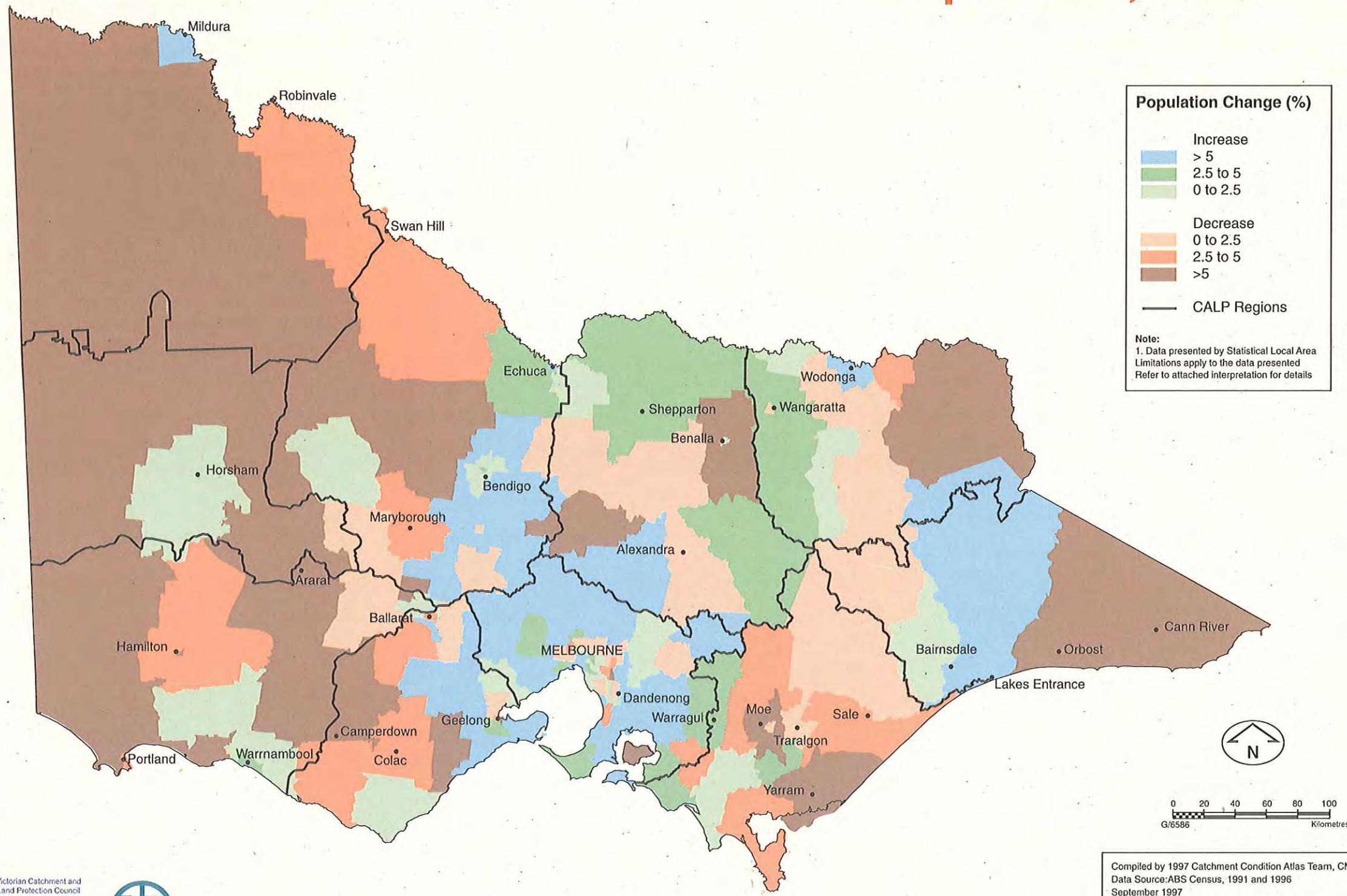
Statewide

- At June 30 1996, the population of Victoria was 4,560,817 with a density of 20 people per square kilometre. Between 1991 and 1996, the Victorian population increased from 4,420,373, a change of 3.2%, or 0.63% per year.
- The population of Melbourne at June 30 1996 was 3,283,014 or 72% of the Victorian population. Between 1991 and 1996, the population of Melbourne increased by 4% from 3,155,654.
- Significant growth areas include the greater Melbourne area, the Calder Highway corridor to Bendigo, Princes Highway corridors to Geelong and west/south Gippsland, central east Gippsland, Wodonga, Wangaratta, greater Shepparton area, greater Warrnambool and greater Mildura.
- Areas of significant population loss include much of western and north western Victoria, the La Trobe Valley and East Gippsland.
- Changes in agricultural production techniques and industry restructuring are driving much of the population change.

Contact

Hetty Verspay, Natural Resources Monitoring and Assessment, CMSA, DNRE

Population, 1991 - 1996



Map 5
Change in Population, 1991 - 96

Income

Background

Real per capita income provides an estimate of a wage earner's annual gross income adjusted for inflation, and allows a simple comparison of income across regions.

Income level has been shown to be highly correlated to human development factors, such as life expectancy, adult literacy, and education attainment, however other factors such as the availability of amenities and services which vary across the state are also important.

Data Collection and Analysis

Data was sourced from the Australian Bureau of Statistics Census for the periods 1976 - 1991. Data is based on 1986 Statistical Divisions. Income is reported as the respondents gross income before tax, falling into a particular income bracket.

Data Limitations

The results are limited by the accuracy and aggregation of the data. Changes in income level are affected by wage and employment levels, participation rates, extent of non-wage income, income from farm and unincorporated enterprises, imputed income from dwellings and demographic influences. These can vary across regions and over time and may not be accounted for.

Results

Excluding Melbourne, real per capita income is clustered between 75% and 95% of average state income, and regional incomes are becoming increasingly similar over time. All non metropolitan areas have lower than average real per capita income.

Over fifteen years, real per capita income has converged to the State mean for all except the North Mallee and Wimmera regions for which regional income has fallen slightly.

Value of Production

Background

Utilisation of our natural resources underpins Victoria's economy. To give an indication of the size of this contribution the value of production for the agricultural, forestry, fishery, manufacturing and tourism industries are reported below.

Results

Total value of production of agriculture varied between \$334m and \$854 million for most CALP Regions but was significantly lower for the Wimmera and North East CALP Regions.

Dairy products were attributed to the extensive industry and apart from the Mallee and Wimmera make up 30 - 60% of the value of extensive livestock products. Most CALP Regions derive between 10 - 20% value from intensive agriculture with the exceptions being the Mallee and the Port Phillip regions which receive more than 50% of agricultural income from intensive agriculture, and Glenelg receiving some 2% agricultural income from the intensive industries.

Food, beverage and tobacco manufacturing dominated manufacturing value of production in eight out of the ten rural Statistical Divisions (SDs). Food, beverage and tobacco manufacturing accounted for more than 60% of manufacturing turnover in the Mallee, Loddon-Campaspe, Goulburn and Gippsland divisions and for more than 40 % of turnover in the Western District, Central Highlands, Ovens-Murray and East Gippsland divisions. Machinery and equipment manufacturing also made a significant contribution to the Central Highlands division. Of the rural SDs, manufacturing turnover in the Mallee and East Gippsland is approximately one quarter of the manufacturing turnover in the other rural SDs.

Data Collection and Analysis

- Gross values of agricultural production are presented by CALP Region. These estimate the value of agricultural commodities at the farm gate. Gross value of production is divided into extensive (broadacre crops, sheep and cattle products) and intensive (poultry and pig products) agricultural industries.
- Fisheries value is based on the quantity of fish caught by port and the relevant Melbourne Wholesale Fish Market price. Annual values are based on monthly catch value by port of catch.
- Forestry values represent the 1996/97 extractions of hardwood forest products including sawlog, residual log, firewood and pulpwood, and are based on timber royalties and a levy.
- Estimated value of gold production for 1995/96 is used as an indicator of the mining industry. Gold value is as at June 1996.
- Manufacturing value is given by regional manufacturing turnover for 1993/94 and presented by Statistical Division.
- The value of tourism is estimated by expenditure on accommodation for 1995/96 and is presented by Statistical Division.

Data Limitations

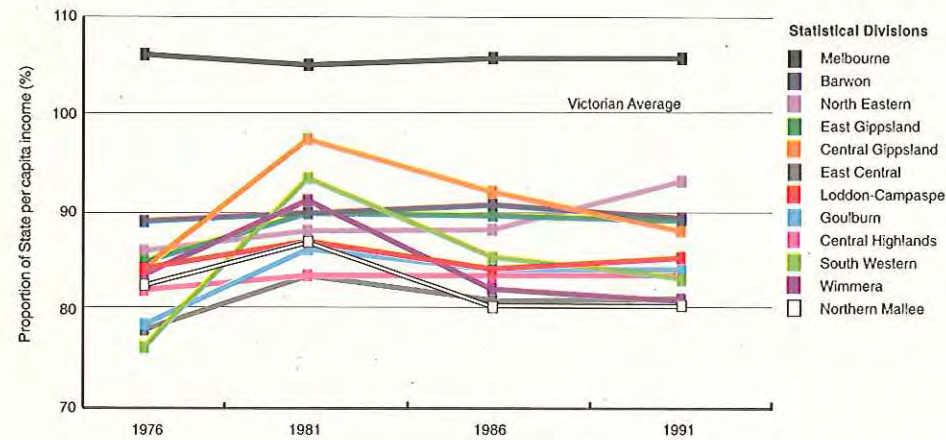
- The value of tourism to a region is underestimated as additional tourist expenditure and other non - market values the tourist places on the site visited are not included.
- All value of production estimates are indicative. Values cannot be compared across industries, only across regions within an industry. Conclusions on the relative importance of industries within a CALP Region cannot be drawn, nor conclusions concerning the value of a resource.

Contact

Hetty Verspay, Natural Resources Monitoring and Assessment, CMSA, DNRE

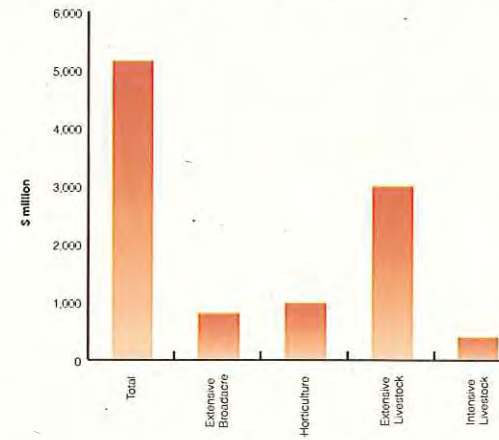
Income and Value of Production

Graph 9: Regional Per Capita Income as a Proportion of Victorian Average, 1976-91



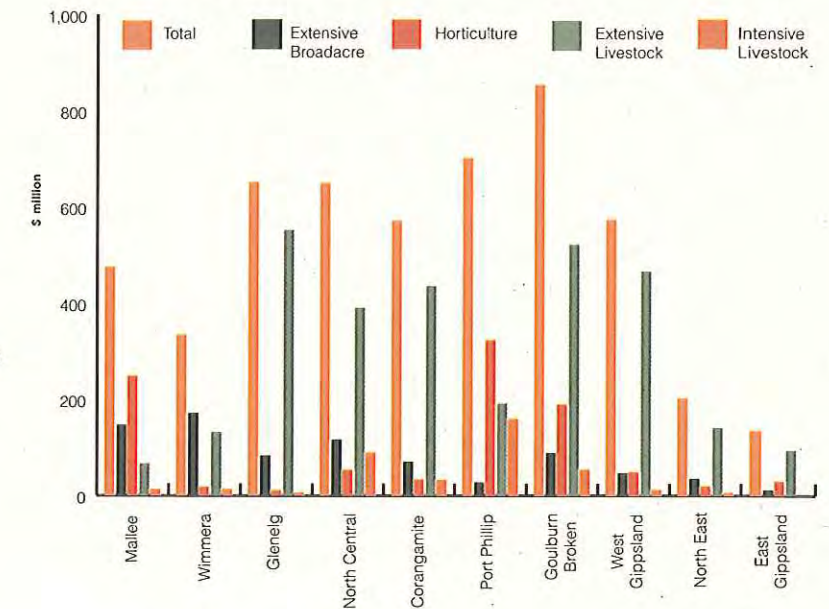
Source: Performance Evaluation Division, DNRE, 1997

Graph 11: Agricultural Gross Value Product, by Industry, 1994/95



Source: ABS Agricultural Census, 1994/95

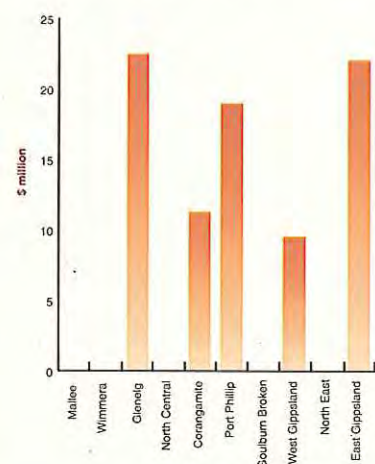
Graph 10: Agricultural Gross Value Product, by CALP Region, 1994/95



CALP Region

Source: ABS Agricultural Census, 1994/95

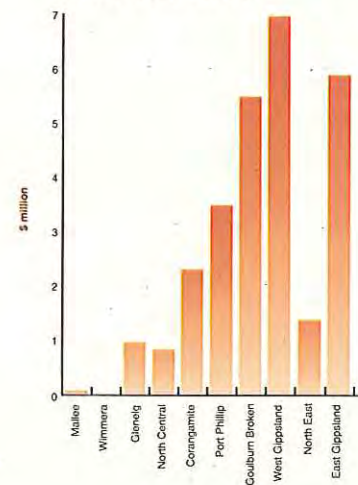
Graph 12: Fisheries - Value of Production, 1995/96



CALP Region

Source: DNRE, 1997

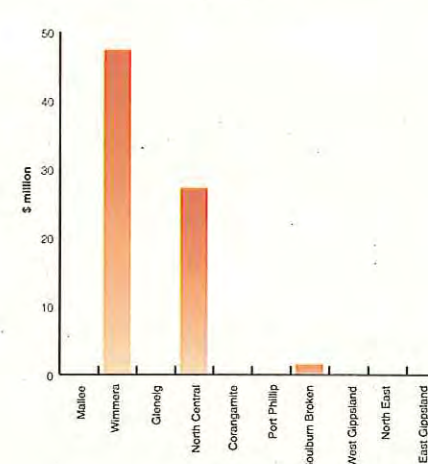
Graph 13: Forestry - Value of Production, 1996/97



CALP Region

Source: DNRE, 1997

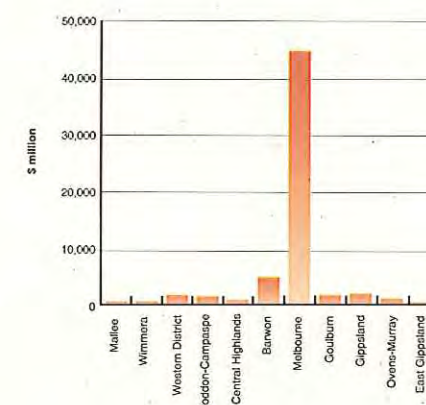
Graph 14: Gold Mining - Value of Production, 1995/96



CALP Region

Source: DNRE, 1997

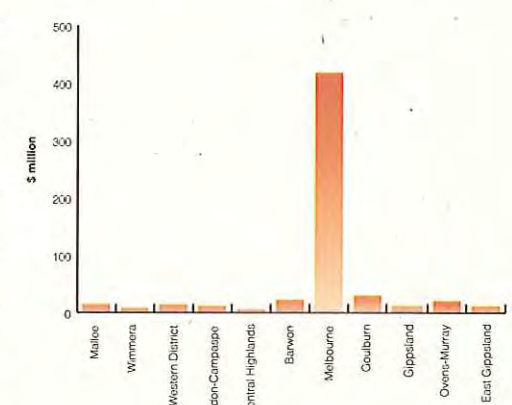
Graph 15: Manufacturing - Value of Production, 1993/94



Statistical Division

Source: ABS Manufacturing Census, 1993/94

Graph 16: Tourism - Expenditure on Accommodation, 1995/96



Statistical Division

Source: ABS Yearbook, 1997

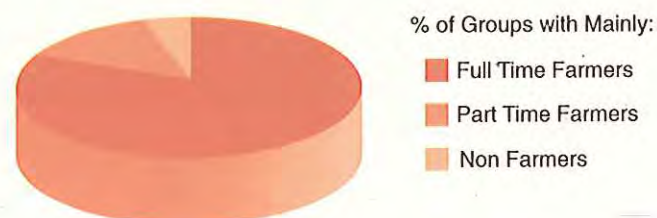
Landcare - type Groups

Background

Landcare is the essential ingredient in the successful management of our natural resource base both now and into the twenty-first century. The first official Landcare group to form in Australia was the Winjallock Landcare group, near St Arnaud in Victoria, on 25 November 1986.

Despite this many coordinators recognise that farmers have been doing Landcare type work for a much longer time. Landcare-type groups first appeared in the broad-acre area of the Wimmera and slowly spread eastward across the state.

Graph 18: Full Time and Part Time Farmers in Landcare-type Groups, 1996

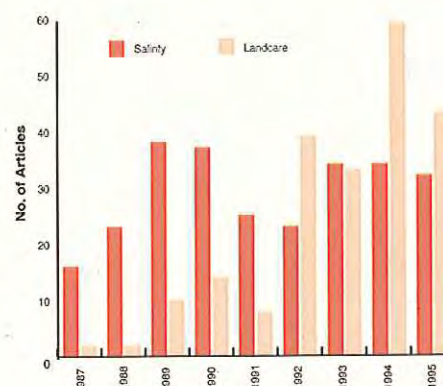


Results

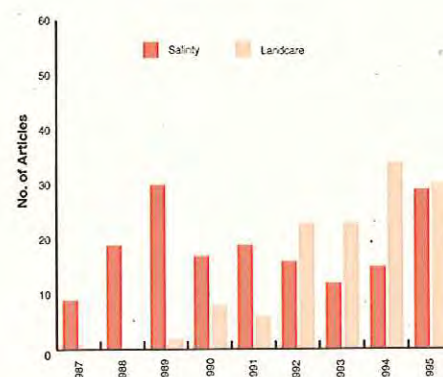
Victoria has 862 Landcare or Landcare-like groups supported by the Department of Natural Resources and Environment. There are also 268 Coastcare groups, 20 regional Landcare networks, ten farm forestry networks and 20 salinity management plan implementation groups.

There are 415 Landcare or Landcare-type groups south of the Great Divide and 439 in the north. The growth of Landcare has accelerated since the title "Decade of Landcare" was assigned to the 1990's and growth parallels the availability of funding through the National Landcare Program.

Official recognition of Landcare groups was given to those groups which voluntarily registered when the Victorian Government instituted the Landcare Program in 1986. With the attention given to Landcare issues and the increasing targeting of funding for natural resource management to group or



Graph 19: Salinity and Landcare Articles in Melbourne Major Daily Newspapers, 1987-95



Graph 20: Salinity and Landcare Articles in Sydney Major Daily Newspapers, 1987-95

collective approaches, Landcare continues to flourish despite the difficulties being faced by rural communities.

New groups are constantly forming and the activity level of established groups is high. With the nine new rural Catchment Management Authorities, established in July 1997, relying on the support of Landcare groups to implement Regional Catchment Strategies the future of Landcare group growth looks set to continue.

Monitoring the growth of Landcare or Landcare-type groups provides an important measure of the success of Landcare and the level of resourcing required to support Landcare.

Contact

Joanne Safstrom, Community Education and Customer Research, CMSA, DNRE

Map 6 shows the Density of Landcare - type Groups, by postcode area, in 1996.

Data Limitations

The data presented represents a limited overview of Landcare in Victoria.

- Due to the number of questionnaires not returned, the results are unsatisfactory for statistical purposes. At best, such data can only be used as a general indicator of what is happening, and should not be used for making predictions, or for the allocation of funds.
- Responses were completed by the Group Co-ordinator who, due to limited resources and available information, often may have had to rely on their own estimates.

Data Collection and Analysis

In 1996 a Landcare questionnaire was sent to all Victorian Landcare coordinators to gain a 'snapshot' of where Landcare groups are around the state, what they are doing, and what are their essential support needs.

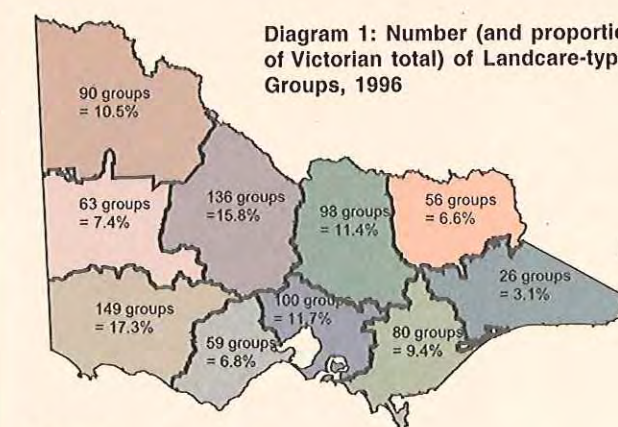
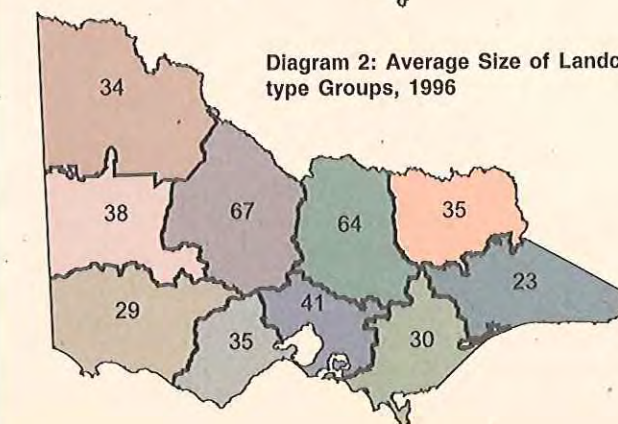
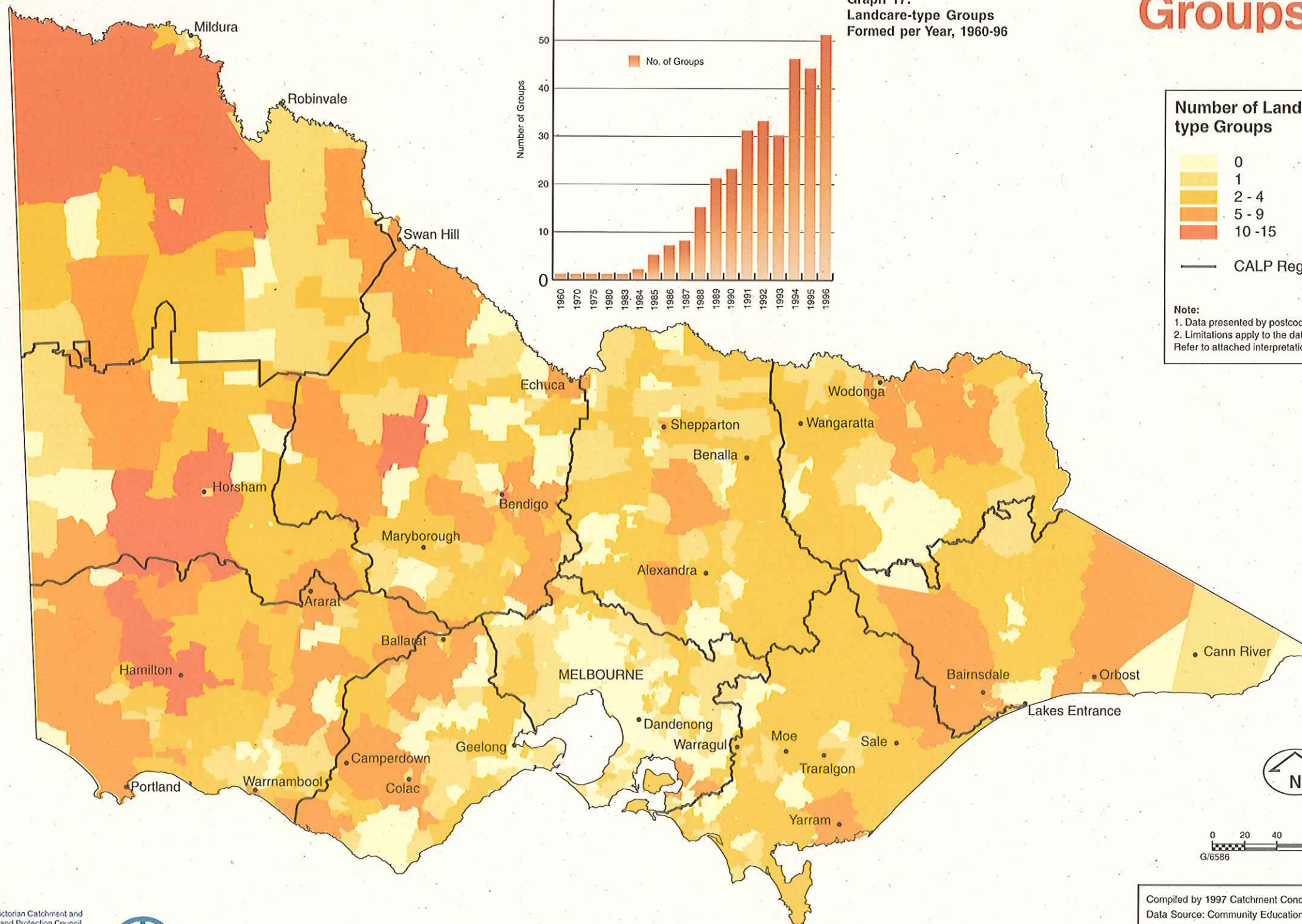


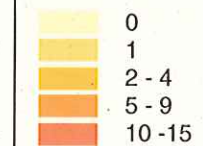
Diagram 2: Average Size of Landcare-type Groups, 1996



Landcare - type Groups, 1996



Number of Landcare - type Groups



— CALP Regions

Note:

1. Data presented by postcode
2. Limitations apply to the data presented. Refer to attached interpretation for details.

Map 6
Landcare - type Groups, by
Postcode Areas, 1996

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: Community Education and Customer Research, DNRE
September 1997

Soils

Overview

The soil underpins the productive potential of agriculture and forestry, and the health of vegetation and wildlife. Contrary to popular opinion, the agricultural soils of Victoria are generally highly productive under good management practices.

The change in land use from native vegetation to other uses such as agriculture has applied pressure to our soils. The result has been a modification of soil structure, nutrient balance and soil pH. The change in soil properties has resulted in soil structure decline, nutrient decline and changes in soil pH. In particular, agriculture has changed soil structure in such a way as to induce waterlogging, surface run-off, soil erosion, and decreased productivity of crops and pastures.

Improved management activities are being recommended to offset the detrimental changes in soil properties caused by past management. Activities such as stubble retention, improved soil tillage and decreased conventional fallowing are aimed at improving soil structure; fertiliser application to rectify nutrient imbalances; and lime to increase soil pH.

Summary

- In Victoria, approximately 12% of the agricultural land is alkaline (pH [water] of greater than 7.5), and 18% of the agricultural land is acid (pH [water] of less than 5.5).
- The majority of Victoria has, over the last twenty years, shown either no change in soil pH or an increasing trend in soil pH.
- Lime application is becoming well accepted as a management option within some agricultural industries with approximately 190,000 tonnes being applied in Victoria in 1994/95.
- The majority of Victoria has, over the last twenty years, shown either no change in soil potassium levels or an increasing trend.
- 78% of stubbles were retained following the 1994 cropping season.
- Approximately 35% of the cropped area was prepared using minimum tillage or direct drilling in the 1994/95 production year.



Soils

Change in Soil pH, 1973/83 - 1984/94

Lime Applied to Crops and Pastures, 1994/95

Change in Soil Fertility, 1973/83 - 1984/94

Soil Structure Decline, 1989 - 1994

Stubble Management, 1994/95

Soil Tillage Methods, 1994/95

Fallowing

Soil Erosion Awareness, 1988 - 1997

Change in Soil pH, 1973/83 - 1984/94

Background

Soil pH is a measure of the acidity or alkalinity of the soil and is measured on a logarithmic scale between 0 and 14; pH of 7 is neutral, less than 7 acid and greater than 7 alkaline.

Soil pH influences the availability of nutrients for plant growth, extremes of pH resulting in toxicities (e.g. aluminium in very acid soils) and deficiencies (e.g. zinc in very alkaline soils). Most plants show optimal growth in soil with a pH of between 6.0 and 7.5.

Results

In Victoria, approximately 1.6 million hectares of agricultural land have a pH of greater than 7.5 (alkaline) and 2.3 million hectares have a pH of less than 5.5 (acid). Soil pH is negatively correlated with annual rainfall ($r = -0.452$).

Mallee CALP Region

Soil pH has increased significantly over much of the Mallee between 1973/83 and 1984/94. The erosion of lighter textured topsoils (Calcareous Sands and Desert Sands Resource Management Units) and/or the cultivation and redistribution of highly alkaline soil materials from deeper in the soil profile to the topsoil may have resulted in the pH increase.

Wimmera CALP Region

Generally, soil pH has not changed significantly between 1973/83 and 1984/94, although soils have become more alkaline particularly in the Calcareous Sands and Desert Sands RMUs. The erosion of lighter textured topsoils of these RMUs and/or the cultivation and redistribution of highly alkaline soil materials from deeper in the soil profile to the topsoil may have resulted in the pH increase.

North Central CALP Region

Between 1973/83 and 1984/94, soil pH has increased significantly associated with the Calcareous Sands and Wimmera Plains RMUs. The erosion of lighter textured topsoils of these RMUs, and/or the cultivation and redistribution of highly alkaline soil materials from deeper in the soil profile to the topsoil may have resulted in the pH increase. The decrease in soil pH in the Bendigo area is likely to be associated with soil acidification. In the south of the Region, soil pH has increased as a result of lime applications associated with intensive cropping.

Natural soil pH (equivalent to pre-European settlement) varies across Victoria and is dependent upon soil forming factors such as parent materials, age of the soil, biological impacts and rainfall.

Reference

MacLaren, G.S., Crawford, D.M., Brown, A.J. and Maheswaran, J., (1996a), Temporal and Spatial Changes in Soil Chemistry across Victoria: (II) pH and Electrical Conductivity, In: *Proceedings of Australian and New Zealand National Soils Conference*, Vol. 3: 151-152, ASSSI, Melbourne.

Goulburn Broken CALP Region

Decreases in soil pH in the north of the Region are likely to be associated with soil acidification of dryland sub-clover based pastures, and the removal of alkaline nutrients in produce. Increases in soil pH in the Euroa and Benalla areas are likely to be associated with lime applications to ameliorate soil acidity.

North East CALP Region

Decreases in soil pH over time in the north of the Region are associated with soil acidification of dryland sub-clover based pastures. Soil pH is trending upwards as a result of lime applications associated with intensive agriculture along the north east river valleys.

Glenelg CALP Region

Decreases in pH across a significant area of the Region is associated with acidification under lower input grazing land use.

Corangamite CALP Region

Soil pH has shown a decreasing trend in areas south of Ballarat associated with sedimentary soils of the Hills Resource Management Unit with dryland grazing as the predominate land use.

Port Phillip CALP Region

Soil pH has shown an increasing trend in areas that support intensive agricultural enterprises eg Dandenong Ranges, Koo Wee Rup and Bacchus Marsh, as a result of lime applications.

West Gippsland CALP Region

Soil pH has shown an increasing trend associated with lime applications in the intensive cropping and dairying areas of the Strzelecki Ranges.

East Gippsland CALP Region

Soil pH across most of the Region has shown an increasing trend associated with lime applications to ameliorate soil acidity.

Map 7 shows average (mean) pH from 1973 to 1994. Significant changes in mean pH between 1973/83 and 1984/94, for each shire, are overlain.

Data Limitations

- The data does not include sub-surface soil pH values and does not include samples from virgin soils. As such, indications of sub-surface soil pH and of conditions prior to European settlement must be gained from other sources.
- There were few samples received from the north west of the state. As such, means and significant differences are less reliably estimated. However, results from this district are in accord with expectations based on experience.
- Despite the large number of samples, many samples were clumped around the same locations. Therefore only limited use should be made of the data at smaller scales than that presented.
- Local geographic variations in factors affecting soil acidity, fertility and structure can be hidden whenever large scale maps are used, and additional ground truthing may be necessary to define these variations.

Data Collection and Analysis

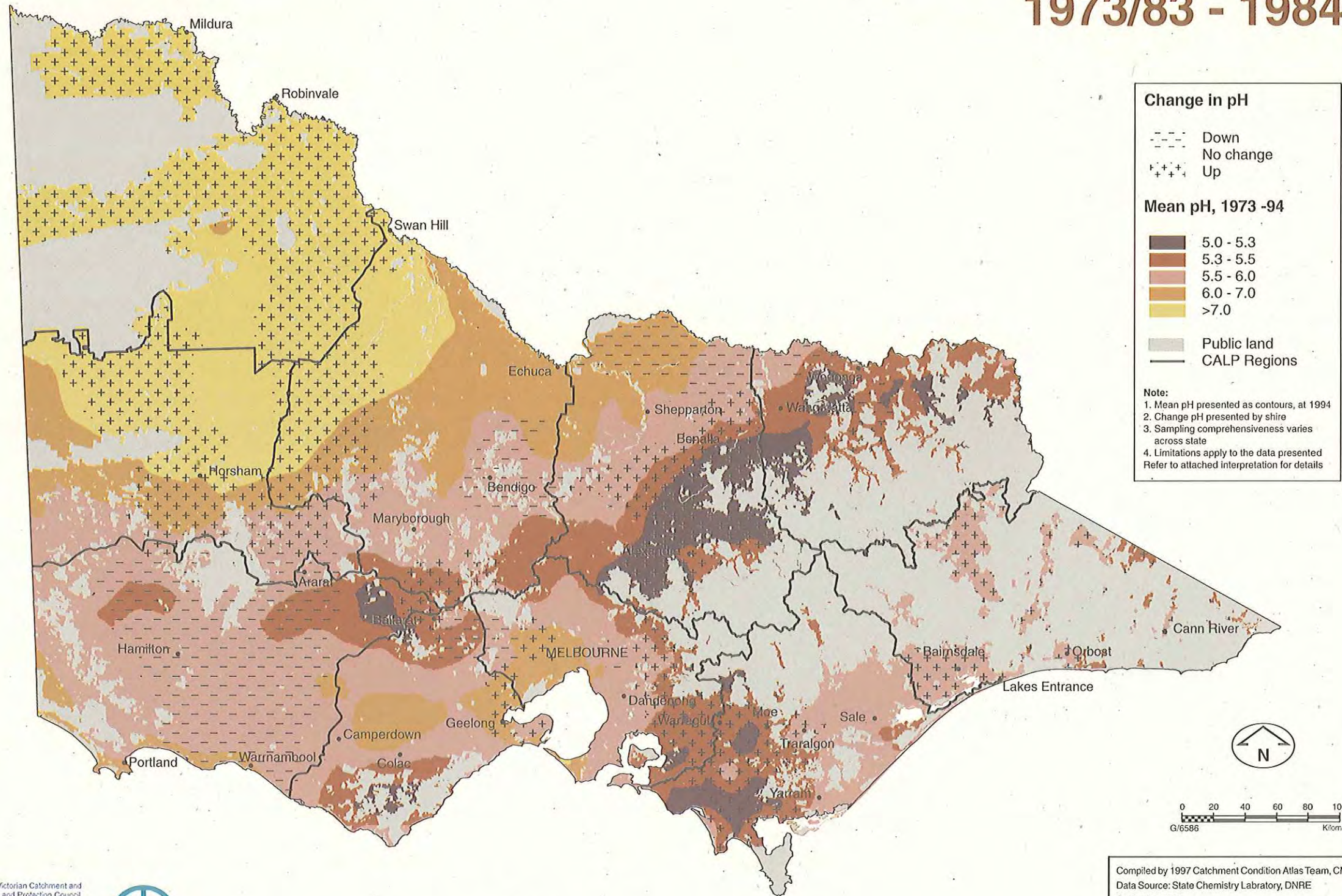
Soil samples from a range of sources were submitted to the State Chemistry Laboratory between 1973 and 1994. Approximately 76,000 soil samples representing the top 10 or 15 cm of soil were analysed.

Soil pH was measured using the 1:5 water method. The change in pH over time was estimated by dividing the data set into two - data collected between 1973-1983 and data collected between 1984-1994, based on the mean pH within local government shires (MacLaren et. al., 1996a). Significant differences between the means is at the 5% level ($P < 0.05$).

Contact

Doug Crawford, State Chemistry Laboratory, DNRE

Change in Soil pH, 1973/83 - 1984/94



Map 7
Soil pH, 1973/94, showing change in
Soil pH, 1973/83 - 1984/94

Lime Applied to Crops and Pastures, 1994/95

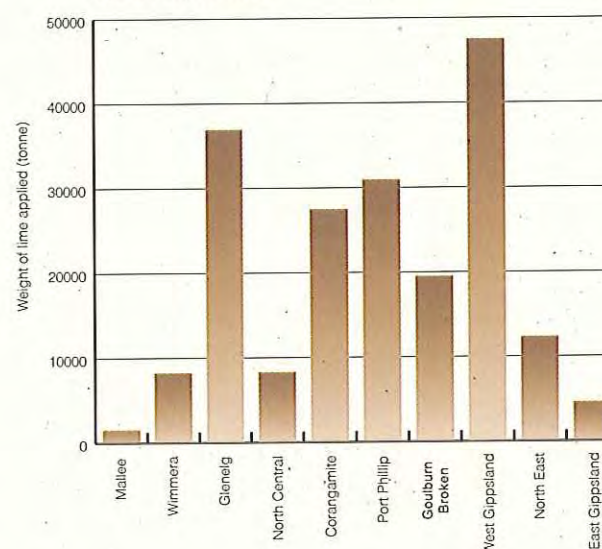
Background

By measuring the adoption of the sustainable agricultural practices that have been advocated by the many planning and implementation groups in Victoria, it is possible to gain considerable knowledge of how landholders are succeeding in managing the land sustainably.

Soil acidification is associated with productive pastures and crops on soils that are characteristically acidic. In Victoria, it is estimated that 3 million hectares of land used for agriculture are naturally acidic and these are in the high rainfall (>600mm/year) grazing and cropping land.

One of the most effective and practical long term solutions to soil acidity problems is to return the soil to, and maintain, a desirable pH by liming the soil. The application of lime is recommended where soil pH is below 4.5, although where acid-sensitive species, such as lucerne, are grown, liming is recommended at a higher pH level.

Graph 21: Lime Applied to Crops and Pastures, 1994/95



Map 8 shows the weight of Lime Applied to Crops and Pastures in 1994/95, for each parish across Victoria.

Data Limitations

- The use of a single years data to draw conclusions about the adoption practices of farmers should be treated with caution.
- The 1995/96 ABS Agricultural Census contains data on the the area and weight of lime applied to correct or stabilise soil acidity. This data was not available at the time of preparing this report.

Data Collection and Analysis

The Australian Bureau of Statistics (ABS) Agricultural Census is distributed annually to all Australian landholders whose businesses meet a minimum gross income criterion. Individual forms remain confidential to the ABS. Statistics are supplied to DNRE only as aggregated data for parishes.

Results

Goulburn Broken, North East and West Gippsland CALP Regions

The greatest use of lime, associated with intensive land uses such as dairy and horticulture.

Glenelg and Corangamite CALP Regions

Considerable amounts of lime applied in the south of these Regions, associated with dairy production.

Glenelg, West Gippsland and Port Phillip CALP Regions

Heavy users of lime on acid soils.

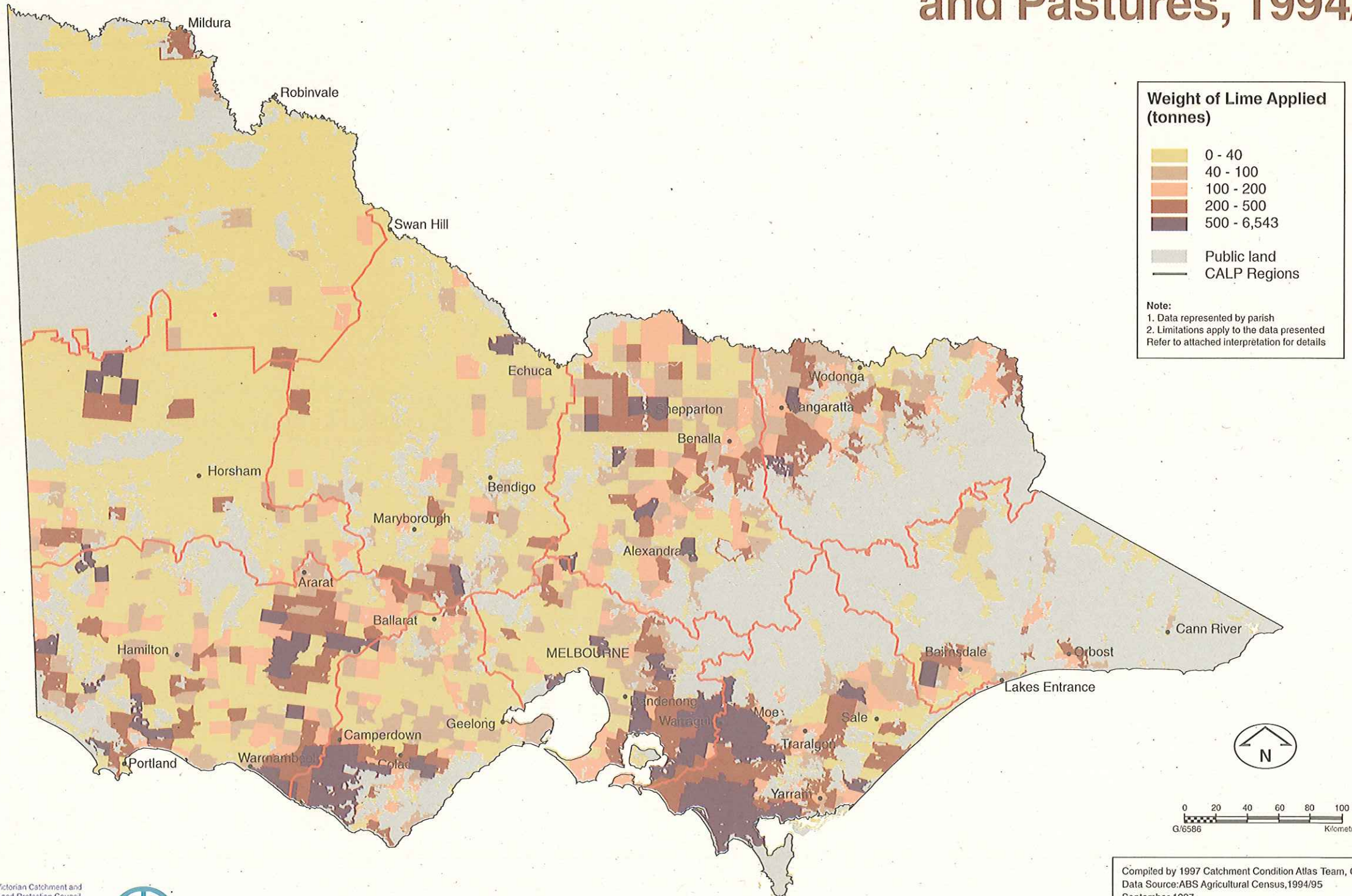
Mallee CALP Region

The least amount of lime applied during 1994/95, due to the absence of a significant soil acidity problem.

Contact

Jodie Cray, Natural Resource Monitoring and Assessment, CMSA, DNRE, Bendigo

Lime Applied to Crops and Pastures, 1994/95



Map 8
Lime Applied to Crops and Pastures,
by Parish, 1994/95

Change in Soil Fertility, 1973/83 - 1984/94

Background

Agriculture, horticulture and forestry utilise soil nutrients for plant growth, some of which are exported in produce. Sustained production requires the regular replacement of macro-nutrients through either fertiliser application, nitrogen fixation by legumes or from the atmosphere.

Phosphorus and potassium are two main macro-nutrients often deficient in Victorian soils. Measurements of available phosphorus and available potassium are indicative of the amount of the nutrient that plants can utilise. Additional nutrient will be bound tightly to soil particles and be unavailable to plants. Available phosphorus and available potassium provide an indication of crop and pasture response to fertiliser.

Reference

MacLaren, G.S., Crawford, D.M., Brown, A.J. and Maheswaran, J., (1996b), Temporal and Spatial Changes in Soil Chemistry across Victoria: (I) Available Potassium and Phosphorus, In: *Proceedings of Australian and New Zealand National Soils Conference*, Vol. 3: 149-150, ASSI, Melbourne.

Results

Available Phosphorus

- Generally across the state, the area of soils deficient in available phosphorus increased gradually from the mid 1970s to the late 1980s, but appears to be declining in later years. This change in available phosphorus levels is likely to be associated with the removal of the superphosphate bounty and changing economic circumstances.
- Available phosphorus decreased significantly in the grazing areas of the North East and East Gippsland, mixed farming areas of central Victoria and cropping areas of the central Wimmera and northern Mallee. The effect of the net decrease in available phosphorus on productivity is unknown.
- Significant increases in available phosphorus are associated with areas of intensive agriculture. In these industries, returns have been sufficiently high to support an improvement in soil phosphorus levels.
- The broadacre cropping areas of the north west, and grazing areas of the south west have shown no change in soil available phosphorus indicating a balance between nutrient exports in produce and superphosphate application.

Available Potassium

- In many parts of Victoria available potassium has increased significantly over the period 1973/83 to 1984/94, probably as a result of fertiliser programs.
- Increases in the north west, where potassium fertilisers are seldom used, are difficult to explain but may be associated with rising saline watertables, containing potassium salts.
- The proportion of soil samples with a deficient concentration of available potassium (<80 mg kg) has steadily decreased from 24% in 1973 to 6% in 1994.
- The intensive horticultural areas of northern Victoria show no trend in available potassium indicating that supplementary applications are balancing the potassium removed in produce.

Map 9 shows average (mean) Soil Potassium Fertility, from 1973 to 1994. Change in Fertility between 1973/83 and 1984/94, for each shire, is overlain.

Map 10 shows average (mean) Soil Phosphorus Fertility, from 1973 to 1994. Change in Fertility between 1973/83 and 1984/94, for each shire, is overlain.

Data Limitations

- There were few samples received from north-western Victoria. As such, means and significant differences are less reliably estimated. However, results from this district are in accord with expectations based on experience.
- Despite the large number of samples, many samples were clumped around the same locations. Therefore only limited use should be made of the data at smaller scales than that presented.
- Local geographic variations in factors affecting soil acidity, fertility and structure can be hidden whenever large scale maps are used, and additional ground truthing may be necessary to define these variations.

Data Collection and Analysis

Soil samples from a range of sources were submitted to the State Chemistry Laboratory between 1973 and 1994. Approximately 76,000 soil samples representing the top 10 or 15 cm of soil were analysed.

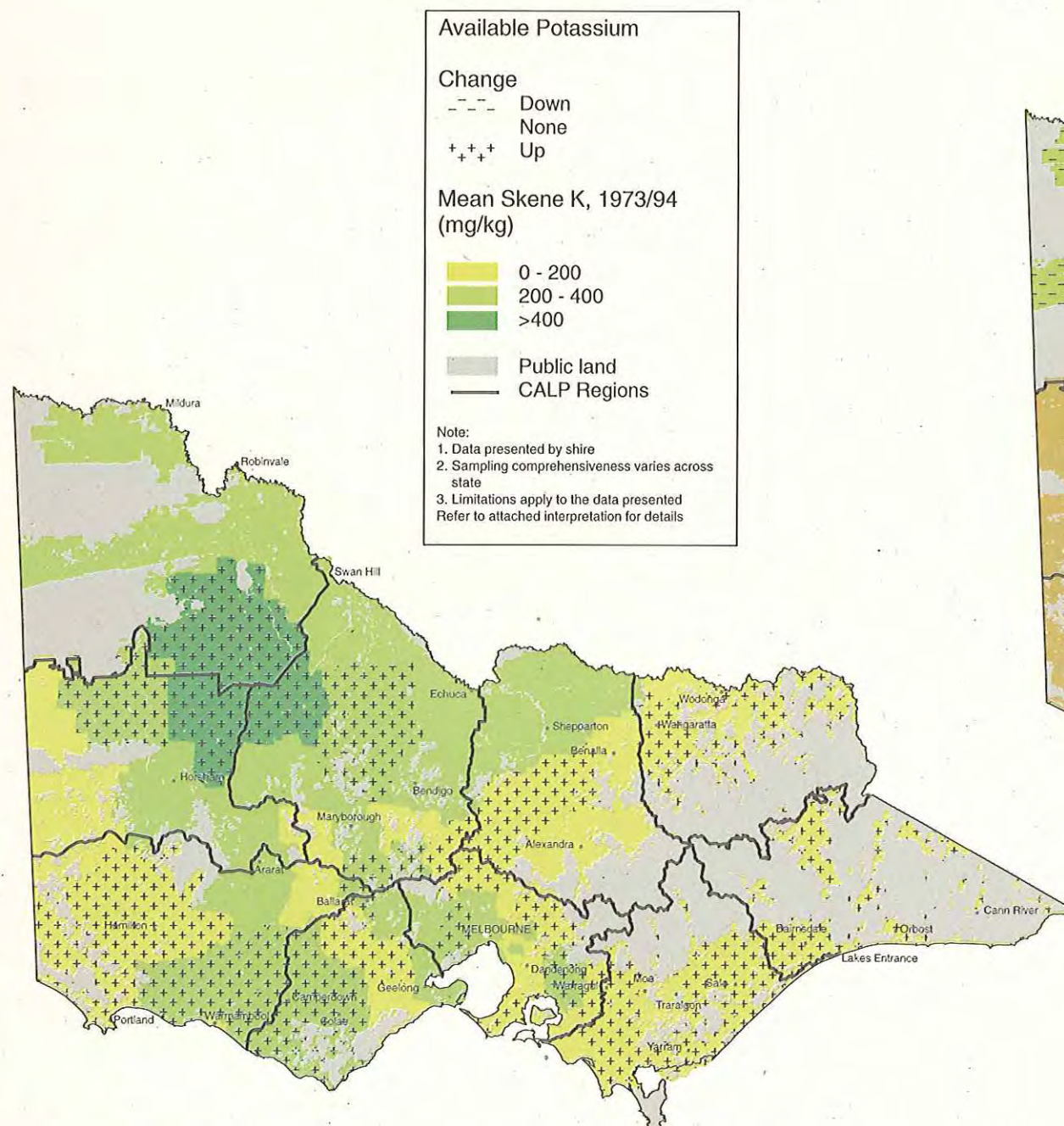
Olsen P and Skene K tests were used to measure available phosphorus and potassium respectively. Spatial trends and temporal trends in Olsen P and Skene K were developed based on means of test results within local government shires.

The change in Olsen P and Skene K over time was estimated by dividing the data set into two - data collected between 1973-1983 and data collected between 1984-1994 (MacLaren et al., 1996b). Significant differences between the means is at the 5% level ($P < 0.05$).

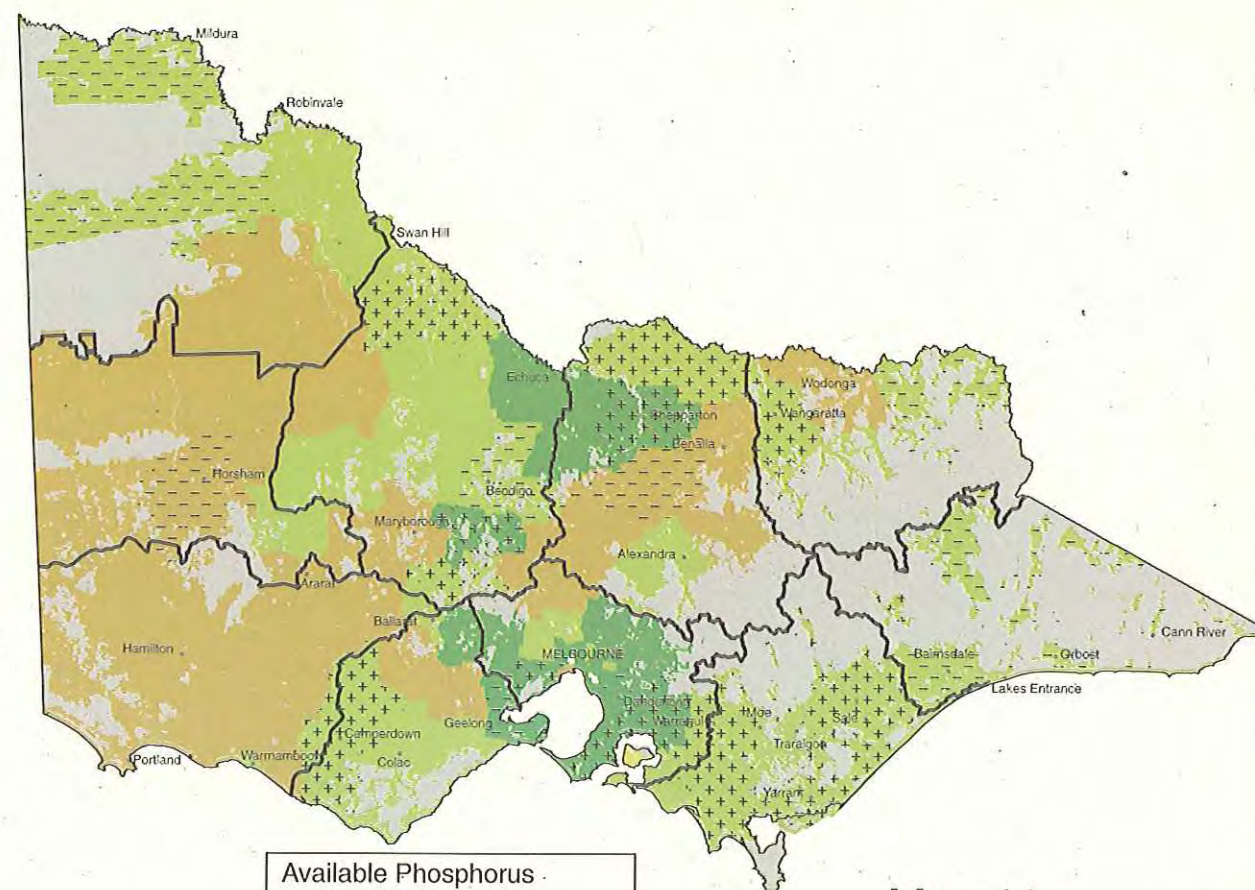
Contact

Doug Crawford, State Chemistry Laboratory, DNRE

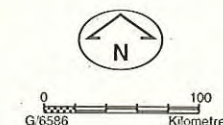
Change in Soil Fertility, 1973/83 - 1984/94



Map 9
 Soil Potassium Fertility,
 1973/94, showing Change in
 Fertility, 1973/83 - 1984/94



Map 10
 Soil Phosphorus Fertility,
 1973/94, showing Change in
 Fertility, 1973/83 - 1984/94



Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
 Data Source: State Chemistry Laboratory, DNRE
 September 1997



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Soil Structure Decline, 1989 - 1994

Background

Soil structure relates to the porosity of the soil. Structure influences the movement of water into and through the soil, exchange of gases between the soil and the atmosphere, and the ease of plant root growth.

Soil structure is based on aggregation of soil particles and the pores between the aggregates. Aggregates can become unstable when wet.

Slaking and dispersion are two indicators of the stability of soil aggregates.



Dispersion is a chemical process in which clay particles repel each other under moist and wet conditions. The result is a decrease in the aggregation of the soil. Sodic soils, soils with low calcium to magnesium ratios, or swelling clays often disperse.

Slaking is a physical process in which soil aggregates disintegrate into smaller aggregates when wet. Slaking often indicates there is insufficient organic matter to hold the aggregate together and is often associated with hardsetting soils.

Results

Mallee CALP Region

Although the lighter textured soils of the Mallee slake or generally slake, the coarse texture of the soils makes slaking a minor soil structure issue. The heavier textured soils of the southern Mallee, and swales in the central and northern Mallee slake when wet.

Wimmera CALP Region

The Wimmera is dominated by clay soils that are unstable and slake when wet, but are generally not dispersive which is associated with the alkalinity of the soil. The Upper Wimmera River catchment area comprises soils formed from sediments and tend to be generally stable (little slaking), although dispersion is a problem.

Glenelg CALP Region

The majority of soils in this Region have moderate soil structure showing slaking but are generally not dispersive. Areas of dispersive soils are found in the Dundas Tablelands and in other areas with soils derived from Tertiary Period deposits.

North Central, Goulburn and North East CALP Regions

The medium to heavy soils of the Riverine Plain have a high inherent hazard of soil structure decline and generally slake and generally disperse. The sedimentary soils of the footslopes and hills of the Divide generally do not slake. Of those that do slake, dispersion is a problem that has resulted in significant erosion in the past. The Basalt soils in the upper reaches of the North Central CALP Region generally slake, however are much less dispersive than the sedimentary soils.

Corangamite CALP Region

The sedimentary soils of the uplands generally do not slake. Of those that do slake, dispersion is a problem that has resulted in significant erosion in the past. The Basalt soils in the upper reaches of the Region generally slake but are less dispersive than the sedimentary soils. The soils of the Otway Ranges have good soil structure.

Port Phillip CALP Region

In the north west of the Region, soils formed on sediments generally do not slake. Of those that do slake, dispersion can be a problem. The remainder of the Region has soils that are generally not dispersive.

West Gippsland CALP Region

The soils of this region are moderately well structured. The Friable Earths Resource Management Unit in the west of the Region are known for their soil structure resilience, and support intensive cultivation based agriculture although will slake following excessive cultivation or poor management. Areas of generally dispersive soils occur in sedimentary soils to the north east of Traralgon. The coastal areas have well structured soil.

East Gippsland CALP Region

The soils of this Region are moderately well structured showing little or no slaking and little or no dispersion. Areas of dispersive soils do occur in some of the upland areas which has resulted in erosion in the past.

Map 11 shows average (mean) Soil Aggregate Slaking and Dispersion, from 1989 to 1994, based on geomorphic units.

Data Limitations

- The data was grouped according to geomorphic units. Thus some areas that have soil structure problems will not be represented as discrete units.
- The data does not include an assessment of sub-surface structure and does not include samples from virgin soils.
- There were few samples received from the north west of the state. As such means and significant differences are less reliably estimated. However, results from this district are in accord with expectations based on experience.
- Despite the large number of samples, many samples were clumped around the same locations. Therefore only limited use should be made of the data at smaller scales than that presented.
- Local geographic variations in factors affecting soil acidity, fertility and structure can be hidden whenever large scale maps are used, and additional ground truthing may be necessary to define these variations.

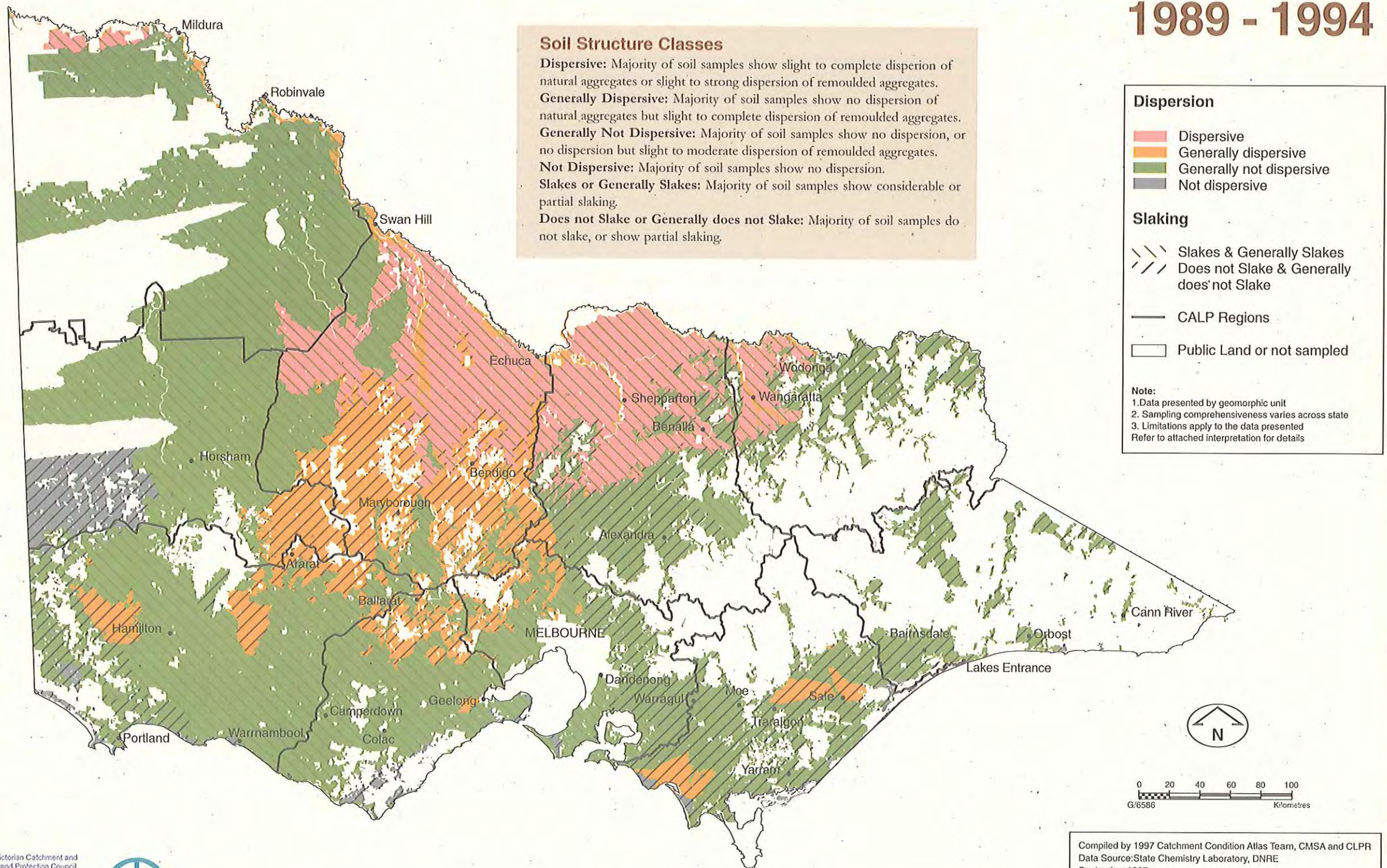
Data Collection and Analysis

Soil samples from a range of sources were submitted to the State Chemistry Laboratory between 1989 and 1994. Samples were grouped according to geomorphic units. Approximately 8,000 soil samples representing the top 10 or 15 cm of soil were analysed.

Contact

Doug Crawford, State Chemistry Laboratory, DNRE

Soil Structure Decline, 1989 - 1994



Map 11
Soil Structure - Aggregate Slaking and
Dispersion, 1989 -1994

Stubble Management, 1994/95

Background

The term stubble retention encompasses a number of stubble management practices with the common aim of converting crop stubble residue to soil organic matter and reducing the risk of soil erosion. These practices include stubble incorporation, stubble mulching and sowing crops directly into standing stubble. Burning stubble is by far the most common means of removing stubble organic matter from the farm ecosystem. The total removal or burning of stubble can be a major contributor to soil degradation, particularly soil erosion.

Table 1: Area and Farmers with Various Stubble Management Practices, 1994/95

CALP Region	Burn		Incorporated		Mulched		Left standing	
	% area	% farmers	% area	% farmers	% area	% farmers	% area	% farmers
Mallee	10	18	50	44	10	13	30	25
Wimmera	29	37	24	20	19	21	28	22
Glenelg	60	50	15	20	4	6	22	24
North Central	21	29	37	33	8	10	34	28
Corangamite	37	37	29	34	10	9	24	20
Goulburn Broken	37	38	27	30	5	5	32	27
North East	34	28	14	35	3	5	50	32
East Gippsland	31	14	39	48	2	14	27	24
West Gippsland	16	8	67	71	6	7	12	14
Port Phillip	10	11	63	59	5	11	23	19
Total	22	33	36	30	12	12	30	25

Source: ABS Agricultural Census, 1994/95

Results

Low rates of stubble retention outside the Mallee are due to the perception that large investments in different sowing machinery are required for land conservation practices.

Mallee CALP Region

The highest rate of stubble retention. This is due to the high risk of erosion in poor seasons and the difficulties of eliminating cultivation from the cropping systems.

Glenelg and Corangamite CALP Regions

Stubble burning is most common in these Regions. Here there is not only a higher stubble burden from cropping, but also less commitment associated with investment in conservation cropping technology.

Wimmera, North Central and North East CALP Regions

The higher rainfall and subsequent higher stubble burden make the option of stubble retention less manageable. Stubble burning is also high in these Regions.

Map 12 shows the area of Stubble Burnt in 1994/95, for each parish across Victoria.

Data Limitations

- The use of a single years data to draw conclusions about the adoption practices of farmers should be treated with caution.
- Although the actual response rate cannot be calculated for the stubble management question in the 1994/95 Census, only 60 per cent of cropping farmers responded to the cultivation question in the same Census. It is likely that a similar number of cropping farmers responded to the stubble management question.
- There is evidence that the response rate is biased in favour of stubble retention.

Data Collection and Analysis

The Australian Bureau of Statistics (ABS) Agricultural Census is distributed annually to all Australian landholders whose businesses meet a minimum gross income criterion. Individual forms remain confidential to the ABS. Statistics are supplied to DNRE only as aggregated data for parishes.

Two measures of adoption are used:

Area adoption

The reported area of each form of stubble management as a percentage of the total area of stubble management reported.

Farmer adoption

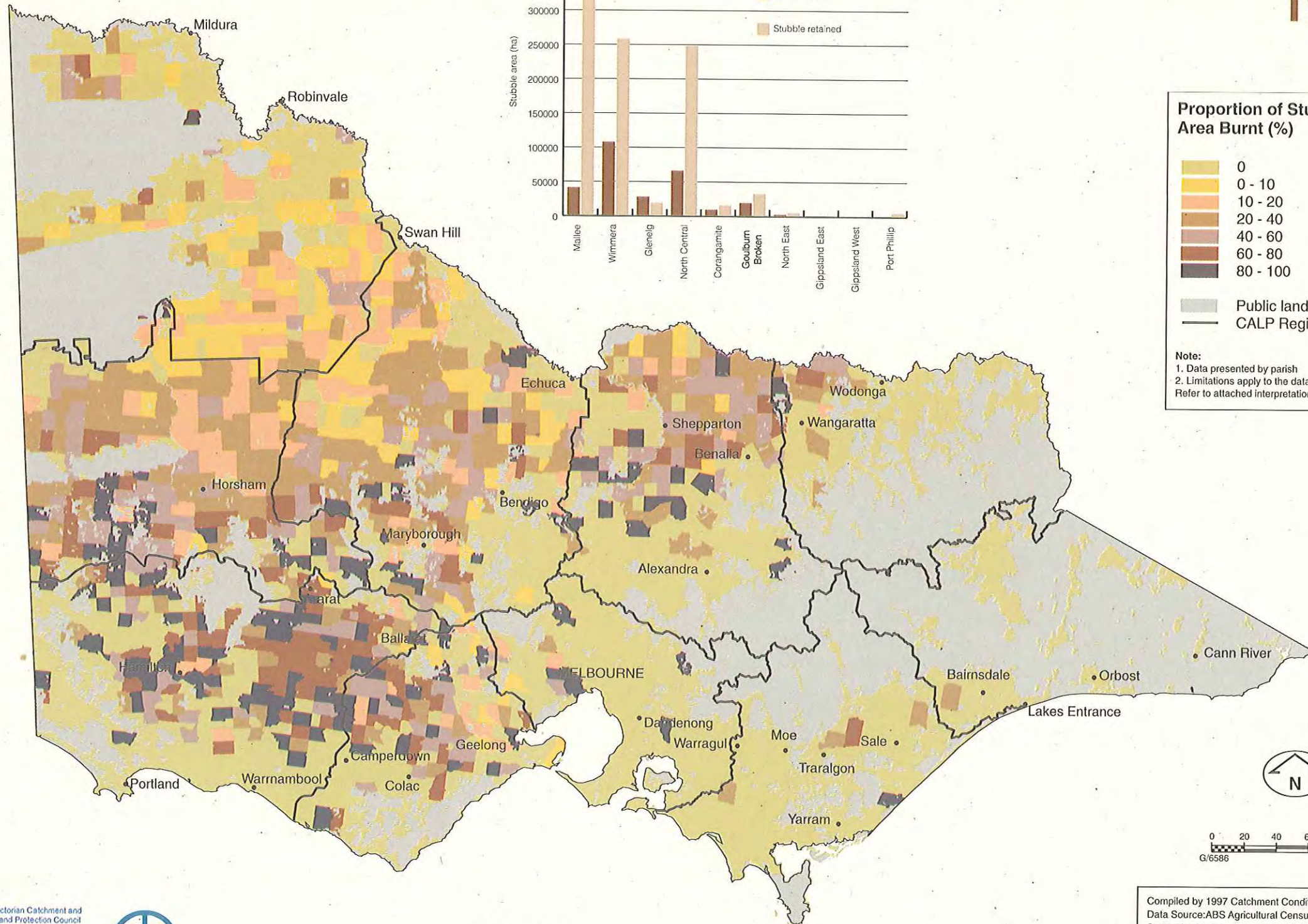
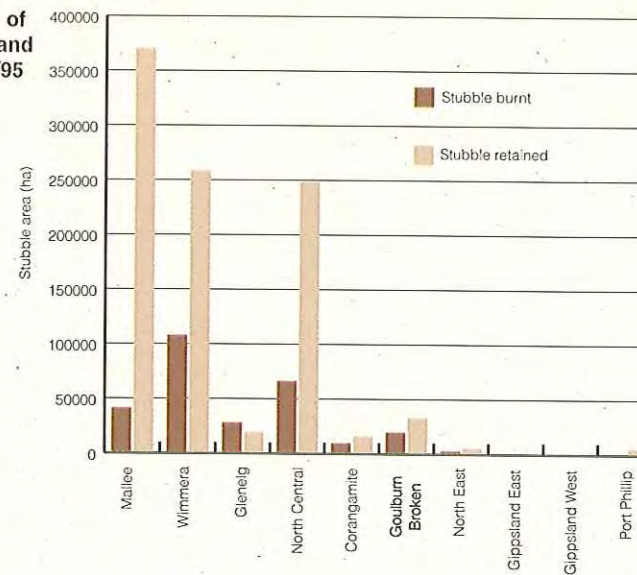
Farmer adoption rates were determined by calculating the number of farmers reporting each form of stubble management as a percentage of the number of farmers reporting any form of stubble management.

Contact

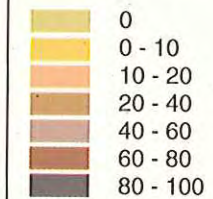
Neil Barr and Komala Karunaratne, Community Education and Customer Research, CMSA, DNRE, Bendigo.

Stubble Management, 1994/95

Graph 22: Area of Stubble Burnt and Retained, 1994/95



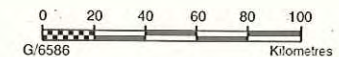
Proportion of Stubble Area Burnt (%)



Public land
CALP Regions

Note:

1. Data presented by parish
2. Limitations apply to the data presented. Refer to attached interpretation for details.



Map 12
Stubble Area Burnt, by Parish, 1994/95

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: ABS Agricultural Census, 1994/95
September 1997



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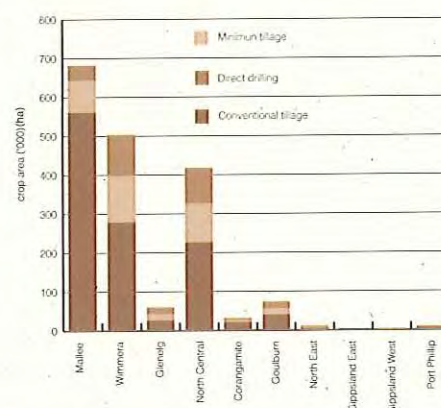
Soil Tillage Methods, 1994/95

Background

Direct Drilling generally refers to sowing a crop into soil which has not been cultivated prior to sowing. Minimum Tillage refers to less than three workings prior to sowing.

Conventional Tillage is generally the sowing of the crop after three or more cultivations. Multiple cultivations of cropland prior to sowing increase the risk of soil structural decline and erosion.

Soil degradation through structural decline and erosion occurs as a result of the extensive use of cultivation in crop preparation.



Graph 23: Crop Area under Various Tillage Methods, 1994/95

Map 13 shows the proportion of tillage area under Direct Drilling in 1994/95, for each parish.

Map 14 shows the proportion of tillage area under Conventional Tillage in 1994/95, for each parish.

Data Limitations

- The use of a single years data to draw conclusions about the adoption practices of farmers should be treated with caution.
- Less than 60% of cropping farmers answered the tillage question in the 1994/95 census.
- The high prevalence of direct drilling in pasture renovation allows overestimates of rates of direct drilling in areas with low cropping intensity.

Data Collection and Analysis

The Australian Bureau of Statistics (ABS) Agricultural Census is distributed annually to all Australian landholders whose businesses meet a minimum gross income criterion. Individual forms remain confidential to the ABS. Statistics are supplied to DNRE only as aggregated data for parishes.

Two measures of adoption are used:

Area adoption

The reported area of each tillage method as a percentage of the total area of tillage reported.

Farmer adoption

Farmer adoption rates were determined by calculating the number of farmers reporting each tillage method as a percentage of the number of farmers reporting any form of tillage.

Table 2: Cropped Area under Various Tillage Methods, 1994/95

CALP Region	Conventional Tillage		Minimum Tillage		Direct Drilling	
	% area	% farmers	% area	% farmers	% area	% farmers
Mallee	82	74	12	18	6	8
Wimmera	55	52	24	29	21	19
Glenelg	44	57	27	27	29	16
North Central	54	52	24	30	22	18
Corangamite	68	72	17	19	15	9
Goulburn Broken	54	55	22	26	24	19
North East	48	59	21	25	30	16
East Gippsland	84	79	9	12	8	10
West Gippsland	85	77	12	19	4	4
Port Phillip	77	85	10	14	13	1
Total	65	59	19	26	16	16

Source: ABS Agricultural Census, 1994/95

Results

- Of the reported area of crop preparation, conventional tillage (three or more cultivations prior to sowing) was used on approximately 66 per cent, minimum tillage was used on 19 per cent, and direct drilling was used on 16 per cent.
- The use of conventional tillage is high in Regions with low cropping intensity, such as occur in the southern parts of Victoria. Investment in the technology and skills required for successful direct drilling is likely to be low for "opportunity croppers" or where cropping is a minor part of the farm program.

Mallee CALP Region

The use of conventional tillage is greatest in the Mallee, where this technique is part of the farming culture. Soil disturbance created from tillage controls the Rhizoctonia fungus which is more prone to occur in the sandy soils of the Mallee. This fungus can greatly reduce crop yields.

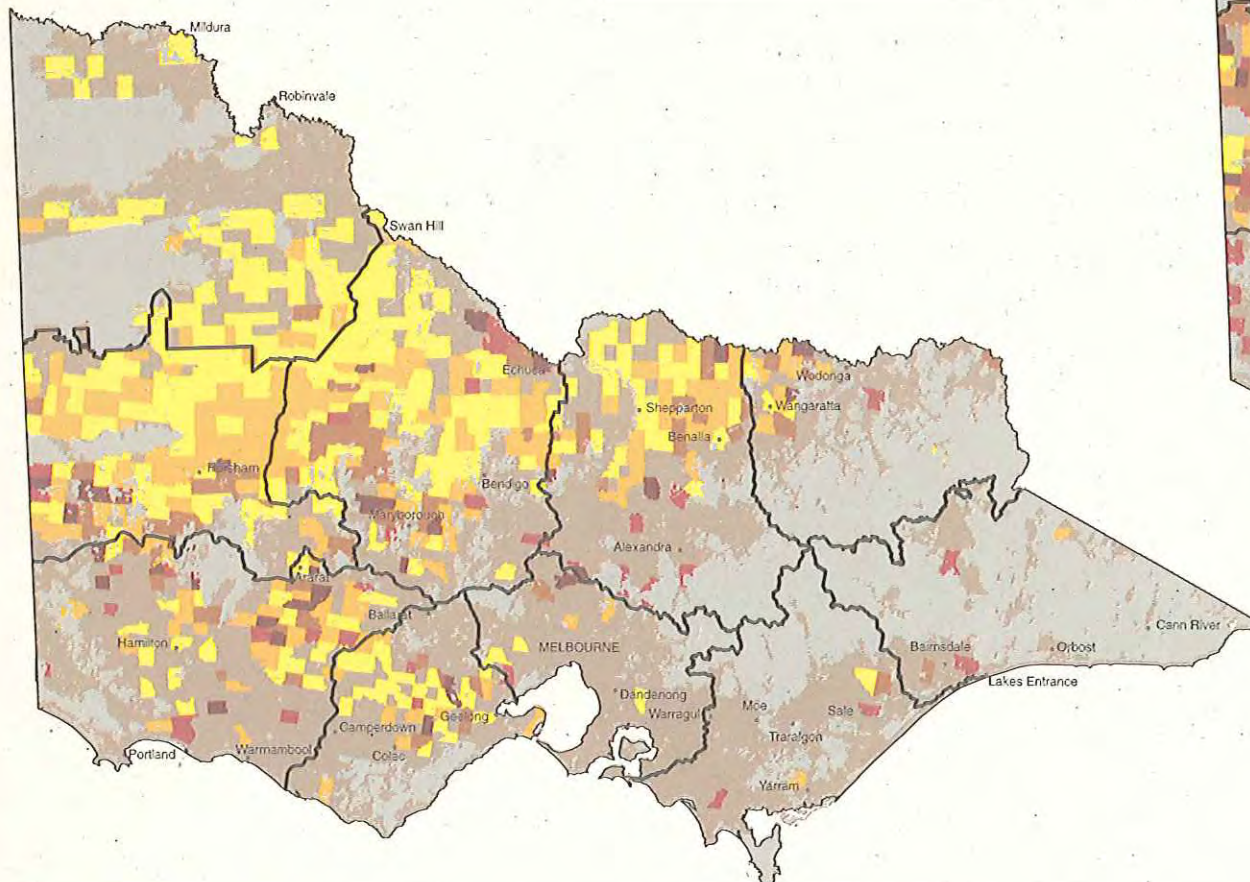
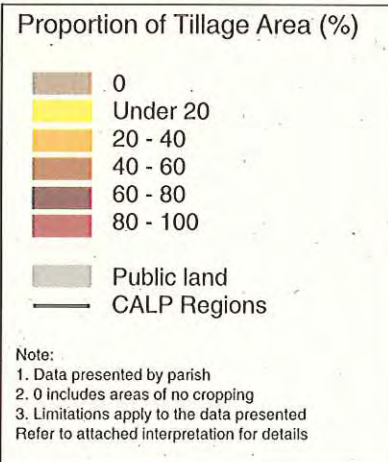
Wimmera, North Central and Goulburn CALP Regions

The use of direct drilling is greatest in these Regions. Rainfall and soil type are also reflected in the use of direct drilling within these Regions. The higher the rainfall, the greater the advantages of timeliness to be gained by direct drilling.

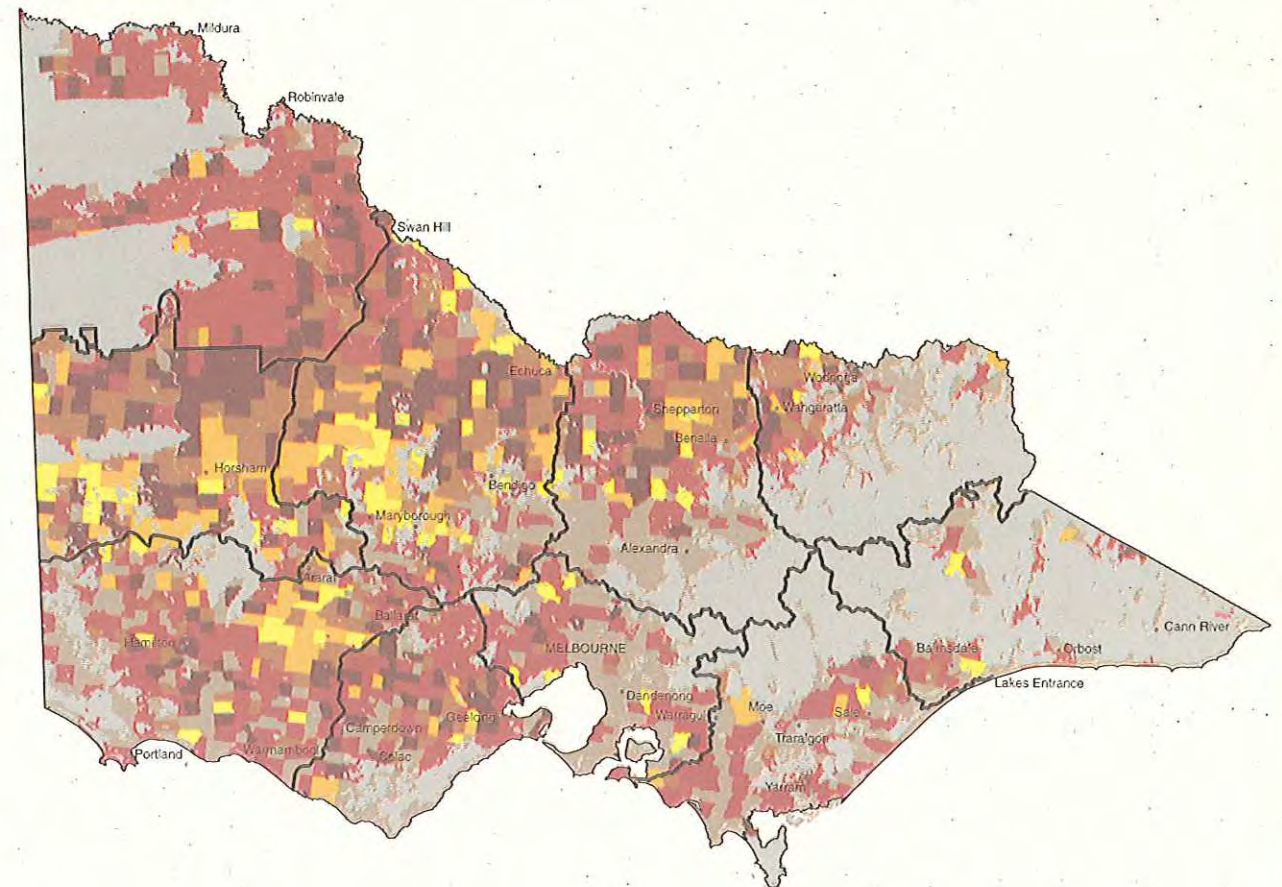
Contact

Neil Barr and Komala Karunaratne, Community Education and Customer Research, CMSA, DNRE, Bendigo.

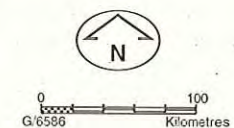
Soil Tillage Methods, 1994/95



Map 13
Tillage Area under Direct Drilling, by
Parish, 1994/95



Map 14
Tillage Area under Conventional Tillage,
by Parish, 1994/95



Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
 Data Source: ABS Agricultural Census, 1994/95
 September 1997

Fallowing

Background

Fallow is generally taken to mean the period between the sowing of each crop. In traditional fallows, land was cultivated to remove all weeds, pastures and crops and cultivated for several months to a year prior to sowing. This is gradually being replaced by shorter fallow periods or the use of chemical fallowing as an alternative means of weed control.

Measures of Fallowing

To obtain the total fallow area, both chemical fallow and cultivation fallow were combined. Four measures of fallow were used in the analysis:

- **Landscape Fallow**
Fallow as a proportion of the total farm area in a given season
- **Single year fallow/crop percentage**
Fallow as a proportion of the crop in a given season.
- **Fallow Management Measure**
Fallow as a proportion of crop sown in the following season.
- **Adoption of fallow**
The proportion of farmers using fallow in any given year.

Table 3: Measures of Fallow Usage, 1991/92 and 1994/95

CALP Region	Landscape Fallow		Single year fallow		Fallow Management Measure *		Adoption of fallow	
	1991/92	1994/95	1991/92	1994/95	1991/92	1994/95	1991/92	1994/95
Mallee	20	11	38	21	56	n/a	35	26
Wimmera	10	5	24	11	28	n/a	52	37
Glenelg	1	0	12	4	13	n/a	12	8
North Central	6	2	22	9	25	n/a	37	16
Corangamite	1	0	14	6	24	n/a	16	10
Goulburn Broken	2	1	21	6	22	n/a	26	9
North East	1	0	15	3	15	n/a	20	6
East Gippsland	n/a	0	n/a	7	n/a	n/a	n/a	10
West Gippsland	n/a	0	n/a	5	n/a	n/a	n/a	8
Port Phillip	13	1	12	6	5	n/a	16	4
Total	7	3	29	14	37	n/a	30	17

* Data for 1995/96 crop area was not available to calculate the Fallow Management Measure for 1994/95 season.

Results

The use of fallow has declined by half from 1992 to 1995 across all CALP Regions. This is most likely due to the poor seasonal conditions of 1994/95.

Fallow is concentrated in the north west of the state, notably central Mallee and northern Wimmera. This is consistent with higher cultivation and stubble incorporation use in these areas. The use of bare fallow has a long history of use in the Mallee Region, with the major benefit being disease control.

Map 15 shows the area of Landscape Fallow in 1994/95, for each parish across Victoria.

Landscape Fallow is the proportion of the total farm area under fallow in a given season.

Data Limitations

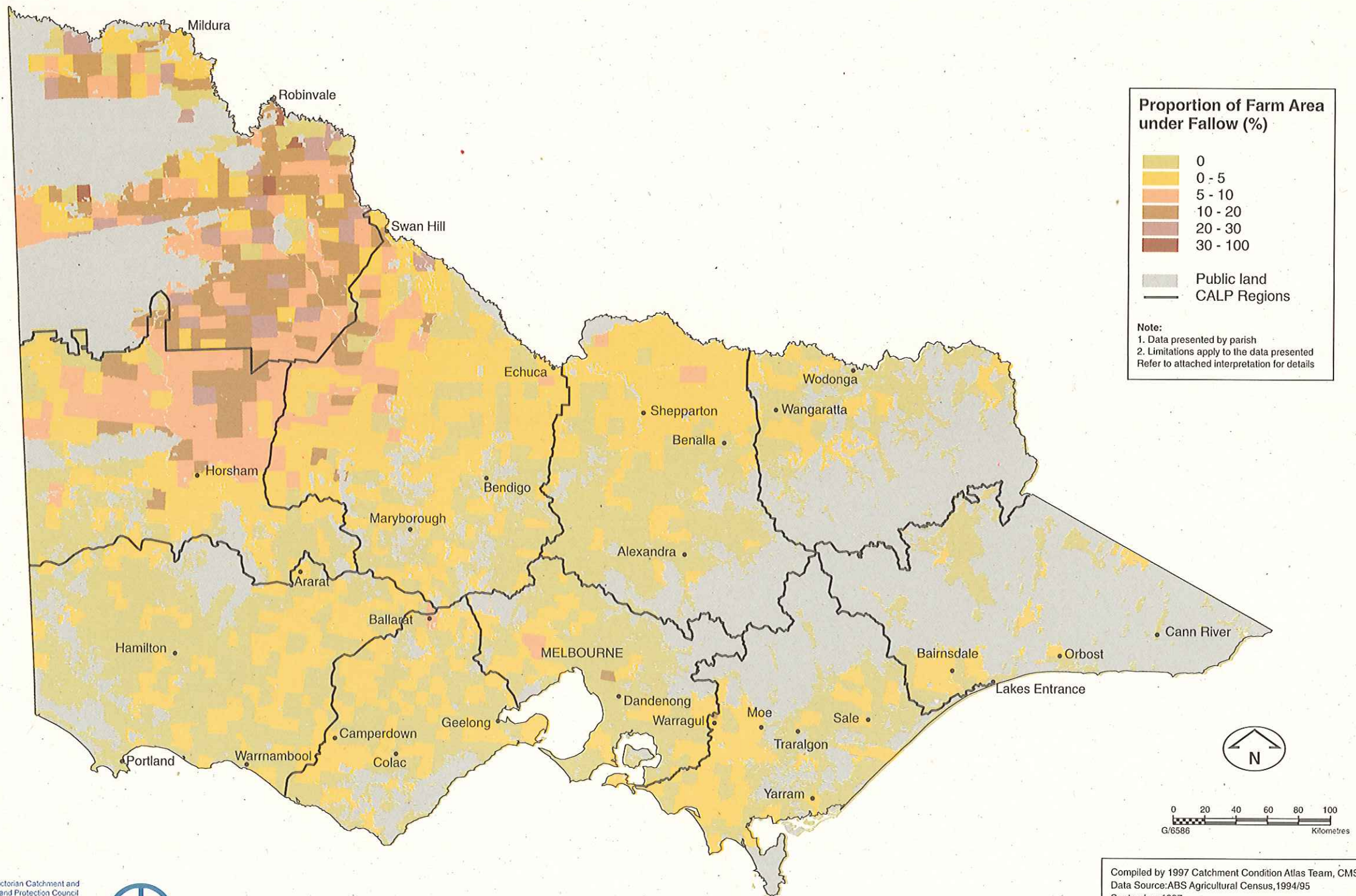
- Measurements of fallow are unstable over time as the amount of fallow is an outcome of farmers' preference to use fallow as well as changes in the balance between cropping and grazing on mixed farms.
- The measures of fallow are complicated by the differing lengths of fallow. Traditionally, long fallow is land which is cultivated up to a year before sowing. Short fallow is land which is cultivated after harvest but before the autumn break. Cultivation after the autumn break is often not considered to be fallowing.
- When asked what a paddock was used for last season, the likely answer will be a crop. However, if asked if fallow was used in crop preparation, a greater fallow area will be mentioned, including short fallows.
- The 1991/92 Census asked whether land had been "spelled". This may have been misinterpreted by some farmers. The question on the 1994/95 Census removed this ambiguity.

Data Collection and Analysis

The Australian Bureau of Statistics (ABS) Agricultural Census is distributed annually to all landholders across Australia whose businesses meet a minimum gross income criterion. Individual forms remain confidential to the ABS. Statistics are supplied to DNRE only as aggregated data for parishes.

Contact

Neil Barr and Komala Karunaratne, Community Education and Customer Research, CMSA, DNRE, Bendigo.



Map 15
Landscape Fallow, by Parish, 1994/95

Soil Erosion Awareness, 1988 - 1997

Background

Catchment protection needs the support of the urban population. It is important that not just rural Victorians, but also Victorians living in urban and provincial areas appreciate the importance of the work of the Catchment Management Authorities.

These indicators present the results of surveys of Victorian's concern for soil erosion and compares this to their concern for environmental issues in general.

Results

There was an increase in concern for soil erosion between 1988 and 1989, although most of this increase had receded by the 1994 survey.

Rural and provincial Victorians showed more concern for soil erosion than those in Melbourne.

Graphs 24 (a to j) show the level of concern for *Soil Erosion* compared to the level of *General Environmental Concern*, for rural and urban residents in each CALP Region, from 1988 to 1997.

Data Collection and Analysis

Surveys of public opinion about catchment management issues were undertaken in 1988, 1989, 1994 and 1997, by the market research firm Reark. These surveys were conducted with samples from rural areas, from provincial towns and from Melbourne.

Each respondent was asked to rank 9 issues based on how serious they consider each is to the future of Victoria. Rankings were from 1 to 10, where 10 is extremely serious.

The issues were

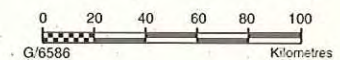
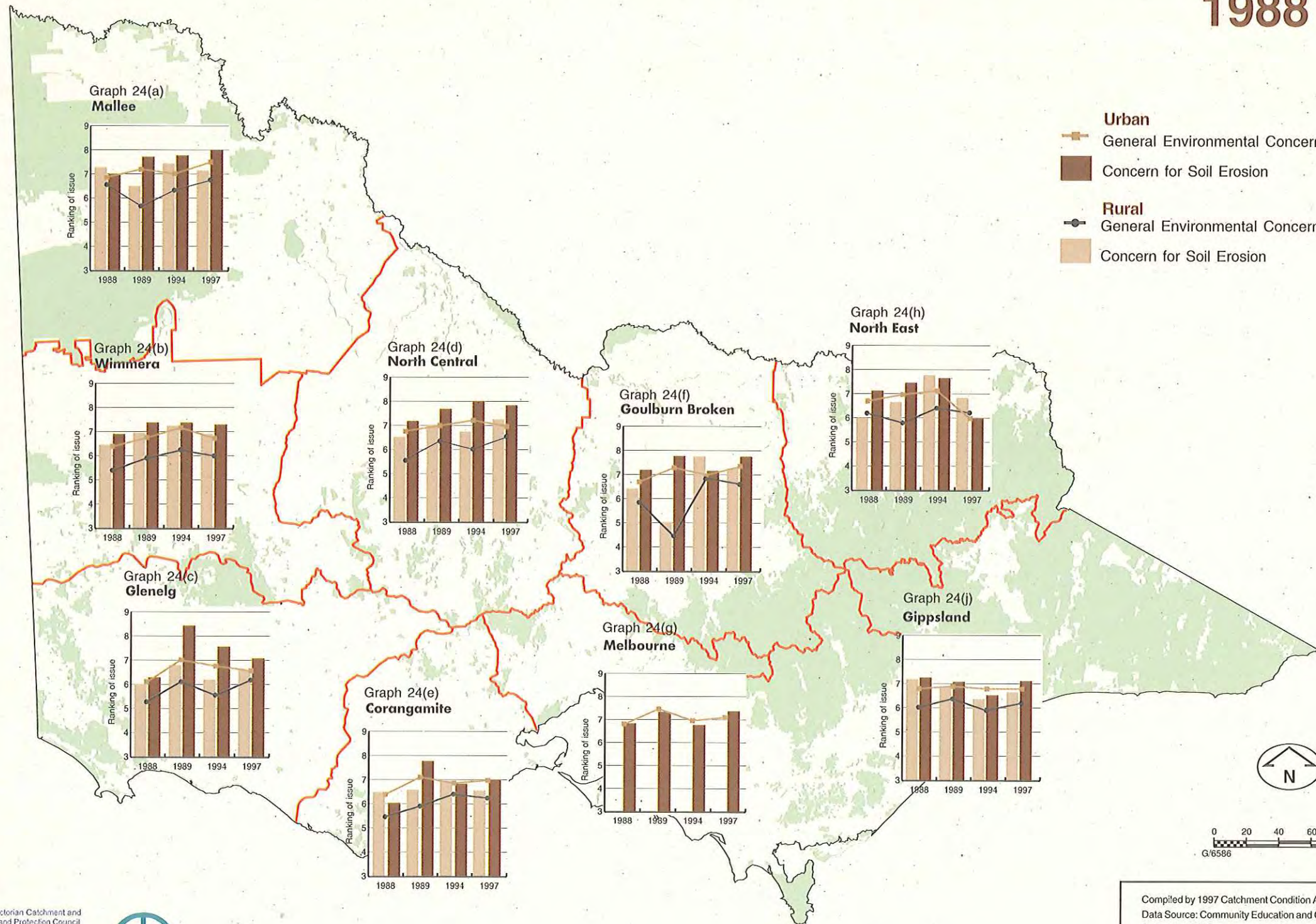
Soil Erosion; Salinity; Extinction of Plants and Animals; Loss of Native Forests; Degraded Rivers and Catchments; Destruction of Wetlands; Pollution; Not Enough Waste Recycling; and Loss of Public Open Space.

For each CALP Region, the results for all 9 issues were averaged to provide an average *General Concern for Environmental Issues* for urban and rural residents.

Contact

Neil Barr and Mal Brown, Community Education and Customer Research, CMSA, DNRE, Bendigo

Soil Erosion Awareness, 1988 - 1997



Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: Community Education and Customer Research, DNRE
September 1997



Natural Resources
and Environment

Victorian Catchment and
Land Protection Council



ENVIRONMENT
PROTECTION
AUTHORITY

Pest Plants and Animals

Overview

Many plants and animals introduced to Victoria following European settlement were intended to provide food supplies, amenity and recreational pursuits. The success of many of these introduced plants and animals has placed pressure on a range of terrestrial and aquatic ecosystems. Competition with other plants and animals, over grazing contributing to soil erosion, and an overall reduction in agricultural production and diversity has often resulted.

Summary

- The cost of lost agricultural production due to weeds is estimated at \$360 million.
- Rabbit Calicivirus Disease is now widespread throughout Victoria with few significant areas remaining where the disease has not spread.
- Rabbit Calicivirus Disease is having a significant impact (between 20 and 90% reductions) on rabbit numbers across large areas of the state.



Pest Plants and Animals

Rabbit Calicivirus Disease, August 1997

Agricultural Weeds, 1996

Weeds Awareness, 1997

Rabbit Calicivirus Disease, August 1997

Background

Rabbits are recognised as the most serious vertebrate pest in Victoria, responsible for causing major environmental and agricultural damage. Rabbits cost Victorian agricultural industries approximately \$109 million each year.

Rabbits have so far defied all attempts to bring numbers to a satisfactory level on a long term basis. They persist throughout all climatic zones and land types. Many infestations occur in areas where management is difficult and/or costly to implement. This includes much of the steep grazing country of central Victoria, the stony rises in western Victoria and some large areas of land in the north-west.

Rabbit Calicivirus Disease (RCD) is a biological control method for rabbits which was approved for national release in October 1996. By September 1997, the virus had been released at 120 sites across the state. The presence of RCD provides a unique window of opportunity to permanently reduce rabbit populations over large areas of Victoria.

Although RCD is a new tool, long term benefits will only occur if outbreaks of the virus are followed up by an integrated control program. These methods include poisoning, ripping and fumigation. Only carefully designed control programs, incorporating conventional and new control methods, will maximise the reduction of the rabbit population. The Victorian Government's \$10 million dollar 3 year Rabbit Buster program aims to achieve maximum environmental and economic benefits from the controlled release of RCD and the use of traditional follow-up rabbit control methods.

RCD offers a new opportunity to combat the rabbit problem but not the total solution. By combining the low cost rapid drop in rabbit numbers with the planned implementation of conventional controls, landholders can capitalise on this opportunity and bring about long-term results. However, without this increased effort of large scale integrated follow-up programs, low populations of rabbits will persist and their numbers will eventually recover.

Results

RCD is now widespread throughout Victoria with few significant areas remaining where the disease has not spread. The combination of the planned release plus the natural spread of the disease from the original outbreak means that Victoria is now virtually blanketed by the virus. The virus, combined with

traditional follow-up rabbit control, is now having a significant impact (between 20 and 90 % reductions) on rabbit numbers across large areas of the state, as indicated on the map.

Map 16 shows the impact of Rabbit Calicivirus Disease (RCD) at assessed release sites, and the area where RCD has had a general impact (20% to 90% reduction) on rabbit numbers, at August 1997.

The incidence of permanent and frequent rabbit problems is also shown.

Data Limitations

- The data presented is indicative only of the spread and impact of the disease. The boundaries of the spread of the disease are estimates only. The virus is highly mobile and its effects can change very rapidly.
- It is sometimes difficult to isolate the effect of the virus from other factors which can reduce rabbit numbers such as drought, myxomatosis and other control techniques.

Data Collection and Analysis

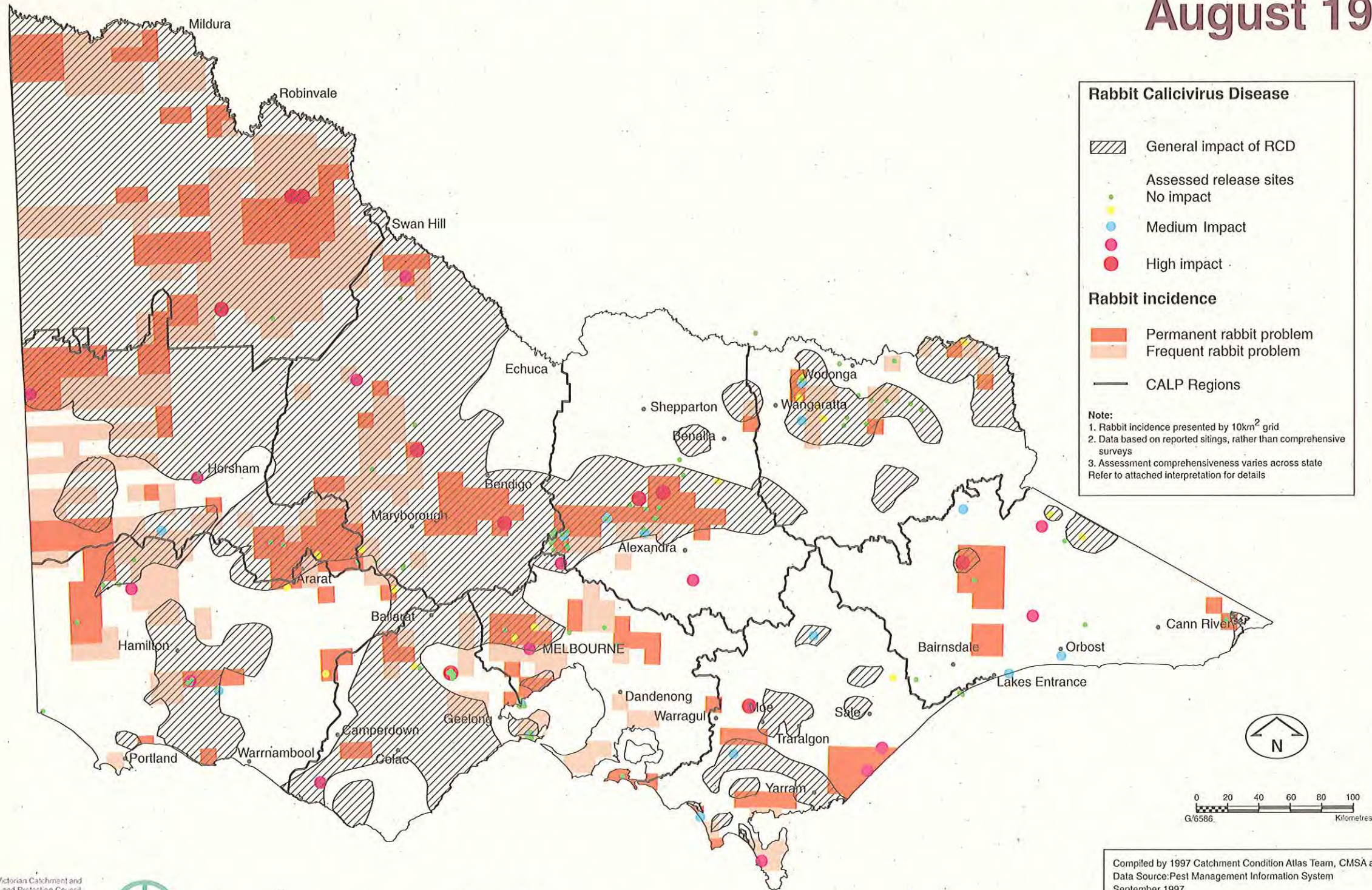
Data on the spread and impact of RCD is based on trends from a number of point or transect assessments of rabbit numbers rather than a comprehensive overall survey.

Rabbit numbers at each RCD release site have been monitored since release to determine the impact of the virus. These results have been combined with those of other routine rabbit abundance monitoring to produce the overall assessment presented.

Contact

Steven Burke, Pest Plants and Animals Program, CMSA, DNRE

Rabbit Calicivirus Disease, August 1997



Map 16
Distribution and Impact of RCD on Rabbit Numbers
from Release Sites and Natural Spread, August 1997



Natural Resources
and Environment

Victorian Catchment and
Land Protection Council



ENVIRONMENT
PROTECTION
AUTHORITY

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: Pest Management Information System
September 1997

Agricultural Weeds, 1996

Background

The Pest Management Information System (PMIS) reflects where attention is being directed at weed management. It is not an inventory of all weed pests across the state. As an indicator of regional departmental priorities and activities, it does however provide us with an indication of where the various weed species are locally identified as a management problem.

The PMIS dataset can be a useful monitoring tool through which to relate pest management programs to the goals, objectives and actions of Regional Catchment Strategies. PMIS can capture a series of descriptions of an infestation over a period of time.

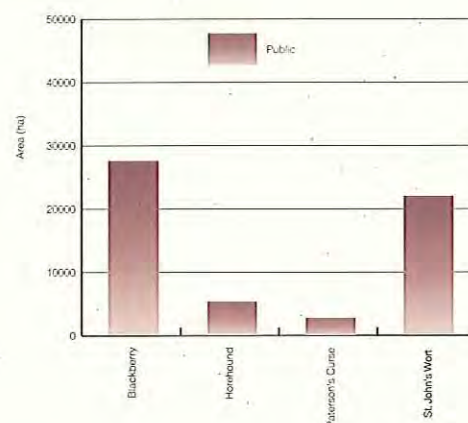
Most infestations documented in PMIS are of weeds proclaimed under the Catchment and Land Protection Act. Environmental weeds are also documented.

PMIS is a management tool designed to support the planning, implementation and evaluation of strategically directed pest management programs. It is a corporate networked computer system accessible to Department of Natural Resources and Environment (DNRE) staff across Victoria. PMIS was launched in 1989 and has been available statewide since 1990.

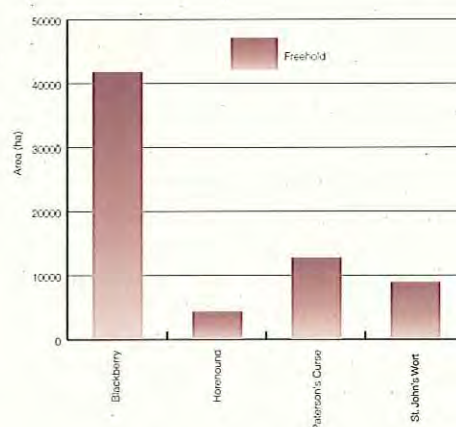
The data within PMIS includes standardised descriptions of strategically significant pest infestations, details of planned and actual control works directed against infestations and evaluations of the effectiveness of the control works.

Results

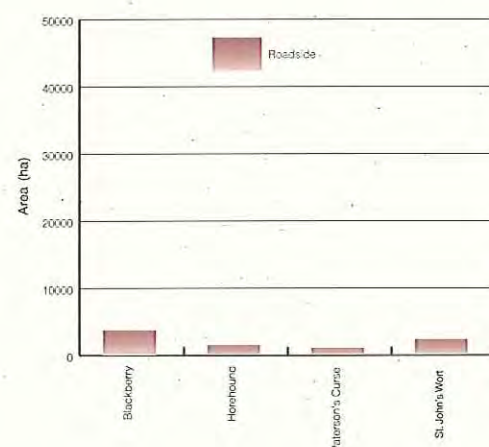
The data gives a broad indication of the occurrence of these chosen species and an indication of the attention directed towards them by DNRE.



Graph 25: Incidence of Four High Priority Agricultural Weeds on Public Land, 1996



Graph 26: Incidence of Four High Priority Agricultural Weeds on Private Land, 1996



Graph 27: Incidence of Four High Priority Agricultural Weeds on Roadsides, 1996

Maps 17 to 20 show the most recent documented infestations of four major agricultural weed species.

Data Limitations

- The PMIS dataset is not an attempted inventory of all weeds and animal pests across the State, nor is it an exhaustive description of a particular species in a particular locality.
- Historically, the collection of data has been influenced by such factors as regional policy and priorities, local staff levels and locations, and information technology issues. Therefore, not all catchments are reported equally.

Data Collection and Analysis

The data presented is a small subset of the entire PMIS database which contains details on over 20,000 infestations.

The choice of species to document in PMIS, and in which situations, has historically been guided by the proclamation of species as noxious weeds under the Vermin and Noxious Weeds Act. More recently, categorisation of weeds under the Catchment and Land Protection Act has provided the basis. This focus will be increasingly influenced by the provisions of Regional Catchment Strategies.

Recent years have seen a marked increase in the participation of various groups and organisations in pest plant and animal management programs. Landcare groups, Local Government and local facilitators/coordinators employed through DNRE, have contributed to the capture of additional data in PMIS.

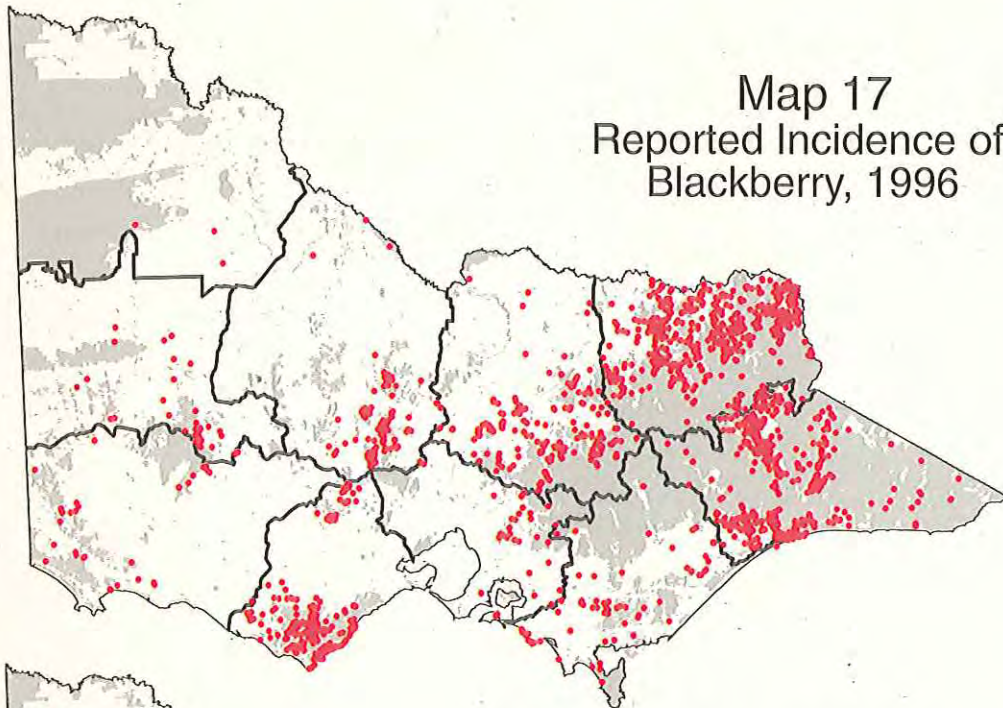
DNRE weed eradication programs such as the Good Neighbour Program are now substantially documented within PMIS.

Contact

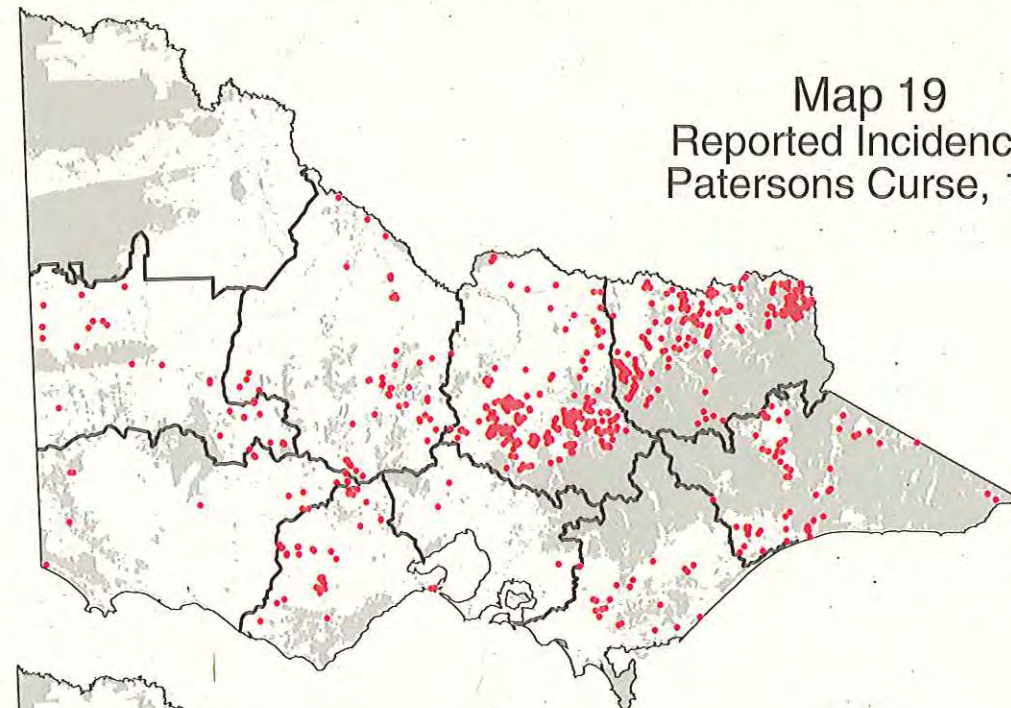
Jim Backholer, Keith Turnbull Research Institute, DNRE

Agricultural Weeds, 1996

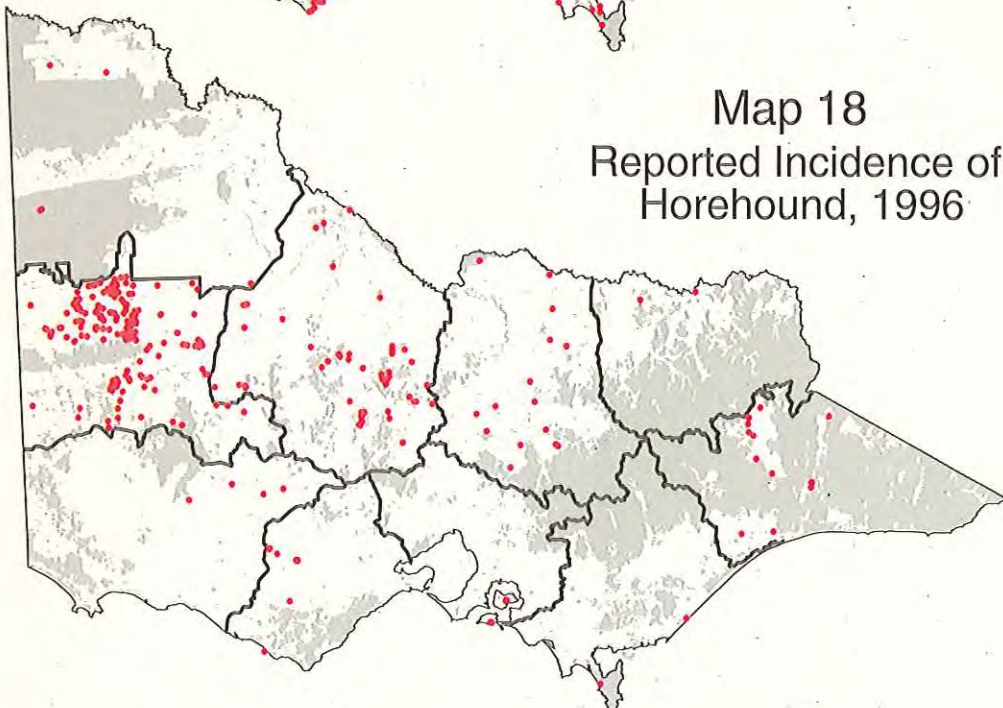
Map 17
Reported Incidence of
Blackberry, 1996



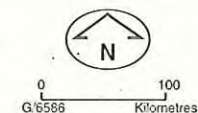
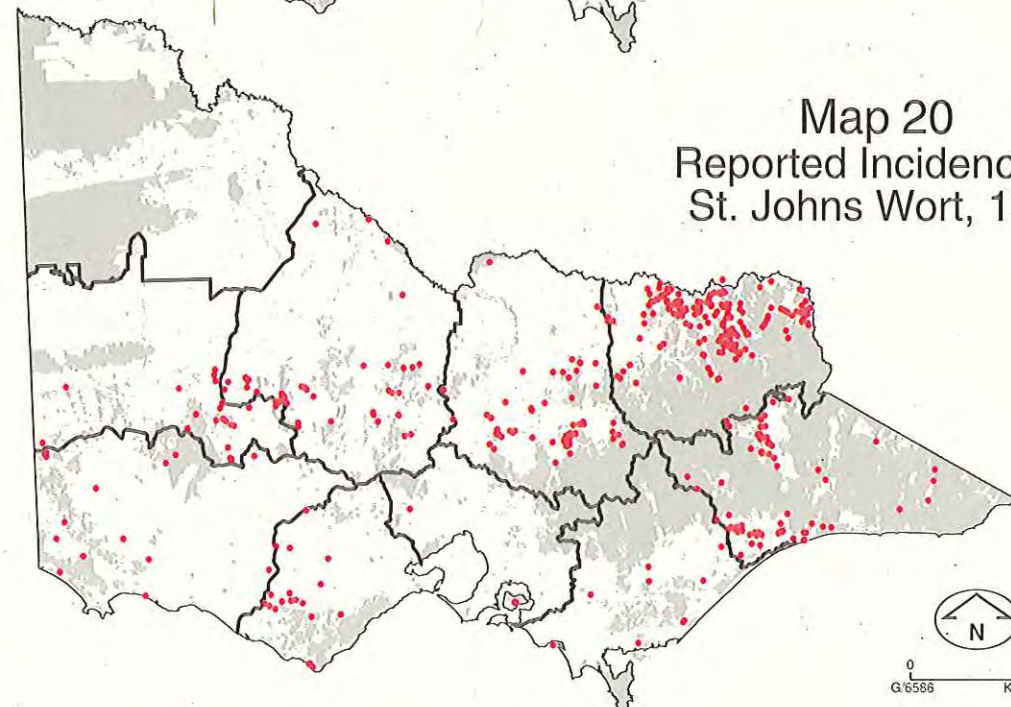
Map 19
Reported Incidence of
Patersons Curse, 1996



Map 18
Reported Incidence of
Horehound, 1996

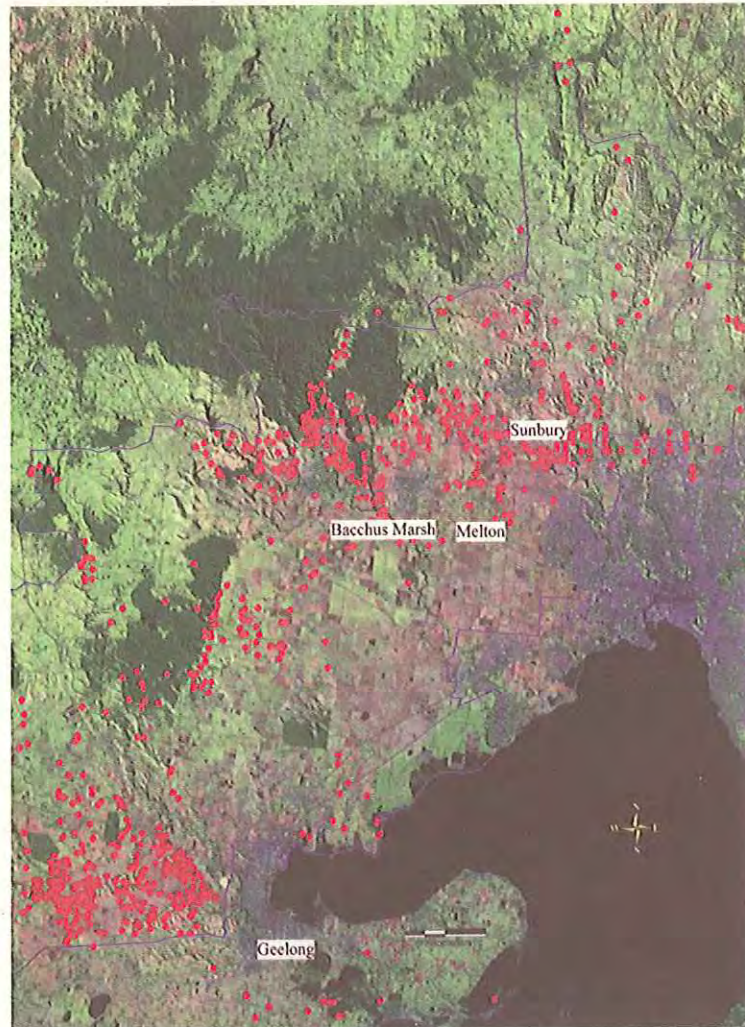


Map 20
Reported Incidence of
St. Johns Wort, 1996



Agricultural Weeds, 1996

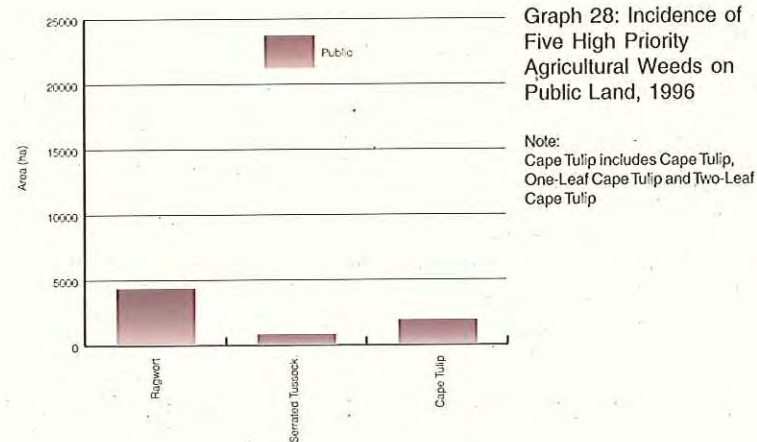
Serrated Tussock Infestations, July 1997



Staff at Catchment Area Services (CAS), Bacchus Marsh, DNRE have linked digital 'dot maps' to an access database to enable efficient access to data on individual infestations.

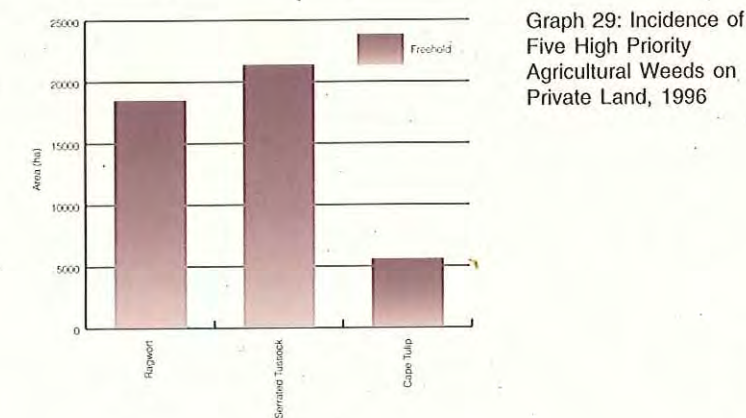
Bacchus Marsh staff are also combining aerial and landholder mapping to prepare digitised maps of rabbit warrens and surface harbour. This will improve targeting of resources at a regional scale, and enable monitoring of infestations and control programs over time.

Air Photo produced by Paula Thompson and Deven McPhan, CAS, Bacchus Marsh, DNRE.

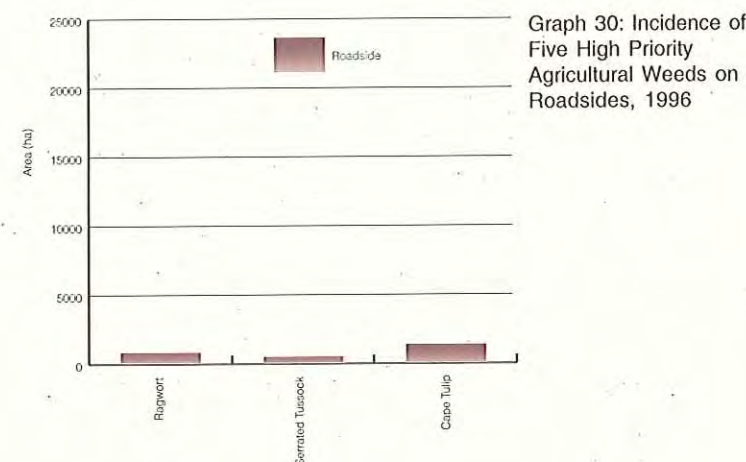


Graph 28: Incidence of Five High Priority Agricultural Weeds on Public Land, 1996

Note:
Cape Tulip includes Cape Tulip, One-Leaf Cape Tulip and Two-Leaf Cape Tulip



Graph 29: Incidence of Five High Priority Agricultural Weeds on Private Land, 1996



Graph 30: Incidence of Five High Priority Agricultural Weeds on Roadsides, 1996

Maps 21 to 24 show the most recent documented infestations of five major agricultural weed species.

Data Limitations

- The PMIS dataset is not an attempted inventory of all weeds and animal pests across the State, nor is it an exhaustive description of a particular species in a particular locality.
- Historically, the collection of data has been influenced by such factors as regional policy and priorities, local staff levels and locations, and information technology issues. Therefore, not all catchments are reported equally.

Data Collection and Analysis

The data presented is a small subset of the entire PMIS database which contains details on over 20,000 infestations.

The choice of species to document in PMIS, and in which situations, has historically been guided by the proclamation of species as noxious weeds under the Vermin and Noxious Weeds Act. More recently, categorisation of weeds under the Catchment and Land Protection Act has provided the basis. This focus will be increasingly influenced by the provisions of Regional Catchment Strategies.

Recent years have seen a marked increase in the participation of various groups and organisations in pest plant and animal management programs. Landcare groups, Local Government and local facilitators/coordinators employed through DNRE, have contributed to the capture of additional data in PMIS. DNRE weed eradication programs such as the Good Neighbour Program are now substantially documented within PMIS.

Results

The data gives a broad indication of the occurrence of these chosen species and an indication of the attention directed towards them by DNRE.

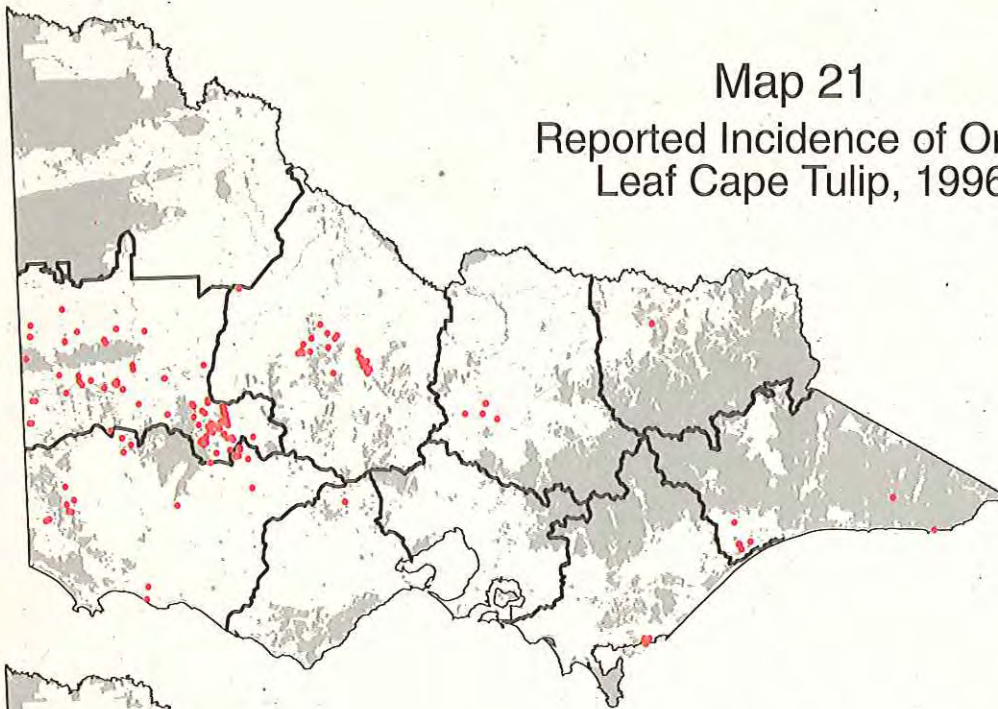
Contact

Jim Backholer, Keith Turnbull Research Institute, DNRE

Agricultural Weeds, 1996

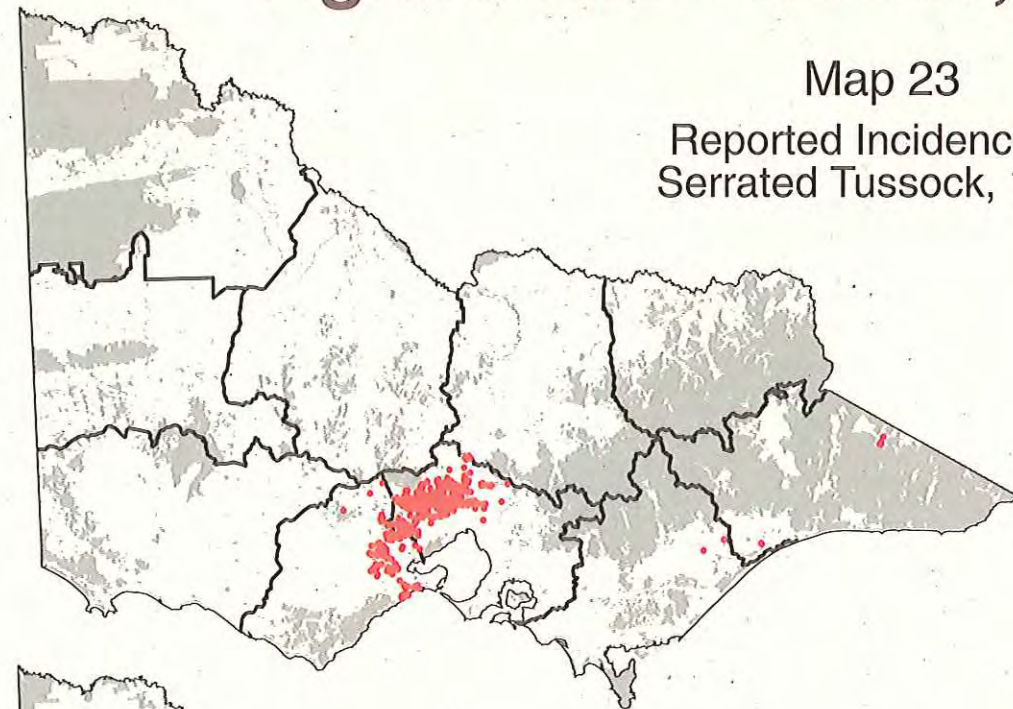
Map 21

Reported Incidence of One-Leaf Cape Tulip, 1996



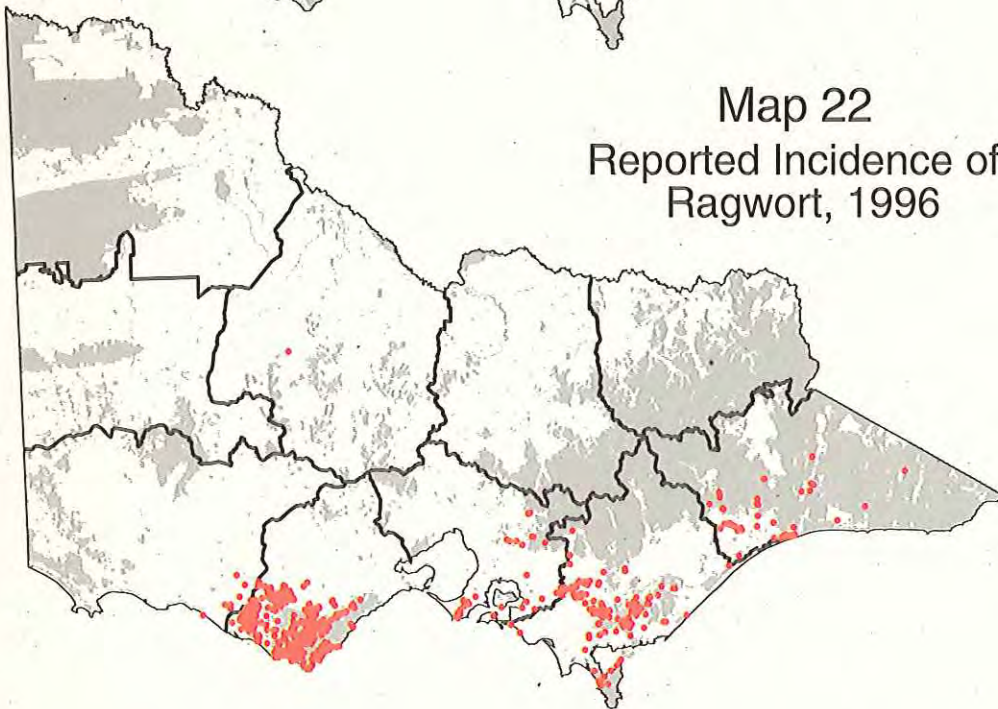
Map 23

Reported Incidence of Serrated Tussock, 1996



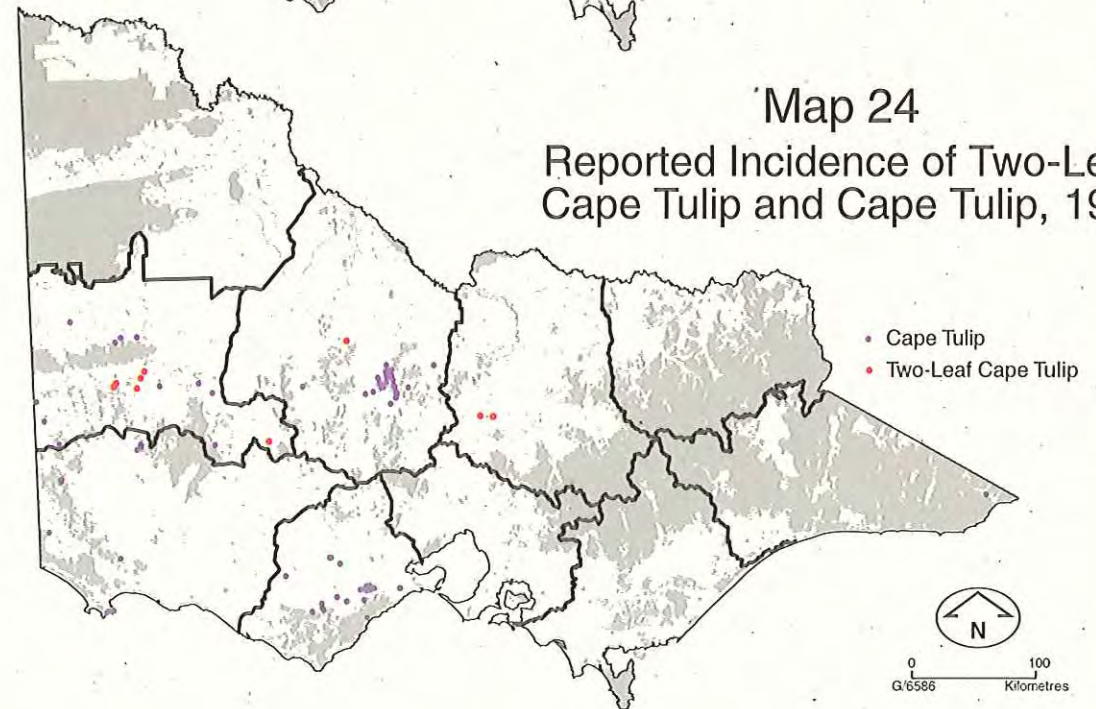
Map 22

Reported Incidence of Ragwort, 1996

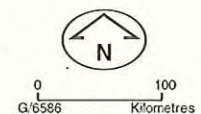


Map 24

Reported Incidence of Two-Leaf Cape Tulip and Cape Tulip, 1996



• Cape Tulip
• Two-Leaf Cape Tulip



— CALP Regions
— Public land

Note:
1. Data based on reported sightings rather than comprehensive surveys
2. Limitations apply to the data presented. Refer to attached interpretation for details

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: Pest Management Information System, DNRE
September 1997

Public Awareness of Weeds, 1997

Background

Catchment protection needs the support of the urban population. It is important that not just rural Victorians, but also Victorians living in urban and provincial areas appreciate the importance of the work of the Catchment Management Authorities.

These indicators present the results of a survey of Victorians' concerns for environmental and farm weeds and compares this to their concern for environmental issues in general.

The results of the survey provide a sound foundation for monitoring the change in concern for weeds, which cost Victoria an estimated \$360 million in lost agricultural production each year.

Weeds Initiative

Early in 1997 the Department of Natural Resources and Environment embarked on a weeds awareness campaign as part of a \$12 million Government Weeds Initiative. Participation in National Weebuster Week in October, community weed control projects undertaken by groups funded under the Initiative, and phasing up awareness during autumn and spring will help to raise the profile of the weeds issue.

Results

- Urban people rated environmental and farm weeds as issues of least concern among the list of nine environmental issues threatening Victoria.
- 63% of urban people were unable to name one environmental weed and 43% were unable to name one farm weed.
- Farmers have a good knowledge of farm weeds. However, 37% were unable to name one environmental weed.
- Rural respondents rated weeds as the fourth issue of concern behind salinity, degraded rivers and catchments, and soil erosion.

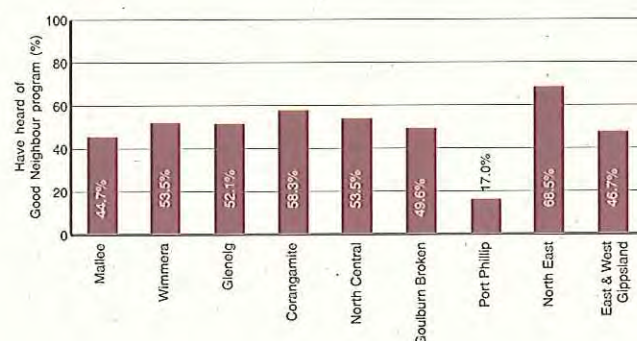
Good Neighbour Program

The Good Neighbour Program, commenced in 1995, aims to protect private land by controlling pest plants and animals on public land boundaries.

The Good Neighbour Program was included in the March 1997 environmental awareness survey. This survey provides important baseline information by which to measure the success of the awareness campaign.

The campaign will be phased up during autumn and spring 1997. A repeat of the awareness survey in March 1998 will be an important element of evaluating the awareness campaign.

Graph 33: Public Awareness of 'Good Neighbour' Program, 1997



Graphs 31 (a to h) show the level of concern for *Environmental Weeds* compared to the level of *General Environmental Concern*, for rural and urban residents in each CALP Region, in 1997.

Graphs 32 (a to h) show the level of concern for *Weeds on Farms* compared to the level of *General Environmental Concern*, for rural and urban residents in each CALP Region, in 1997.

Data Collection and Analysis

Surveys of public opinion about catchment management issues were undertaken in 1988, 1989, 1994 and 1997, by the market research firm Reark. These surveys were conducted with samples from rural areas, from provincial towns and from Melbourne.

Each respondent was asked to rank 9 issues based on how serious they consider each is to the future of Victoria. Rankings were from 1 to 10, where 10 is extremely serious.

The issues were:

Soil Erosion; Salinity; Extinction of Plants and Animals; Loss of Native Forests; Degraded Rivers and Catchments; Destruction of Wetlands; Pollution; Not Enough Waste Recycling; and Loss of Public Open Space.

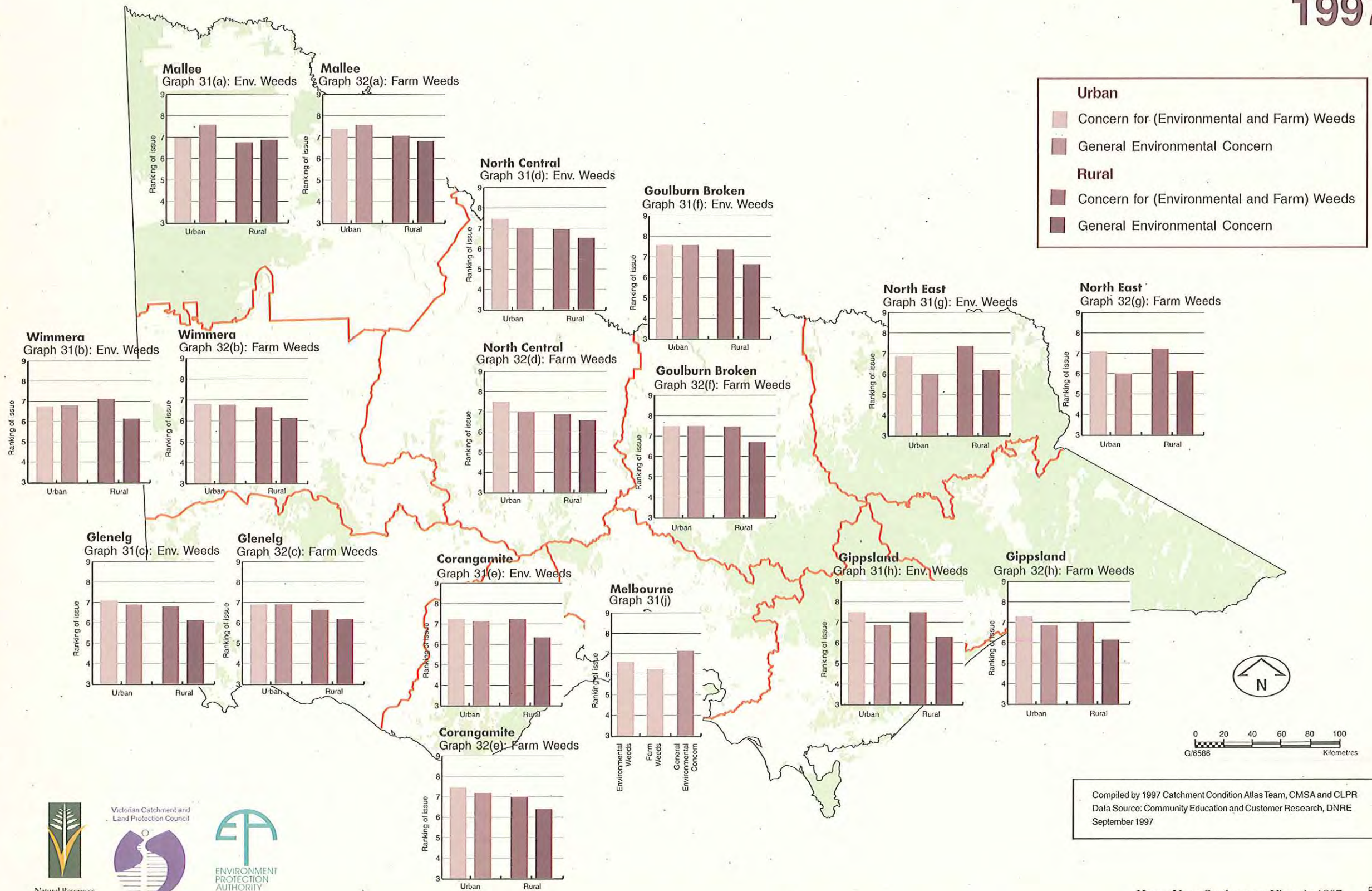
For each CALP Region, the results for all 9 issues were averaged to provide an average *General Concern for Environmental Issues*, for urban and rural residents.

Environmental and farm weeds were included in the public awareness surveys in 1997.

Contact

Mal Brown and Neil Barr, Community Education and Customer Research, CMSA, DNRE

Weeds Awareness, 1997



Streams and Wetlands

Overview

The health of streams and wetlands is important for biodiversity issues, human and animal health, irrigation and industry. Significant pressures have been placed on streams and wetlands as a result of water diversion, regulating watercourse flow regimes, grazing and removal of vegetation along streambanks, invasion by pest plants and animals and the movement of salts, nutrients and suspended soil into watercourses.

The condition of streams and wetlands is therefore dependent on the condition and management of the surrounding catchment.

Summary

- 60% of recording sites had total phosphorus levels of less than 0.05mg/L, while 42% of recording sites had levels less than 0.025mg/L.
- Approximately 50% of recording sites had low turbidity.
- The number of groups participating in the Waterwatch program has grown steadily since 1991. In 1996, 570 groups were involved.
- Between 1989 and 1997, public concern for the degradation of rivers and catchments increased in most CALP Regions.



Streams and Wetlands

Stream Total Phosphorus

Stream Turbidity

Stream Electrical Conductivity (EC)

Stream Health, 1994 - 1996, using macroinvertebrates

Algal Blooms

Streams Protected from Livestock, 1993/94 - 1994/95

Saltwatch and Waterwatch, 1987 - 1997

Awareness of Rivers and Catchments, 1988 - 1997

Stream Total Phosphorus

Background

Various plant nutrients are required for normal plant growth. Phosphorus (as phosphate ions, PO_4^{3-}), like nitrogen, is an important nutrient in natural water bodies.

In Australian inland waters, phosphorus is commonly implicated in eutrophication - excessive plant growth resulting from nutrient enrichment.

Climate, hydrology and geomorphology influence the initial nutrient concentrations in streams. However, increased total phosphorus levels can indicate a range of management problems within the catchment, including inappropriate land clearing; over irrigation; unrestricted grazing; over fertilisation and point source pollution.

Phosphorus is not toxic, even in high concentrations. But high concentrations may have a significant impact on the structure and function of aquatic ecosystems. Where total phosphorus levels become too high, eutrophication of waterbodies often causes significant problems including, anoxia, increased turbidity and potential toxicity from blue green algae.

Results

- Sites with high levels of total phosphorus occur over a wide area of the state and are not limited to specific Regions.
- Nearly 12% of the sites were in the highest category ($>0.1\text{mg/L}$) for total phosphorus levels.
- More sites had unacceptable stream total phosphorus levels, than had unacceptable levels of stream turbidity or EC.
- Sites with unacceptable total phosphorus levels are spread more widely across the state than are sites with unacceptable stream turbidity or EC. High levels of total phosphorus are therefore a greater potential problem across a wider range of the state. Turbidity and EC often indicate more localised problems.
- All of the sites in the highest category ($> 0.100\text{mg/L}$) were lotic (stream) sites. There were no lentic (lakes and wetlands) sites in this highest category.

Lowland rivers and the Murray River

Have a high proportion of sites with total phosphorus levels in the two highest categories.

Corangamite, Goulburn Broken, North Central, and Port Phillip CALP Regions

Have low water quality as a result of nutrient pollution.

Port Phillip CALP Region

The region around Melbourne has a higher concentration of sites with high total phosphorus levels.

North East and East Gippsland CALP Regions

The more mountainous Regions. Therefore have more acceptable total phosphorus levels.

East Gippsland CALP Region

The only region with no sites falling in the highest category.

Map 25 shows Total Phosphorus levels for 254 historical and current stream monitoring sites. These are median values for each site over the period of monitoring, which varies from 3 to 20 years.

Total Phosphorus includes available phosphorus (able to be used by plants) and phosphorus in chemical forms unavailable to plants.

Data Limitations

The limitations of the sampling program must be considered when interpreting the stream total phosphorus data:

- Sites are distributed to give a good broad scale picture of the state, not specific detailed analysis. The results indicate total phosphorus levels only at the sites shown, and do not necessarily indicate the extent of the problem across the Region.
- The Mallee CALP Region is represented by only a few sites. Therefore interpreting data from this Region, and comparing with other Regions, should be done with caution.
- The results shown are medians of data collected over a period of up to 20 years. Therefore results should only be interpreted in a broad statewide sense.

Data Collection & Analysis

Stream total phosphorus, turbidity and EC have been routinely measured at sites throughout Victoria for up to 20 years. Originally established under a number of different programs, these sites now form the Victorian Water Quality Monitoring Network (VWQMN).

The results presented are from sites initially established under 3 programs - the Victorian Water Quality Monitoring Program, Major Storages Operational Monitoring Program and the Murray Darling Basin Commission Baseline Monitoring.

Future reporting could also include data from the EPA's Inland Water Quality Monitoring Network and Melbourne Water's Streamwatch program.

Contact

Michael Shirley, Water Ecoscience, Melbourne

Stream Total Phosphorus

Graph 34: Sites with Stream Total Phosphorus Levels in each Category

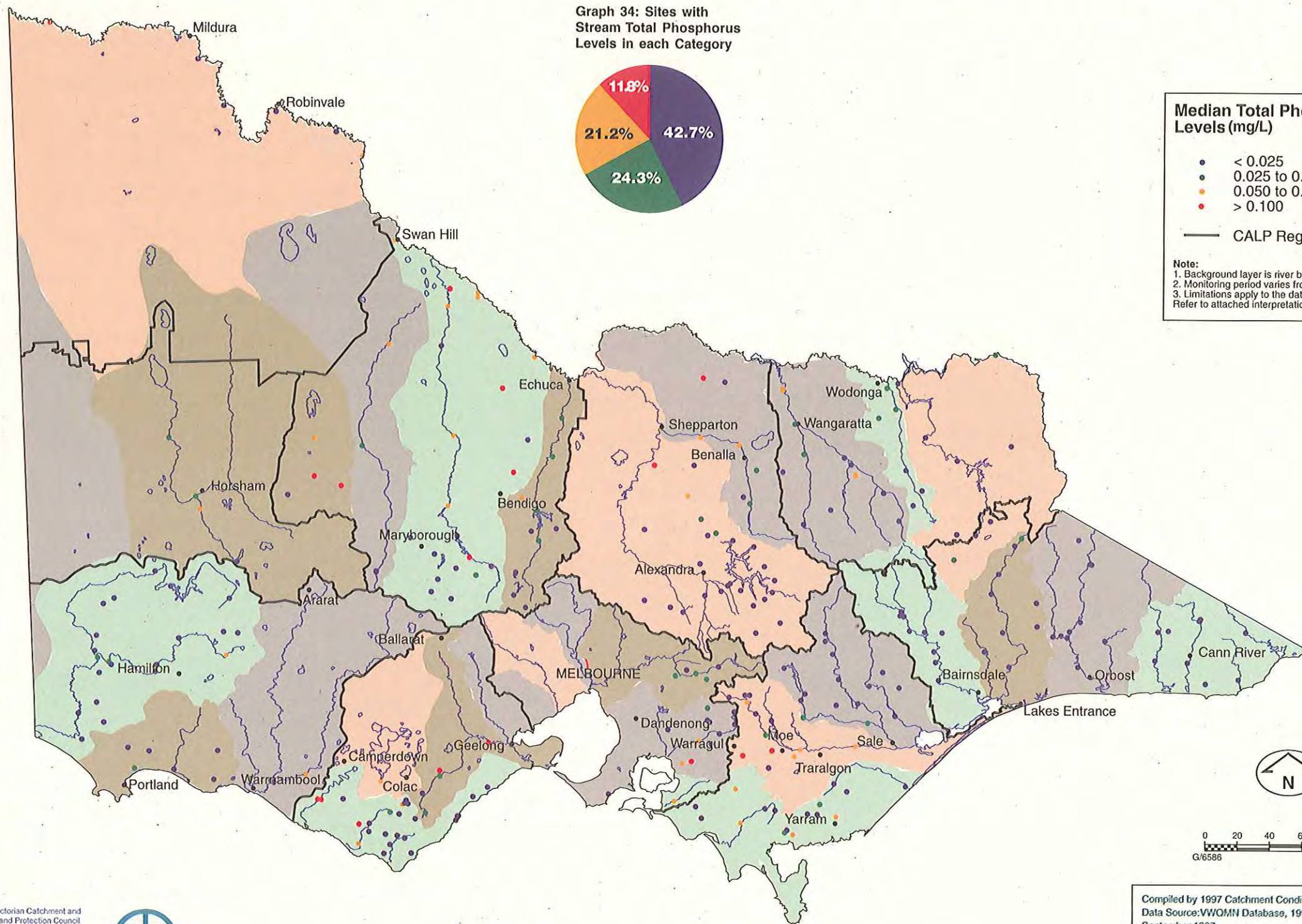


Median Total Phosphorus Levels (mg/L)

- < 0.025
- 0.025 to 0.050
- 0.050 to 0.100
- > 0.100

— CALP Regions

Note:
 1. Background layer is river basins
 2. Monitoring period varies from 3 to 20 years
 3. Limitations apply to the data presented
 Refer to attached interpretation for details



0 20 40 60 80 100
 Kilometres
 G/6586

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
 Data Source: VWOMN Database, 1996
 September 1997

Map 25

Median Stream Total Phosphorus



Natural Resources
 and Environment



ENVIRONMENT
 PROTECTION
 AUTHORITY

Stream Turbidity

Background

Turbidity is often the most obvious water quality indicator to the casual observer, being observed as a change in water clarity.

Turbidity is caused by the suspension of particles in the water. These are most commonly soil particles, although other particles may include detritus or algae. An increase in turbidity causes a decrease in the transmission of light through the water which can have far-reaching implications for the energetics of aquatic systems.

The natural seasonal variation of rivers and streams can often include changes in turbidity. The extent of this variation is governed by the hydrology and geomorphology of the particular region.

The headwaters of rivers and streams in mountain regions tend to have low turbidity, whereas high turbidities usually occur in the lowland river reaches.

Increased turbidity can result from a range of land management practices which increase sediment loads in the water, including land and riparian zone clearing; over irrigation; unrestricted access of stock to waterways; removal of aquatic vegetation and bank destabilisation. High densities of carp may also be a major contributing factor in many waterbodies.

Results

For many lowland regions the management of increased turbidity and sediment loads should become a crucial objective.

- Nearly half (47.3%) of the sites sampled have low turbidity levels (< 5 NTU)
- Only 2.3% of the sites have extreme turbidity levels (> 60 NTU).
- The lower turbidities are aggregated around the more mountainous areas.
- Sites which fall into the two highest categories (25 NTU and over) are all lotic sites (streams). None of the lentic sites (lakes and wetlands) fall into these categories.

- Lowland river areas are prone to high turbidity. High carp densities, removal of riparian and aquatic vegetation and unrestricted grazing, are particularly prevalent in these areas.

Murray River in North-west Victoria

Lowland sites along the lower Murray have higher values (25 NTU and over).

Wimmera and Goulburn Broken CALP Regions

Encompass significant lowland areas. These regions have the highest proportion of high turbidity sites.

North East and East Gippsland CALP Regions

Predominantly upland areas, therefore have no sites in the high turbidity categories.

Map 26 shows Turbidity levels for 436 historical and current stream monitoring sites. These are median values for each site over the period of monitoring, which varies from 3 to 20 years.

Turbidity units are NTUs - Nephelometer Turbidity Units

Data Limitations

The limitations of the sampling program must be considered when interpreting the stream turbidity data:

- Sites are distributed to give a good broad scale picture of the state, not specific detailed analysis. The results indicate turbidity levels only at the sites shown, and do not necessarily indicate the extent of the problem across the Region.
- The Mallee CALP Region is represented by only a few sites. Therefore interpreting data from this Region, and comparing with other Regions, should be done with caution.
- The results shown are medians of data collected over a period of up to 20 years. Therefore results should only be interpreted in a broad statewide sense.

Data Collection & Analysis

See Stream Total Phosphorus map.

Future Catchment Condition Reporting

The VWQMN is currently undergoing a review to improve the spatial coverage and regional relevance of water quality assessment.

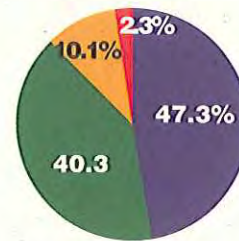
A program of analysing historical water quality data for significant trends over time is currently being implemented around the state.

Contact

Michael Shirley, Water Ecoscience, Melbourne

Stream Turbidity

Graph 35: Sites with Stream Turbidity Levels in each Category

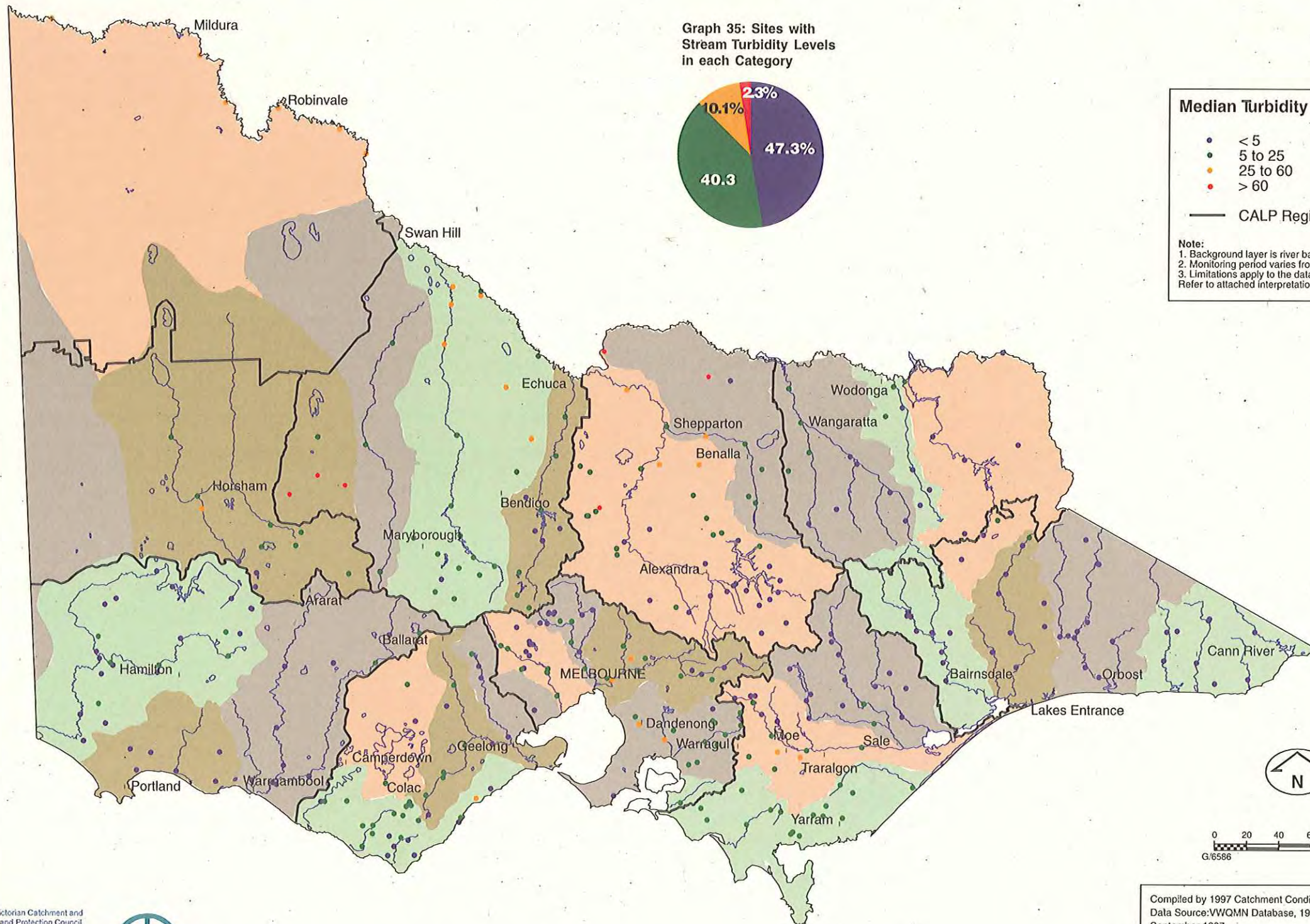


Median Turbidity (NTU)

- < 5
- 5 to 25
- 25 to 60
- > 60

— CALP Regions

Note:
 1. Background layer is river basins
 2. Monitoring period varies from 3 to 20 years
 3. Limitations apply to the data presented
 Refer to attached interpretation for details



0 20 40 60 80 100
 Kilometres
 G/6586

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
 Data Source: VWQMN Database, 1996
 September 1997

Map 26
Median Stream Turbidity

Stream Electrical Conductivity (EC)

Background

EC can be naturally high, depending on geology, geomorphology and the presence of tidal influenced streams. High EC may also be related to other problems within the catchment, including long-term land degradation; decreased agricultural productivity; decreased biodiversity; uncontrolled surface water drainage from agricultural properties; and unregulated water resource and catchment management.

High EC levels may result from long-term land management practices, such as inappropriate land clearing, over irrigation, and clear felling. Improving current land use and management will help to improve EC at a range of sites. However, the process may be difficult to reverse in some of the worst affected areas.

For much of the state, stream EC is generally low. It is important, however, that a close watch is kept on EC to ensure that emerging problems are identified.

Electrical Conductivity (EC)

Electrical Conductivity (EC) of water is a measure of the conductivity of a solution. It therefore provides an indicator of the level of dissolved salts in a water sample. TDS (total dissolved solids) may also include other particles such as algae or non-conductive ions.

EC and TDS usually exhibit a strong correlation for a particular type of water. For most Australian inland waters the relationship is:

$$EC (\mu S/cm) = TDS (\mu g/L) * 0.6$$

Results

- 95.7 % of the sites meet the minimum requirements for agricultural use of water as determined by SaltWatch in 1997 (5,000 $\mu S/cm$).
- Only 19 of the 441 sampled sites exceed this recommended level for agricultural use.
- The predominant value of EC across the state was < 800 $\mu S/cm$. This indicates that the majority of waterbodies in the state had acceptable EC levels.

Murray River

All sites on the Murray were in the lowest category.

Mallee and Wimmera CALP Regions

Have a more even distribution of the categories.

Mallee and Glenelg CALP Regions

Contain only 2% of the sites in the lowest EC category.

Glenelg CALP Region

Contains nearly 60% of the sites in the 2,500-5,000 $\mu S/cm$ category.

Glenelg and Corangamite CALP Regions

Contain over 60% of the sites in the highest EC category. These Regions include areas of the Western District lakes and other areas of high EC, where geology or the tidal influence of streams may cause naturally high EC.

Mallee, Goulburn Broken, North East and East Gippsland CALP Regions

No sites in the highest EC category.

Port Phillip CALP Region

High ECs in the urban areas of Yarra and Maribyrnong catchments may occur naturally, due to the tidal influence on streams.

North-East CALP Region

EC is generally low, therefore little remedial activity is required.

East and West Gippsland CALP Regions

All ECs were in the lowest category.

Map 27 shows Electrical Conductivity (EC) levels for 441 historical and current stream monitoring sites. These are median values for each site over the period of monitoring, which varies from 3 to 20 years.

Data Limitations

The limitations of the sampling program must be considered when interpreting the stream EC data:

- Sites are distributed to give a good broad scale picture of the state, not specific detailed analysis. The results indicate EC levels only at the sites shown, and do not necessarily indicate the extent of the problem across the Region.
- The Mallee CALP Region is represented by only a few sites. Therefore interpreting data from this Region, and comparing with other Regions, should be done with caution.
- The results shown are medians of data collected over a period of up to 20 years. Therefore results should only be interpreted in a broad statewide sense.
- The natural EC level can vary greatly depending on the geology and geomorphology of the Region. Consequently, some sites may have naturally high EC, unrelated to human-induced effects.
- Surface water monitoring does not always indicate sub-surface conditions. Surface water monitoring will only detect increases in the EC of the watertable if the sampling site is at a discharge site, where the watertable has broken through to the surface.

Data Collection & Analysis

See Stream Total Phosphorus map

Contact

Michael Shirley, Water Ecoscience, Melbourne

Stream Electrical Conductivity (EC)

Graph 36: Sites with Stream EC Levels in each Category

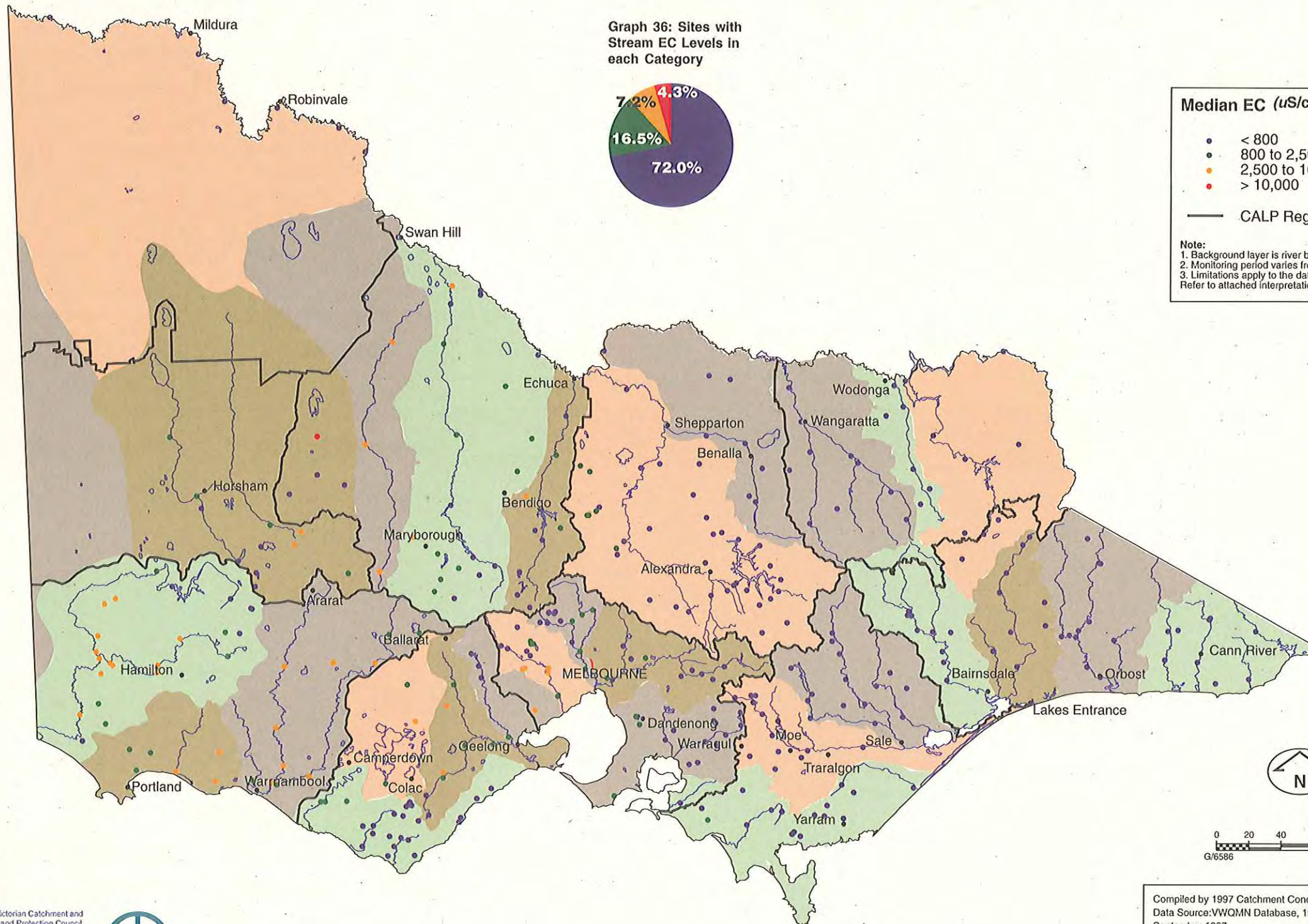


Median EC ($\mu\text{S/cm}$)

- < 800
- 800 to 2,500
- 2,500 to 10,000
- > 10,000

— CALP Regions

Note:
 1. Background layer is river basins
 2. Monitoring period varies from 3 to 20 years
 3. Limitations apply to the data presented
 Refer to attached interpretation for details



Map 27

Median Stream Electrical Conductivity (EC), 1996



Natural Resources
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Victorian Catchment and
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Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
 Data Source: VWOMN Database, 1996
 September 1997

Stream Health, 1994 - 1996, as determined by AUSRIVAS, using macroinvertebrates

Background

The AUSRIVAS O/E score provides an integrated indicator, incorporating water quality, habitat condition and biological factors to provide an assessment of stream health. The AUSRIVAS scores compare each site to similar streams of reference quality - that is, streams which are subject to minimal impact.

AUSRIVAS scores do not provide a clear indication of the cause of a disturbance. However, the scores enable us to place the current condition of individual streams in a statewide context. Thus we can identify the needs for further investigation and management action.

By comparing the O/E scores to categories (bands) representing different levels of biological condition, (Table 4) an assessment of the level of impact on the site can be made. Combining this with general catchment assessment will allow the general health of the reach of the stream to be characterised.

Results

Despite the emphasis on reference sites, most Regions contained sites which showed some degree of impact. Most impacts were considered to be mild. Given the predominance of agricultural land use surrounding the sites, the reasons for the low scores would include clearance of trees in the riparian zone, erosion and sediment accumulation in streams, nutrient enrichment, high salinity and possibly biocide contamination. Some streams had low scores due to regulated flow regimes.

Streams in urban areas are subject to a multitude of impacts, including intermittent pollution spills, high nutrient concentrations, severely degraded habitats and greatly altered flow regimes.

Wimmera - Ten sites, mostly within cropping and grazing land. Two sites in forested areas. AUSRIVAS O/E scores of reference quality at all but two sites which were mildly impacted.

Glenelg - Twenty three sites, mostly within agricultural areas. Five sites in relatively undisturbed areas such as the Grampians National Park. AUSRIVAS O/E scores generally of reference quality. Seven sites were mildly impacted.

North Central - Twenty three sites, mostly within cropping or grazing land. AUSRIVAS O/E scores generally of reference quality. Eight sites were mildly impacted. One site was severely impacted.

AUSRIVAS O/E Score

The Australian Rivers Assessment System (AUSRIVAS) consists of several mathematical models which use field data to predict the aquatic macroinvertebrate families which would be expected to be present in specific stream habitats under reference conditions - that is, if there were no environmental impacts.

Following field sampling of sites, a ratio of the *observed number of macroinvertebrate families* to the *expected number of families* (the O/E score) can be calculated for each test site.

The value of the O/E index can range from zero (none found) to around one (all families which were expected were found). A score of greater than one indicates more families were found at the site than were predicted by the model.

Corangamite - Thirty sites, generally within cropping and grazing land. AUSRIVAS O/E scores generally of reference quality. Five sites were mildly impacted.

Port Phillip - Eighty sites, more than half in the Melbourne metropolitan area. AUSRIVAS O/E scores generally acceptable in the non-urban areas. Within urban areas, around half the sites were moderately to severely impacted. Four sites were highly degraded. The remainder were generally in good condition.

Goulburn Broken - Twenty two sites, mostly within agricultural areas. Six sites in undisturbed forested areas in the upper part of the catchment. AUSRIVAS O/E scores generally of reference quality. Three sites were mildly impacted. Two sites were moderately to severely impacted.

West Gippsland - Twenty nine sites, within a wide range of land uses, from intensive agriculture to relatively undisturbed forested catchments. AUSRIVAS O/E scores generally of reference quality. Four sites were mildly impacted.

North East - Twenty eight sites, within a wide range of land uses, from natural upland headwaters of streams, to intensive agriculture and small urban catchments. AUSRIVAS O/E scores generally good.

East Gippsland - Thirty five sites, within a wide variety of land uses, from intensive agricultural areas to a number of relatively undisturbed upland catchments. AUSRIVAS O/E scores generally of reference quality.

Map 28 shows Stream Health, as determined by the AUSRIVAS ratio of observed over expected macroinvertebrates, at 280 sites on 177 streams, monitored from 1994 to 1996. No sites were monitored in the Mallee CALP Region.

Data Limitations

- The scores indicate Stream Health *at the sampling site shown*. Further analysis of point source and dispersed pollution, and other catchment disturbances, is required before the values can be used to categorise the health *of a particular length* of stream.
- The scores are for the stream sampled. They do not necessarily represent all the streams in a Region.
- The information available from this stage of the program is deliberately biased towards an over-representation of better quality streams. The scores are based on data from the developmental phase of the program and present a best possible view of current stream conditions.
- This measure is very new and is still undergoing considerable research.

Data Collection and Analysis

Aquatic macroinvertebrates are very useful indicators in biological monitoring. They are visible to the naked eye and are commonly found in streams. They are an important source of food for fish, and many are well known to anglers - such as yabbies, mudeyes, stoneflies and mayflies. They are widespread, easy to collect, relatively immobile and reflect the build-up of impacts of environmental change on the stream ecosystem.

Monitoring sites have been selected to include a variety of sites, representative of the waterways in each river basin.

To build up the reference site database for AUSRIVAS modelling, most sites were chosen in stream reaches that were relatively unimpacted. These comprised 80-90% of the sites in most regions. About 10-20% of the sites sampled were subject to some form and degree of disturbance, although most were situated away from any obvious point source of pollution. Between 1997 and 1999, EPA will be sampling between 400 and 600 disturbed or impacted sites.

Contact

Lisa Dixon, Freshwater Sciences, Environment Protection Authority

Stream Health, 1994 - 1996

Table 4: AUSRIVAS Score Categories for Observed / Expected Macroinvertebrate Families

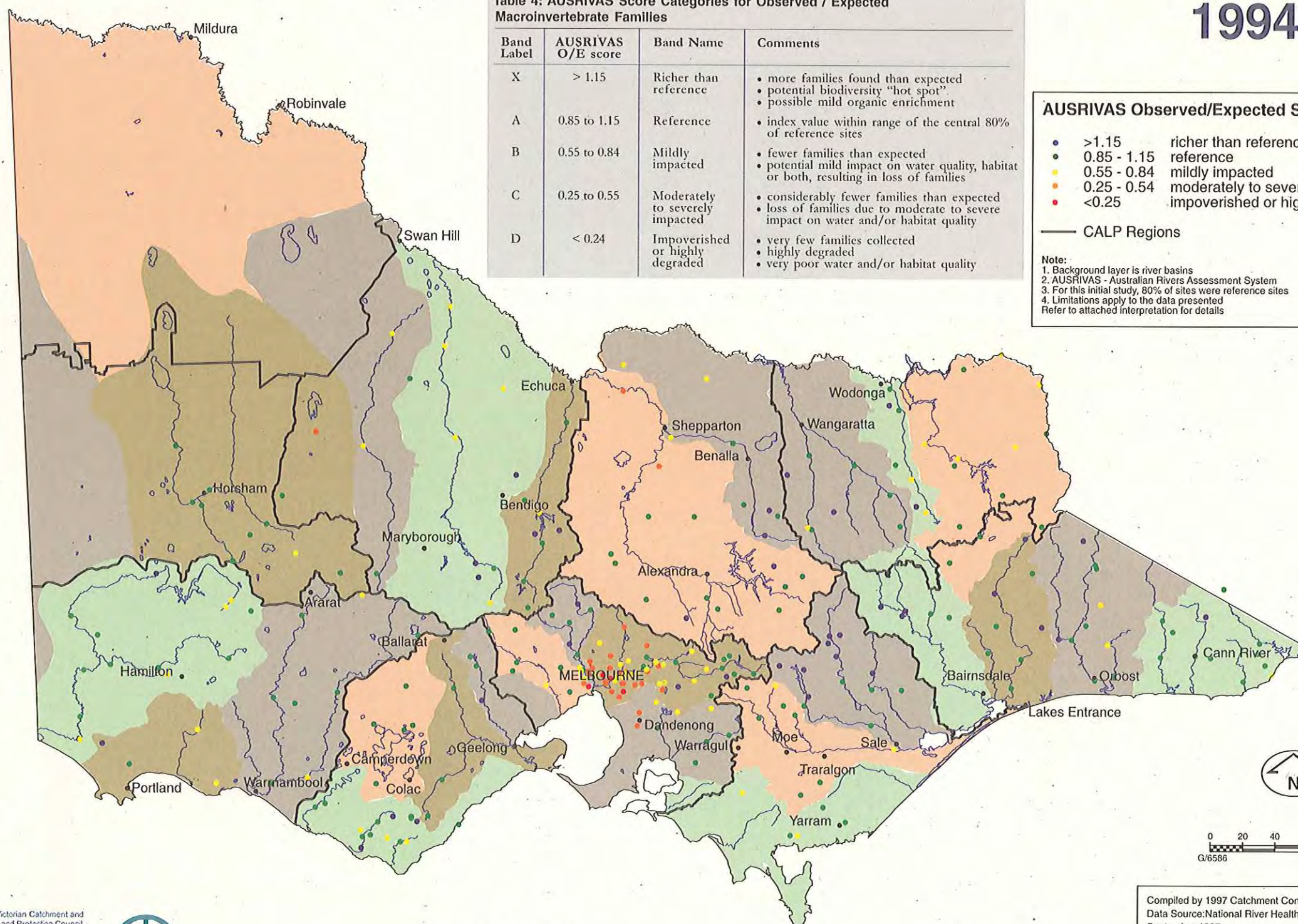
Band Label	AUSRIVAS O/E score	Band Name	Comments
X	> 1.15	Richer than reference	<ul style="list-style-type: none"> more families found than expected potential biodiversity "hot spot" possible mild organic enrichment
A	0.85 to 1.15	Reference	<ul style="list-style-type: none"> index value within range of the central 80% of reference sites
B	0.55 to 0.84	Mildly impacted	<ul style="list-style-type: none"> fewer families than expected potential mild impact on water quality, habitat or both, resulting in loss of families
C	0.25 to 0.55	Moderately to severely impacted	<ul style="list-style-type: none"> considerably fewer families than expected loss of families due to moderate to severe impact on water and/or habitat quality
D	< 0.24	Impoverished or highly degraded	<ul style="list-style-type: none"> very few families collected highly degraded very poor water and/or habitat quality

AUSRIVAS Observed/Expected Score

- >1.15 richer than reference
- 0.85 - 1.15 reference
- 0.55 - 0.84 mildly impacted
- 0.25 - 0.54 moderately to severely impacted
- <0.25 impoverished or highly degraded

— CALP Regions

Note:
 1. Background layer is river basins
 2. AUSRIVAS - Australian Rivers Assessment System
 3. For this initial study, 80% of sites were reference sites
 4. Limitations apply to the data presented
 Refer to attached interpretation for details



Map 28
Stream Health, 1994-96, as determined by
AUSRIVAS, using macroinvertebrates

Algal Blooms

Background

The frequency and intensity of algal blooms, particularly toxic varieties of blue-green algae (cyanobacteria), have become an ever increasing problem in south-eastern Australia over recent years, for both the environment and for domestic, agricultural, industrial and recreational users of water.

Algal blooms result in the depletion of dissolved oxygen and the production of toxins. Toxic blooms can have serious health implications for recreational users, and humans, animals and birds when contaminated water is contacted or consumed.

The growth of algae is influenced by a number of environmental factors including nutrients, light, temperature, turbidity, pH, conductivity, salinity, carbon availability, river flow and water storage levels. The development of an algal bloom is the result of a complex interaction of the above factors. The combination of factors that trigger and sustain an algal bloom is not well understood at present and it is not possible to attribute algal blooms to any specific factor.

Waterbodies that are affected by algal blooms, have high nutrient concentrations, or are perceived to be at risk from eutrophication, need to be properly identified. This will assist the development of appropriate catchment management strategies to address water quality issues.

Results

- Algal Blooms have generally been recorded in waterbodies located in the lower reaches of river basins, where catchments are more likely to have been modified by agriculture and urbanisation. Nutrient levels at these monitoring sites also tended to be higher than those recorded in upper catchment areas, especially for phosphorus.
- Over 400 algal blooms have been recorded in Victoria since 1928. The records include those of blue-green algae and of true algae. Prior to 1994, approximately 84% of the recorded blooms were blue-green algae.
- The number of reported blooms has shown a steady increase since the early 1990s. Prior to the 1990s, less than 10 blooms were recorded per year. Higher public awareness of algal blooms and increased monitoring may account for this

Reference

Cottingham, P., Bennison, G., Dunn, R., Lidston, J. and Robinson, D., 1995, *Algal Bloom and Nutrient Status of Victorian Inland Waters*, Vic. Dept. Conservation and Natural Resources.

increase in recordings. The number of algal blooms recorded pre-1990s is presumed to be an under-estimate of the number of blooms.

- The river basins with the highest number of recorded blooms (>9) were the Loddon, Wimmera-Avon, Bunyip, Broken, Goulburn, Mallee, South Gippsland, Yarra, Hopkins, Campaspe and Werribee.
- The East Gippsland and Snowy River Basins had no records of algal blooms.
- Lakes and reservoirs have had higher levels of recorded blooms, which are presumably favoured by the still conditions. This also reflects the number of users or observers of these waterbodies. Wetlands had the lowest number of recordings, possibly reflecting the lower human use.

Algal Blooms

While there is no general agreement on what level of algal biomass constitutes a bloom, it is generally accepted that the term encompasses any concentration of phytoplankton sufficient to impair water quality.

An algal bloom is defined as:

- the visible appearance of free floating algae or distinct discolouration of surface water (greening); and/or
- an algal cell count greater than 2,000 cells/ml of water.

Map 29 shows the locations of Algal Blooms recorded between 1928 and mid 1994, and Blue Green Algal-Bloom recorded between mid 1994 and mid 1995.

Data Limitations

- It is not possible to determine whether the increasing number of algal blooms recorded in Victoria in recent years is real or perceived, as there is little reliable historical information against which recent data may be compared. However, the recent high number of blooms suggests that the potential for future algal blooms in inland waters remains high.
- Data is limited by changing public awareness over the recording period and the unstructured method of data collection. Prior to the establishment of the Victorian Blue-Green Algae Project Team in late 1991 there was no system for recording algal bloom data in Victoria.
- The actual number of algal blooms in Victorian inland waters, particularly wetlands and estuaries, is likely to be far higher than recorded. Water quality and algal monitoring is more widespread in rivers, lakes and reservoirs than in wetlands and estuaries, and this is reflected in the number of recorded algal blooms.

Data Collection and Analysis

The incidence of algal blooms including blue-green algae recorded on Victoria inland waterways was sourced from a range of historic and current sources. The data up to and including 1994 was sourced from Cottingham et al., 1995. Since 1991, records have been compiled by the Algal Bloom Registry, DNRE.

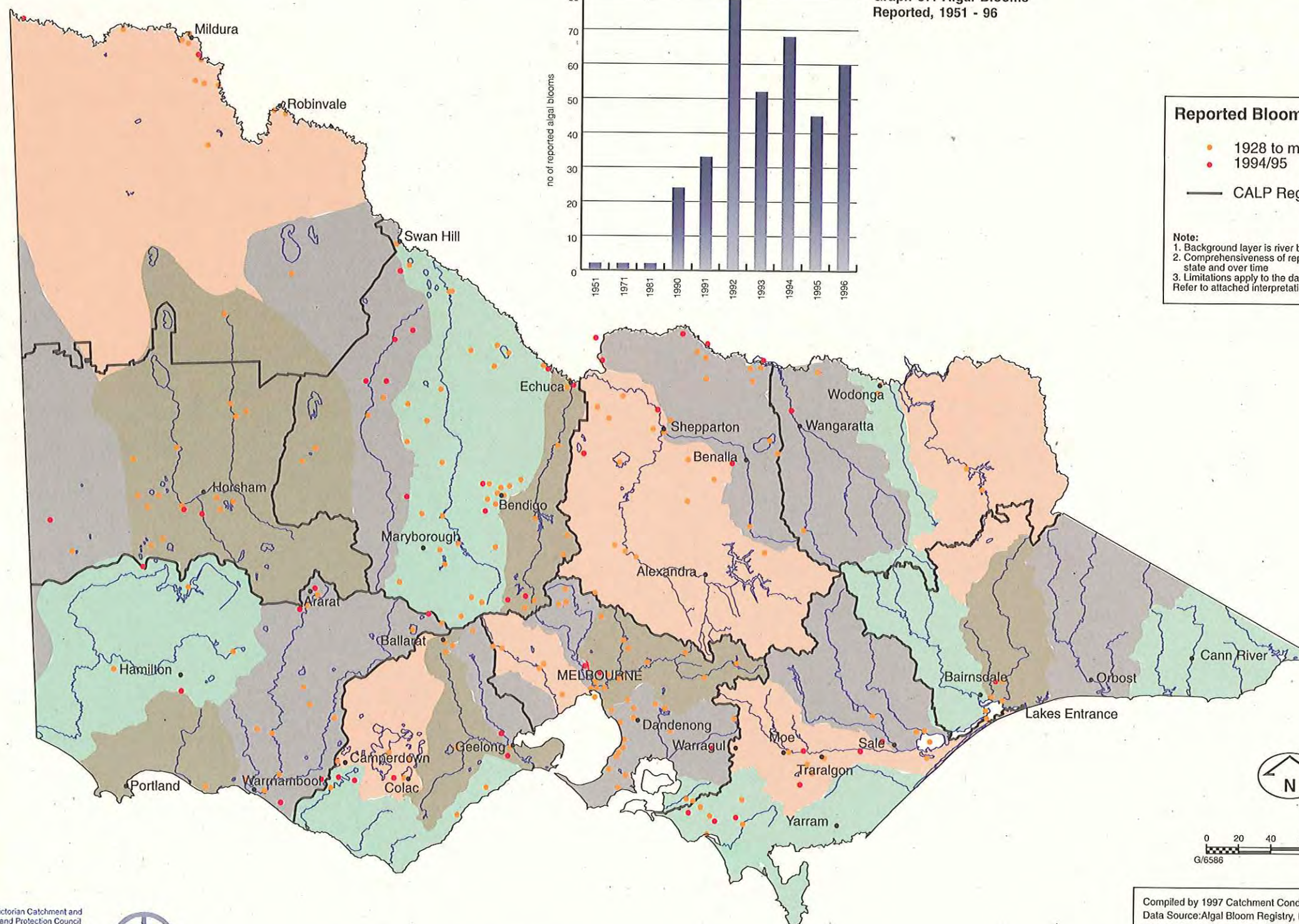
Since 1994 only blue-green algal blooms have been recorded.

The revised Victorian Water Quality Monitoring Network (VWQMN), and the Major Storage's Operational Monitoring Program introduced in 1992, will allow a more detailed analysis of the temporal occurrence of algal blooms and the nutrient status of surface waters as data accumulates.

Contact

Ross Perry, Water Bureau, DNRE

Algal Blooms



Map 29
Algal Blooms Reported, 1928-1995

Streams Protected from Livestock

Background

Fencing of streams to exclude stock has a variety of benefits including controlling stream bank erosion to allow regeneration of vegetation; protecting ecologically important habitat; improving water quality; and improving aquatic native habitats by reducing sediment and nutrient loads in streams.

Data Collection and Analysis

The Australian Bureau of Statistics (ABS) Agricultural Census is distributed to all landholders across Australia whose businesses meet a minimum gross income criterion. Individual forms remain confidential to the ABS. Statistics are supplied to DNRE only as aggregated data for parishes.

In 1993/94 farmers were asked to provide *the total area of river/creek frontage on their holding and the area of this frontage from which stock were excluded, at March 1994*. The following year, 1994/95, farmers were asked *the length of fencing constructed in that year to further protect river and stream sides, at March 1995*.

Stream lengths on Graph 38 are as recorded by landholders in the Agricultural Census.

Results

The distinct differences between CALP Regions can in part be explained by the distribution of farmers and streams. East Gippsland and North Central CALP Regions contain the greatest length of rivers and tributaries in Victoria. The Mallee CALP Region has by far the least. In other catchments, such as East Gippsland, many kilometres of stream frontage occur on public land.

- During 1994/95, fencing was reported on an additional four to six per cent of stream length in most catchments.
- No distinct pattern of stream fencing across the state is shown.
- Parishes showing the highest amount of stream fencing are spread across the state.
- High levels of stream fencing were reported in only a few areas, such as the western area of Port Phillip, the south east of Goulburn Broken and the north west of Glenelg CALP Regions.

Mallee and Wimmera CALP Regions

Have low stream density and far fewer farms than other catchments. Therefore, lower lengths of streams are protected.

Glenelg, North Central and Port Phillip CALP Regions

Contain the greatest proportion of streams protected on farmland.

Goulburn Broken CALP Region

The highest area of streamsides reported on farmland, but one of the lowest rates of protection. The low rate of protection may reflect the higher density of streams on each farm.

East Gippsland CALP Region

Contains the greatest length of streams, but also the greatest area of public land. Therefore, very little fencing of streams on private land is reported.

Map 30 shows the total Length of Stream Frontage Protected from Grazing by Livestock in each parish across Victoria, to March 1995. This may occur through fencing or by being otherwise inaccessible to stock.

Graph 38 shows total stream lengths from which stock were excluded in 1993/94, the area of additional exclusion in 1994/95 and the length of stream which remained accessible to stock at March 1995, for each CALP Region.

Data Limitations

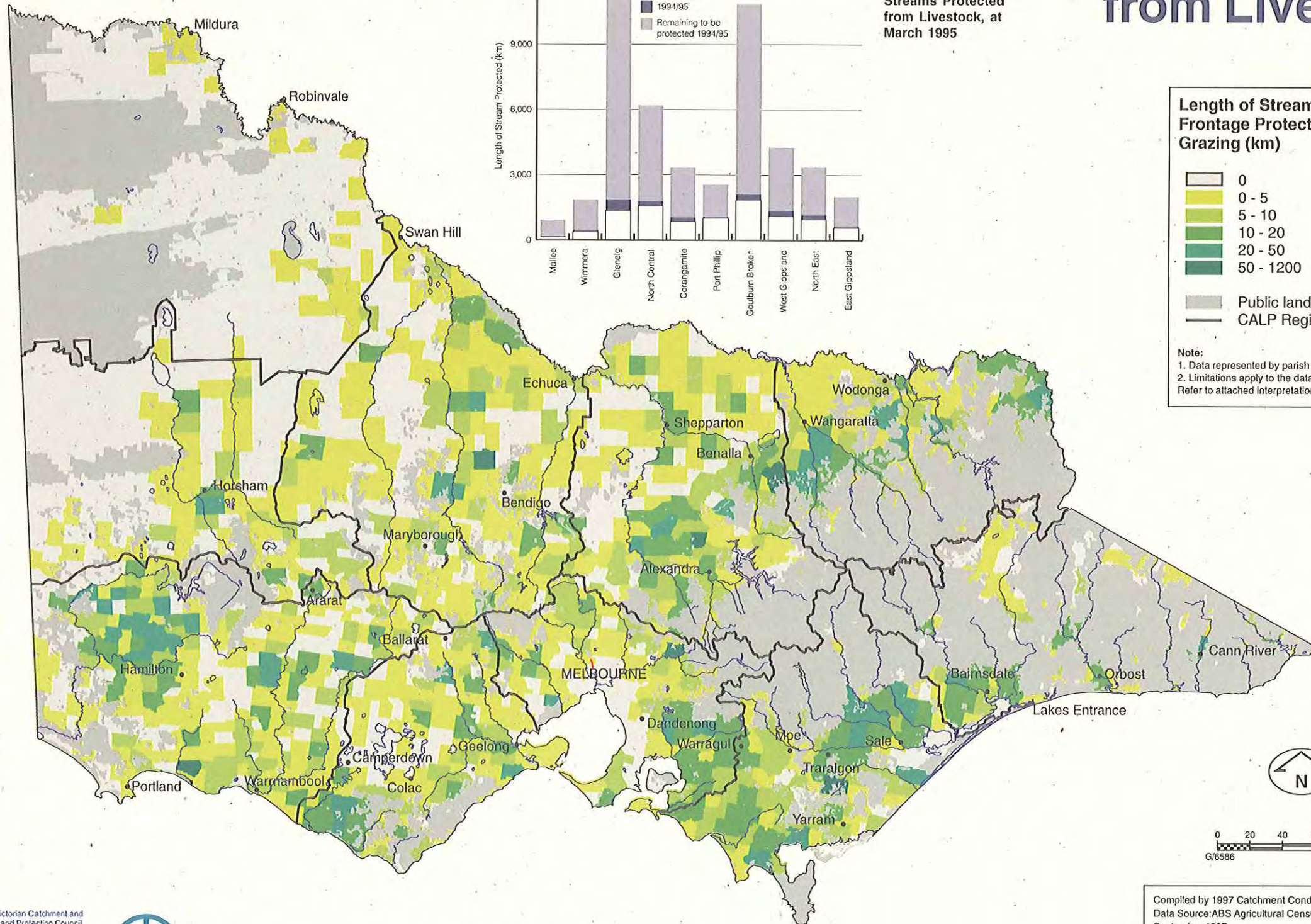
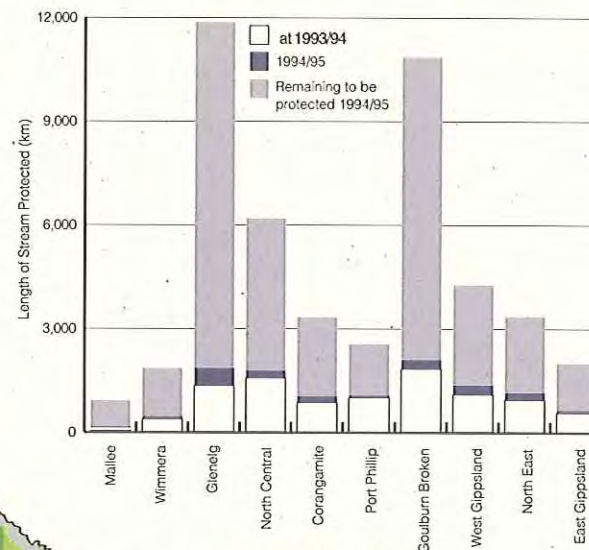
There are a number of limitations to using Australian Bureau of Statistics (ABS) data to determine the protection of watercourses on Victorian farms:

- Using data from only two years to draw conclusions about the adoption practices of farmers should be treated with caution.
- Data is presented at a parish level. Therefore, the stream length shown as protected may represent many farmers protecting smaller areas, or just a few protecting larger areas.
- The percentage of watercourses that are protected within the parish is not shown. A small area protected in a parish with few watercourses may be more significant than a large area protected within a parish with very large stream lengths.
- Only streams protected on private *farm* land is reported. In catchments such as Port Phillip, many landholders are not defined as farmers by the ABS. Thus, many kilometres of streams on private land are not included in the ABS survey.
- The relative importance of the stream protected is not shown. Streams with a high priority for protection include those with highly erodible soils, high conservation priority stream habitats, or streams already severely degraded. A small area of fencing of these higher priority streams may represent a significant achievement in stream protection. Conversely, large areas of lower priority stream habitat may be protected within some parishes.

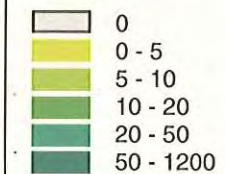
Contact

Jodie Cray, Natural Resource Monitoring and Assessment, CMSA, DNRE, Bendigo

Streams Protected from Livestock



Length of Stream Frontage Protected from Grazing (km)



Public land
CALP Regions

Note:
1. Data represented by parish
2. Limitations apply to the data presented
Refer to attached interpretation for details



0 20 40 60 80 100
Kilometres
G/6586

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: ABS Agricultural Census, 1993/94 and 1994/95
September 1997

Saltwatch and Waterwatch, 1987 - 1997

Waterwatch

Waterwatch is a National Program introduced into Victoria in 1991. Waterwatch brings together schools and community groups, Landcare groups, and landowners, councils and water authorities to test the quality of their local stream or water source so that practical actions can be taken to maintain and improve water quality.

Most monitoring programs involve surveys of stream habitat, macroinvertebrates and algae as well as tests to monitor the physical and chemical conditions of the water. Results are monitored and recorded in central databases through catchment coordinators. Action workshops are then arranged to discuss the causes and effects of water degradation, and to plan the actions required to repair the damage.

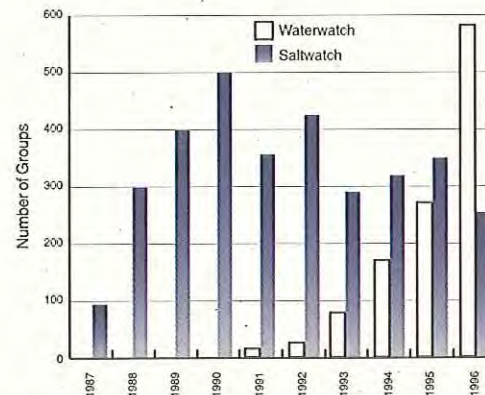
Anecdotal evidence from the 18 co-ordinators around the state suggests that landholders are serious monitors both in terms of regularity of monitoring and commitment to quality assurance. For landholders, turbidity, reactive phosphorus and EC are the most popular parameters. The program is rapidly gaining a reputation for its collaborative scientific projects and valuable input into the newly formed Catchment Management Authorities.

Waterwatch is equally relevant for schools. The split between secondary and primary school involvement is 50/50 and the program is ideal in the way it fits into the current curriculum and provides real-world experiences beyond the classroom. Schools have historically focussed on the chemical and physical parameters. More recently, there has been more interest in biological monitoring, in particular, macroinvertebrates and habitat assessment.

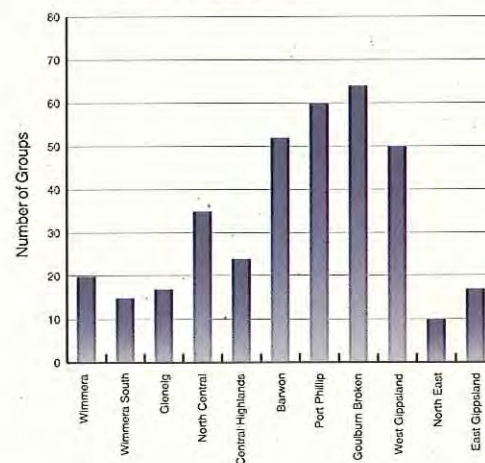
Results

In Victoria, Waterwatch is seen as an ideal partner to the Landcare program. The number of Waterwatch groups has steadily increased from 16 in 1993, to 570 groups monitoring 1,238 sites in 1996. Over a third of these participants are landholders or members of Landcare groups.

Graph 40: Groups Participating in Saltwatch and Waterwatch, 1987 - 97



Graph 41: Groups Participating in Waterwatch Snapshot Program, 1997



While Waterwatch is a year round activity, the Waterwatch *Snapshot* program, like Saltwatch, is a week long program occurring once each year.

Graphs 39 (a to k) show the number of Groups Participating in Saltwatch from 1987 to 1996, for each CALP Region.

Saltwatch

Saltwatch traditionally takes place in the second week of May.

Each year approximately 300 groups from around Victoria register with the Saltwatch program. On average each group collects 20 samples from their local rivers, creeks, dams and bores. Perhaps once considered a rural event, particularly in areas of salinity, more and more groups have recognised the educational benefits of the program - practical, environmental monitoring, cross-curriculum activities, skills including mapping, entering results on computer, graphing, analysing and contrasting the local environment with other areas of the State.

Schools and local landcare groups working together are also an important feature of the program and more and more of these partnerships have developed across the State. Saltwatch has often been a catalyst for further environmental projects between community groups.

Saltwatch has seen many changes since its inception ten years ago. A Saltwatch Web site, launched in 1997, allows groups to up-load their data onto the Internet. Groups can therefore access data from around the State as soon as it is entered, and also communicate with other groups.

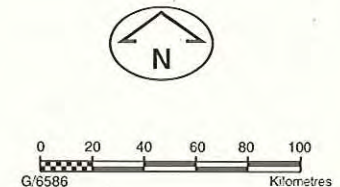
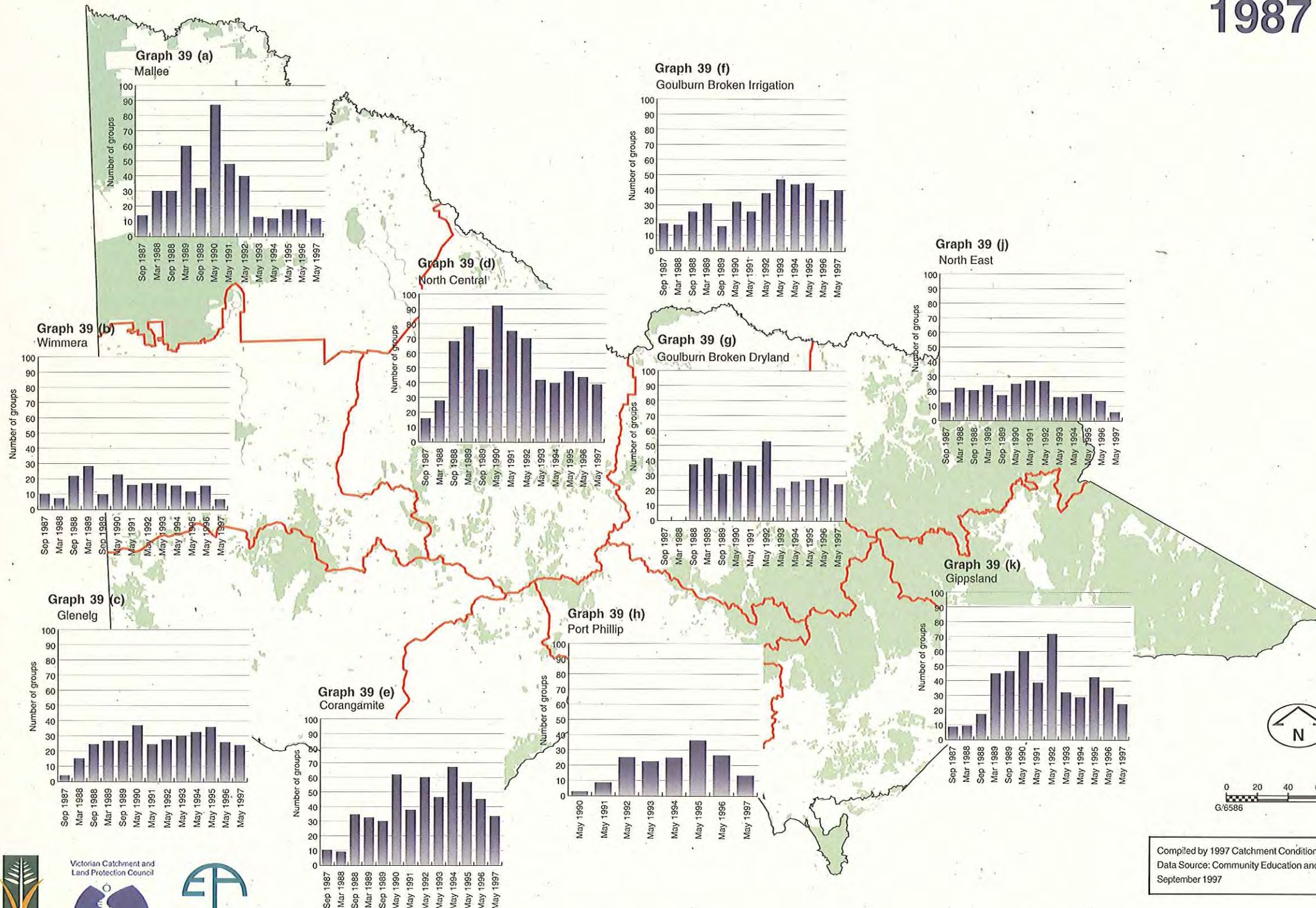
Because of the strong support of schools and community groups, Saltwatch is Australia's longest running environmental monitoring program.

Contact

Waterwatch: Vera Lubczenko, Waterways and Floodplain Management, CMSA, DNRE

Saltwatch: Tarnya Kruger, Community Education and Customer Research, CMSA, DNRE

Saltwatch and Waterwatch, 1987 - 1997



Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: Community Education and Customer Research, DNRE
September 1997

Public Awareness of Degraded Rivers and Catchments, 1988 - 1997

Background

Catchment protection needs the support of the urban population. It is important that not just rural Victorians, but also Victorians living in urban and provincial areas appreciate the importance of the work of the Catchment Management Authorities.

These indicators present the results of surveys of Victorian's concern for degraded rivers and catchments and compares this to their concern for environmental issues in general.

Results

Concern for rivers and catchments is a middle ranking issue for urban Victorians, whether in provincial towns or Melbourne. Concern rose from 1988 to 1989, fell in the intervening period to 1994, and rose between 1994 and 1997.

In rural areas, the concern for rivers and catchments has risen consistently since 1989. By 1997, rural concern for catchment health equalled that of urban Victorians. This rise in concern is a reflection of the success of the Landcare movement.

Graphs 42 (a to j) show the level of concern for *Degraded Rivers and Catchments* compared to the level of *General Environmental Concern*, for rural and urban residents in each CALP Region, from 1988 to 1997.

Data Collection and Analysis

Surveys of public opinion about catchment management issues were undertaken in 1988, 1989, 1994 and 1997, by the market research firm Reark. These surveys were conducted with samples from rural areas, from provincial towns and from Melbourne.

Each respondent was asked to rank 9 issues based on how serious they consider each is to the future of Victoria. Rankings were from 1 to 10, where 10 is extremely serious.

The issues were

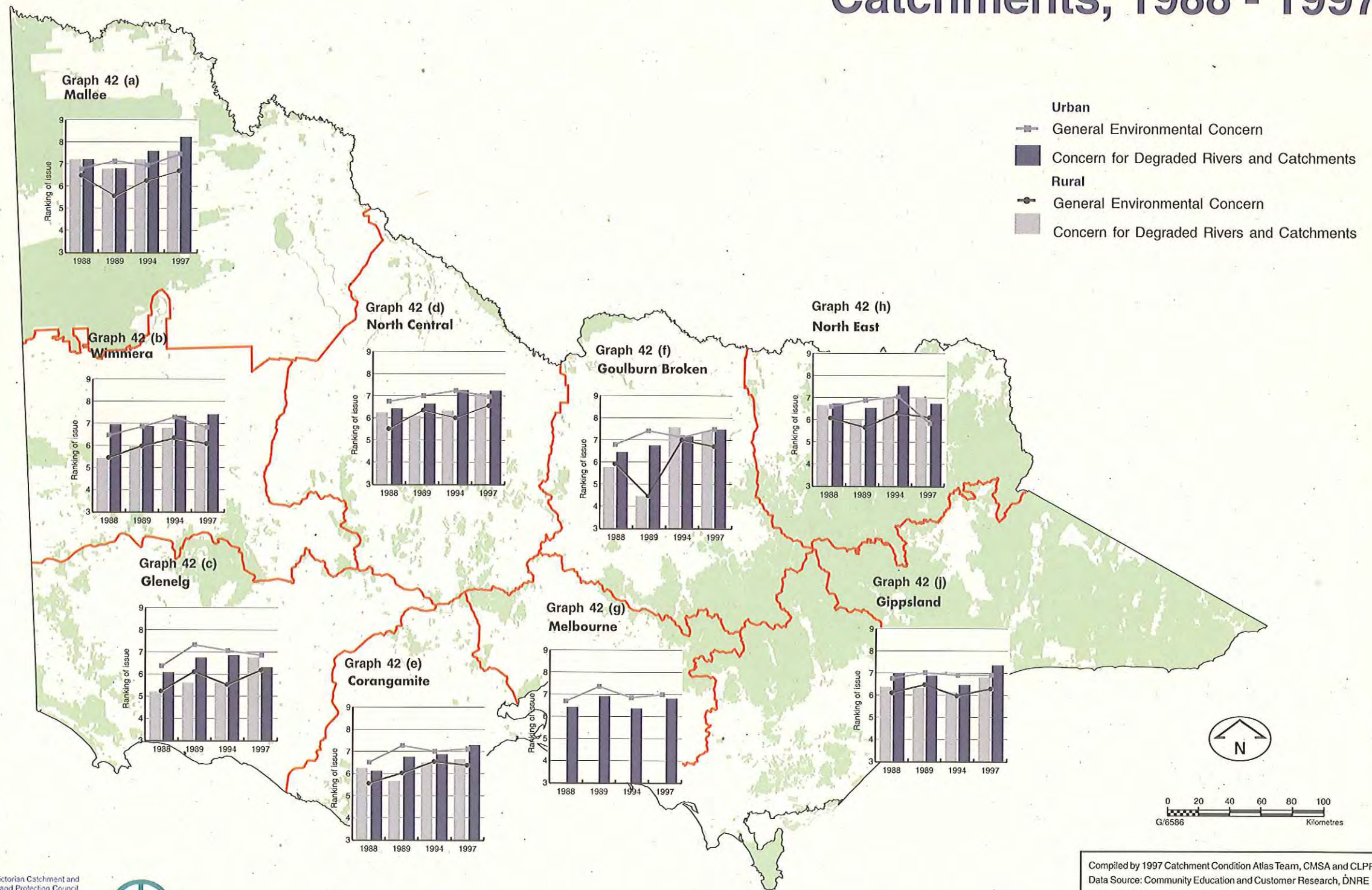
Soil Erosion; Salinity; Extinction of Plants and Animals; Loss of Native Forests; Degraded Rivers and Catchments; Destruction of Wetlands; Pollution; Not enough Waste Recycling; and Loss of Public Open Space.

For each CALP Region, the results for all 9 issues were averaged to provide an average *General Concern for Environmental Issues* for urban and rural residents.

Contact

Neil Barr and Mal Brown, Community Education and Customer Research, CMSA, DNRE, Bendigo.

Awareness of Rivers and Catchments, 1988 - 1997



Salinity and Watertables

Overview

Victoria has significant groundwater resources, although much of the groundwater is saline. Since European settlement, the replacement of native vegetation with crops and pastures, and the rise of irrigation developments have resulted in changes in the water balance. Throughout many areas of Victoria, this changed water balance has seen an increase in the height of saline groundwater, resulting in groundwater discharging to the surface in some areas. Discharge areas become saline, often waterlogged, support only salt tolerant vegetation, and often suffer from soil erosion. Rising groundwater is as much an environmental problem as a problem to agriculture and urban areas.

Many salinity control activities rely on vegetation management, such as tree planting on recharge areas, protecting remnant vegetation, improving management of dryland cropping and the sowing of higher water using perennial pastures. In irrigation areas salinity control is also achieved by improved management of water application.

Summary

- Around 2,200,00 ha of perennial pastures were resown in 1993/94.
- Approximately 120,000 ha of dryland areas are affected by secondary salinity.
- The majority of Salinity Management Plans are either exceeding or meeting their on-ground works targets.
- Rising groundwater trends remain a significant issue in most areas. Because of the long term nature of the problem, results of on ground activities will not be obvious for decades.
- In rural areas salinity is the greatest environmental concern.



Salinity and Watertables

Trends in Watertable Depth, 1997

Dryland Salinity, 1997

Perennial Pasture Established, 1993/94

Irrigation Management Practices,
1990 - 1996

Salinity Awareness, 1988 - 1997

Trends in Watertable Depth, 1997

Background

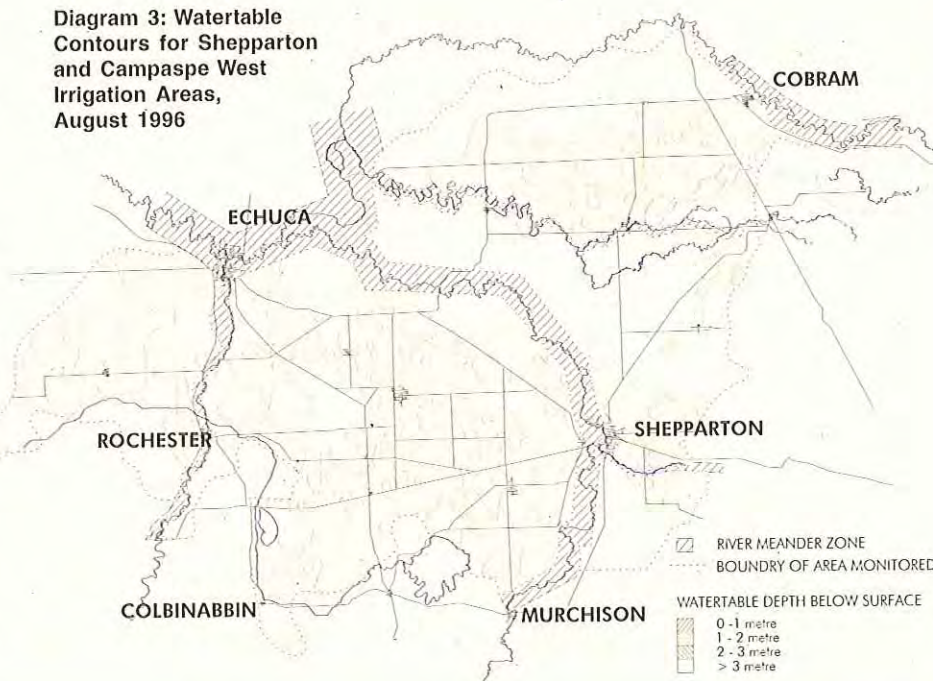
The watertable is defined as the uppermost surface below which strata are completely saturated. The watertable trend is the change measured in the watertable level or depth over time and is usually represented as a hydrograph.

The focus is usually on obtaining the long term underlying trend. This is often masked by events of shorter periodicity, such as annual climatic events. Therefore, considerable length of record needs to be achieved (often greater than 5 to 10 years) before long term trends can be confidently determined.

The four Trend Categories (see Box, p73) are applied to two sets of observation bores in each region - those which currently have standing water levels of ≤ 3 m below ground surface, and those which currently have standing water levels of >3 m below ground surface.

Watertable assessment for the Shepparton and Campaspe West Irrigation Areas is undertaken as a series of contour maps. Contours for August 1996 are shown on Diagram 3.

Diagram 3: Watertable Contours for Shepparton and Campaspe West Irrigation Areas, August 1996



Results

It is important to note that in areas with shallow watertables a flat trend does not necessarily indicate that there is no issue or problem.

Dryland areas

- The northern catchments contain around 30% of deeper (>3 m) watertables that exhibit significant long term rising trends. This is significant as trends cannot be detected from up to 50% of the bores.
- The most widespread groundwater rises are occurring in the north-east of the State where more than 50% of all watertable bores are significantly rising. Rising trends of over 20 cm/yr have been detected in the alluvial plains of the Broken River catchment.
- In the Avoca, Avon Richardson and Wimmera catchments greater than 50% of deeper watertable bores exhibit significant rising trends.

- In the Mallee many bores are either rising (60%) or falling (35%). In the ≤ 3 m watertable depth population the significant rising/falling trend proportions are dampened, with a greater proportion of flat or indeterminate trends.

- In south-west Victoria there is a lower proportion of significant rising trends, despite a high incidence of salinity. This is thought to be either due to substantial land use change or climate.

Irrigation areas

- Consistently, 30-60% of both shallow and deeper watertable bores in the irrigation areas are classed as rising, suggesting the development of shallow watertables. Improved drainage and irrigation practices could alleviate this problem.
- The majority of the Shepparton Irrigation Area experiences watertables of ≤ 3 m depth from the surface (Diagram 3). This area showed an overall fall in watertables in 1996 compared to the previous year. However, the August 1995 study was influenced by above average rainfall in the months prior to data collection.

Graphs 43 (a to u) show Trends in Watertable Depth of bores with standing water levels ≤ 3 metres and > 3 metres, for each Salinity Region or Management Plan Area. These are averages (means) of a range of sampled bores in each Region.

Data Limitations

The derived statistics provide an indication of the general trend of a Region and do not attempt to describe the groundwater conditions in all parts of all areas under study.

Some of the main limitations in interpretation are:

- Insufficient length of record to give confidence in trends. Even 10 years of data may not be sufficient.
- Inaccurate or insufficient data due to inadequate monitoring frequency, bore measurement or database input errors.
- Sparse bore networks make interpolation of trends difficult.
- Bores are not distributed evenly over the state.
- The reasons for trends are not shown. These may result from general catchment condition, adoption of salinity control measures, general management practices or climate.

Data Collection and Analysis

Groundwater information has been accessed from existing reports, the Statewide Groundwater Database (managed by SKM) and the CLPR Groundwater Database.

Trend analysis has occurred in a number of ways:

- adapting information from recent groundwater trend reports
- rapid, relatively subjective appraisal of trends from selected hydrographs i.e. fit trend line by eye
- rigorous statistical analysis of hydrograph trends using regression techniques.

Trends for Goulburn Broken Dryland were developed by the Goulburn Broken Salt and Water Balance Study, 1996.

Contacts

Mark Reid, Centre for Land Protection Research, DNRE, Bendigo
Anthony Brinkley, Sinclair Knight Merz, Armadale

Trends in Watertable Depth, 1997

Trend Categories

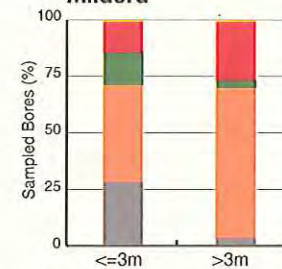
Significantly rising: a calculated rising trend of > 2.5 cm/year over the period of record.

Significantly falling: a calculated falling trend of > 2.5 cm/year over the period of record.

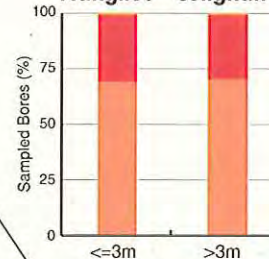
Significantly flat or stable: a calculated trend of between 0 and 2.5 cm/year over the period of record.

Inconclusive: no conclusion can be drawn from the data.

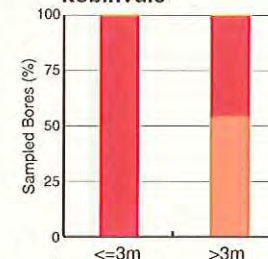
Graph 43 (b)
Mildura



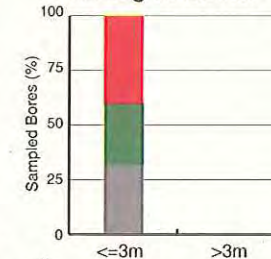
Graph 43 (c)
Nangiloc - Colignan



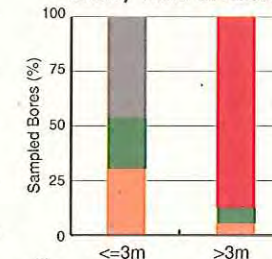
Graph 43 (d)
Robinvale



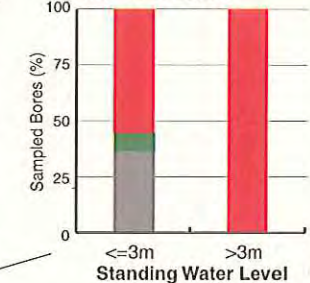
Graph 43 (e)
Kerang-Swan Hill



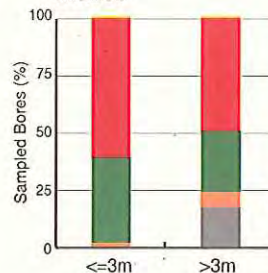
Graph 43 (f)
Boort, West of Loddon



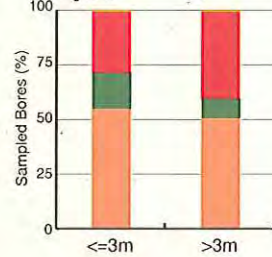
Graph 43 (g)
Torrumbarry,
East of Loddon



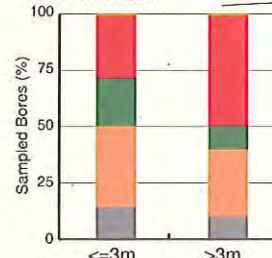
Graph 43 (a)
Mallee



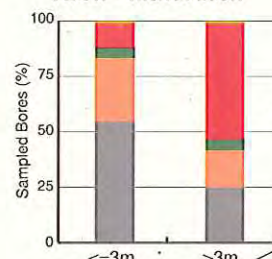
Graph 43 (u)
Nyah



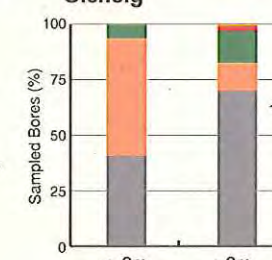
Graph 43 (t)
Wimmera



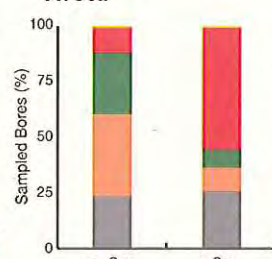
Graph 43 (s)
Avon - Richardson



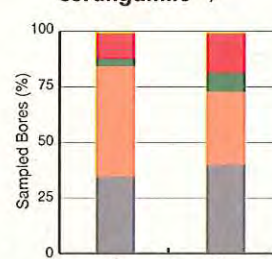
Graph 43 (r)
Glenelg



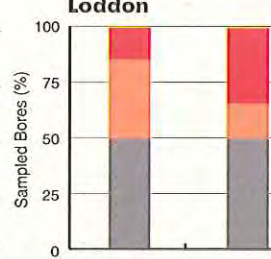
Graph 43 (q)
Avoca



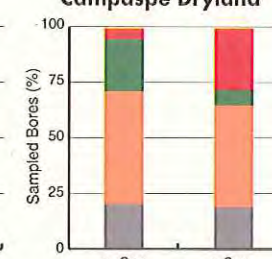
Graph 43 (p)
Corangamite



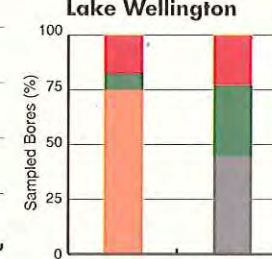
Graph 43 (n)
Loddon



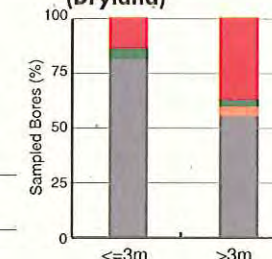
Graph 43 (m)
Campaspe Dryland



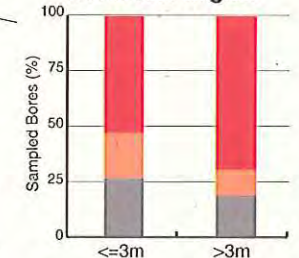
Graph 43 (l)
Lake Wellington



Graph 43 (k)
Goulburn Broken
(Dryland)



Graph 43 (j)
North East Region

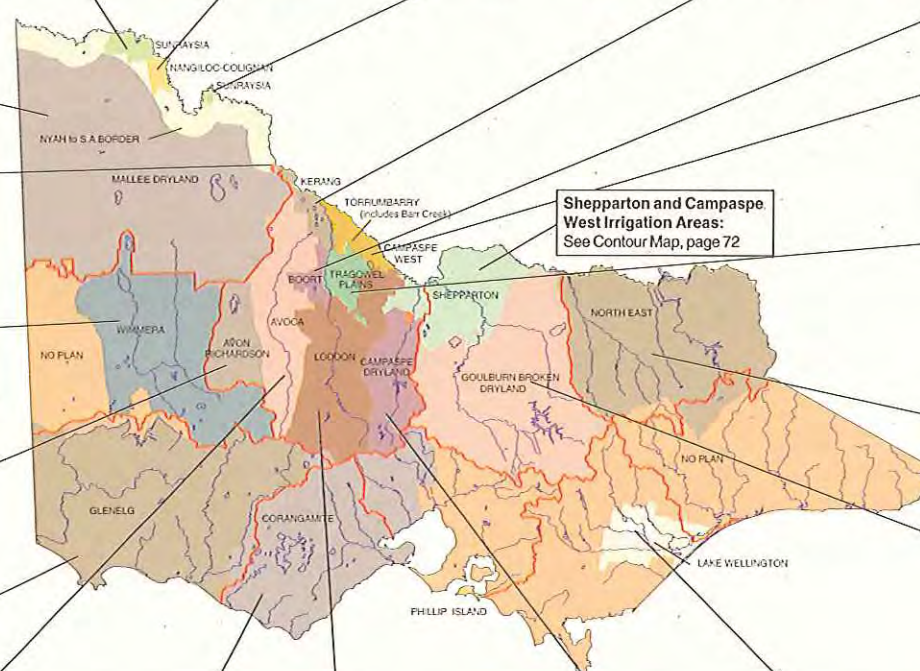


Proportion of Sampled Bores (%)

- Rising
- Falling
- Flat
- Inconclusive

Note:

1. Graphs show results for Standing Water Levels of ≤ 3 metres and > 3 metres.



Map 31

Salinity Regions and Management Plan Areas, 1997



Natural Resources
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Victorian Catchment and
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AUTHORITY

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: CLPR Groundwater Database; State Groundwater Database
September 1997

Dryland Salinity, 1997

Background

Large salinity discharge sites usually occur at the break of slope. Groundwater recharged through the more elevated areas with thin and/or more permeable soils is discharged in low lying areas. This problem is exacerbated when native tree cover over the higher recharge areas has been removed and replaced with shallow rooted annual vegetation.

Losses to agriculture and impacts on infrastructure and urban communities are the major costs of salinisation. Large areas of salinity have recently been recognised in urban centres, and it is likely that more land will be taken out of agricultural production in the future.

Management is centred on intercepting the groundwater before it discharges, through strategic plantings of deep rooted vegetation.

Table 5: Accurately Mapped Dryland Salinity, by CALP Region, 1997

CALP Region	Area of accurately mapped secondary salinity (ha)
Wimmera	16,348
Glenelg	2,234
North Central	27,635
Corangamite	15,250
Port Phillip	1,790
Goulburn Broken	4,900
West Gippsland	15,872
North East	123
East Gippsland	1,140
Total	85,292

Results

- Approximately 120,000 hectares of Victoria is affected by dryland salinity.
- The largest areas of dryland salinity occur on fine grained alluvial areas of the North Central and West Gippsland CALP Regions, as well as on saline finely textured sediments in the Wimmera CALP Region.

- In the sedimentary bedrock areas across the Central Highlands (Northern Footslopes RMU), rainfall is typically less than 800mm and recharge occurs through thin soils with high permeability under shallow rooted annual vegetation.
- Some of the CALP Regions have a higher total mapped area affected by secondary salinity, but a lower density of sites shown on the map. This occurs where there is a greater proportion of large sites (>200ha) than in other Regions.

Map 32 shows the location of Dryland Secondary Salinity Discharge Sites across Victoria, at 1997.

The background layer of the map is Resource Management Units (RMUs) of Victoria.

Data Limitations

The main limitation of the data is the uneven density of mapping across the state. Further work over the ensuing year will establish a benchmark of sufficient detail to enable assessment of progress, based on Catchment and Land Protection (CALP) and Salinity Management Plan (SMP) Regions.

In particular, more work on mapping saline areas is occurring in the Glenelg, North Central, North East and Wimmera CALP Regions. The data presented underestimates sites in these Regions.

Data Collection and Analysis

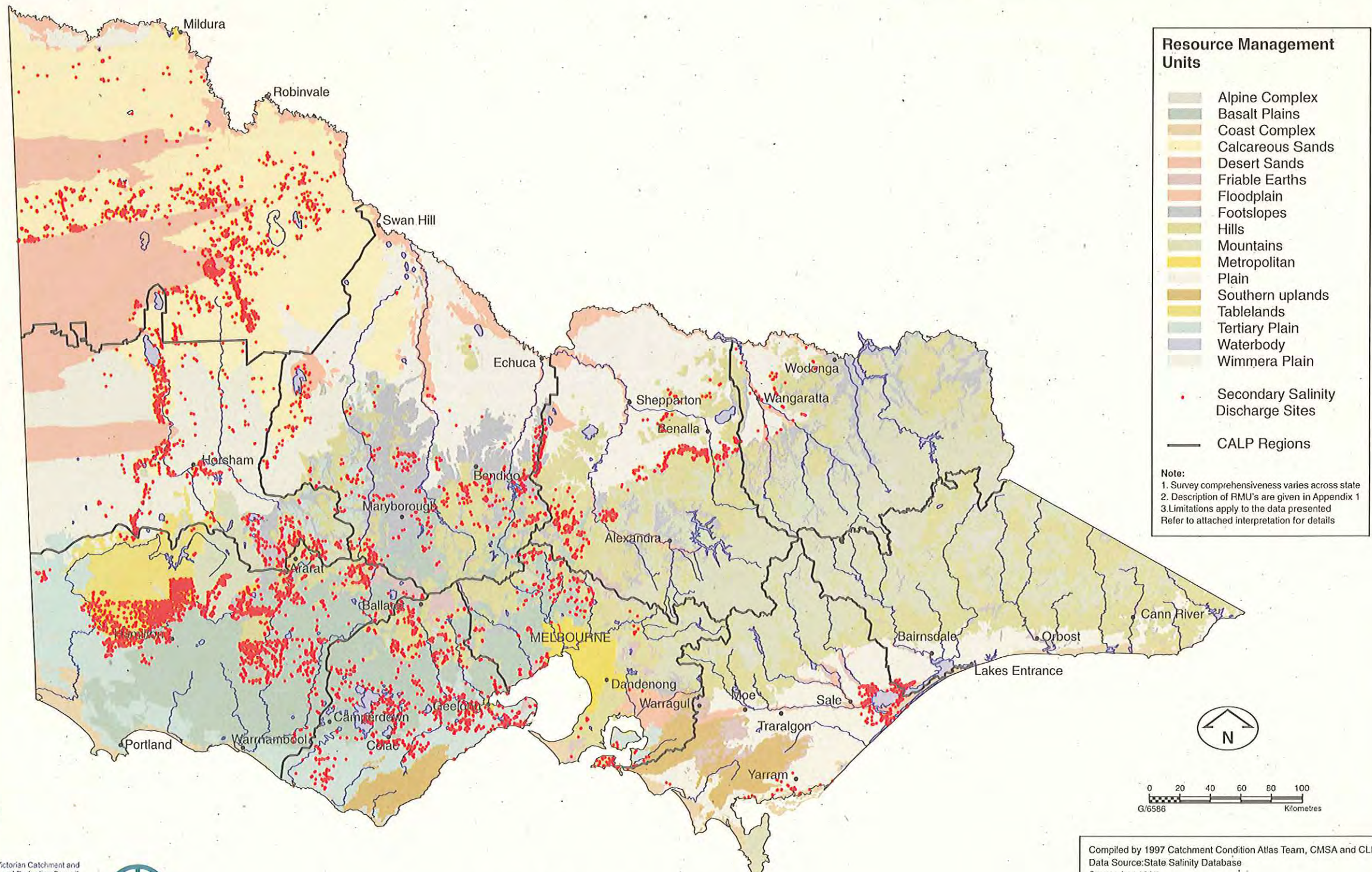
Data collection began in the late 1960s. Field assessment by regional staff was based on the presence of salinity indicator plants and aerial photos. Estimates of area were made for each site and entered on the State Salinity Database.

Since 1992, EM38 surveys have been used to map salt affected sites, and data have been stored on a Geographic Information System (GIS).

Contact

Sara Hill, Centre for Land Protection Research, DNRE, Bendigo

Dryland Salinity, 1997



Map 32
Dryland Secondary Salinity
Discharge Sites, 1997

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
 Data Source: State Salinity Database
 September 1997

Perennial Pasture Established, 1993/94

Background

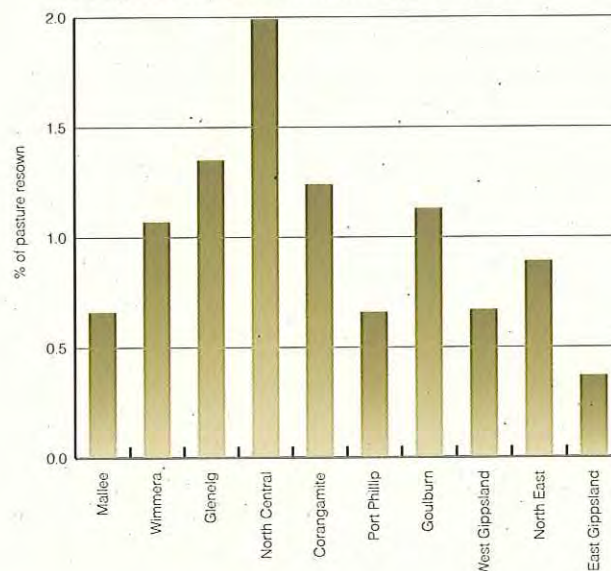
Replacing native vegetation with shallow rooted pastures and crops has resulted in an increase in salinity and soil erosion. Establishing perennial pastures on agricultural land is a long standing practice to control many forms of land degradation. Perennial pastures are most notably used for salinity control in lower rainfall areas.

For salinity control in higher rainfall areas, perennial pastures are an alternative to trees where land is to be retained in agricultural production.

Results

- The establishment of perennial pasture is greatest in those catchments where grazing industries predominate.
- The rate of perennial pasture resowing is generally lower than desirable, with rates only in the order of 0.3 to 2 per cent. This is due to a number of complex economic, demographic and social factors.
- High rates of sowing of perennial pasture occur on larger farms and where farmers are more motivated by productivity improvement.

Graph 45: Perennial Pasture Resown as a Proportion of Total Pasture, 1993/94



Map 33 shows the Area of Perennial Pasture Resown from March 1993 to March 1994, in each parish across Victoria.

Data Limitations

There are a number of limitations to using ABS data to determine the adoption of perennial pastures on Victorian farms:

- Using a single year's data to draw conclusions about the adoption practices of farmers should be treated with caution.
- Data is presented at parish level. Therefore, the area shown as resown may represent many farmers sowing smaller areas, or just a few sowing larger areas.
- The percentage of pasture within the parish that is resown with perennial pasture is not shown. A small area resown in a parish with small areas of pasture may be more significant than a large area resown within a parish with very large pasture areas.
- Where recharge is a significant problem, a small area of perennial pastures may represent a significant achievement, provided it is the high recharge areas that are resown. Conversely, large areas of low recharge potential may be resown within some parishes.

Data Collection and Analysis

The Australian Bureau of Statistics (ABS) Agricultural Census is distributed to all landholders across Australia whose businesses meet a minimum gross income criterion. Individual forms remain confidential to the ABS. Statistics are supplied to DNRE as aggregated data for parishes.

The total area of perennial pasture resown in 1993/94, was obtained by totalling the area resown to pure lucerne, mixture of lucerne and other pasture species, and mixture of perennial grasses and legumes

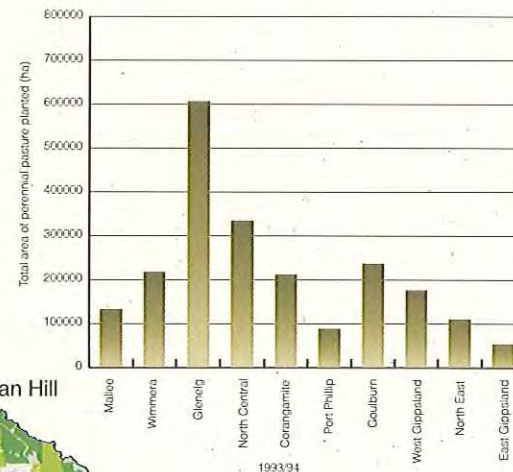
The rate of resowing was obtained by dividing this total area resown by the total area of pasture on each landholding.

Contact

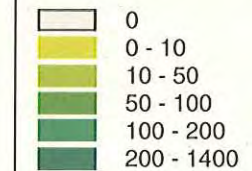
Jodie Cray, Natural Resources Monitoring and Assessment, CMSA, DNRE, Bendigo

Perennial Pasture Established, 1993/94

Graph 44: Perennial Pasture Resown, 1993/94



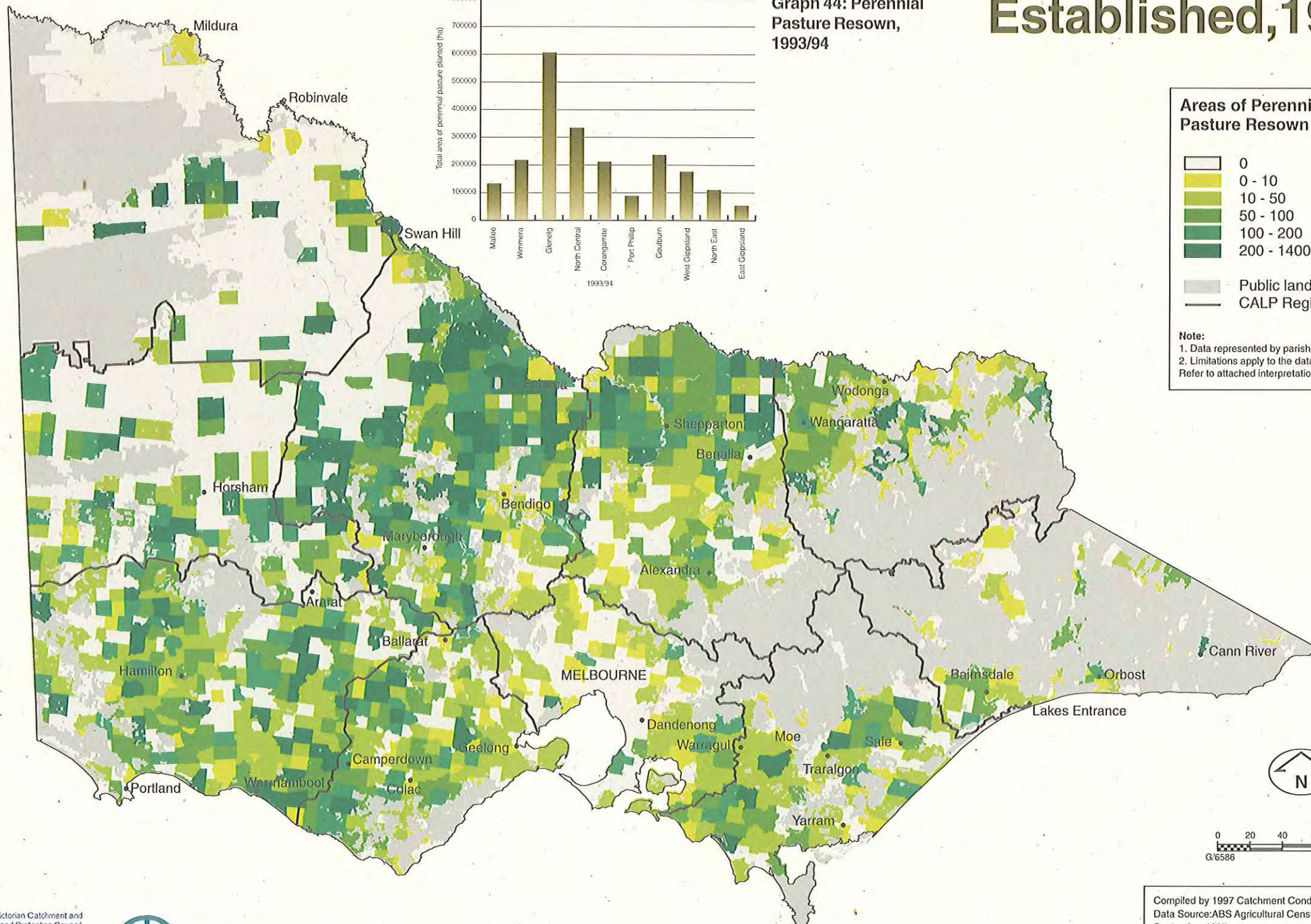
Areas of Perennial Pasture Resown (ha)



Public land
CALP Regions

Note:

1. Data represented by parish
2. Limitations apply to the data presented. Refer to attached interpretation for details



0 20 40 60 80 100
Kilometres
G/6586

Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: ABS Agricultural Census, 1993/94
September 1997

Map 33
Perennial Pasture Resown,
by Parish, 1993/94



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Victorian Catchment and
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AUTHORITY

Irrigation Management Practices, 1990 - 1996

Background

Victoria's Salinity Program has been in implementation now for almost 10 years. There are currently nineteen government endorsed Salinity Management Plans (SMPs) in operation across Victoria.

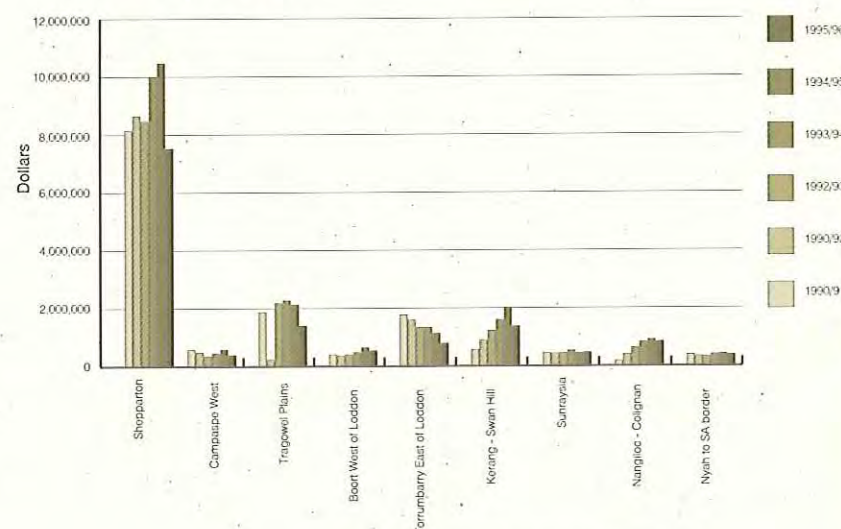
Only the SMPs in irrigation areas are included in this section, as management practices in dryland areas are reported on elsewhere in this report eg. perennial pastures and cropping practices.

To record progress of the SMPs, the extent of on-ground works reported in each Plan's Annual Report is measured against the targets set by the Plan prior to implementation.

Each of the Irrigation SMPs aims to achieve a unique mix of salinity control activities. In this report we have reported only on the activities that are deemed as being the most significant to each of the Plans.

Graphs were produced for a maximum of three of the more important indicators of implementation for each Irrigation SMP (except the Lake Wellington SMP).

Graph 47: Irrigation Salinity Management Plan Budgets, 1990/91 - 1995/96



Source: Victorian Salinity Program budget documents 1990/91 to 1995/96

Graphs 46 (a to q) show Irrigation Management Practices adopted under the Salinity Management Plans in irrigation areas, between 1990 and 1996, compared to the initial targets set at the launch of each plan.

Data Limitations

The success of the irrigation areas in achieving their targets for implementation is dependent on a variety of factors:

- The level of funding provided each year for on-ground works, staff resources and extension type activities.
- Factors out of our control, like commodity prices and seasonal conditions, also play a large role in determining the amount of work that is carried out.
- Targets set by Salinity Management Planning groups are often ambitious, and were set at a time before implementation budgets were known. In many cases the targets have remained at high levels even if expected budgets were not received.

Data Collection and Analysis

Targets and achievements for the past financial year are drawn from the Annual Reports of each Salinity Management Plan.

Works reported in the Annual Reports are obtained from the applications to carry out the works submitted by the landholders.

Results

The majority of the Plans are making strong progress towards their objectives. Most are either exceeding or meeting their targets for on-ground works.

Studying instances where implementation has been slower than planned, encourages the search for better ways of achieving the goal of salinity control. All plans are required to be reviewed annually to ensure that budgets are spent effectively and efficiently.

An analysis of the budgets (state and federal) that each Plan has received since 1990/91 is shown on Graph 47. The Shepparton Irrigation Region receives the most funding of all the irrigation plans each year. However, Shepparton is also the largest of the irrigation areas in terms of area, so on a \$/ha basis, it is not the most expensive of the irrigation Plans.

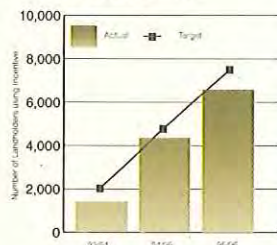
Contact

Jodie Cray, Natural Resources Monitoring and Assessment, CMSA, DNRE, Bendigo

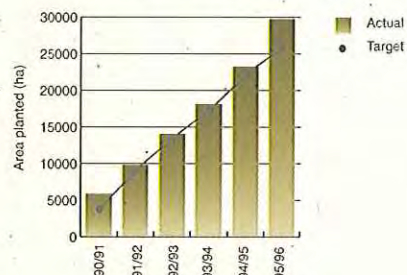
Irrigation Management Practices, 1990 - 1996

**Nyah to SA border
Graph 46 (a)**

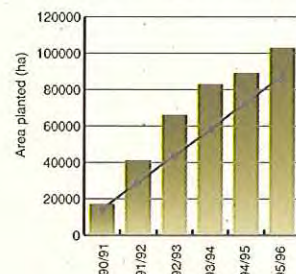
Development of water licences
in Low Impact Areas



**Tragowel Plains
Graph 46 (n)
Whole Farm Plans**

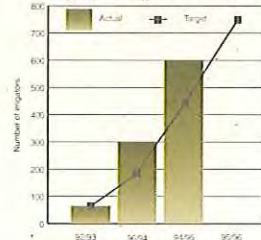


**Tragowel Plains
Graph 46 (p)
Soil Salinity Survey**



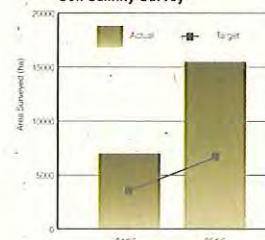
**Sunraysia
Graph 46 (b)**

Sunraysia - Irrigators Completing
Irrigation Management Courses

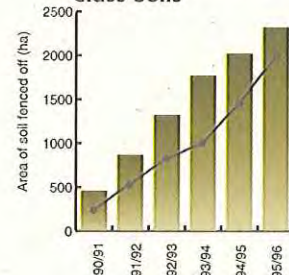


**Boort West of Loddon
Graph 46 (m)**

Boort West of Loddon
Soil Salinity Survey

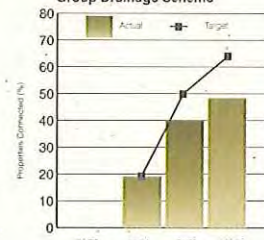


**Tragowel Plains
Graph 46 (q)
Fencing of C and D
Class Soils**



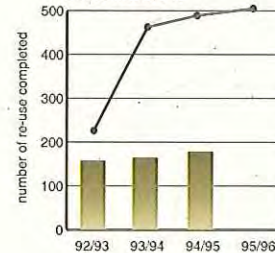
**Nangiloc - Colignan
Graph 46 (c)**

Nangiloc - Colignan
Group Drainage Scheme

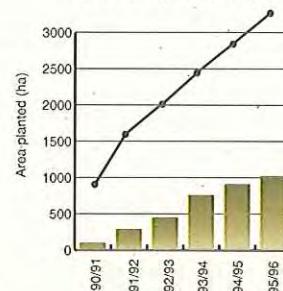


**Torrumbarry
East of Loddon
Graph 46 (l)**

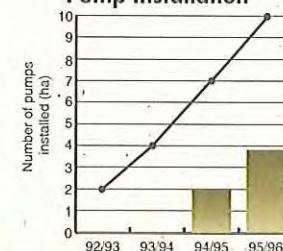
Re-use Systems
Constructed



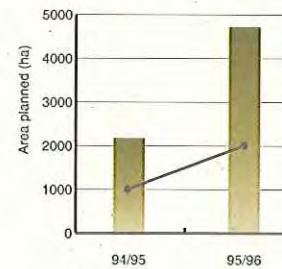
**Campaspe West
Graph 46 (k)
Whole Farm Plans**



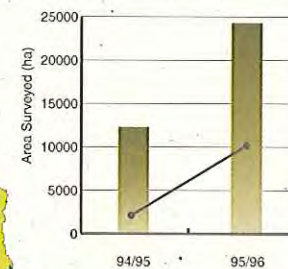
**Campaspe
Graph 46 (j)
Private Groundwater
Pump Installation**



**Kerang
Graph 46 (d)
Whole Farm Plans**

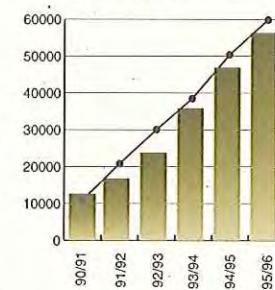


**Kerang
Graph 46 (e)
Soil Salinity Surveys**

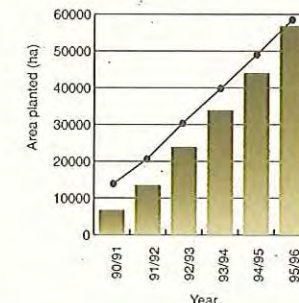


**Shepparton
Graph 46 (f)**

Farm Surface Drainage



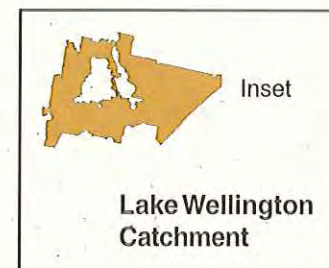
**Shepparton
Graph 46 (h)
Whole Farm Plans**



Salinity Management Plans

- Torrumbarry, East of Loddon
- Boort, West of Loddon
- Campaspe West
- Kerang
- Lake Wellington Catchment
- Nangiloc - Colignan
- Nyah Irrigation District
- Nyah to S.A. Border
- Shepparton
- Sunraysia
- Tragowel Plains

Note:
1. Limitations apply to the data presented.
Refer to attached interpretation for details.



Note:
No data are presented for
Nyah Irrigation District or Lake
Wellington Catchment

Salinity Awareness, 1988 - 1997

Background

Catchment protection needs the support of the urban population. It is important that not just rural Victorians, but also Victorians living in urban and provincial areas appreciate the importance of the work of the Catchment Management Authorities.

These indicators present the results of surveys of Victorian's concerns for Salinity and compares this to their concern for environmental issues in general.

Results

The concern for salinity continued to rise between 1988 and 1994, and then fell from 1994 to 1997.

Urban

The Melbourne sample showed that in 1988, people were least concerned about salinity, but this then rose significantly between 1988 and 1989, and again between 1989 and 1994. This latter rise in concern was against the trend in concern of other environmental issues. This pattern occurred elsewhere in Australia and has been linked to the impact of a widespread community education campaign.

Since 1994, concern for salinity amongst the Melbourne population has fallen to make it the least priority environmental concern.

Rural

The rural sample showed a similar pattern in the rise in concern for salinity as the Melbourne population, although the rise was not as steep for the rural population.

In rural areas, salinity is the highest environmental concern.

Regional observations

The Mallee population (both rural and urban) were significantly more concerned about salinity than other Victorians. This is due to the Mallee being on the downstream end of the Murray River.

Concern was low in the North East.

Increases in concern were measured in urban Corangamite as well as rural Wimmera and Goulburn Broken.

Graphs 48 (a to j) show the level of concern for *Salinity* compared to the level of *General Environmental Concern*, for rural and urban residents in each CALP Region, from 1988 to 1997.

Data Collection and Analysis

Surveys of public opinion about catchment management issues were undertaken in 1988, 1989, 1994 and 1997, by the market research firm Reark. These surveys were conducted with samples from rural areas, from provincial towns and from Melbourne.

Each respondent was asked to rank 9 issues based on how serious they consider each is to the future of Victoria. Rankings were from 1 to 10, where 10 is extremely serious.

The issues were

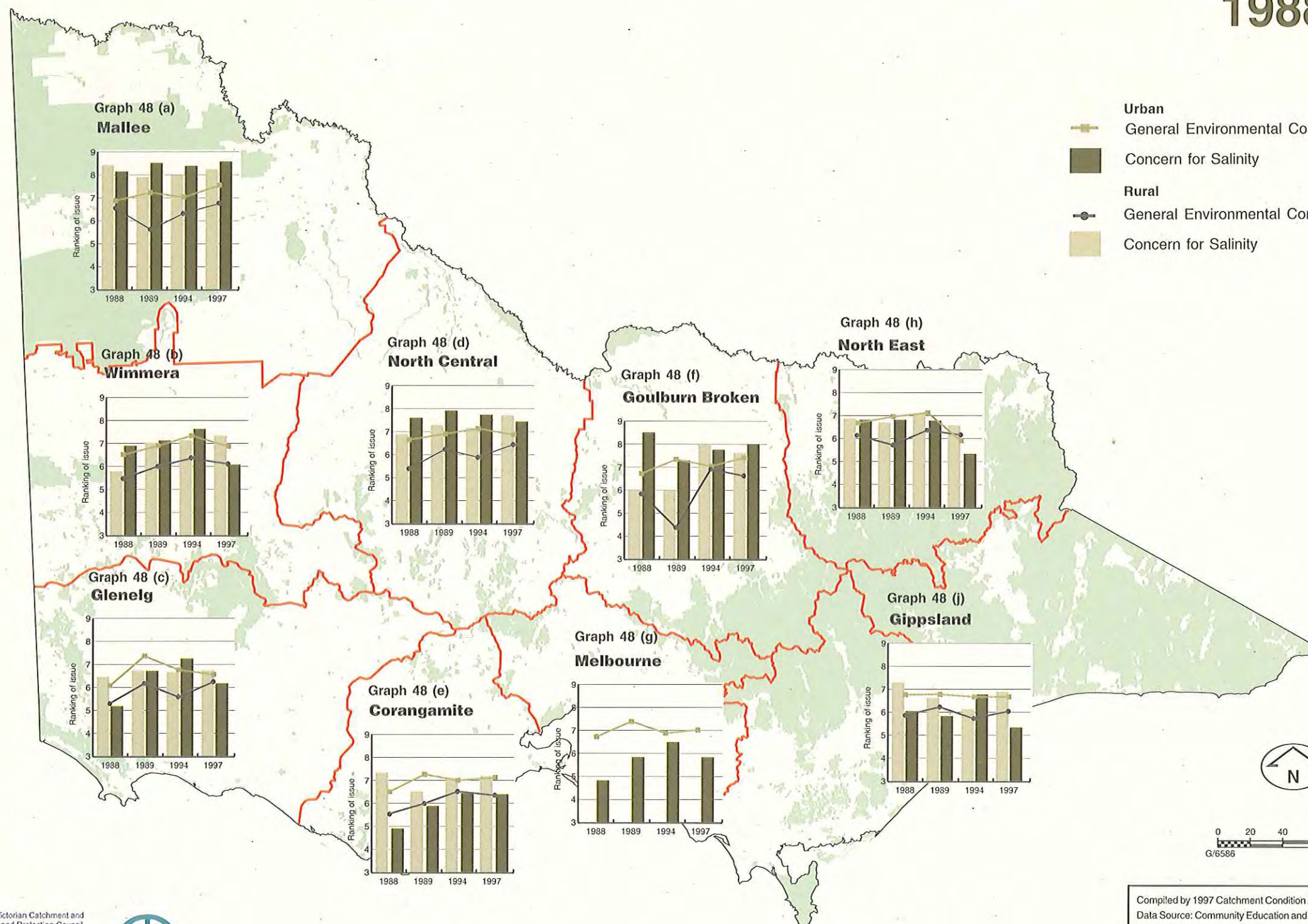
Soil Erosion; Salinity; Loss of Native Forests; Extinction of Plants and Animals; Degraded Rivers and Catchments; Destruction of Wetlands; Pollution; Not Enough Waste Recycling; and Loss of Public Open Space.

For each CALP Region, the results for all 9 issues were averaged to provide an average *General Concern for Environmental Issues* for urban and rural residents.

Contact

Neil Barr and Mal Brown, Community Education & Customer Research, CMSA, DNRE, Bendigo

Salinity Awareness, 1988 - 1997



0 20 40 60 80 100
Kilometres
G/6586



Compiled by 1997 Catchment Condition Atlas Team, CMSA and CLPR
Data Source: Community Education and Customer Research, DNRE
September 1997



Natural Resources
and Environment

Victorian Catchment and
Land Protection Council



ENVIRONMENT
PROTECTION
AUTHORITY

Vegetation and Wildlife Habitat

Overview

Vegetation clearance and subsequent fragmentation of the remaining vegetation, the introduction of pest plants and animals, and changes in the flow regimes of watercourses have resulted in significant changes to native vegetation and wildlife.

Native vegetation is important for biodiversity conservation through the provision of habitat for wildlife and contributing to the ecologically sustainable management of natural resources.

The following indicators relate to native vegetation and wildlife habitat on both public and private land. Awareness of the value of native vegetation and the role it plays in natural resource management is enhanced through the implementation of programs such as Land for Wildlife. Participation in programs such as this will assist in the conservation and management of areas of native habitat.

Summary

- Over 4,200 properties included in the Land for Wildlife programme with just under 100,000 ha of private land being managed for wildlife.
- 16% of Victoria is protected via national parks or other reserves.
- Up until March 1994, approximately 165,000 ha of native vegetation on private land has been protected from grazing
- Approximately 7,600,000 trees were planted for land protection, wildlife protection, amenity or farm forestry on private land between March 1993 and March 1995.



Vegetation and Wildlife Habitat

Trees Planted on Farmland,
1993/94 - 1994/95

Land for Wildlife, 1997

Native Vegetation Protected from
Livestock, 1993/94

Biological Diversity Awareness,
1988 - 1997

Trees Planted on Farmland, 1993/94 - 1994/95

Background

Tree planting rates depend upon farmers perceptions of the potential benefits of trees planted.

Trees are one means of controlling land degradation problems like soil erosion and salinisation. Trees are also planted for nature conservation and biodiversity reasons such as providing habitat for wildlife. Farm forestry integrates trees into the productive farm in a way that provides for land protection and income.

Research suggests that aesthetics, shade and shelter and capital gain are the primary motivations for planting trees on farming land.

Results

The drop in the number of trees planted across Victoria from 1993/94 to 1994/95 could be an indication of the financial and environmental effects of the drought of 1994/95. Soil preparation and watering of newly planted trees can be a major burden during dry periods.

Glenelg, Corangamite and West Gippsland CALP Regions
Primarily dryland grazing areas. Highest tree planting rates. It is well documented that tree planting is more readily adopted in grazing enterprises.

Glenelg CALP Region

One of the Regions that has advocated private forestry as a motivation for establishing a larger area of trees. This is reflected in the high numbers of trees planted in the Region.

The success of private forestry plantations relies on adequate rainfall. The areas that are broadly suited for private forestry are cleared agricultural land with an annual rainfall of at least 600 mm. Much of southern Victoria falls into this high rainfall belt.

Port Phillip CALP Region

Planting activity has been quite high over the two production years. This activity has occurred on the perimeter of the Region, particularly in the south west area, where there is less urbanisation.

The northern parts of North Central and Goulburn CALP Regions

The number of trees planted is also quite high. The higher number of trees planted in these two catchments include areas covered by the Tragowel Plains, Torrumbarry East of Loddon (Barr Creek) and Shepparton Salinity Management Plans. These Plans have included tree planting as a salinity control option and have invested resources to increase the adoption of trees for this purpose.

Mallee, Wimmera, North East and East Gippsland CALP Regions

Very few trees were planted in the 1993/94 and 1994/95 production years.

Mallee CALP Region

Agriculture is based primarily on cropping. Property sizes in this Region are also generally greater than in other areas of the state. Landholders of these large properties have less time to spend planting trees than those on smaller holdings. Tree planting has also been shown to be less attractive to cropping farmers.

North East and East Gippsland CALP Region

Large areas of public land. The low number of trees planted is therefore to be expected.

Map 34 shows the total number of Trees Planted on Farmland, from March 1993 to March 1995, in each parish across Victoria.

Data Limitations

There are a number of limitations to using ABS data to determine the rate of tree planting on Victorian farms:

- Using only two year's data to draw conclusions about the adoption practices of farmers should be treated with caution.
- Data is presented at parish level. Therefore, each parish may represent many farmers planting a small number of trees, or just a few planting a greater number of trees.
- Agricultural Census data relies heavily on each landholders time, ability and determination to provide accurate results. The way that landholders interpret the questions can also vary.

Data Collection and Analysis

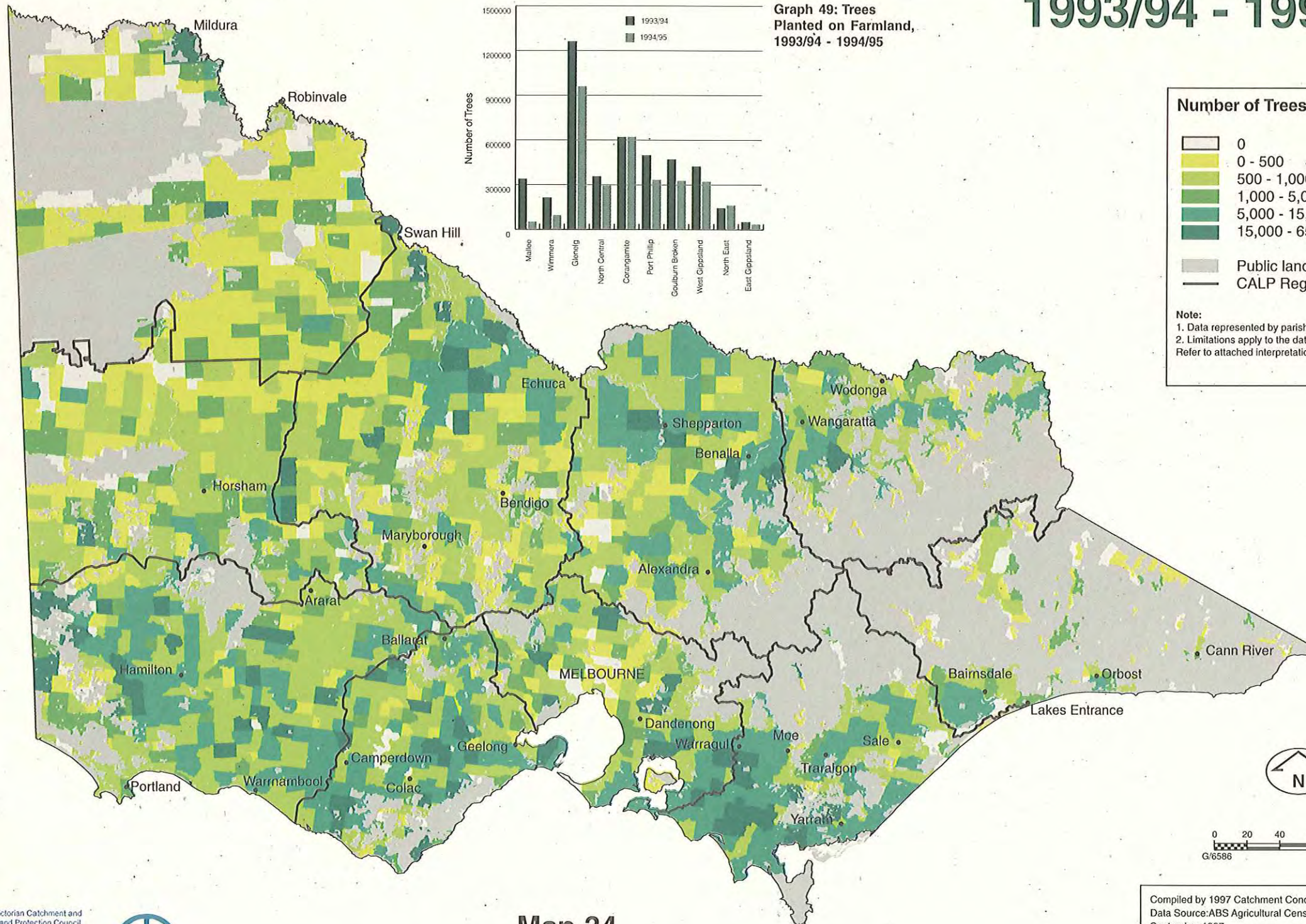
The Australian Bureau of Statistics (ABS) Agricultural Census is distributed to all landholders across Australia whose businesses meet a minimum gross income criterion. Statistics are supplied to DNRE only as aggregated data for parishes.

1993/94 and 1994/95 were the first years that questions on tree planting were asked of landholders in the Agricultural Census. At the time of preparing this report, 1995/96 ABS data was not available.

Contact

Jodie Cray, Natural Resources Monitoring and Assessment, CMSA, DNRE, Bendigo

Trees Planted on Farmland, 1993/94 - 1994/95



Map 34
Trees Planted on Farmland, by
Parish, 1993/94 - 1994/95

Land for Wildlife Properties, 1997

Background

Land for Wildlife is a voluntary nature conservation program on private land. It aims to encourage and assist private landholders to provide habitats for wildlife on their property and to integrate the provision of habitat with other uses of the property. Community ownership and acceptance are central to the approach.

The scheme involves:

- responding to approximately 500 voluntary applications per year
- targeting specific habitats on private land
- seeking to identify and develop solutions for barriers which inhibit the adoption of *Land for Wildlife* principles of land management.

There are a number of targeted projects underway, where landholders are approached directly. These targets focus on particular habitats, potential wildlife corridor links and specific large areas of habitat which are often under-represented in the reserves system.

The program involves working with Landcare groups to incorporate wildlife values into their plans, and having input to Property Management Planning through the provision of a biodiversity component.

Extent of Land for Wildlife

- At August 1, 1997 there were 4,222 properties in the *Land for Wildlife* Scheme in Victoria
- The total property area was 466,420 hectares.
- The greatest number of properties are in the regions where *Land for Wildlife* Extension Officers are located.

Table 6: Total Area of Retained and Restored Habitat on Land for Wildlife Properties, August 1997

	Area (hectares)
Total area of retained habitat being managed for wildlife	96,338
Total area of land under restoration as wildlife habitat	16,944
Total area of habitat/land being retained and restored for wildlife	113,282

Habitats

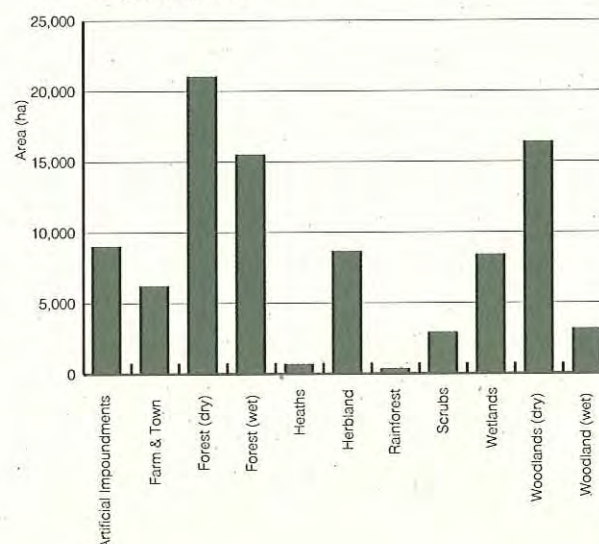
Habitats are classified according to the Victorian Atlas of Birds classification system.

- The largest areas of habitats occur in the Dry Forest - Box-Ironbark, Woodland - Box-Buloke, Wet Forest - Stringybark, Grasslands and Freshwater Wetlands categories.
- The greatest number of properties occur in the Stringybark Forest category - 874 properties with an average of 9.5 ha of habitat.
- 150 properties have Grasslands with an average area of 53.7 ha per property.

Table 7: Increase in Area of Two Targeted Habitats on Land for Wildlife Properties, 1994-97

	March 1994	January 1997
Box-Ironbark	2,700 ha	18,000 ha
Grasslands/Herblands	2,500 ha	8,000 ha

Graph 52: Habitat Types on Land for Wildlife Properties, 1997



Map 35 shows the distribution of *Land for Wildlife* properties across Victoria, at August 1997.

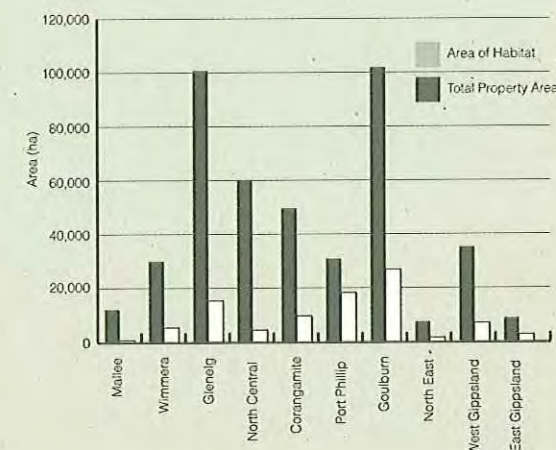
Properties listed after the first regional *Land for Wildlife* extension officers were employed in 1990 are shown separately from properties listed prior to 1990.

Registration

Land for Wildlife has 2 levels of participation. Following a site visit and discussion, properties may be listed for *Full registration* or *Working towards registration*. Full registration gives properties the right to show a *Land for Wildlife* sign. Working towards registration involves landholders working towards agreed goals before receiving a *Land for Wildlife* sign. This gives landholders an incentive to implement changes in their on-ground management. 414 properties are currently working towards registration.

Properties are automatically de-registered following a change of ownership. Landholders are asked to notify the Department when properties are sold. This enables extension officers to contact the new owners and discuss the value of integrating *Land for Wildlife* land management principles with other management goals.

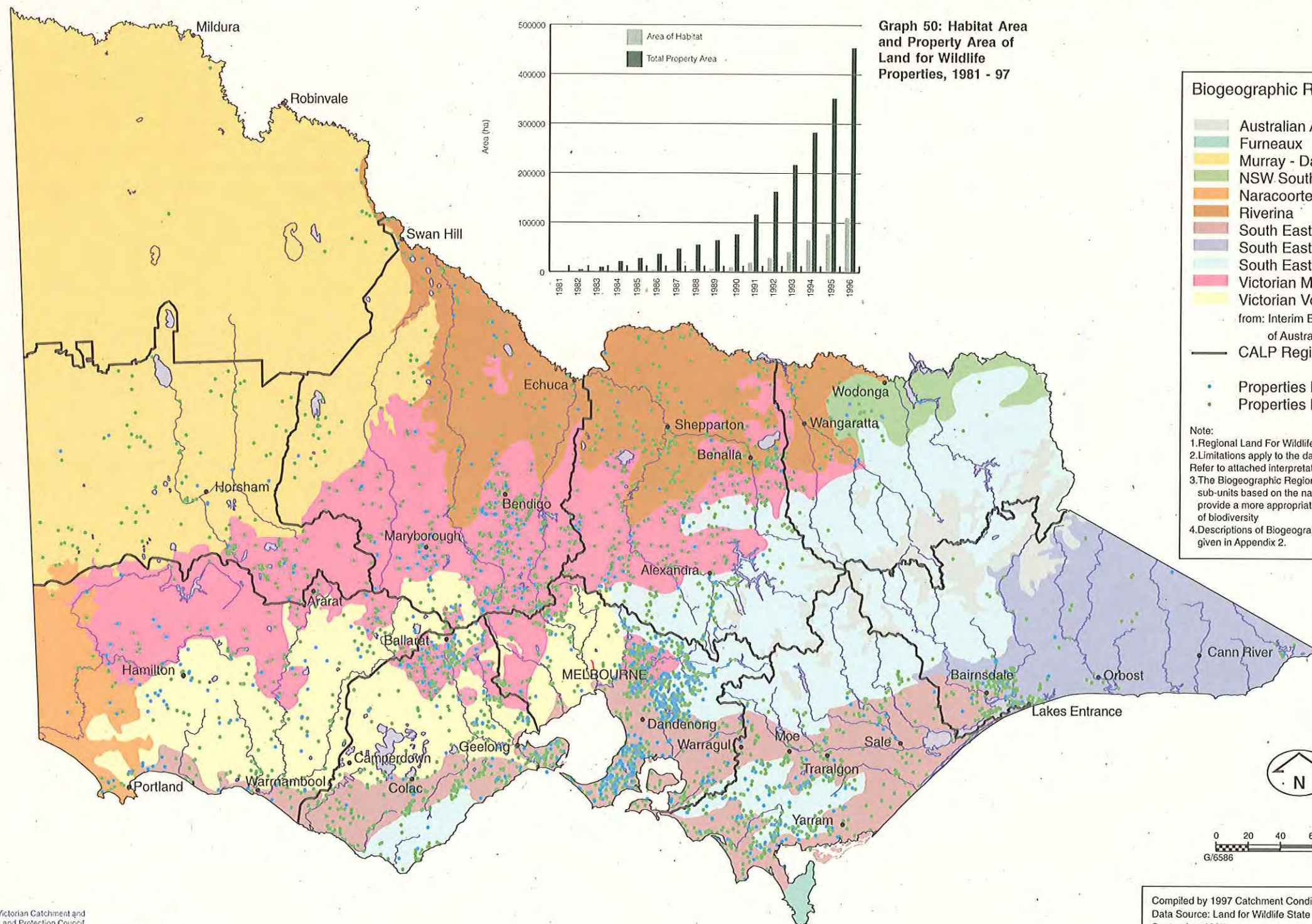
Graph 51: Habitat Area and Property Area of Land for Wildlife Properties, by CALP Region, 1997



Contact

Jean Edwards, Land for Wildlife, Flora & Fauna Branch, DNRE.

Land for Wildlife, 1997



Map 35
Distribution of Land for Wildlife
Properties, August 1997

Native Vegetation Protected from Livestock, 1994

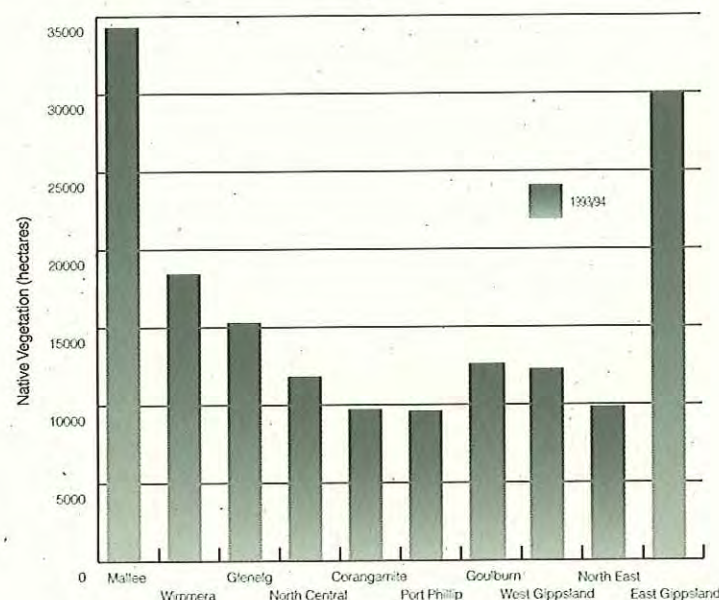
Background

Fencing of remnant native vegetation to exclude stock is vital in maintaining and regenerating biodiversity on private land throughout Victoria.

However, the objective is not just saving trees. In many cases, trees make up only a small though highly visual part of the biodiversity of an ecosystem. Fencing provides protection for the numerous unique flora and fauna in the understorey of our rural landscape.

Protecting vegetation may also increase water use, thus reducing recharge of watertables in recharge areas of catchments.

Graph 53: Native Vegetation Protected from Livestock, at March 1994



Map 36 shows the area of Native Vegetation Protected from Grazing by Livestock, to March 1994, in each parish across Victoria. This may occur through fencing or being otherwise inaccessible to stock.

Data Limitations

There are a number of limitations to using ABS data to determine the protection of native vegetation on Victorian farms:

- Using a single year's data to draw conclusions about the adoption practices of farmers should be treated with caution.
- Data is presented at parish level. Therefore, the area shown as protected may represent many farmers protecting smaller areas, or just a few protecting larger areas.
- The percentage of remnant vegetation within the parish that is protected is not shown. A small area protected in a parish with little remnant vegetation, may be more significant than a large area protected within a parish with very large areas of remnant vegetation.
- The type of vegetation protected is not shown. Where high priority vegetation types occur in parishes with relatively small areas of unfenced vegetation, a small area of fencing may represent a significant achievement in biodiversity protection, provided it is the high priority vegetation types that are being protected. Conversely, large areas of lower priority vegetation may be protected within some parishes.

Data Collection and Analysis

The Australian Bureau of Statistics (ABS) Agricultural Census is distributed to all landholders across Australia whose businesses meet a minimum gross income criterion. Individual forms remain confidential to the ABS. Statistics are supplied to DNRE as aggregated data for parishes.

In 1993/94, landholders were asked to provide *the area of native vegetation on their holding protected from domesticated grazing animals, through being fenced or otherwise inaccessible, at 31 March 1994.*

Contact

Jodie Cray, Natural Resources Monitoring and Assessment, CMSA, DNRE, Bendigo

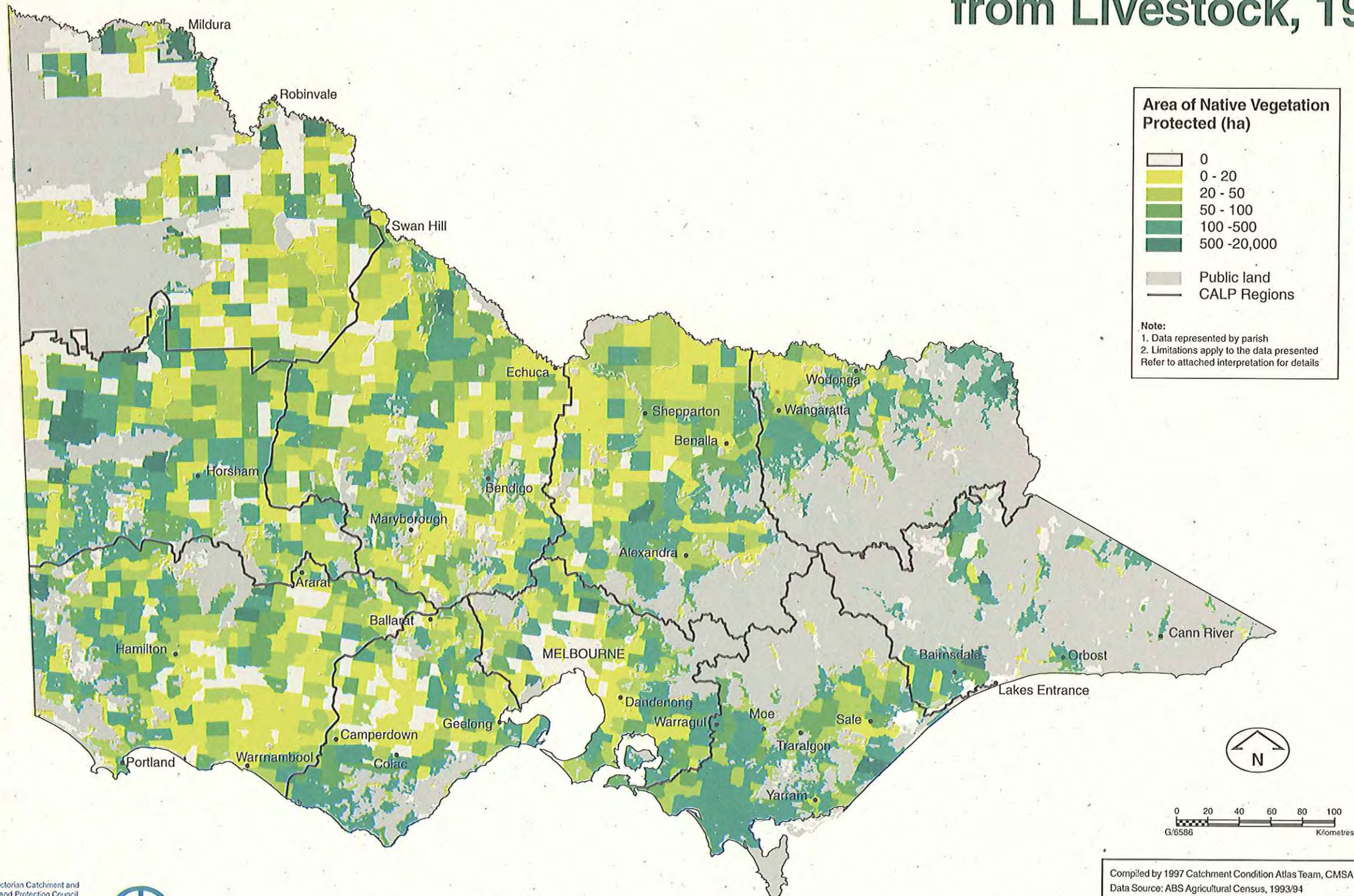
Results

- Significant fencing activity was reported across the state.
- Much of the protection of native vegetation has occurred in areas around the perimeter of the public land areas, particularly in the east of the State.

Mallee and East Gippsland CALP Regions

Have the largest area of protected native vegetation but the lowest rate of tree planting. High rates of fencing in the Mallee may be related to the creation of the Mallee-Sunset National Park, whereby land was withdrawn from lease-holding, requiring the erection of new fencing.

Native Vegetation Protected from Livestock, 1994



Map 36
Native Vegetation Protected from Livestock, by Parish, March 1994

Public Awareness of Extinction of Plants and Animals, 1988 - 1997

Background

Catchment protection needs the support of the urban population. It is important that not just rural Victorians, but also Victorians living in urban and provincial areas appreciate the importance of the work of the Catchment Management Authorities.

These indicators present the results of surveys of Victorian's concern for extinction of plants and animals and compares this to their concern for environmental issues in general.

Results

Concern for extinction of plants and animals is a high priority issue for urban Victorians in Melbourne and provincial towns. In rural areas the concern is lower, but has risen significantly since 1989.

Graphs 54 (a to j) show the level of concern for *Extinction of Plants and Animals* compared to the level of *General Environmental Concern*, for rural and urban residents in each CALP Region from 1988 to 1997,

Data Collection and Analysis

Surveys of public opinion about catchment management issues were undertaken in 1988, 1989, 1994 and 1997, by the market research firm Reark. These surveys were conducted with samples from rural areas, from provincial towns and from Melbourne.

Each respondent was asked to rank 9 issues based on how serious they consider each is to the future of Victoria. Rankings were from 1 to 10, where 10 is extremely serious.

The issues were

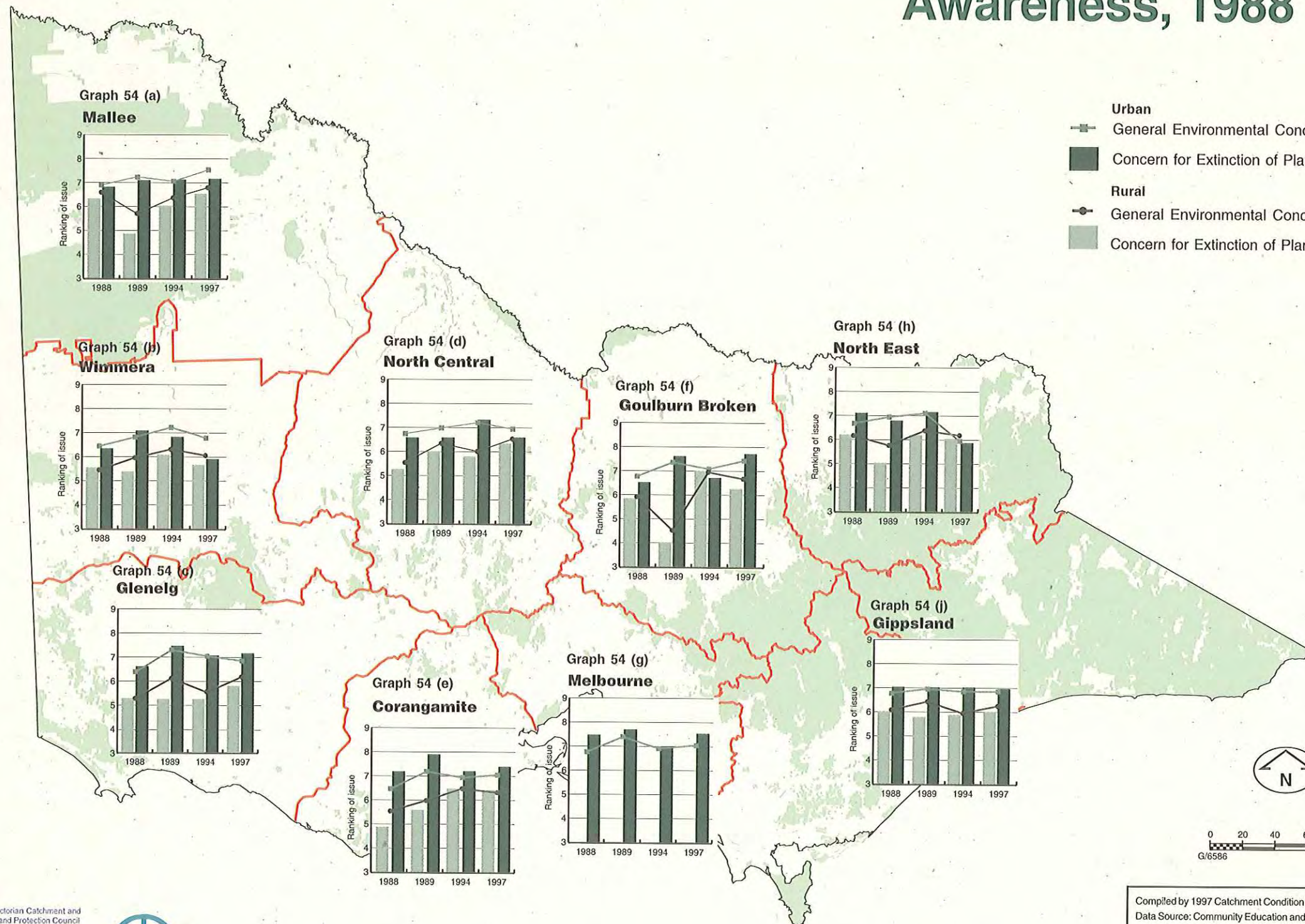
Soil Erosion; Salinity; Extinction of Plants and Animals; Loss of Native Forests; Degraded Rivers and Catchments; Destruction of Wetlands; Pollution; Not Enough Waste Recycling; and Loss of Public Open Space.

For each CALP Region, the results for all 9 issues were averaged to provide an average *General Concern for Environmental Issues* for urban and rural residents.

Contact

Neil Barr and Mal Brown, Community Education and Customer Research, CMSA, DNRE, Bendigo

Biological Diversity Awareness, 1988 - 1997



Appendices



Appendices

Appendix 1
Resource Management Units,
1997

Appendix 2
Biogeographic Regions, 1997

Glossary

Notes

Your Comments

Resource Management Units (RMUs)

Resource Management Units are used as the background layer on the Dryland Secondary Salinity Discharge map.

Resource Management Units (RMUs) are an approach to produce spatial planning units which can be used at a number of scales, either at the state scale (approximately 1:1,000,000) or at the regional scale (1:250,000).

Their role is that of a consistent bio-physical planning base for statewide and regional considerations so that any cross regional investigations have a common base and can be interpreted at the state or national level. There are assumptions that there will be a level of homogeneity within these units and a way to standardise the range of approaches (planning frameworks) across the state that existed at the time that RMUs were developed.

The units are based on the Rowan's Statewide Land System coverage published at 1:500,000 scale but also available at 1:250,000 scale. Where differentiation is not possible from the Statewide land system coverage then the original surveys which make up the Statewide coverage were consulted, as in the case for differentiating between Mountains and Hills.

Statewide RMU Definition

Alpine (AL)

These units occupy the highest positions in the Victorian landscape and consist of (mainly) sub alpine and alpine land units. The main definition used here is elevation; 1,220 m. Major areas include the Bogong High Plains and the Mount Baw Baw Plateau.

Basalt Plains (BP)

These units are part of one of the most extensive basalt plains in the world; at a range of elevations and with a range of component features such as eruption points, stony rises, extensive plains and lakes. These units occur at a range of elevation and predominate in the west of the State.

Calcareous Sands (CS)

These units are based on unconsolidated deposits (Quaternary age) mainly of aeolian origin in North West Victoria which have high carbonate contents. The landscape generally consists of low dunes, sand sheets and lesser areas of discharge zones where gypsum has accumulated.

Coastal Complex (CC)

These units consist of the dune barrier systems along the coast as well as the lagoonal and swampy land units located immediately behind the barrier systems.

Desert Sands (DS)

These units are large areas of more recent, mainly aeolian unconsolidated material (Quaternary age). The major units are the Big and Little Deserts and the Sunset Country, consisting of dune complexes of pale and yellow sand of little nutritional value and occasional plains and swales with some clay accumulation.

Floodplains (FP)

These units constitute the lowest parts of the landscape associated with the extensive Plain units. These units are generally topographically well defined with the main river systems of the State.

Footslopes (FS)

These units constitute the footslopes to the major solid geological blocks, mainly as colluvial slopes and no or limited solid geological parent material. These units are essentially depositional. These areas include the Corryong area and the upper Murray River terraces downstream from Corryong and represent older alluvial material.

Friable Earths (FE)

These units consist of those areas where friable earth soil types occur. Examples include the red friable earths found on basalt such as the Ballarat area, Thorpedale (West Gippsland), other red earths such as at Kinglake and Tanjil and friable earths on alluvial deposits such as the Mitchell and Snowy and Werribee River flats.

Hill (H)

Generally these units are less than 300m (to 90 m) relative elevation, with shorter slope lengths but variable slope. This group of RMUs consists of Low Hills, Plateaux, Basins and Rises.

Irrigation (I)

These units are currently defined as those areas defined as irrigation districts such as those associated with the Murray and Goulburn Rivers as well as south of the Dividing Range such as at Maffra and South Werribee.

Metropolitan (MA)

These units are confined to the major metropolitan centres of Victoria such as Melbourne, Geelong and Mildura. These areas of urbanisation are now the most intensive management of land and unlikely to be used for other uses.

Mountain(M)

Generally these units consist of at least 300m elevation but more generally at least 300m relative elevation, long slopes (longer than other sloping landforms) and generally steep slopes (>32%). These RMUs are generally the highest in the landscape and provide the majority water entrapment (highest rainfall areas) and the potential to export large amounts of sediment.

Plains (P)

These units are extensive, particularly north of the Great Dividing Range. Some specific Plain units have been separately highlighted. These are depositional units which could be subdivided at the regional scale.

Southern Uplands (SU)

These units consist of the elevated Cretaceous (age) Uplands of the Otway Range and the Strzelecki Ranges which are of different age and material (mainly sandstones) to the older material of the Great Dividing Range and separated by deposition material (i.e. La Trobe Valley).

Tablelands (T)

These units consist of elevated flat plains that have been dissected. The (Dundas and Merino) Tablelands of South West Victoria are of Tertiary geological age which have been ferruginised.

Tertiary Plains (TP)

These units refer to a particular geological age and represent older depositional surfaces which have since been dissected. These units are often found at the footslopes of the main solid geological massifs, such as the Great Dividing Range.

Wimmera Plains (WP)

These units are very gently undulating in the east of their extent to undulating in the west and represent wind blown material as well as lagoonal deposits associated with prior coastlines. These units now cover a large area of western Victoria and are divided by Desert Sands units. Stranded beach ridges, undulating rises (including low dunes) and paleo(old) and recent lagoonal deposits are some of the more specific features of this land complex.

Appendix 2

Biogeographic Regions

The Interim Biogeographic Regionalisation for Australia (IBRA), provides the background layer for the Land for Wildlife map.

IBRA is an integrated classification of biotic and abiotic variation. IBRA regions represent a landscape based approach to classifying the land surface, incorporating attributes of climate, geomorphology, landform, lithology, and characteristic flora and fauna mapped at 1:500,000.

The IBRA regions provide an appropriate level of classification for statewide strategic planning. IBRA regions provide a meaningful unit for assessing ecological diversity, determining critical management actions and monitoring their effectiveness.

IBRA uses a conceptual process model as the basis for understanding and explaining ecological patterns and processes. It is the physical processes which drive ecological processes. These, in turn, are responsible for driving the observed patterns of biological productivity and the associated patterns of biodiversity.

The IBRA reflects the best information available at the time of its development. Validation of the regions is required and subsequent revisions will be necessary. As regional surveys are undertaken, new data and information will be incorporated into the IBRA and its conservation planning attributes. The current version is Version 4.

Biogeographic Sub-regions

Version 4.0 has been updated by DNRE using land systems mapping at 1:250,000. This is a more appropriate scale for Victoria and ties nationally compiled mapping to local features. As part of this process of refining the IBRA map, Sub-regions were incorporated which are based on the Natural Regions of Victoria, produced in Volume 1 of the Victorian Flora.

Across Victoria, 22 Biogeographic Sub-regions, based on Ecological Vegetation Classes, have been developed to provide an appropriate level of classification for effective ecological assessment and land management at a regional scale. This enables more meaningful units for local managers and strategic planners at the state scale. This information is available digitally from Natural Resource Systems.

Descriptions of Biogeographic Sub-regions are currently under development.

Interim Biogeographic Region Descriptions

Australian Alps (AA) - a series of high elevation plateaus capping the South Eastern Highlands region and the southern tablelands in NSW. The geology consists largely of granitic and basaltic rocks. Vegetation is dominated by alpine herbfields, and other treeless communities, snow gum woodlands and montane forests dominated by alpine ash.

Furneaux (FUR) - moist subhumid warm granitic island chain, comprising coastal plains dominated by siliceous soils and low ranges with sandy loams. Vegetation consists of a gradation from heath, scrub and dry woodlands to dry sclerophyll forest with gullies of wet sclerophyll forest and rainforest remnants on the ranges. Coastal plain region of herb-rich woodlands heavily modified by agriculture (grazing).

Murray Darling Depression (MDD) - an extensive gently undulating sand and clay plain of Tertiary and Quaternary age frequently overlain by aeolian dunes. Vegetation consists of semi arid woodlands of Buloke/Belah, Buloke/Rosewood and Acacia spp. mallee shrublands and heathlands and savanna woodlands.

Sub-regions: Lowan Mallee, Murray Mallee, Wimmera

NSW Southwest Slopes (NSS) - an extensive area of foothills and isolated ranges comprising the lower inland slopes of the Great Dividing Range extending through southern NSW to western Victoria. Vegetation consists of foothill peppermint forests, rainshadow grassy woodlands and box/ironbark woodlands.

Naracoorte Coastal Plains (NCP) - a broad coastal plain of Tertiary and Quaternary sediments with a regular series of calcareous sand ridges separated by inter-dune swales. Now extensively cleared for agriculture. Vegetation consisted of plains grasslands, herb-rich and grassy woodlands on heavier soils and heaths and heathy woodlands and lowland forests on lighter soils.

Riverina (RIV) - an ancient riverine plain and alluvial fans composed of unconsolidated sediments with evidence of former stream channels. Vegetation consists of river red gum and black box forests, box woodlands, saltbush shrublands, extensive grasslands and swamp communities.

South East Coastal Plain (SCP) - undulating Tertiary and Quaternary coastal plains. Vegetation consists of heathy woodlands, dry sclerophyll forests, grasslands and grassy woodlands and heathlands.

Sub-regions: Gippsland Plain, Otway Plain, West Coastal Plain

South East Corner (SEC) - a series of deeply dissected near coastal ranges composed of Devonian granites and Paleozoic sediments, inland of a series of gently undulating terraced (piedmont downs) composed of Tertiary sediments and flanked by Quaternary coastal plains, dunefields and inlets. Climate strongly influenced by the Tasman Sea and the close proximity of the coast to the Great Dividing Range. Vegetation consists of high elevation woodlands, wet and damp sclerophyll forests interspersed with rain-shadow grassy woodlands in the Snowy River Valley. Lowland and coastal sclerophyll forests, woodlands, warm temperate rainforest and coastal communities occur in the Lowlands.

Sub-regions: Lowlands, Foothills

South Eastern Highlands (SEH) - steep dissected and rugged ranges extending across southern and eastern Victoria and southern NSW. Geology predominantly Paleozoic rocks and Mesozoic rocks. Vegetation predominantly wet, damp and dry sclerophyll forests, woodland, minor cool temperate rainforest and minor grassland and herbaceous communities.

Sub-regions: Southern Fall, Northern Fall, Otways

Victorian Midlands (VM) - an extensive area of foothills and isolated ranges comprising the lower inland slopes of the Great Dividing Range. Vegetation consists of wet/damp sclerophyll forests, peppermint forests and box/ironbark woodlands.

Sub-regions: Goldfields, Western Uplands, Greater Grampians, Dundas

Victorian Volcanic Plain (VPP) - an extensive basaltic plain with numerous volcanic cones and eruption points. Vegetation formerly consisted of grassy woodlands and grasslands, now mostly cleared.

Reference

Interim Biogeographic Regionalisation for Australia, R. Thackway and I.D. Cresswell, 1995, Australian Nature Conservation Agency (ANCA), Canberra.

Contact

David Parkes, Flora and Fauna Branch, DNRE.

Glossary

Abiotic

Not living

Acidity

The chemical activity of hydrogen ions in soil expressed in terms of pH.

Adsorbed

Condensation of a gas, liquid or dissolved substance onto the surface of a solid.

Anoxia

Depletion of free oxygen; anaerobic

Aquifer

A porous soil or geological formation, often lying between impermeable subsurface strata, which holds water and through which water can percolate slowly over long distances and which yields groundwater to springs and wells.

Benthic

Inhabiting the bottom of streams, lakes or oceans.

Biocide

Substance for the purpose of destroying biota; includes pesticides, herbicides, fungicides and insecticides.

Biotic

Living

Bore

A well drilled into rock or sediment body for the purposes of monitoring or extracting groundwater.

Calcareous

Refers to materials, particularly soils, containing significant amounts of calcium carbonate.

Calcium/magnesium ratio

Ratio of calcium (Ca^{2+}) ions to magnesium (Mg^{2+}) ions.

Discharge area

Area where watertable intersects with soil surface.

Ecosystem

A community of organisms and the environment in which they live.

Electrical Conductivity

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. Soil salinity is normally expressed as millisiemens per centimetre (mS/cm) at 25°C . Salinity of water is usually expressed as microsiemens ($\mu\text{S/cm}$).

Energetics

The mechanisms of energy transfer

within a biological community.

Eutrophication

Increase in the nutrient content of a body of water resulting in oxygen depletion of the water, often resulting in algal blooms.

Fecundity

The productiveness or potential productiveness of an organism, measured in the number of viable offspring it may produce.

Geomorphology

The branch of geological science traditionally concerned with the origin and configuration of landforms.

Gross Value Product

An estimate of the value of agricultural commodities at the farm gate.

Hydrograph

A graph that shows some property of groundwater or surface water as a function of time.

Hydrology

The study of the occurrence, distribution and chemistry of all waters of the earth.

Ionic and osmotic balance

Balance of the water pressure on either side of a water permeable layer due to a balance in the number of ions (salts) present on either side.

Land Management Unit

A grouping of areas which share similar landform and have common hydrogeology and salinity processes.

Lentic

In relation to standing or non-flowing freshwaters

Lotic

In relation to flowing water, such as rivers or streams

NTUs

Nephelometric Turbidity Units; units of measurement of turbidity.

Olsen P

Method for determining the available phosphorus levels in soils.

Organic production

The conversion of organic material to energy by organisms in the system.

Parish

A subdivision or unit of local government.

Perennial pasture

Deep-rooted pasture that grows for more than one season, e.g. phalaris, cocksfoot.

pH

A measure of the acidity or alkalinity of a soil or water. A pH of 7.0 denotes neutrality, higher values (up to 14) indicate alkalinity and lower values (as low as 1) indicate acidity.

Phosphorus

A solid, non-metallic, naturally-occurring element used in fertilisers.

Point source

Source of pollution can be pinpointed.

Real Income per Capita

An estimate of wage earners' annual gross income adjusted for inflation

Recharge area

An area where water is absorbed to be added to an aquifer.

Riparian

Belonging to a stream bank.

Secondary salinity

Salting due to human activities, such as irrigation, forest clearing and agricultural practices; also called human-induced salinisation.

Skene K

Method for determining available potassium levels in soils.

Sodic Soil

A soil containing sufficiently exchangeable sodium to adversely affect soil stability, plant growth and/or land use. The soils would be dispersible and may be improved by the addition of gypsum.

Standing water level

The level of the watertable measured from ground level.

Sublethal

Involving a stimulus below the level that causes death.

Tillage

The mechanical preparation of the soil by tractor-drawn implements to produce a seedbed for plant growth.

Turbidity

The cloudy condition caused by suspended solids and soil sediment in a liquid, usually water.

Value of Production

An estimate of incomes from sectors of the economy, such as agriculture, forestry, fisheries, manufacturing and tourism.

Watertable

Upper surface of unconfined groundwater below which the pores of rock and soil are saturated.

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

Your Comments

This report has been produced as part of the Victorian Integrated Monitoring and Assessment Strategy and forms a basis for future catchment condition monitoring and assessment efforts.

However, developing a useful and coherent format for future Catchment Condition Reporting is an ongoing project.

Your opinions on the information provided in *Know Your Catchments*, and its presentation, are encouraged.

The following questions provide a guide only. Additional comments are welcomed.

Do the presented indicators provide a useful picture of catchment management and condition in relation to each section (eg. Catchment Communities; Soils; etc.)?

What additional indicators would you find useful?

Are there other catchment management programs you would like to see included?

How could we have presented or arranged the information in a more useful or accessible way?

How could we have interpreted the maps and graphs to make them more relevant and useful for your particular needs?

How could we have distributed the report to make it more accessible?

Are you involved in:

- ☐ on-ground land management
- ☐ land management agency or authority
- ☐ teaching
- ☐ study
- ☐ general interest

Please forward your comments to:

Department of Natural Resources and Environment
Box 2500
Bendigo Mail Centre 3554

or

Catchment and Land Protection Council
Level 4, 115 Victoria Pde
Fitzroy, 3065

