



Natural Resources  
and Environment

AGRICULTURE

RESOURCES

CONSERVATION

LAND MANAGEMENT

# *REVERSING THE TREND*

## NORTH EAST SALINITY STRATEGY

A component of the North East  
Regional Catchment Strategy



NORTH EAST  
CATCHMENT  
MANAGEMENT  
AUTHORITY

North East Salinity Working Group

&

North East Catchment Management

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### **ACRONYMS**

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*Front Cover Indigo Valley and Chiltern Landcare group members inspect Tall Wheat Grass sown on a discharge area, August 1999.*

## **FOREWORD**

### **NORTH EAST SALINITY WORKING GROUP**

This Salinity Strategy is the culmination of two and a half years of work by members of the North East Salinity Working Group (NESWG). The group was made up of landholder representatives from Landcare groups with salinity in the Ovens River, Blackdog Creek, Indigo Creek catchments, the Upper North East and representatives from the Department of Natural Resources and Environment and Charles Sturt University.

I would like to acknowledge the hard work and commitment that the Landcare volunteers and agency staff have shown in the preparation of the strategy, the valuable contribution they have made to this document and the way they have enabled the involvement of the wider community in the process. The cooperative way in which the working group members have worked during countless meetings and discussions is a credit to those involved.

The reason this strategy exists at all is also due to the persistence and observation of landholders who kept insisting that all was not well in their groups and that the salinity problem was gradually getting worse. These landholders were insistent that more needed to be done and they were not satisfied with the status quo. They wanted better answers to what was happening and some more definite guidelines as to what management practices they needed to adopt. The perception that the North East was unlikely to have a significant salinity problem was being challenged. We now know that salinity is a significant issue both to the local community and downstream users, with rapidly rising watertables and increasing discharge areas.

While it may seem that the investigation into the salinity problem has raised more questions than it answered because of the lack of information concerning high rainfall areas, we have now documented to the best of our ability based on the best information available what we think needs to be done. Some of the questions raised by landholders have been answered and we have determined directions for where works and further research is needed.

Landholders have not been idle during the years of questioning what was happening and during the strategy formulation process, much has been achieved on the land in the form of revegetation and pasture improvement. This improvement needs to be continued but at a more accelerated rate and in more defined priority areas. More emphasis needs to be given to revegetation and protection of remnants and this is one of the most challenging aspects of this strategy. How do we revegetate more of the landscape to reduce recharge while at the same time ensure the viability of farming?

This strategy sets the framework for future on-ground action. It is seen as a partnership between the community and the government providing the opportunity to focus activities in strategic locations to maximise the impact of on-ground works.

The strategy requires government support to address salinity and related water quality issues in the North East Region. Additional funding is sought to enhance the on-ground works program, provide technical advice and build on our current level of understanding of groundwater processes to benefit the whole community.

The NESWG, the North East Catchment Management Authority (NE CMA) and the Landcare community are looking forward to the challenges that lie ahead in addressing the salinity issue.

**Denis Martin**

*Former Chair*

*North East Salinity Working Group.*

# SUMMARY OF RECOMMENDATIONS

## SUMMARY OF RECOMMENDATIONS UNDER EACH PROGRAM.

### Research and investigation program

#### General Recommendations

- That the North East Strategy Salinity prepares a Research and Investigation (R&I) strategy that sets direction and priorities for research over the next five years.
- That opportunities to link with other salinity regions R&I strategies be sought to maximise the outcomes from limited research funding.
- That funding opportunities be sought from a broad range of funding bodies (both Govt and industry) to fulfil the research needs identified in Tables 12, 13 &14 for the North East Salinity Strategy.

### Monitoring program

#### General Recommendations

- That the North East Salinity Working Group (NESWG) work closely with the Upper North East Victoria Water Quality Working Group to develop programs to better monitor the impact of salinity on stream water quality.
- That Murray Darling Basin Commission (MDBC) be encouraged to upgrade their monitoring sites with continuous recorders for flow and salinity to more accurately predict the impact of salinity on the Murray River.
- That the bore network and groundwater monitoring for the North East Region be expanded over the next 5 years to include all sites and recommendations in the above boxes.
- That an investigation of the potential impact of groundwater rises on wetlands, streams and remnant vegetation throughout the North East Region be carried out, and appropriate monitoring and management recommendations be developed.
- That the annual report and business plan be used to inform the regional community and governments on the progress of works and developments within the Strategy.
- That the Salinity Strategy be reviewed after 5 years to monitor the effectiveness of implementation.

#### Specific Recommendations

- That draft recommendations listed in Box 3 from the *Review of Water Quality Monitoring in the Ovens Basin* be supported and funded appropriately.
- That sites for the statewide monitoring of discharge be identified in the areas outlined in Table 15.
- That all incentives be administered through the Grants and Incentive Tracking System (GAITS).
- That the Geographic Information System (GIS) be used to accurately record location and type of on-ground works carried out under the Salinity Strategy.

# SUMMARY OF RECOMMENDATIONS

## Environmental program

### General Recommendations

- That appropriate cost-share incentives be available to assist land managers to fence out remnant vegetation on identified high recharge areas to protect trees and understorey species through controlled grazing of stock.
- That the Salinity Strategy and Regional Biodiversity Strategy complement each other to prioritise and target areas of high environmental significance on identified high recharge areas.
- That the Salinity Strategy encourage the protection of remnant vegetation in identified high value wetlands by encouraging the removal of stock and fencing of sites with the appropriate cost-share being available.
- That extension staff encourage land managers to use indigenous vegetation in conservation tree plantings.
- That extension staff encourage the use of a diverse range of understorey species in conservation and farm forestry tree plantings.
- Management to ensure persistence and species diversification of existing native pastures will be encouraged on high recharge areas through the extension program.
- That community groups and the Salinity Strategy seek funding opportunities through Natural Heritage Trust (NHT) and other Department of Natural Resource and Environment (DNRE) natural resource management programs to enhance the environmental on-ground works program.

## Farm tree program

### General Recommendations

- That appropriate cost share incentives be available to fence existing remnant vegetation areas identified on high recharge zones throughout the whole region. As this is a very cost effective method of attaining salinity protection, it is recommended that it be available for all remnant vegetation on high recharge in the North East Region, with priority given to priority area high recharge zones.
- That farm forestry be promoted as a priority for reducing groundwater recharge in high priority areas with the appropriate cost-share provided.
- That joint ventures be investigated as a means of funding on-ground application of farm forestry.
- That farm forestry be encouraged where feasible outside priority areas.
- That the North East Salinity Working Group (NESWG) work along side local government to ensure that planning controls for farm forestry complement the Salinity Strategy.
- That alley farming be promoted in all areas of high recharge.
- That appropriate trial demonstration areas be set up to assess the potential of alley farming in the North East Region to lower watertables. Monitoring of groundwater movement will be included as part of the demonstration.
- That appropriate technical advice be available through the extension program to land managers in priority areas on the full range of tree growing options, including conservation plantings, alley farming and farm forestry.
- That interception tree plantations be promoted and funded with appropriate cost sharing in areas identified by DNRE staff as having suitable geological characteristics provided they are priority areas for treatment.

## SUMMARY OF RECOMMENDATIONS

- That the Salinity Strategy work in cooperation with industry (eg. Victorian Plantation Corporation (VPC) and Australian Newsprint Mills (ANM)) to link the criteria for establishment of softwood plantations to priority areas with a particular focus on high recharge land.
- That North East Salinity Strategy (NESS) liaise with industry (eg. VPC and ANM) to develop cooperative approaches to plantation development.
- That funding be sought from private industry to establish a demonstration site to highlight the impact of pines on groundwater.
- That the Salinity Strategy work in cooperation with the timber industry and the Regional Plantation Committee (RPC) to encourage plantation development in priority areas with a particular focus on high recharge land.
- That funding be sought from the range of options available to promote farm forestry in the North East.

### Specific Recommendations

- That an appropriate cost share incentive be available to encourage land managers to establish high density tree plantations at 500 stems per hectare (including understorey). The use of indigenous species will be encouraged by extension staff.
- That the potential of tree interception plantings be investigated around Springhurst, in the Permian Tillite Land Management Unit (LMU) and Indigo Valley/Wodonga area within the Gneisses and Schists LMU.
- That trial demonstration sites of tree interception plantations be established on the interface between the Riverine Plain Upper and Lower Terrace. Monitoring of groundwater will be included as part of the demonstration.

## Pastures program

### General Recommendations

- That management to ensure persistence of existing native pastures be encouraged on high recharge areas through the extension program.
- Where fencing is required to assist in the successful management of native pastures, that appropriate cost share be available.
- That the continued evaluation and selection of the best performing lines of native pastures be encouraged and supported by the NESWG.
- That demonstration sites for introduced and native perennial pastures (eg. phalaris, cocksfoot, native species, lucerne) be established in the 600 mm rainfall zone to assist land managers in choosing the most appropriate pasture species for their area.
- That the Salinity Strategy, through the extension program, provide specialist technical advice to assist land managers in the management of perennial pastures for land protection (including phalaris, cocksfoot, lucerne and native pastures).
- That the growing and appropriate management of perennial pastures (including phalaris, cocksfoot, lucerne and native pastures) continues to be encouraged in all cleared areas of the Region, including those areas above the 600mm rainfall zone and low recharge areas.



# SUMMARY OF RECOMMENDATIONS

## Specific Recommendations

- That introduced perennial pastures, such as phalaris and cocksfoot, be promoted on high recharge areas in priority areas of the 600mm rainfall zone (eg Springhurst, Rutherglen and the Riverine Plain north of Wangaratta) through an appropriate cost-share. (Except where native pastures are successfully growing.)
- Where fencing is required to assist in the successful establishment and recommended management of perennial pastures in the 600mm rainfall zone that appropriate cost share be available.
- That the availability of cost-share incentives be linked to carrying out a full soil analysis on the site with sowing and management recommendations to increase the likelihood of persistence of the pasture after sowing.
- That the NESWG stay informed of the latest research findings for water use of perennial pastures above the 600mm rainfall zone and adjust the Strategy to reflect these findings (if required).
- That introduced lucerne pastures be promoted in those high recharge priority areas where they will persist and be supported with an appropriate cost-share incentive.
- Where fencing is required to assist in the successful establishment and recommended management of lucerne, that appropriate cost share be available.
- That the availability of cost-share incentives be linked to carrying out a full soil analysis on the site and seeking advice from DNRE pasture officers on its sowing and management to increase the likelihood of persistence of the pasture.

## Cropping program

### General Recommendations

- That funding is sought from a range of programs (such as TopCrop) to encourage land managers to adopt good crop husbandry techniques that improve the crops ability to use water.
- That land managers be encouraged to incorporate lucerne into cropping rotations where feasible.
- That the Salinity Strategy work in conjunction with new agricultural industries to establish groundwater monitoring of demonstration sites to determine the impact of these industries on watertables.

## Saline agriculture program

### General Recommendations

- That appropriate cost-share incentives be available with advice to assist land managers in carrying out pasture establishment on all discharge areas in priority areas in the North East Region.
- That appropriate cost-share incentives be available with advice to assist land managers in carrying out tree establishment around discharge areas in priority areas in the North East Region.
- That appropriate cost-share incentives be available to assist land managers to fence out remnant vegetation on identified discharge areas to protect trees and understorey species from grazing stock.

# SUMMARY OF RECOMMENDATIONS

## Groundwater pumping and drainage program

### General Recommendations

- That the NE CMA coordinate the development of a drainage strategy for the Region by initiating a scoping study to assist in setting future directions for drainage management. Crucial to the success of this strategy will be broad community involvement including the implementation committees, local government, water authorities, Landcare, Victorian Farmers Federation (VFF), Environmental Protection Authority (EPA), Goulburn Murray Water (GMW) and the Department of Natural Resources and Environment (DNRE).
- In the interim period of developing the drainage strategy, that monitoring of salinity be carried out on a range of drainage activities to assess downstream impact.
- That sub-surface drainage be investigated as a salinity control option in areas where these practices are expected to significantly alleviate groundwater rise.
- That groundwater pumping be investigated as a salinity control option in areas where these practices are expected to alleviate groundwater rise (eg. Riverine Plain Upper Terrace and Gneisses and Schists LMUs).

## Implementation Program

### General Recommendations

- That funding be sought to build on the existing Community Education Program to develop community understanding and ownership of the salinity issue in the North East Region.
- That the Waterwatch, Saltwatch and Watertable Watch programs be promoted throughout the Region.
- That funding be sought (eg. Farm\$mart) to promote property management planning activities that assist in developing management strategies related to improving natural resource management and farm viability.
- That funding be sought to improve management practices related to water movement on farms.
- That opportunities for funding be sought to carry out EM mapping in areas outside the salinity priority areas to assist farmers in the development of property management planning.
- That all shires be encouraged to link into the database of tree cover in association with DNRE. This will assist in assessing further applications for native vegetation removal.
- That the 5 shires of the North East Region (Alpine, Towong, Indigo, Rural City of Wangaratta and Wodonga City Council) be encouraged to work together to address planning control issues.

### Specific Recommendations

- That the Salinity Strategy employ 2 extension staff with skills in tree growing, forestry and pasture management.
- That the targets for on-ground works set in Table 17 be adopted for the North East Salinity Strategy.
- That a Strategy Co-ordinator be employed to fulfil the requirements of the North East Salinity Strategy.

## Budget

- That the cost share for salinity works outlined in Table 19 be adopted for the North East Salinity Strategy.
- That Table 20 be adopted as the 5 year budget for the North East Salinity Strategy.

## CHAPTER 1

### INTRODUCTION AND BACKGROUND

#### 1.1 North East Regional Catchment Strategy

As a component of the North East Regional Catchment Strategy (NERCS), this Salinity Strategy is part of the 'big picture' in addressing land degradation in the North East Region. The NERCS identified salinity and rising watertables as a major threat with this Strategy aiming to address salinity over the next 30 years.

Most of the other land and water degradation issues identified in the Regional Catchment Strategy have links to varying degrees with this Strategy, in particular water quality, rural tree decline, waterlogging, soil acidity, soil structure decline, erosion, habitat decline and genetic biodiversity decline. Strategies put in place to address other issues will intrinsically complement this Salinity Strategy.

#### 1.2 History

##### North East Salinity Working Group (NESWG)

NESWG was formed in November 1994 as a response to growing community concerns about the salinity threat in North East Victoria. The Region received funding in 1994/95 through the Natural Resources Management Strategy (NRMS) with the aim to produce a salinity management strategy.

In 1994, with the development of the Catchment and Land Protection Act, the North East Catchment and Land Protection Board (NE CALP) was formed. The Board's role was to co-ordinate and monitor strategies for sustainable natural resource management in the North East Region. The NESWG saw the Salinity Strategy as part of this, and in early 1996 formally became recognised as a sub-committee of the Board.

The Board was formally succeeded in July 1997 by the North East Catchment Management Authority. The NE CMA has a much broader role in catchment management than the NE CALP, incorporating river management authorities, salinity implementation groups and water quality groups. The roles of the CMA will include the identification of priority programs and works under the regional catchment strategy.

# THE REGION

## Box 1. Membership of NESWG

The NESWG is made up of Landcare groups which consider salinity an issue plus some neighbouring groups along with key Agency staff. The representatives are:

Tony Ransom, Chair & Springhurst Byawatha Hills Landcare Group

Denis Martin, immediate past Chair

David Dinning, Greta Valley Landcare Group

Ron Briggs, Hodgsons/Horseshoe Creeks Landcare Group

Phyllis McLean, Indigo Valley Landcare Group

Royce Sample, Burgoigee Creek Landcare Group

Bob Peake, Chiltern Landcare Group

Peter Curtis, Wangaratta Urban Landcare Group

John Stokes, Carboor Bobinawarrah Landcare Group

Dan Taylor, Whorouly Landcare Group

Anthony Murphy, Boorhaman & District Landcare Group

Ken Whan, Warby Range Landcare & Rabbit Control Landcare Group, member NE CMA

Sue Brunskill, Wooragee Landcare Group

Allison Chambers, Rutherglen Landcare Group

Allan Curtis, Charles Sturt University & former member NE CALP Board

Lindsay Jarvis, Member NE CMA, representing Landcare groups in upper NE

Judy Griffiths, former member NE CALP Board

Meredith Mitchell, DNRE Rutherglen

Bob Moodie, DNRE Wodonga

Peter Ockenden, Executive Officer, DNRE Wangaratta

Mark Cotter, DNRE Benalla

Peter Farrell, DNRE Wangaratta

Rick Felton, DNRE Wangaratta

## CHAPTER 2

### NORTH EAST REGION

#### 2.1 Location

The North East Region covers an area of 1.9 million hectares and includes the three major catchments of:

Upper Murray (including the Mitta Mitta River), Kiewa and Ovens (including the King River and Black Dog/Indigo Creek) catchments.

#### 2.2 Land Management

Over 61% of the region consists of Public land Forestry on public land is a major industry in the North East Region. The strategy will mainly focus on those areas in private land management.

#### 2.3 Physical environment

##### 2.3.1 Climate

The climate in the region varies dramatically. Rainfall ranges from 500 mm on the plains in the North of the catchment to over 1500 mm in the alpine areas.

A large proportion of this rain falls between May and October and this is when much of the groundwater recharge occurs. Temperatures vary greatly and are strongly influenced by location and topography.

##### 2.3.2 Water

The North East of Victoria is a very important water producing region, with around 38% of the flow of the Murray Darling Basin flowing from the Upper Murray (on the Victorian side) , Kiewa and Ovens catchments, providing large quantities of high quality water for downstream users. Protection of this valuable resource from salinity is paramount from a regional, State, Basin and Federal perspective.

##### 2.3.3 Flora & Fauna

The Region has a very diverse indigenous flora and fauna with over 520 indigenous fauna species being recorded.

Many endangered and threatened flora and fauna species are located in the Region. The distribution of these species has been greatly affected by habitat modification resulting from European settlement.

Much of the region is still covered by native vegetation, most of which is on public land set aside in parks, reserves and state forest.

However a significant amount of remnant vegetation still exists under private land management (around 102,500ha.).

##### 2.3.4 Wetlands

There are a number of significant wetlands in the Region. These have significant environmental qualities providing biologically productive sites and are key habitat and feeding grounds for fauna. Table 1 provides an indication of the wetlands in the region and their current status.

#### Heritage Rivers

Parts of the Ovens and Mitta Mitta Rivers have been nominated under the *Heritage Rivers Act* in recognition of their significant features. The parts nominated are the Mitta Mitta River from Glen Valley to the tail-waters of Lake Dartmouth, and the 52 km of river corridor on the Ovens River from Killawarra to Lake Mulwala

## THE REGION

**Table 1 Wetlands in the North East Region**

<b>Wetland category</b>	<b>Drained</b>	<b>Public</b>	<b>Conservation</b>	<b>Private</b>	<b>Total</b>
Freshwater meadow (ha)	1,245	98	4	3,962	4,060
Shallow freshwater marsh (ha)	475	369	227	972	1,341
Deep freshwater marsh (ha)	253	310	54	810	1,120
Permanent open freshwater (ha)	49	25,250	322	828	26,078
Sewage pond (ha)		102		8	110
<b>Total (ha)</b>	<b>2,022</b>	<b>26,129</b>	<b>607</b>	<b>6580</b>	<b>32,709</b>

1. The drained area includes all wetlands lost since settlement but those areas totally drained have not been counted.
2. Ownership classes are based on LCC final recommendations which may not reflect the current situation
3. Conservation reserves primarily for conservation eg. Wildlife Reserves, Flora & Fauna Reserves, Game Refuges and National Parks

**Table 2 Native forest and woodland vegetation on freehold land**

<b>Catchment</b>	<b>Upper Murray</b>	<b>Kiewa</b>	<b>Ovens</b>
% of basin total area	6%	4%	5%
Area of remnant vegetation on private land (ha)	59,000	7,000	36,500
% of freehold land with remnant vegetation	20%	8%	10%

# THE REGION

## 2.4 Social profile

The population of the region is approximately 176,000 based on 1994 census data with over 40% (over 72,000) in townships or urban centres. Wodonga is the largest town with a population of around 27,800 followed by Wangaratta with a population nearing 16,000. Within the holiday periods the population increases significantly.

## 2.5 Economic development

The North East Region has a solid agricultural and forestry base but is also strong in tourism, manufacturing, retailing, defence and community services.

### 2.5.1 Agriculture

Agriculture and related industries are very important in providing economic wealth to the Region. The fertile valleys and riverine plains combined with reliable rainfall has produced a diverse range of agricultural commodities. The following table provides some detail on the economical value and importance of the various agricultural industries within the region.

**Table 3 Area of land used in agricultural production.**

Catchment	Area (ha)
Upper Murray	293,000
Kiewa	91,000
Ovens	378,000
Total	762,000

Approximately 43% of the total agricultural land in the Region consist of pastures (both irrigated and dryland) supporting beef, sheep and some dairying in the valleys. On the Riverine Plain there is broadacre cropping of wheat, oats, triticale, barley, lupins, peas and canola. Horticulture crops such as berries, nuts and apples are grown around Beechworth and the Ovens Valley. Tobacco and hops have primarily been grown in the Ovens, King and Kiewa Valley areas. Grape/wine production in the Ovens and King valleys and Rutherglen add both to agricultural production and tourism in the area.

The Region has been progressive in developing new agricultural industries as an alternative to tobacco. These include intensive irrigated crops such as berry crops, peppermint and essential oils and vegetables.

**Table 4 Gross value for Agricultural products 1993-94**

Enterprise	Gross value
Livestock (includes meat, milk and wool production)	\$134 million
Crops	\$14 million
Horticulture (including grapes)	\$28 million
Total	\$176 million

### 2.5.2 Forestry

Commercial forestry is a major industry in the area. It has an estimated value of \$213 million in the North East Region. Over 90% of this forestry occurs on public land. Of the forestry that does occur on private land the majority is in softwood plantations.

The potential for establishing hardwood and softwood plantations has been investigated with the farming community showing increasing interest in this new enterprise. It has been identified as one of the future growth areas for the Region.

### 2.5.3 Tourism

Tourism is an important economic resource to the Region. In the Alpine Shire alone tourism is estimated to add \$200 million to the local economy. Tourism is growing across the whole Region and is contributing to changes in the roles of towns and rural areas.

# THE REGION

## 2.5.4 Water

One of the North East Region's most valuable resources is the high quality water it produces. The Regional Catchment Strategy identifies protection of this resource as essential and has as one of its outcomes, "high quality water for the growing regional and downstream urban agricultural and industry needs". Management of this resource will impact on the social, environmental and economic well-being at a regional scale, and also on those downstream users dependent on good water quality for their livelihood.

The quality of this surface water for the Upper Murray, Kiewa and Ovens Basins is generally rated as "good". A major factor contributing to this is that much of the Region is still covered with native vegetation. In those areas that are extensively cleared water quality declines, for example in the Ovens River nutrient levels increases between Myrtleford and Wangaratta, and increasingly nutrient run-off from both point and diffuse sources is linked to algal blooms.

## 2.6 Future Regional Economic Development

Potential for further development in the Region has been identified in the following areas:

### Agriculture

- ◇ increase intensive horticulture including wine and grape production;
- ◇ farm forestry;
- ◇ new and emerging industries, eg. vegetables, peppermint oil crops.

The *North East Agribusiness Forum* has been established to look for opportunities to develop agriculture industries. The Forum is developing strategies for particular agriculture industries that promote growth, with particular emphasis on overseas marketing.

### Tourism

- ◇ ecotourism
- ◇ increased hospitality sector and hospitality training
- ◇ snow-fields development
- ◇ National, State & Regional Parks

### Forestry

- ◇ value adding
- ◇ hardwood plantations
- ◇ increased softwood plantations
- ◇ residual hardwood timber market

**Table 5** Quantity of Water produced in the North East Catchments

Catchment	Average Annual Streamflow ML	Total Victorian Discharge %	Total Murray Discharge %
*Upper Murray	3,920,000	17.8	35
Kiewa	705,000	3.2 (6%)	6
Ovens	1,620,000	7.3(14%)	14
<b>Total</b>	<b>6,245,000</b>	<b>28.3</b>	<b>55</b>

\*Includes portion for New South Wales

### Reference

All facts and figures quoted are from the draft Regional Catchment Strategy (North East) unless otherwise referenced.



## CHAPTER 3

### SALINITY IN THE NORTH EAST REGION

#### 3.1 Salinity in the North East

##### 3.1.1 Salinity issue

Salinity has emerged as a serious issue in the North East Region. Over 2100 hectares of salt affected land has now been identified, along with a trend of steeply rising watertables in some Land Management Units (LMUs).

Salinity caused by rising watertables has been identified as one of the factors contributing to a decline in water quality. Protection of this resource is of great importance, and is rated very highly in the Regional Catchment Strategy.

##### 3.1.2 Community involvement

On-ground works to address the salinity issue have been carried out by some land managers due to increasing concern about the salinity issue. Works have included pasture establishment, alley farming and tree growing. Some groups are also starting to develop their own sub-catchment plans.

Landcare groups in priority salinity areas (See 4.3) have also been actively involved in the monitoring of bores. Groups have volunteered to collect valuable bore data which is put onto the DNRE groundwater database. (See 4.6.2)

#### 3.2 Research and monitoring

##### 3.2.1 Discharge mapping

Work carried out by Anthony Fanning through Charles Sturt University has identified over 2100 ha of salt affected land.

**Table 6 Discharge areas in the North East Region**

Category	Number of sites	Total area affected (ha)
<b>Class 1</b>	<b>58</b>	<b>1067</b>
<b>Class 2</b>	<b>54</b>	<b>429</b>
<b>Class 3</b>	<b>46</b>	<b>665</b>
<b>Total</b>	<b>158</b>	<b>2161</b>

- Class 1 Area of low level salting. Usually a warning sign of potentially bigger problem.*
- Class 2 Areas of moderate salting. Soil salting is easy to recognise.*
- Class 3 Severely affected area. Large areas of bare ground can be recognised.*

##### Urban impact

Saline discharge areas have been identified in both the townships of Wodonga and Wangaratta. The potential damage to concrete structures is very high in these areas.

##### Rate of spread

The estimated rate of spread of discharge areas for North East Victoria is 5.83% per annum without the Strategy. It is anticipated that without intervention over 11,700 ha of land will be affected by salinity over the next 30 years (Fanning 1996).

##### 3.2.2 Geology and groundwater

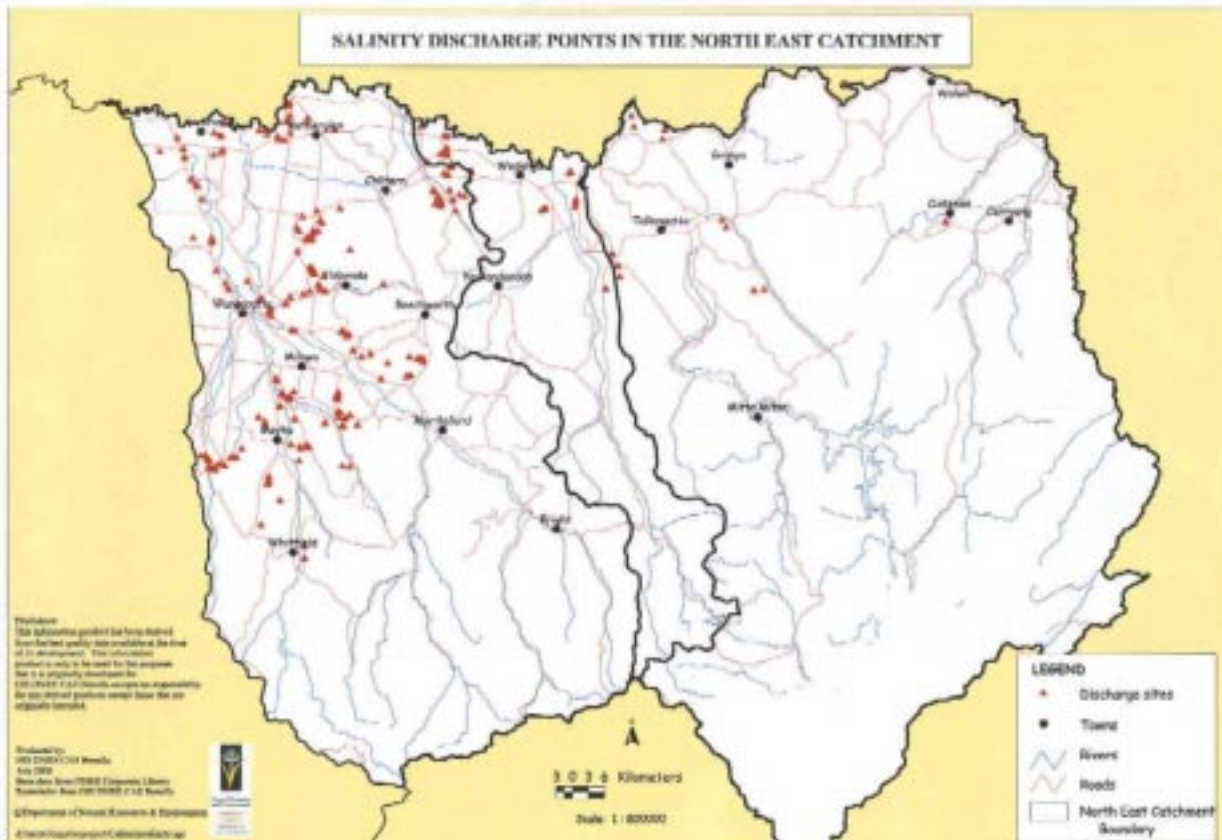
The Centre for Land Protection Research (CLPR) was commissioned to prepare a study, 'Groundwater Trends and Salinity in the North East Region'. The results suggest that all cleared land in the North East Region has the potential to contribute to the salinity problem. However, particular LMUs have been identified as key salinity risk areas based on geology, landscape criteria and groundwater trends.

*For a comprehensive report on the existing bore network including information on location, interpretation of results and predicted salinity risk the above report is available from DNRE Wangaratta office (see front cover).*

Continued improvement of the bore network and regular measurements of groundwater levels and salinities will significantly improve the prediction of salinity risk, the understanding of groundwater systems and processes, and help gauge the effectiveness of salinity treatment.

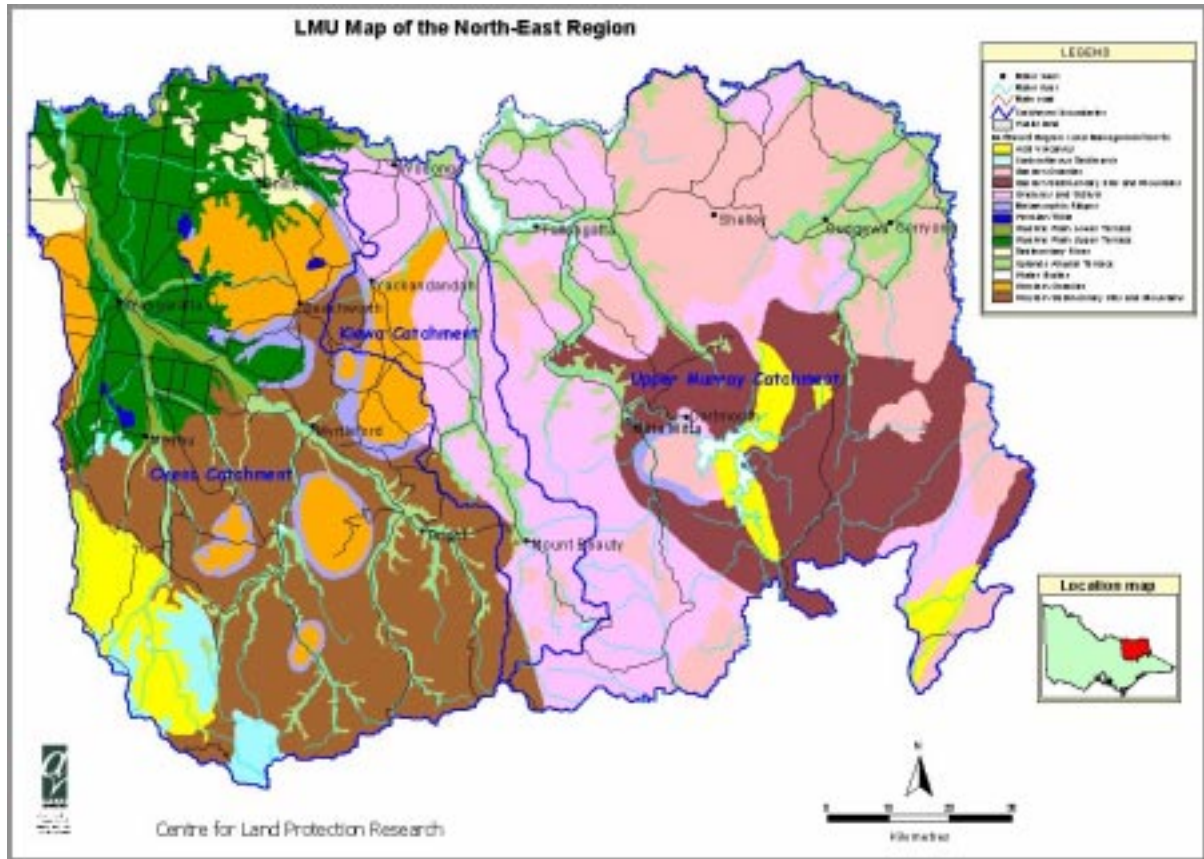
# SALINITY IN THE NORTH EAST REGION

Map 1 Recorded Discharge in North East.



# SALINITY IN THE NORTH EAST REGION

Map 2 shows the thirteen broad Land Management Units (LMU) that have been identified in the North East Region.



Land Management Units for the North East Region

Seven of the thirteen LMUs have been identified as priority LMUs. These are:

- ◇ Riverine Plain Lower Terrace
- ◇ Riverine Plain Upper Terrace
- ◇ Permian Tillite
- ◇ Metamorphic Ridges
- ◇ Sedimentary Rises
- ◇ Western Sedimentary Hills and Mountains
- ◇ Gneisses and Schists

Three broad types of salinity process operate within these 7 priority LMUs. These processes are:

1. **upland fractured bedrock process** in the various metamorphic and sedimentary rock LMUs ( Fig 1)
2. **alluvial plain process** in Upper and Lower Riverine Plain Terraces (Fig 2)
3. **glacial deposits process** in the Permian Tillite LMU (Fig 3).

# SALINITY IN THE NORTH EAST REGION

## 1. Upland Fractured Bedrock Process

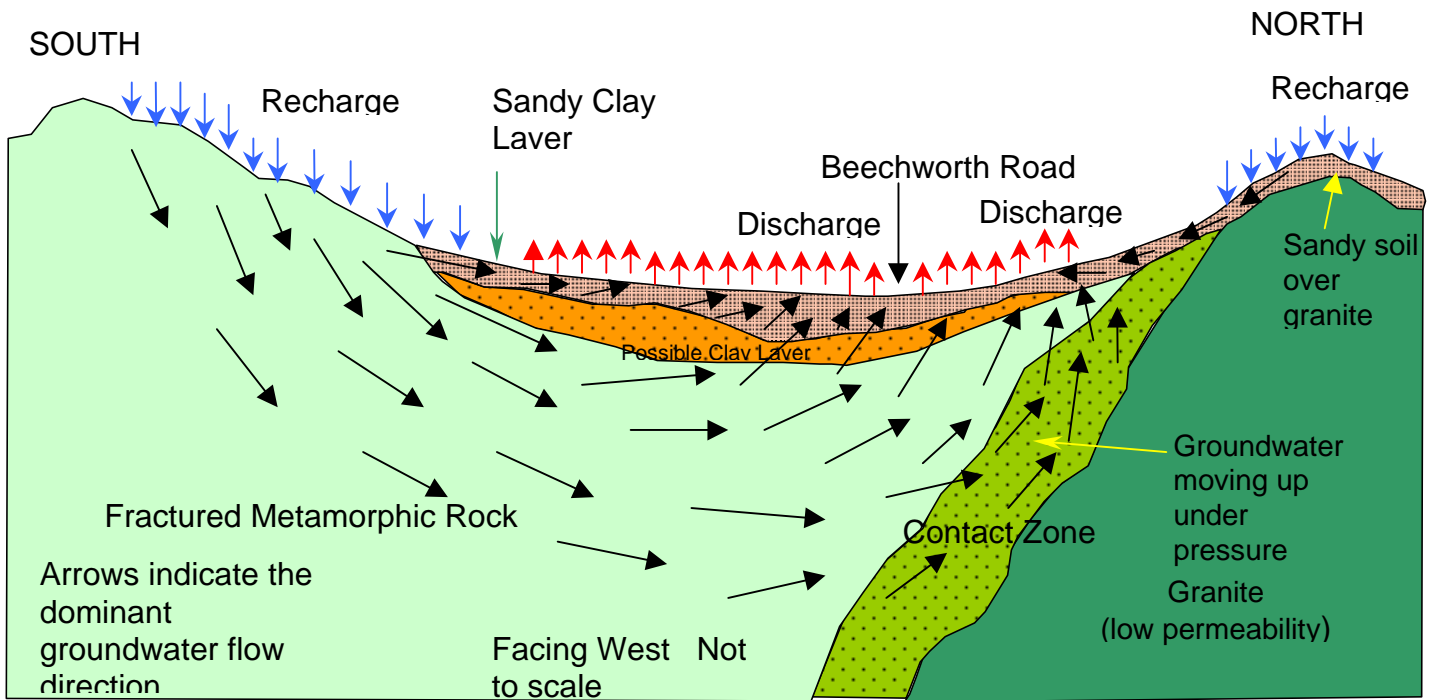
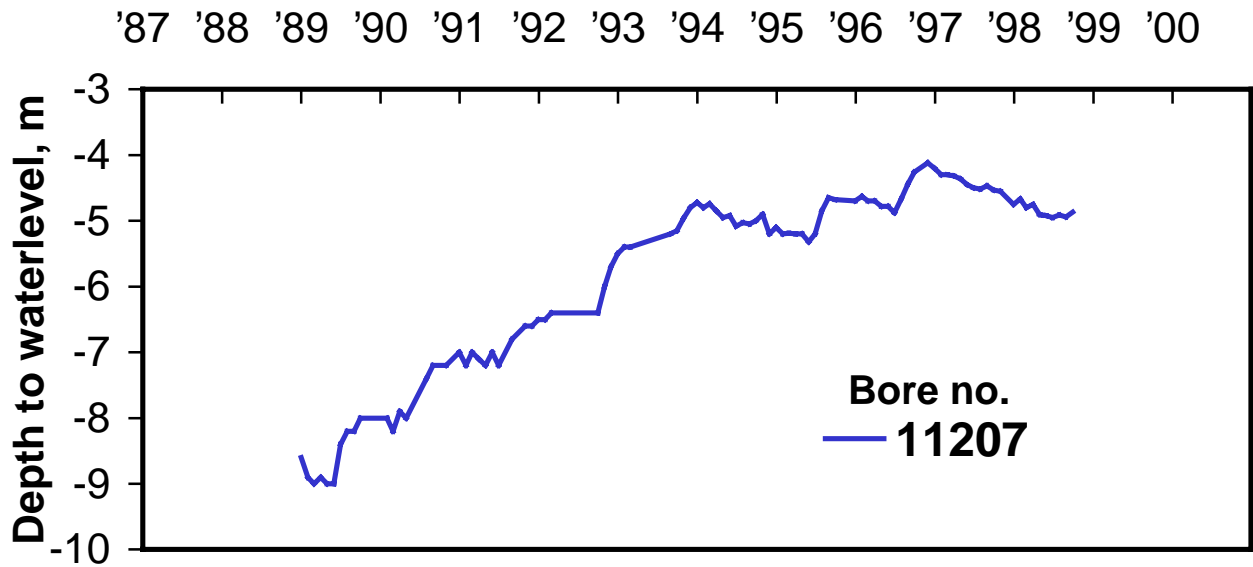


Figure 1. Upland fractured rock salinity process (in this example near Everton). Prior to European settlement forested catchments kept the watertables low. Following clearing, watertables began to rise.

Salinity is related to the clearing and replacement of deep rooted perennial native vegetation by shallow rooted grasses. More rain is now infiltrating through the soil profile into the fractured bedrock and eventually entering the groundwater.

This is the predominant process occurring in the uplands LMUs. Water preferentially enters through the shallow stony soils on the top of a hill (**recharge area**) and flows through the soil profile and

fractured bedrock to the groundwater system. Due to the hydrological imbalance caused by clearing, the groundwater system cannot release the extra water as fast as it is entering, thus causing groundwater levels to rise. Once the groundwater is within 2 metres of the surface, soil salting can occur. Salts that existed naturally in the soil are brought to the surface with the groundwater and are concentrated by evaporation. Areas affected by salt are called **discharge areas**.



Hydrograph of fractured bedrock bore near Everton in the Metamorphic Ridge LMU, with its steeply rising groundwater trends.

**Locality:** Off Bennetts Lane, 1.5km west of Everton

**LMU:** Metamorphic Ridges

**Land Cover at site:** Perennial Pasture, phalaris

**Bore Depth:** 15m

**Aquifer description:** Weathered Ordovician metamorphics (slates, hornfels, quartzites etc)

**Landscape Position:** Lower slope, not far below saddle

**Average Annual Rainfall:** 720mm

**Groundwater trends:** Rising sharply at an average rate of about 67 cm/y from 1989-1995. Substantial salinity threat in this area.

# SALINITY IN THE NORTH EAST REGION

## 2. Alluvial Plain Process

### The threat to the Riverine Plain

Groundwater level rises of up to 36cm/yr. have been recorded on the Riverine Plain (alluvial plain process, see figure 2). Although not clearly understood as yet, current thinking suggests that the highest rates of recharge on the Riverine Plain (estimated range 200 - 100 mm/yr.) occurs along 1-2 km wide strips of the Upper Terrace, either side of the Lower Terrace. It appears that groundwater levels within these strips show greater seasonal rises in response to winter rainfall suggesting a greater recharge rate than the rest of the Riverine Plain.

Soils within this band tend to have a relatively high sand content, with clay content increasing moving further away from the Ovens River. Although recharge rates on the rest of the Riverine Plain are much lower (estimated average 30mm/yr.), recharge is still **very significant** as it is occurring over such a large area (Approx. 129,000 ha). Priority for on-ground works will be targeted along the 1-2 km strips adjoining the Ovens and Murray Rivers. It is also very important to provide incentive for works in the remainder of the Riverine Plain LMU.

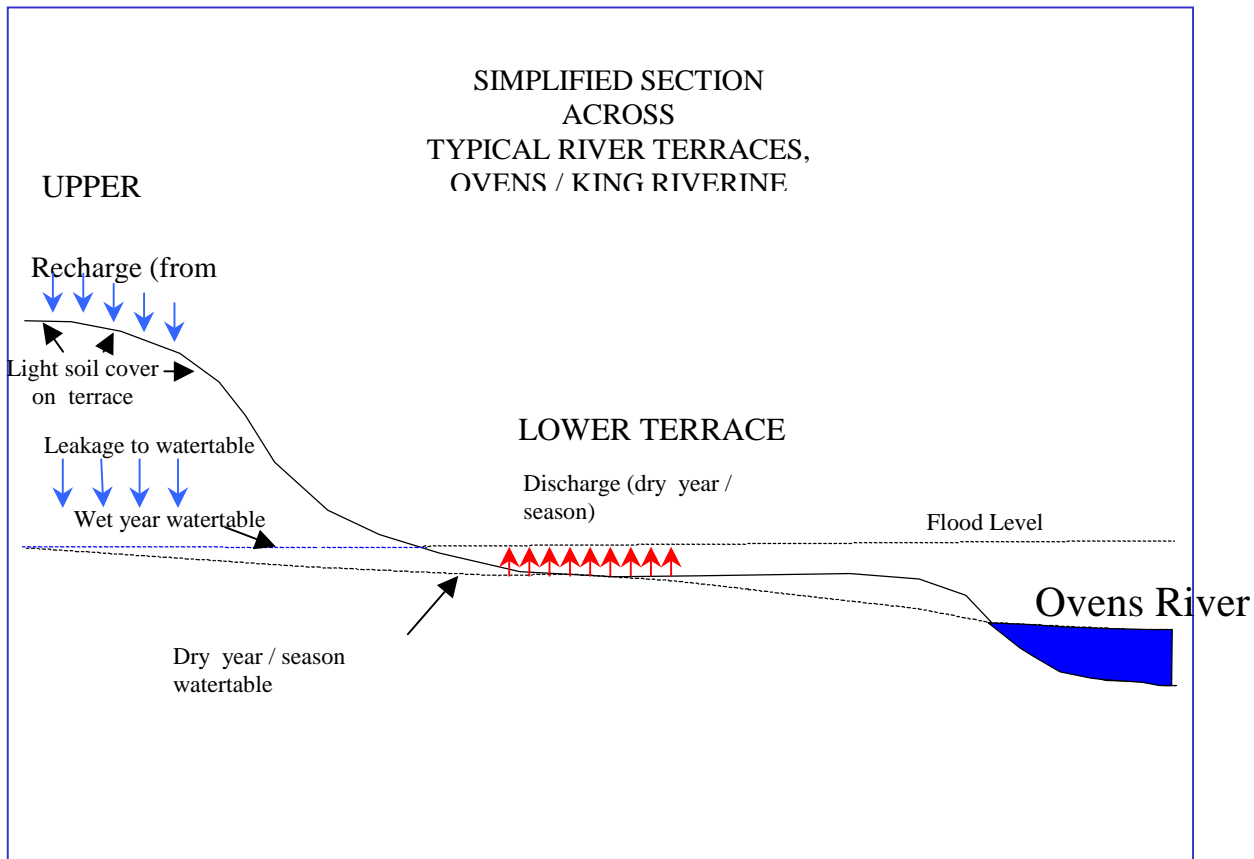
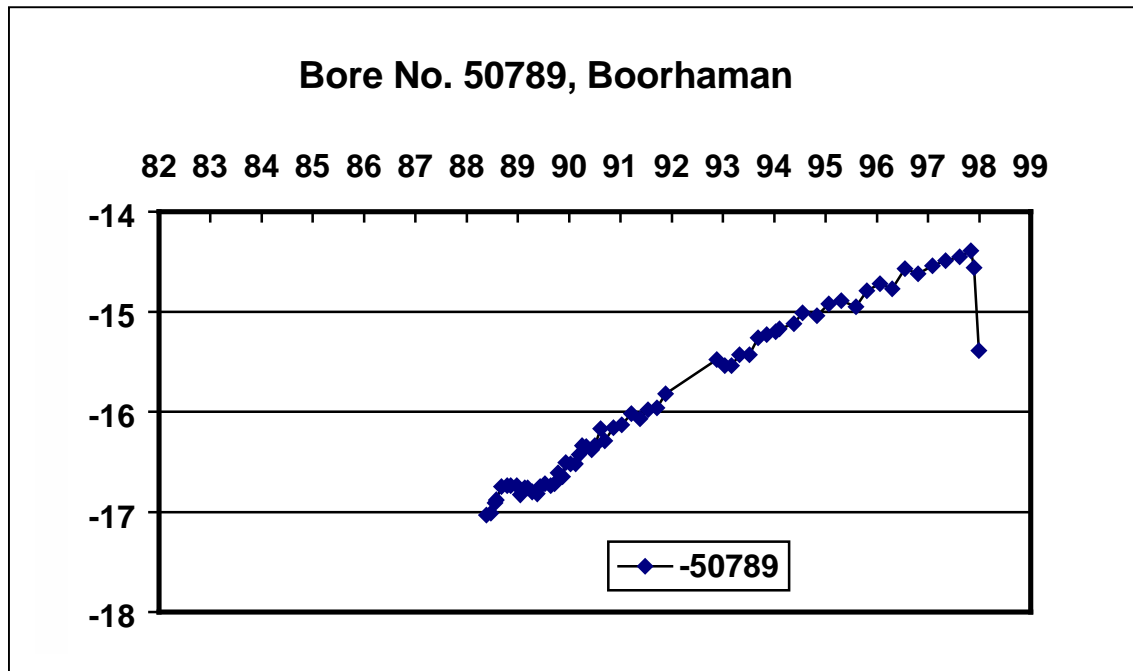


Figure 2 The alluvial plain salinity process highlighting the relationship between the Riverine Plain Upper and Lower Terrace (based on limited information).

## SALINITY IN THE NORTH EAST REGION

The Riverine Plain Upper Terrace and Riverine Plain Lower Terrace are of greatest concern in the North East Region for the following reasons:

- ◇ the rapidly rising watertable,
- ◇ the size and number of discharge sites,
- ◇ The threat to floodplain and wetland systems associated with the Ovens and Murray River, and
- ◇ the large area of high value agricultural land potentially under threat from salinity.



Hydrograph of Upper Terrace Riverine Plain bores. Note the lineal rise between 1988 and 1998.

**Locality:** Boundary Road, north of Diddah Diddah creek, near Boorhaman East

**LMU:** Riverine Plain Upper Terrace

**Land Cover at site:** Annual pasture

**Bore Depth:** 30m

**Aquifer description:** Shepparton formation, mottled silty clay with fine to coarse lenses

**Landscape Position:** Ovens riverine Plain

**Average Annual Rainfall:** 590mm

**Groundwater trends:** Rising linearly at an average rate of 26cm/y from 1988-1994. Monitoring lapse in 1992

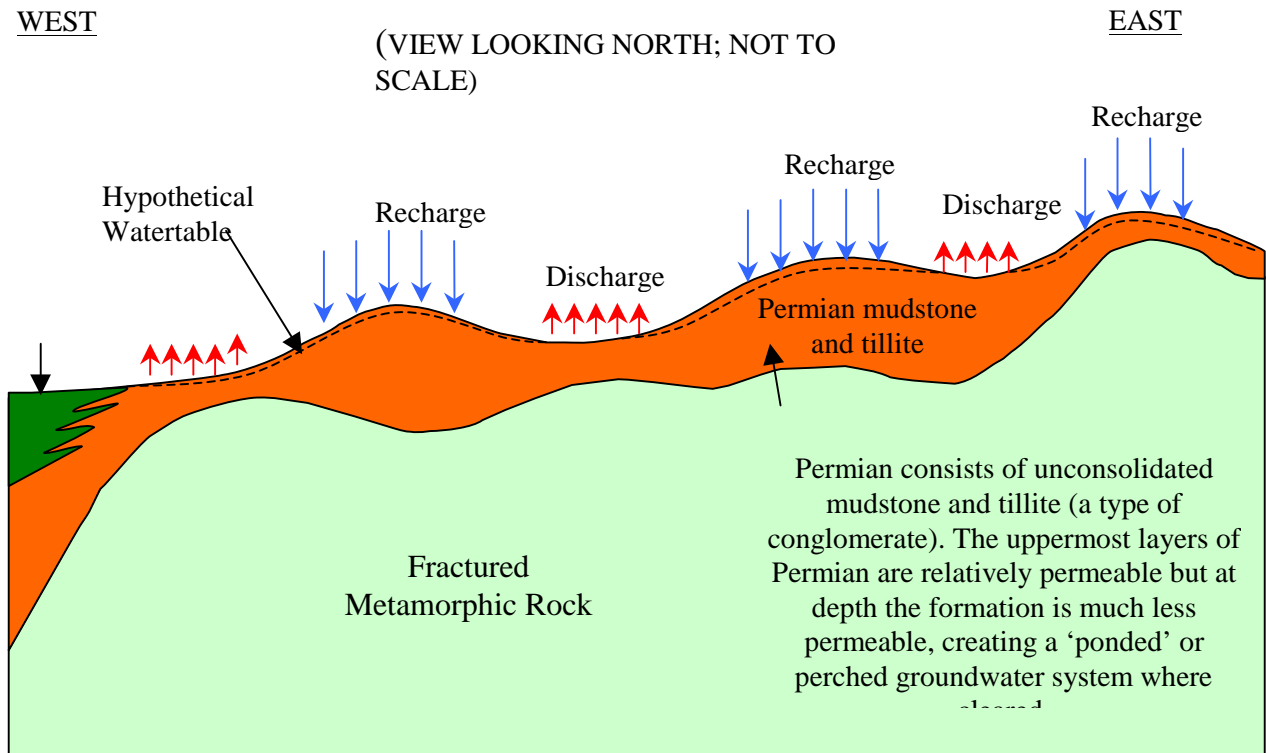
# SALINITY IN THE NORTH EAST REGION

## 3. Glacial Deposit Process (Permian Tillite LMU)

Although this LMU only covers a small area of the Region, the very nature of the sediments gives rise to a very serious salinity threat. Widespread clearing of vegetation has exposed relatively permeable soils on broad rounded hills of weathered Permian Tillite (predominantly comprising fluvioglacial till deposits - pebbles and cobbles in clay or silt groundmass). Beneath the soil, and with increasing depth, the

freshier Permian stratum becomes less permeable. Consequently, with the increased shallow infiltration and lack of deep drainage, a perched groundwater system has developed. Shallow groundwater has been rapidly mounding and travelling along the upper weathered Permian horizon, picking up salts left concentrated by the prior vegetation. Where the perched aquifer has broken the ground surface, salinity discharge is observed.

SIMPLIFIED CROSS-SECTION SHOWING RECHARGE AND DISCHARGE AREAS IN THE SPRINGHURST-BORALMA AREA





## SALINITY IN THE NORTH EAST REGION

The following table outlines the characteristics and salinity threat for each of the priority LMUs.

**Table 7 Characteristics and salinity threat for each priority Land Management Unit (LMU)**

Land Management Unit (LMU)	Characteristics	Salinity threat
Riverine Plain Lower Terrace	1.6 % region Floodplain Rainfall 500 -700 mm Regional groundwater system	Seriously threatened. Already large areas of discharge at break of slope, below the edge of the Riverine Plain Upper Terrace LMU. Linked to Riverine Plain Upper Terrace.
Riverine Plain Upper Terrace	9.3% Region Ancestral floodplain Rainfall 500 - 700 mm Regional groundwater system	Rapidly rising watertable - potential salinity threat great concern. Linked to Riverine Plain Lower Terrace. More data needed.
Permian Tillite	0.2% Region Glacial deposits Rainfall 600-700 mm Permian strata clayey and tightly packed at depth- results in local groundwater systems	Much is salt affected with degradation spreading rapidly. Groundwater rising at 'alarming' rate. Freeway and railway embankments may be compounding problem in some areas.
Sedimentary Rises	1.5% Region Rainfall 500- 600 mm Local and intermediate groundwater systems	High groundwater salinity recorded. Serious salinity problems. Understanding of groundwater processes and trends poor as limited bore information.
Metamorphic Ridges	2.1% Region Rainfall - generally >700mm Highly fractured bedrock. Local groundwater systems	High infiltration on exposed rock or thin soils contributing significantly to discharge in lower landscapes and LMUs. Significant salinity risk.
Western Sedimentary Hills and Mountains	19.0% Region Rainfall - high Local groundwater systems	Salinity problem evident in cleared areas, mainly around northern fringe - most of this LMU is uncleared. Groundwater salinities and yield are variable but predominantly low. Groundwater processes poorly understood.
Gneisses and Schists	19.4% Region Rainfall 500mm - very high Metamorphic Highly fractured & jointed Local groundwater systems	High recharge on exposed rock and thin soils on crests and upper slopes. Some discharge. Groundwater processes poorly understood. Potential salinity threat not clear.

The six LMUs not described are considered to be under less salinity threat, but careful land and water management is required to ensure that decisions in the future protect these areas from salinity and related land degradation issues. Chapter 4 discusses the management options to be adopted as a preventative strategy.

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### 3.2.3 Electromagnetic (EM) surveys

With the aid of Charles Sturt University, the NESWG undertook a number of Electromagnetic (EM31) surveys to provide land managers and agencies with an additional useful means to assist with understanding soil-water processes and delineating recharge areas and existing and potential discharge areas. The EM31 instrument uses induced electromagnetic fields to probe the soil profile for information on soil conductivity. The survey identified large variations of soil conductivity in differing soil types and in similar soil types with different salt and moisture contents.

The NESWG, DNRE and Landcare groups did not have an adequate understanding of salinity risk and processes and looked for cost effective ways to gain that knowledge. Charles Sturt University, Centre for Conservation Farming at Wagga, NSW was contracted by the NESWG to survey portions of high priority areas within the region. Approximately 14000 hectares were surveyed in cooperation with eight Landcare groups three of which part funded this project. The EM31 maps for the sub-catchments are to be used as a tool for farm planning. DNRE has provided some individual EM maps as part of farm planning workshops. Areas covered include:

- Carboor Landcare Group (four areas)
- Kilborn Road, Rutherglen Landcare area
- A section of Burgoigee Creek Catchment
- Springhurst Landcare area
- Greta Landcare area
- Indigo Valley Landcare area
- Everton Landcare area
- Tarrawingee area
- a section of the Lower Kiewa Valley

The NESWG realises that there are limitations to using EM techniques, however, combined with other available data it can provide valuable assistance to both land managers and agency extension staff.

### 3.2.4 Ovens groundwater modelling

A consultancy was let by the Ovens Basin Water Quality Strategy to study groundwater-surface water interactions in the Ovens Basin (SKM 1997). This information has assisted in developing our understanding of groundwater processes in the Riverine Plains.

The report concluded that there were three main areas of discharge within the Riverine Plain of the Ovens River Valley. These are:

- ◇ direct groundwater discharge to the surface water channels including Reedy Creek and the Ovens River,
- ◇ at the break of slope between the Upper and Lower Terraces as shown by significant areas of salinised land at this point in the landscape,
- ◇ at the break of slope between the Upper Terrace and bedrock hills at the extreme eastern edge of the Riverine Plain

### 3.2.5 Salt loads

It is estimated that over 180,000 tonnes of salt is currently exported annually from the North East Region. The majority of this is generated in the upper Murray catchment, however this is attributed to a much larger annual discharge from the basin and not poorer quality water or a more salinised catchment (SKM, 1997). It is estimated that over 1 million tonnes of salt flows into South Australia in the Murray River each year (Norman et al. 1996). Southern South Australia begins to draw its water supply from Morgan on the Murray River, and the MDBC uses this site as its benchmark for assessing the effectiveness of all salinity plans and their impact on the Murray River.

The average annual salt loads and their impact at the Morgan monitoring site were calculated for the period 1985-1995.

**Table 8 Current Salt Loads in the North East Region.**

Catchment	Average annual salt load (t/yr.)	Impact on Murray River (EC at Morgan)
Upper Murray	104,668	15.5
Kiewa	21,078	4.4
Ovens	55,942	10.8
Total	181,688	30.7

### Impacts of the Strategy

The *no intervention* scenario represents the expected increase in salt loads exported from the North East if no salinity management activities were implemented.

The North East region is expected to contribute an increase in salt load to the Murray River of 1% (compound) over the next 30 years.

This corresponds to a 35% increase in salt loads if nothing is carried out to the year 2027.

**Table 9 Predicted Salt Loads in the North East Region in 2027.**

Catchment	Average annual	Impact on
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## ADDRESSING THE ISSUE

	salt load (t/yr.)	Murray River (EC at Morgan)
Upper Murray	141,077	21.03
Kiewa	28,410	5.90
Ovens	75,401	14.52
<b>Total</b>	<b>244,888</b>	<b>41.45</b>

Comparing Tables 8 & 9 identifies an increase in salinity in the Murray River of 10.8 EC over a 30 year period.

The *with strategy* scenarios (Table 10) represents the expected reduction in the predicted rate of increase of salinity if the management options funded through the Strategy are implemented over the next 30 years. (See 4.14.3)

**Table 10 Impact of implementation of the North East Salinity Strategy.**

Possible implementation rates*	Discharge area saved (ha)	Average annual salt load (t/yr.)	Impact on Murray River (EC at Morgan)
10% <sup>1</sup>	757	4,677	0.82
20%	1,514	9,354	1.65
50%	3,784	23,385	4.13

\* *Implementation rate is the percentage implementation of on-ground works on cleared high recharge area in priority areas (See Chapter 4)*

<sup>1</sup> *The figure of 10% implementation rate is the preferred option in the plan.*

The growth in discharge areas and salt loads into streams and rivers is significantly reduced over 30 years depending on the level of implementation.

There are a number of assumptions that are implicit in the reduction over 30 years and these include:

*For every 10 ha of high density (conservation) planting, farm forestry or lucerne established on high recharge area, 1 ha of discharge area is reclaimed*

*For every 20 ha of perennial pasture established on high recharge area, 1 ha of discharge area is reclaimed.*

These assumptions are based on those in the Goulburn Broken Dryland Salinity Management Plan.

## CHAPTER 4

### ADDRESSING THE ISSUE

#### 4.1 North East Salinity Strategy

##### objectives:

To control salinity in the North East Region for the benefit of the environment, local communities and downstream users for future generations.

#### 4.2 Using rain where it falls

The Salinity Strategy will focus on implementing options that promote higher water use in all cleared areas of the Region, including the promotion of activities that protect and enhance remnant vegetation.

The NESWG recognises that salinity control needs to be tackled from a farm/sub-catchment perspective looking at a whole range of land and water

##### Box 2 Seven principals underlying the actions within the Strategy

The following **seven principles** underlie all actions within the strategy:

1. **protection of high value environmental areas**
  - ◇ This will include the protection of those high value natural areas threatened by rising watertables such as wetlands and streams.
2. **protection of water quality for downstream users**
  - ◇ Protection of downstream water quality from the impact of salinity and groundwater drainage is of paramount importance. The development of a salinity and drainage strategy will be a crucial step in ensuring its preservation.
3. **treatment of high recharge areas**
  - ◇ Focus will be on reducing groundwater accessions to the watertable by treatment of high recharge areas with on-ground works. This includes:
    - ⇒ protection of indigenous vegetation existing on high recharge areas to ensure their current role in limiting recharge is maintained.
    - ⇒ revegetating cleared high recharge areas with trees and perennial pastures.
    - ⇒ promoting land management practises which maximise water use.
4. **interception of groundwater**
  - ◇ Intercepting water after it recharges but before it discharges will be investigated further eg. groundwater pumping and interception tree establishment.
5. **integration with other natural resource programs**
  - ◇ Identifying opportunities to complement other natural resource programs (in the NE CALP strategy) through integration with the salinity program will be a focus of this Strategy. Particular emphasis will be on water management at a farm level and the development of farm forestry.
6. **protection and rehabilitation of discharge areas**
  - ◇ Establishing salt tolerant perennial vegetative cover on discharge areas to reduce erosion, waterlogging, increase water use, and improve productivity.
7. **integration with primary production**
  - ◇ Maintaining a productivity focus while integrating sustainable land management practices will be implicit in implementation of this Strategy.

management techniques while still maintaining a productivity focus. Property management planning will have a key role in identifying the broad range of options to use rainfall more effectively. Issues such as waterlogging and water movement around the farm will be crucial to the long-term control of salinity on farms.

For this reason this strategy will focus on:

- ◇ implementing options that promote high water use; and
- ◇ integrating with other programs that complement the salinity strategy.

The Salinity Strategy will take a multi-faceted approach to salinity control through property management planning /sub-catchment planning.

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### 4.3 A strategic approach

This strategy aims to focus the limited resources into priority areas. All priority areas (except Riverine Plain) were chosen on a combination of the following criteria:

- ◇ local community commitment to address the issue
- ◇ area of salt affected land
- ◇ potential spread
- ◇ impact on environmental values ( eg flora and fauna)
- ◇ impact on urban community
- ◇ impact on surrounding areas
- ◇ sound land management practises

The Riverine Plain priority area was chosen due to:

- ◇ the rapidly rising watertable, the size and number of discharge sites,

- ◇ the threat to floodplain and wetland systems associated with the Ovens and Murray River, and
- ◇ the large area of high value agricultural land potentially under threat of salinity.

#### Expansion into other areas

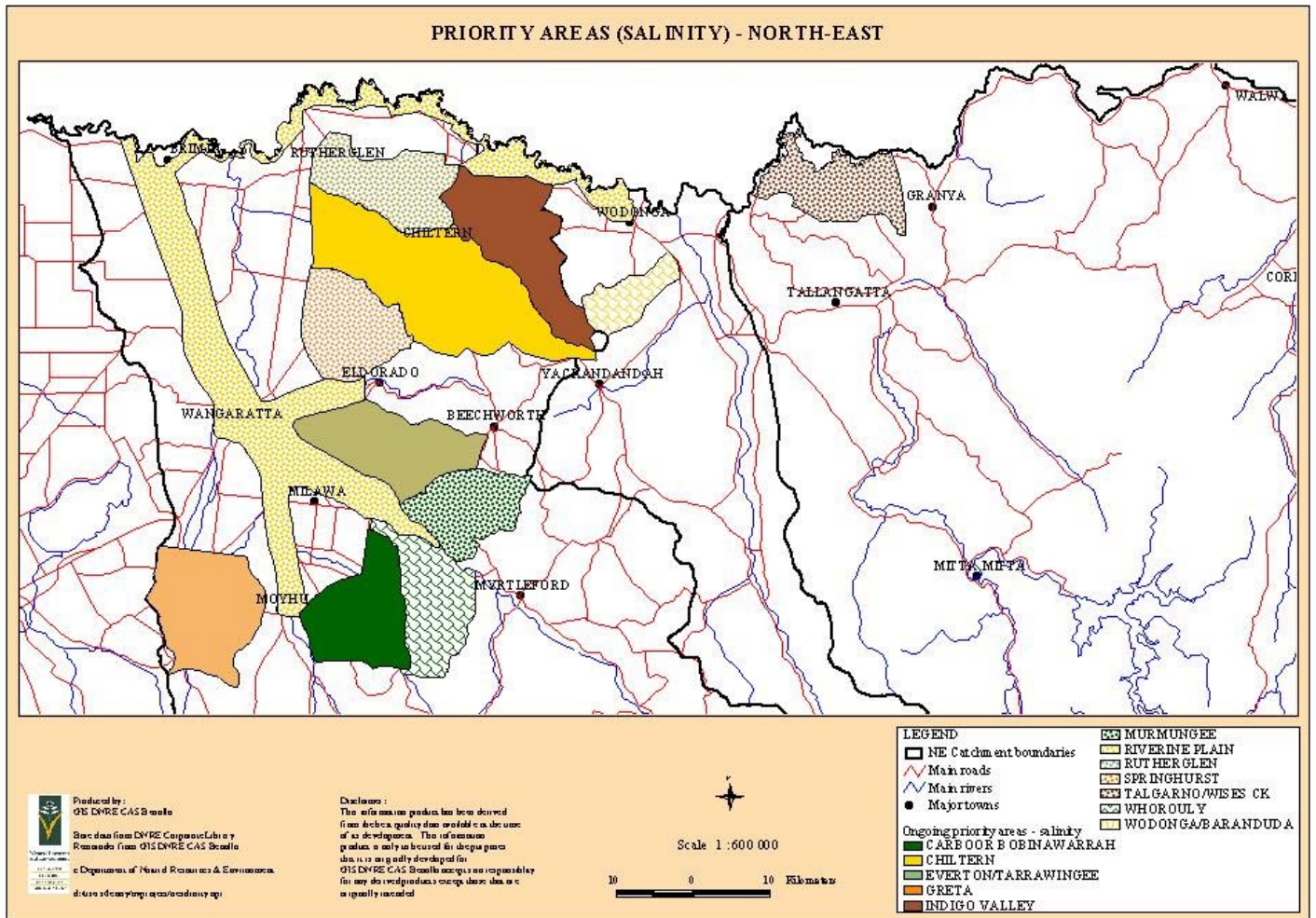
Limited understanding of the groundwater processes in some areas of the North East (eg. Kiewa and Upper Murray Catchment areas) has restricted the ability to predict trends in groundwater. The expansion of the bore network (see 4.6.2) into these areas will allow for the collection of useful data to be used to more accurately predict the salinity risk in these areas. As this information becomes available and our understanding of groundwater processes increases it may be necessary to increase the number of priority areas.

**Priority areas will be the focus for on-ground works through the Salinity Strategy. Where possible priority areas were chosen on a sub-catchment basis (3 exceptions). This will be particularly important in measuring and reviewing the impact of on-ground works. Priority areas will be subject to review on an annual basis.**

**Table 11 Identified priority areas in the North East Region**

Priority areas		total area ha	area of cleared high recharge ha	area of discharge ha
Riverine Plain	Ovens Murray	43,920 15,000	21960 10,000	569
Rutherglen		14,745	6,560	28
Springhurst/ Byawatha		14,515	7,260	130
Indigo Valley		19,240	5,210	142
Wodonga/ Baranduda		6,130	4,670	68
Everton/ Tarrawingee		18,995	6,120	119
Carboor/ Bobinawarrah		15,705	6,980	185
Greta		18,995	4,400	332
Murmungee		11,935	2,520	16
<b>Total</b>		<b>179,180</b>	<b>75,680</b>	<b>1589</b>

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Salinity Priority areas in North East, March 2000

## 4.4 Programs

The Salinity Strategy has been divided into 9 programs, 2 identifying areas of further investigation and 7 related to on-ground works:

### 4.4.1 Investigation

- ◇ Research and investigation program
- ◇ Monitoring program

### 4.4.2 On-ground works

- ◇ Environmental program
- ◇ Farm tree program
- ◇ Pasture program
- ◇ Cropping program
- ◇ Saline agriculture program
- ◇ Groundwater pumping and drainage program
- ◇ Implementation Program

## 4.5 Research and investigation program

### 4.5.1 Research and investigation strategy

The North East Region will rely heavily on other salinity research and investigation programs within Victoria and the Murray Darling Basin to fulfil its research needs. However, some specific research and investigation will be required. The North East Region will prepare a Research and Investigation (R&I) strategy that will set direction and priorities for research over the next five years. Opportunities to link the R&I strategy with other salinity regions with similar research requirements will be sought, with a view to complement or supplement other research strategies on a State, Basin and Federal level.

### Recommendations

- That the North East Region prepares a Research and Investigation (R&I) strategy that sets direction and priorities for research over the next five years.
- That opportunities to link with other salinity regions R&I strategies be sought to maximise the outcomes from limited research funding.

### 4.5.2 Research needs

CLPR has made several recommendations for further research in *Groundwater trends and salinity risk in the North East Region*. The following table gives a summary of their recommendations and prioritised by the NESWG.

## ADDRESSING THE ISSUE

**Table 12** Research needs identified by Centre for Land Protection Research and prioritised and commented on by North East Salinity Working Group.

Priority	Issue	Research needs
1	<b>Farming production systems</b>	Salinity control research trials and economic analysis for the following farming production systems: <ul style="list-style-type: none"> <li>• farm forestry - break of slope tree belts, interception tree belts, tree plantations etc.</li> <li>• alley farming systems</li> <li>• rotational cropping systems with lucerne</li> <li>• rotational grazing systems with 'summer active' perennial pastures</li> <li>• rotational grazing with native grasses (and shrubs)</li> </ul>
2	<b>Hydrogeological study</b>	Recommended priority LMUs for hydrological research - Riverine Plain Upper and Lower Terraces, Sedimentary Rises, Metamorphic Ridges, and Sedimentary Hills and Mountains
3	<b>Environmental Impact on Riverine Plain Lower Terrace</b>	Research into the environmental impact of salinity on the Riverine Plain Lower Terrace in the Ovens River systems and beyond.
4	<b>Recharge mapping</b>	Recharge mapping should occur on an as needed basis. If and where recharge mapping is required, EM31 resistivity mapping data (where available), soil/landform data and bore data be used as a common basis for mapping.
5	<b>Subsurface drainage and groundwater pumping</b>	Further research into the potential of subsurface drainage and groundwater pumping as salinity control options.
6	<b>Discharge treatment</b>	Research into the most appropriate methods of treating discharge areas (including trials). How are discharge areas changing and at what rate? How can they best be treated? Can treatment actually help to restore the health and improve productivity?
7	<b>Identification of salt tolerant species</b>	Research into the commonly occurring salt tolerant species in the North East (may be different to drier areas of the State.
8	<b>Surface drainage</b>	Develop a drainage strategy.

### CLPR Report Research Recommendations

Recommendations from the *Groundwater trends and salinity risk in the North East Region* by CLPR outlined in Table 12 are supported by the NESWG with priorities as listed.

Research into the development of farming systems was given the highest priority as the NESWG are looking to identify practical on-ground solutions to addressing rising watertable and reducing salinity risk.

Further investigation into the hydrogeological processes was also given a high priority reflecting the concern over the information gaps (especially in the Kiewa and Upper Murray areas) in the hydrological data currently available. Particular concern was expressed over the hydrological processes in the Lower Riverine Plain LMU where discharge is very evident and the impact on the environment is unknown



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### Technical input workshop

A workshop aiming to identify innovative ways to address salinity and related land degradation issues in the North East was held at Institute for Integrated Agricultural Development, Rutherglen. Technical staff of selected disciplines from North East Region DNRE were asked to provide input into the Strategy. One of the outcomes of the workshop was that gaps in technical information were identified. The following table is a result of the workshop, which has been prioritised in order of importance by the NESWG.

**Table 13 Information gaps in information identified at technical input workshop**

Priority	Issue	Information Gaps
1	Perennial pastures	What is the water use potential of perennial pastures above 600 mm rainfall zone? What vegetation management practises will assist in maximising water use and productivity? What is the cumulative benefit of perennial pastures when considering other land degradation issues? eg. water quality, weed and erosion control. Where will the most productive pastures grow in the North East Region? What alternative pasture species can be used in high rainfall zones?
2	Farm forestry	What are the economic benefits and market potential of farm forestry in the North East Region? What are the barriers to adoption?
3	Remnant vegetation	What role does remnant vegetation play in salinity control in North East Victoria? What is the impact of rural tree decline on groundwater accessions? What is the rate of tree decline? Which are the best management options for the health of the remnant vegetation? eg. grazing.
4	Tree	What density of trees will maximise water use in high rainfall zones? What is the impact of different tree species on water use? What species are most appropriate for the lower rainfall areas?
5	Changed management practises	What new incentives could the Salinity Strategy introduce to bring about long-term change in land management practises? eg. paid land management, rate relief, Landcare levy, reduced licences, land retirement on marginal hills and wetlands. What is the likelihood of these being adopted?
6	Management systems	What is the impact of different management systems on groundwater accessions? eg. grazing practises, water storages, drainage, pugging/ compaction, soil properties.
7	Alley farming	What combinations of trees, pastures and crops will maximise water use and productivity? What role do pastures and crops have to play in alley farming systems?
8a	Acid soils	How does soil acidity impact on the establishment and persistence of salinity control techniques?
8b	Upper North East	What are the groundwater trends in the Upper North East? What are the potential impacts and threats?

continued on next page

## ADDRESSING THE ISSUE

Priority	Issue	Information Gaps
9	Natural environment	What is the impact of increased salinity on the natural environment? eg. wetland communities.
10	Recharge mapping	Which parts of the landscape is the majority of recharge occurring?
11a	Lucerne pastures	Where will lucerne grow? What management options need to be put in place to ensure they persist?
11b	Riverine Plain LMU	What are the groundwater processes in the Riverine Plain LMUs?
12	Native pastures	What role does native pasture have in salinity control in the North East?
13	Groundwater pumping	What role does groundwater pumping have in salinity control, particularly in the Riverine Plain LMUs?
14	Social and economic impact	What is the long term economic and social impacts of salinity on the local and regional community?
15a	Drainage	What is the potential of surface and sub-surface drainage as a salinity control strategy?
15b	Cropping	What is the potential of intercropping cereals and oil seeds into lucerne stands?

### Technical input workshop

The technical input workshop was instrumental in linking research and extension priorities. It identified a very diverse range of research currently being carried out in the area of natural resource management that will have benefits well beyond salinity and groundwater management. The NESWG support further research into all the information gaps identified by the technical staff.

Prioritisation of information gaps highlighted NESWG concern over the effectiveness of the salinity control options in high rainfall areas eg. What impact do pastures play as a salinity control option above the 600mm rainfall zone? This

was identified as a critical research need with the highest priority. The role of remnant vegetation in salinity control was another issue highlighted.

Research into areas that address both the sustainability issues along with providing economic returns also ranked highly. These factors are fundamentally linked to the social, environmental and economic development of the region. This includes improving water use, developing new enterprises such as farm forestry and industries linked to using groundwater pumping.

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The NESWG have identified further research needs (Table 14) beyond those identified by CLPR and the technical workshop in Tables 12&13.

### Other NESWG research needs

Electromagnetic Induction (EM31) is seen as a useful tool at a farm planning level when used in association with other soil and water information. Further investigation needs to be carried out to evaluate the role of different EM techniques in identifying recharge and discharge. Ground truthing at farm and sub-catchment level will need to be carried out. Expansion of EM31 survey in priority areas is seen a very useful tool in property management planning.

### Acid soils

Much of the North East Region has acid soils which are having a negative impact on pasture productivity. NESWG sees this as a major limitation on pasture growth and consequently plant water use. Further research in this area is supported by the NESWG.

The NESWG and NE CMA support all research into the gaps and needs identified.

### **Recommendation**

- That funding opportunities be sought from a broad range of funding bodies (both Govt and industry) to fulfil the above research needs for the North East Salinity Strategy.

**Table 14 Research needs identified by North East Salinity Working Group**

Priority	Issue	Research need
1	Electromagnetic (EM31) survey	Evaluation of existing EM31 mapping. How accurate is this method of measuring recharge and discharge areas? What is the line between high and low recharge?
2		Expand the EM 31 survey to cover more of the priority areas at a farm scale level to assist farmers in property management planning. The NESWG believe that expanding the EM31 survey work is crucial in identifying the potential recharge and discharge areas.
3	Acid soils	What are the benefits/disadvantages of using lime in clay soils to establish and sustain perennial pastures (including lucerne)

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### 4.6 Monitoring program

Monitoring is essential to evaluate the long-term performance of the Salinity Program against its goals and objectives. However, bore and stream water quality data essential in doing this in the North East Region is very limited.

#### Water quality monitoring programs

Two water quality strategies are currently in preparation in the Region, the Ovens Basin Water Quality Strategy and the Upper North East Victoria Water Quality Strategy. The Ovens Basin Strategy is under way with expected completion at the end of 1997. The Upper North East Victoria Water Quality Strategy has just started its evaluation of information over the last 3 months, with expected completion by the end of 1998.

Both these strategies aim to address a range of water quality issues including salinity. As a part of this, reviews of the existing water quality monitoring data programs are being carried out. The Ovens Basin Water Quality Strategy will be reviewing both stream and bore monitoring programs, while the Upper North East Victoria Water Quality Strategy will be reviewing only stream data.

#### 4.6.1 Stream monitoring

Stream water quality monitoring allows quantification of the effects of salinity and salt loads at a regional and basin level, and assists in evaluating the impact of works downstream. The Ovens Basin Water Quality Strategy's review of stream data has made several recommendations to fill some of the identified information gaps (Box 3). The North East Salinity Strategy supports these recommendations, as all water quality information will build on our understanding of salinity processes in the North East Region.

#### Box 3 Priority recommendations from the *Review of Water Quality Monitoring in the Ovens Basin*

From a salinity perspective particular importance is placed on the following recommendations made from the *Review of Water Quality in the Ovens Basin*:

1. Establishment of new stream gauging/water quality monitoring sites at:
  - ◇ Black Dog Creek, near its outflow into the Murray River
  - ◇ Indigo Creek, near its outflow into the Murray River
  - ◇ Fifteen Mile (Three Mile) Creek, near its outflow into the Ovens River
  - ◇ Buffalo River at Ovens
2. Re-establish water quality monitoring programs at:
  - ◇ Reedy Creek at Wangaratta North
  - ◇ Ovens River at Wangaratta

The review of stream monitoring sites through the Upper North East Victoria Water Quality Strategy will see the development of a series of recommendations similar to those in the Ovens Strategy.

The Murray Darling Basin Commission currently funds monitoring of physical, chemical and biological parameters at 6 sites within the North east Region. These sites are:

- ◇ Ovens River at Peechelba
- ◇ Mitta Mitta River at Tallandoon
- ◇ Hume dam
- ◇ Kiewa River at Bandianna
- ◇ Murray River at Heywood
- ◇ Murray River at Albury

Currently the MDBC sites are monitored for salinity and flow on a weekly basis. To more accurately determine the impact of salt loads into the Murray River, the installation of continuous recorders for flow and salinity at these sites would be of great value.

#### Recommendations

- That draft recommendations listed in Box 3 from the *Review of Water Quality Monitoring in the Ovens Basin* be supported and funded appropriately.
- That the North East Salinity Working Group work closely with the Upper North East Victoria Water Quality Working Group to develop programs to better monitor the impact of salinity on stream water quality.
- That MDBC be encouraged to upgrade their monitoring sites with continuous recorders for flow and salinity to more accurately predict the impact of salinity on the Murray River.

#### 4.6.2 Groundwater monitoring

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An analysis of available groundwater data for the North East Region was carried out by CLPR. Insufficient bore data, short lengths of monitoring and substantial gaps in the records limited their ability to accurately determine the groundwater trends and processes controlling salinity. A serious lack of information has been identified in the Kiewa and Upper Murray areas. To overcome this problem the Strategy recommends that the bore monitoring network be expanded to fill these gaps.

A sub-committee of the NESWG was established to review and prioritise the recommendations made by CLPR. Boxes 4&5 give a summary of the outcomes of that review in priority order. The following criteria (in priority order) were used to assess the most effective method of establishing an monitoring program:

1. maintaining the monitoring of bores currently in the network;
2. upgrading the network with existing DNRE bores currently removed from monitoring; and
3. expanding the network with strategically located new bores.

### **The first step**

**Critical to the success of the Monitoring Program is the census of the bores setting future direction for monitoring.**

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### Box 4 Recommendations for establishment of an effective groundwater monitoring program in the North East Region.

1. A thorough census of all bores be carried out by a suitably qualified authority incorporating bore labelling, restoration of leaking and damaged bores, bore mapping, bore depth measurements and groundwater sampling and pump testing etc. This will involve the preparation of a report setting future direction for monitoring (including prioritised recommendations).
2. All DNRE bores be levelled to Australian Height Datum. This will enable the spatial correlation of groundwater level data including the construction of watertable surface maps and cross-sections.
3. Urgent resumption of monthly monitoring of water levels in all serviceable DNRE bores.
4. All bores in the CLPR study be returned to monthly monitoring as well as other selected State Groundwater Monitoring (SGM) bores in the Boorhaman, Wangaratta, Oxley, Tarrawingee (Ovens Valley) and Kergunyah (Kiewa Valley) areas.
5. Several exploratory bores in data deficient areas be established to gauge the salinity threat for those areas. This would include the lower Kiewa Valley (Tangambalanga area), Upper Murray (eg. Corryong vicinity) Indigo Valley and Kergunyah.
6. At least 3 bore transects spanning across the Ovens/King Riverine Plain Lower terrace and Upper Terrace LMUs, one of these transects intersecting a farm forestry treatment trial on the Upper Terrace. Also a bore transect crossing the Reedy creek lower and upper Terraces.
7. Shallow bores at some existing deep SGM bores in the Ovens Riverine Plain Upper Terrace.
8. Several control bores on uncleared areas would provide valuable groundwater trend benchmarks to be compared to nearby cleared areas.
9. A transect of bores across the Hume Freeway in the Springhurst area and the *Blackdog Creek area* would more accurately establish its effect on groundwater flow and salinity occurrence.
10. As a means of monitoring the effectiveness of salinity treatment strategies, that demonstration sites be monitored for groundwater levels.
11. Existing bore networks in Greta, Bobinawarrah, Murrumgee and Everton be enhanced with additional bores in hill crest to lower slopes positions. In each of the Sedimentary Rises, Metamorphic Ridges and Gneisses and Schists LMUs, at least one bore transect comprising of three sites, ranging from upper slope to discharge.

### Box 5 Maintenance of groundwater monitoring program

Following the bore census which will identify key bores for salinity investigation

1. Identified key bores be maintained to ensure they are giving the most accurate data including an annual sampling of groundwater for electrical conductivity.
2. Groundwater depth data be circulated to relevant Landcare groups on a biannual basis.
3. Groundwater data be reviewed in detail biennially and a report prepared by a suitably qualified authority. This report will be distributed to NESWG, NE CMA, relevant Landcare groups and individuals.
4. Individuals within Landcare groups will be employed by DNRE to monitor identified key bores in the North East Region.
5. Monthly monitoring of rainfall by community groups will be encouraged in areas where data from the Bureau of Meteorology does not fulfil research requirements.

#### Recommendation

- That the bore network and groundwater monitoring for the North East Region be expanded over the next 5 years to include all sites and recommendations in the above boxes.

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### 4.6.3 Discharge monitoring

The CLPR has recommended that discharge monitoring be carried out on three paired sites (one treated and one untreated) in the North East. This will assist in measuring the rate of expansion/degradation of discharge sites in the short-term, and in the longer term help to monitor the effectiveness of salinity control techniques.

**Table 15 Recommended sites for discharge monitoring.**

Location	LMU
Ovens River around Wangaratta	Riverine Plain Lower Terrace
Everton area	Metamorphic Ridges
Boralma area	Permian Tillite

#### Recommendation

- That the three paired sites identified in Table 15 be included as part of the statewide monitoring of discharge sites.

### 4.6.4 Environmental monitoring

As discussed in Sections 2.3.3 and 2.3.4, there are many wetlands, streams and remnant vegetation areas of high environmental value in the North East Region. The protection of these areas from rising watertables is a high priority, however, the understanding of this threat is not well understood. Further investigation in this area is anticipated, with a study to assess the impact of salinity on the natural environment starting early in 1997. The study will include the following:

1. an assessment of the environmental significance at a international, national and/or State level, eg. RAMSAR wetlands or vegetation communities containing threatened or protected species;
2. identification of sites affected by salinity; and
3. identification of 'representative' sites of the Region's wetlands and remnant vegetation to be included in the Statewide monitoring program.

#### Areas requiring further investigation include:

##### Lower Ovens River

Of extremely high value is the lower Ovens River and associated flood plains. The area is listed as a Heritage River containing a significant area of intact native vegetation and habitat under potential threat from rising watertables and salinity.

##### Murray River

Numerous high value wetlands are associated with the floodplain of the Murray River that are potentially threatened by watertable rises.

##### Boorhaman Wetlands

The Boorhaman system on the Riverine Plain flows directly into the Murray River. It includes a range of habitat types making it very important feeding grounds for many native species including broilgas.

The Black Swamp is part of Boorhaman System, being a seasonal freshwater wetland dominated by River Red Gum. The wetland is located at the confluence of several intermittent streams draining large areas of cleared agricultural land. The freehold sections of the wetland are grazed regularly with the Public Land components being grazed under licence.

##### Other wetlands

The Upper Riverine Plain LMU contains numerous wetlands on private land. The majority of these areas are grazed and much of the understorey vegetation has been eliminated, large Red Gum is the predominate feature of these areas.

##### Other rivers and streams

Many stream systems throughout the North East Region contain natural wetlands associated within their floodplain. In many instances the only remaining vegetation is the Red Gum overstorey. The impact of salinity on the wetlands along the major stream systems is unknown and in need of further investigation.

##### Remnant Vegetation

The impact of dryland salinity on remnant vegetation is unknown and is also requires further investigation as part of the environmental study.

#### Recommendation

- That an investigation of the potential impact of groundwater rises on wetlands, streams and remnant vegetation throughout the North East Region be carried out, and appropriate monitoring and management recommendations be developed.

### 4.6.5 Implementation monitoring

All salinity works will be administered through the Grants and Incentives Tracking System (GAITS), which has the ability to both monitor the progress of works under the Strategy and ensures applicability of the incentive to the Strategy.

Information for the development of this strategy has been collected on a Geographic Information System (GIS). Works that assist in salinity control can easily be recorded on the GIS to accurately record where

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works have been undertaken. This can also be used as a tool for reviewing progress.

The annual reporting and business planning process will be used to report to the regional community and governments on progress of works and developments within the Strategy. A 5 year review will monitor the effectiveness of implementation.

### **Recommendations**

- That all incentives be administered through the Grants and Incentive Tracking System (GAITS).
- That the Geographic Information System (GIS) be used to accurately record location and type of on-ground works carried out under the Salinity Strategy.
- That the annual report and business plan be used to inform the regional community and governments on the progress of works and developments within the Strategy.
- That the Salinity Strategy be reviewed after 5 years to monitor the effectiveness of implementation.

### **4.7 On-ground works**

A two pronged approach under each program is used to identify, firstly, implementation within the Salinity Strategy (priority areas), and secondly, identify how other natural resource programs can be integrated with this Strategy to assist in salinity control.

### **Treatment protection efficiency**

The following outlines the assumptions made on the efficiency of each of the salinity control options. These assumptions are taken from the latest research from around the State giving an outline of the present understanding. As our understanding develops with new research these assumptions may change. The current assumptions are:

#### **Lucerne**

- ◇ Lucerne will give 100% recharge control after 4 years;
- ◇ For every 10 hectares of high recharge treated with lucerne 1 hectare of discharge will be saved.

#### **High density trees**

- ◇ High density trees will give 100% recharge control after 5-15 years depending on species and climate etc.

- ◇ For every 10 hectares of high recharge treated with high density (conservation) planting, 1 hectare of discharge will be treated.

#### **Perennial grasses**

- ◇ Perennial grasses (such as phalaris and cocksfoot) in the 600 mm rainfall zone will give 75% recharge control after 4 years. Assuming good management these pastures will deteriorate after 12-15 years and will need to be re-established.
- ◇ For every 20 hectares of high recharge treated with perennial grasses in the 600 mm rainfall zone 1 hectare of discharge will be saved.
- ◇ Perennial grasses in the 800 mm zone will give 50% recharge control after 4 years of establishment and persist for 12-15 years when they will need to be re-established.

Recharge control refers to the amount of recharge intercepted when compared to a mature native forest with intact understorey.

#### **Discharge growth**

The estimated rate of discharge spread is assumed to be 5.8% without the Salinity Strategy. (See 3.2.1)



## 4.8 Environmental program

### *Within salinity strategy*

This program aims to both protect those natural areas threatened by salinity, and enhance and protect indigenous vegetation on high recharge areas. Protection of natural areas is not only important from a salinity perspective, but also for other values such as habitat preservation that helps enhance biodiversity.

### 4.8.1 Protection of remnant vegetation

The protection of existing remnant vegetation on identified high recharge is currently the most cost effective method of high recharge control. Unfortunately many remnant vegetation sites are in decline due to a number of factors including insect attack, compaction, changed nutrient status, soil acidification, loss of understorey, weed invasion and continual grazing.

The management of these areas to ensure vegetation does not decline and that regeneration occurs is a high priority. Fencing of sites to protect from stock and rabbits and encouragement of regeneration of tree and understorey has been identified as a major management tool in improving the health of remnant vegetation sites. Staff will promote fencing and management of remnant vegetation including controlling weeds through the extension program.

The NESWG has identified an opportunity for the Salinity Strategy to work in association with the Regional Biodiversity Strategy which is in the process of being prepared. This strategy will map ecological vegetation classes on private land.

This information when completed will allow the Salinity Strategy to set priorities and target high recharge works to include such values as:

- ◇ the protection of rare and threatened communities
- ◇ working on the largest and most diverse sites first
- ◇ assisting in the linkage of habitats by way of vegetation corridors

### Recommendations

- That appropriate cost-share incentives be available to assist land managers to fence out remnant vegetation on identified high recharge areas to protect trees and understorey species through controlled grazing of stock.
- That the Salinity Strategy and Regional Biodiversity Strategy work complement each other to prioritise and target areas of high environmental significance on identified high recharge areas.

### 4.8.2 Native pastures

Included in the protection of remnant vegetation is the management of native grasses. Latest research suggests that native pastures have a significant role to play in salinity control, especially on the steeper less productive slopes where soils generally have high acidity and low fertility. Management of these areas for persistence of native perennial species is a cost-effective means of controlling recharge in the long term.

Opportunities once again exist to work in with the biodiversity strategy to encourage management for species diversification. Extension staff will be encouraged to incorporate biodiversity management options into extension advice. This may include the fencing of sites into smaller paddocks and using grazing regimes that encourage persistence of native grasses and maximise water use.

### Recommendations

- Management to ensure persistence and species diversification of existing native pastures will be encouraged on high recharge areas through the extension program.
- That extension staff be trained in understanding the value of grasslands and the identification and management of native grass species.

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### 4.8.3 Protection of wetlands

As discussed in 4.6.4, the protection of wetlands from rising watertables is a high priority. It has been recommended that an investigation into the potential impact of groundwater rise on wetlands be carried out. Management actions to reduce the potential impact on the Lower Ovens flood plain of groundwater discharge need to be investigated and encouraged. An assessment of the impact of disposal of saline water from ground water pumping will be required, should this method of disposal eventuate. The likely impact of sub-surface drainage works on wetlands will also require investigation.

Until these investigation is complete, the protection of wetlands will still be a priority. Land managers will be encouraged to manage these areas to maintain ecosystems as close to pre-European settlement as possible. Removal of stock and the fencing of wetlands to retain existing remnant vegetation will be encouraged through the Salinity Strategy.

#### Recommendation

- That the Salinity Strategy encourage the protection of remnant vegetation and water quality in identified high value wetlands by encouraging the removal of stock and fencing of sites with the appropriate cost-share being available.
- That the Salinity Strategy investigate other options for protecting wetlands such as interception revegetation, interception drainage and groundwater pumping where appropriate.

### 4.8.4 Conservation tree establishment

The value of planting a diverse range of indigenous trees and understorey species is now recognised for the long-term health of the plantation. Having a diverse understorey encourages a range of bird, mammal and insect species back into the landscape which has a significant impact in the control of rural tree decline. Indigenous trees, having evolved in the local environment, have a demonstrated ability to persist in environments where introduced species may not, or where their growth is not as good. Current research suggests that greater than 500 plants per hectare will give recharge control in 7-10 years. The strategy will encourage 200 - 300 of these be tree species and the remainder as perennial understorey species.

#### Recommendations

- That extension staff encourage land managers to use indigenous vegetation in conservation tree plantings.
- That extension staff encourage the use of a diverse range of understorey species in conservation and farm forestry tree plantings.

### 4.8.5 Integration with other programs

Other environmental programs including the Natural Heritage Trust (National Landcare Program, National Vegetation Initiative) and State programs (Tree Victoria, Community Salinity Grants) make a significant contribution to catchment wide programs. These programs provide community groups with significant funds to carry out community awareness and on-ground works programs.

#### Recommendation

- That community groups and the Salinity Strategy seek funding opportunities through NHT and other DNRE natural resource management programs to enhance the environmental on-ground works program.

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### 4.9 Farm tree program

#### *Within salinity strategy*

#### 4.9.1 Indigenous tree retention

As discussed in 4.8.1 the retention of indigenous vegetation is the most cost effective method to control salinity. Research has shown that mature forest offers the maximum recharge protection. Over 60% of the Region is still vegetated with indigenous vegetation with most of this within the parks, reserves and state forest system. Over 102,500 hectares of vegetation still exist under private land management. Protection of these areas is essential as they offer maximum recharge control and many other benefits, such as improved water quality, habitat for wildlife and maintenance of genetic diversity (see Section 4.8). Other agricultural benefits such as shelter for stock and wind break protection may also be gained.

#### **Recommendation**

- That appropriate cost share incentives be available to fence existing remnant vegetation areas identified on high recharge zones throughout the whole region. As this is a very cost effective method of attaining salinity recharge control, it is recommended that it be available for all remnant vegetation on high recharge in the North East Region.

#### 4.9.2 Conservation planting

Strategic planting of high density trees offers one of the best salinity control options on identified high recharge. Current research suggests that a plant density of greater than 500 stems per hectare is optimal to maximise water use. Indigenous vegetation will be encouraged by extension staff as this has the greatest conservation value. (see Section 4.8)

#### **Recommendation**

- That an appropriate cost share incentive be available to encourage land managers to establish conservation plantations at a minimum of 500 stems per hectare (including understorey). The use of indigenous species will be encouraged by extension staff.

#### 4.9.3 Commercial Farm Forestry

The role of trees in soil and water management will be critical to the Strategy to maximise use of water where it falls. The majority of the NE region has an annual rainfall greater than 600mm. Current research indicates that success in salinity control will require a greater emphasis on managing trees in the rural landscape where the rainfall exceeds 600mm. To date, trees have been thought of in terms of other benefits such shade, shelter and habitat. This program will create opportunities for commercial farm forestry.

Much of the mid to lower portions of the Ovens catchment and the cleared portions of other river valleys in the Region present opportunities for plantation development where it fits in with other farm enterprises. There has been a noticeable emphasis on softwood plantation development to date with only recent consideration of eucalypts as an alternative. The market for softwoods make them an immediate attraction however there has been perceived opposition to softwoods on the grounds of social and environmental implications. The program will emphasise balance in community perception on farm forestry. The Salinity Strategy will focus on the need for better utilisation of available soil water rather than thinking pines are 'better' than eucalypts or vice versa.

The NESWG acknowledges the importance of working with local governments to resolve planning scheme issues with regard to the establishment of farm forestry. Emphasis will be placed on ensuring that the establishment of farm forestry is not to the detriment of existing native vegetation. Planning controls currently exist to control this.

#### **Recommendations**

- That farm forestry be promoted as a priority for reducing groundwater recharge in high priority areas with the appropriate cost-share provided.
- That joint ventures be investigated as a means of funding on-ground application of farm forestry.
- That farm forestry be encouraged where feasible outside priority areas.
- That the NESWG work along side local government to ensure that planning controls for farm forestry complement the Salinity Strategy.

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### Interception plantings

Interception of water using trees is a new development in salinity management plans. Hydrogeological studies in other regions have identified a number of areas where the bedrock is relatively impervious to water and considerable lateral flow occurs within a shallow depth of the surface. Belts of trees in the correct part of the landscape may intercept water as it moves laterally downslope before it discharges. Initial research results suggest that trees planted on the *Break of Slope* can use 5 to 10 times more water than direct recharge plantings.

Based on early research indications, suitable geological conditions for interception plantings appear to occur near the boundaries of the Western Granites LMU and on the interface between the Upper and Lower Terrace on the Riverine Plain. Subject to further research findings, interception plantings may have application in other LMUs eg. Permian Tillite LMU. Protection of existing remnant vegetation on this part of the landscape will also be encouraged through the Strategy.

#### **Recommendations**

- That the potential of tree interception plantings be investigated around Springhurst, in the Permian Tillite LMU and Indigo Valley/Wodonga area within the Gneisses and Schists LMU.
- That trial demonstration sites of tree interception plantations be established on the interface between the Riverine Plain Upper and Lower Terrace. Monitoring of groundwater will be included as part of the demonstration.
- That interception tree plantations be promoted and funded with appropriate cost sharing in areas identified by DNRE staff as having suitable geological characteristics provided they are priority areas for treatment.

### Alley Farming

Alley farming systems incorporates the role of crops and pastures grown in alleys between belts of trees and shrubs. Alley farming can offer greater opportunity to incorporate salinity and groundwater control than conventional farming systems.

#### **Recommendations**

- That alley farming be promoted in all areas of high recharge.
- That appropriate trial demonstration areas be set up to assess the potential of alley farming in the North East Region to lower watertables.
- Monitoring of groundwater movement will be included as part of the demonstration.

### General forestry

#### **Recommendation**

- That appropriate technical advice be available through the extension program to land managers in priority areas on the full range of tree growing options, including conservation plantings, alley farming and farm forestry.

#### **4.9.4 Integration with other programs**

Generally speaking, tree growing is the most effective agronomic option for salinity control. The promotion of activities that use more water on all cleared landscape in the North East will reduce groundwater recharge to the watertable and therefore benefit the Salinity Strategy. Several initiatives both within government and private industry exist to promote tree growing in the North East Region.

### Softwood

Softwood production is a large industry in North East Victoria with commercial mills located at Myrtleford, Wangaratta, Albury and Benalla. The bulk of the production of softwood timber is sourced from plantations on public land. However, as the demand for the product continues to grow and further areas of cleared land are not available on public land there is opportunity available on private land. Softwood plantations utilise soil water at comparable rates to eucalypts thus creating opportunities as a means of recharge control. There is now choice available for landholders in this area to make informed decisions on softwoods compared to eucalypts. The focus will be on working in partnership with industry and the Victorian Plantation Corporation (VPC) to encourage softwood production in the priority areas where suitable cleared land exists which does not support remnant native vegetation.

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Australian Newsprint Mills (ANM) Albury offers softwood joint venture forestry agreements with landholders in NE Victoria, within 100km of Albury.

impediments to farm forestry. This can be achieved by working through existing community and industry groups.

### **Recommendations**

- That the Salinity Strategy work in cooperation with industry (eg. Victorian Plantation Corporation (VPC), Australian Newsprint Mills (ANM), Dominance Industries and Carter Holt Harvey) to link the criteria for establishment of softwood plantations to priority areas with a particular focus on high recharge land.
- That NESS liaise with industry (eg. VPC and ANM) to develop cooperative approaches to plantation development.
- That funding be sought from private industry to establish a demonstration site to highlight the impact of pines on groundwater.

### **Recommendations**

- That the Salinity Strategy work in cooperation with the timber industry and Plantations North East to encourage plantation development in priority areas with a particular focus on high recharge land.
- That funding be sought from the range of options available to promote farm forestry in the North East.

### **Farm Forestry Initiatives**

The State Government initiated the Farm Forestry North East/North Central (FFORNE) Project in 1995. The FFORNE Project is to run 3 years and aims to develop a self sustaining farm/private land based hardwood forestry industry in North East North Central Victoria.

The Department of Primary Industry and Energy (DPIE) have funded a number of regional farm forestry projects in Australia through the National Farm Forestry Program. North East Victoria received funding for initiating a regional plantation committee, Plantations North East Incorporated, and a scheme to promote on ground work via extension through the Cooperative Farm Forestry Initiative (COFFI).

Plantations North East aims to facilitate the expansion and development of commercial timber plantations and the associated timber industry. This facilitation will result in the expansion of plantation areas in softwood and hardwood species and promote community understanding of the timber industry including its social, economic and environmental benefits.

Through the recruitment of farm forestry advisers, the COFFI project aims to increase awareness amongst landholders of the benefits of farm forestry and to build their skill in establishing, managing and harvesting trees for commercial purposes.

These projects emphasise developing a viable farm forestry industry along with the links to local government and the community by overcoming the

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### 4.10 Pastures program

#### *Within salinity strategy*

#### 4.10.1 Phalaris/Cocksfoot

Introduced perennial pastures, such as phalaris and cocksfoot, have an important role in the 600 mm and below rainfall zone. In the priority areas of Springhurst, Rutherglen and the Riverine Plain north of Wangaratta, perennial pastures can play an important role in high recharge management.

Current research from south west and central Victoria indicates that beyond this zone the ability of introduced perennial pastures to utilise sufficient water to control recharge is significantly reduced. However, these pastures still use more water than unimproved annual pastures. From a salinity control perspective, promotion of all options that improve water use will be of benefit to the Strategy. The growing of perennial pastures will still be encouraged, even though incentives for establishment above the 600mm zone will not be available.

Acid soils, high aluminium levels, low fertility, inappropriate species selection and poor or inappropriate follow up management are the most common limiting factors to successful pasture establishment and persistence. Technical advice to manage these issues will be available through the implementation of the Salinity Strategy.

#### **Recommendations**

- That introduced perennial pastures, such as phalaris and cocksfoot, be promoted on high recharge in priority areas of the 600mm rainfall zone (Springhurst, Rutherglen and the Riverine Plain north of Wangaratta) through an appropriate cost-share (except where native pastures are successfully growing).
- Where fencing is required to assist in the successful establishment and recommended management of perennial pastures in the 600mm rainfall zone that appropriate cost share be available.
- That the availability of cost-share incentives be linked to carrying out a full soil analysis on the site with sowing and management recommendations from DNRE to increase the likelihood of persistence of the pasture after sowing.
- That the NESWG keep informed on latest research findings for water use of perennial pastures above the 600mm rainfall zone and adjust the Strategy to reflect these findings (if required).

#### 4.10.2 Lucerne

Generally, lucerne is the most effective pasture species for salinity control currently recommended, and as such, has a role to play in the North East Region. Its deep-rooted nature and summer activity make it a particularly high water using plant. Its efficacy is not restricted to the 600mm and below rainfall zone, and as such will be encouraged in all high recharge zones in priority areas

However, the acid soils and high aluminium levels of the North East Region limit its potential as a major recharge option in most high recharge areas. However, Lucerne is likely to be a popular recharge control option in the Riverine Plain priority area.

#### **Recommendations**

- That introduced lucerne pastures be promoted in all those high recharge priority areas where they will persist and be supported with an appropriate cost-share incentive.
- Where fencing is required to assist in the successful establishment and recommended management of lucerne, that appropriate cost share be available.
- That the availability of cost-share incentives be linked to carrying out a full soil analysis on the site and seeking advice from DNRE pasture officers on its sowing and management to increase the likelihood of persistence of the pasture.

#### 4.10.3 Native pastures

Having evolved with low fertility and acid soils these pastures show great potential to assist in salinity control, particularly where introduced pastures will not persist for example on those difficult areas such as rocky outcrops. Research into native pastures in Victoria over the last 8 years has been centred at the Institute for Integrated Agricultural Development, Rutherglen. This research has resulted in the selection of 20 of the best performing lines for further evaluation.

Establishment of native pastures is yet to be widely adopted across the Murray Darling Basin, as techniques for sowing on a broad scale are yet to be fully developed, seed availability is limited and returns are not yet economic.

Management of already existing native pastures to ensure persistence in the long term is currently the most effective method of managing these pastures.

## ADDRESSING THE ISSUE

### Recommendations

- That management to ensure persistence of existing native pastures be encouraged on high recharge areas through the extension program.
- Where fencing is required to assist in the successful management of native pastures, that appropriate cost share be available.
- That the continued evaluation and selection of the best performing lines of native pastures be encouraged and supported by the NESWG.

### General pastures

### Recommendations

- That demonstration sites for introduced and native perennial pastures (eg. phalaris, cocksfoot, native species, lucerne) be established in the 600 mm rainfall zone to assist land managers in choosing the most appropriate pasture species for their area.
- That the Salinity Strategy, through the extension program, provide specialist technical advice to assist land managers in the management of perennial pastures for land protection (including phalaris, cocksfoot, lucerne and native pastures).

### 4.10.4 Integration with other programs

A very successful pasture extension program offered through DNRE in Wodonga and Benalla currently exists. These programs have focused on:

- ◇ general pasture extension covering all aspects of pasture management including grazing management, fertiliser regimes and weed control.
- ◇ specific projects including native pastures and improved pasture management.

The benefits of growing perennial pasture move well beyond salinity and include water quality benefits such as reducing erosion and waterlogging, and improved farm viability. Farm viability and rural adjustment is the single greatest threat facing the traditional farming sector today, particularly in the grazing industries. Improving pastures in these areas has the potential to increase the carrying capacity of farms, and may therefore increase their long-term viability.

The acid soils of the North East Region is one of the most limiting factors to growing a productive perennial pasture. Much research is currently being carried out in this area particularly at Institute for Integrated Agricultural Development, Rutherglen. Opportunities to integrate with the acid soil program exist.

### Recommendation

- That the growing and appropriate management of perennial pastures (including phalaris, cocksfoot, lucerne and native pastures) continues to be encouraged in all cleared areas of the Region, including those areas above the 600mm rainfall zone and low recharge areas to contribute to improving farm viability.
- That opportunities be sought to link with the acid soil program.

## 4.11 Cropping program

### *Within salinity strategy*

Very little cropping exists in the priority areas and therefore no on-ground works has been developed through the Salinity Strategy. However, some high recharge cropping areas have been identified in the Riverine Plain Upper Terrace and Sedimentary Rises LMUs.

#### 4.11.1 Integration with other programs

This strategy acknowledges the importance of promoting techniques that reduce groundwater accessions in cropping areas. However, the options available for salinity mitigation in cropping areas are limited. Most research has focused on **increasing the crop's ability to use water** by improving soil fertility through the use of grain legumes (lupins), improving soil structure (direct drill and minimum till) and the agronomic management of cropping enterprises. Recent research has confirmed that the opportunity for increased water use by crops depends on good crop husbandry practises (Lolicato 1995). In other parts of the State, lucerne has successfully been incorporated into the crop rotation to assist in improving water use. The feasibility and level of interest in this is high.

Substantial areas of the Riverine Plain LMUs are cropped, mostly on low recharge. As discussed in 3.2.2, the salinity processes in these areas are not well understood, but the rapidly rising watertable is a great concern and suspected to be of a regional nature. If this is the case, treatment of these low recharge areas is required to help control this watertable rise. In these areas, salinity control will need to be tackled from a whole farm/sub-catchment perspective. This approach not only has salinity and other land protection benefits, but also maintains the productivity focus that is so important to the long-term viability of cropping industries in the North East Region.

#### **Recommendations**

- That funding is sought from a range of programs (such as TopCrop) to encourage land managers to adopt good crop husbandry techniques that improve the crops ability to use water.
- That land managers be encouraged to incorporate lucerne into cropping rotations where feasible.

### Horticulture

The North East has a large range of horticultural crops grown across the Region. The promotion of high water using crops will be encouraged, particularly tree crops. New crops, such as peppermint growing on the Riverine Plain, may also create areas of concern for water use, as many of these industries are irrigated. Groundwater monitoring of new industries (particularly horticulture) will be encouraged during the establishment stage of demonstration sites to assist in assessing its impact on watertables.

#### **Recommendation**

- That the Salinity Strategy work in conjunction with new agricultural industries to establish groundwater monitoring of demonstration sites to determine the impact of these industries on watertables.



## ADDRESSING THE ISSUE

### 4.12 Saline agriculture program

#### *Within salinity strategy*

#### 4.12.1 Discharge treatment

Protection of all discharge areas in priority areas from erosion, the reduction of saline run-off and increasing productivity are the aims of this program

Land managers will be encouraged to fence out and maintain a vegetative cover on their salt affected land. Salt tolerant pasture species such as tall wheat grass, Puccinellia, Balansa clover and strawberry clover will be recommended with the aim of maintaining vegetative cover and lifting productivity.

The establishment of trees around discharge sites may also be appropriate in some areas. Although this is only expected to be appropriate in limited areas, it is seen as an appropriate method to control watertable rise.

The protection of remnant vegetation on discharge sites will be encouraged with fencing available to control stock access to these sites.

#### **Recommendations**

- That appropriate cost-share incentives be available with advice to assist land managers in carrying out pasture establishment on all discharge areas in priority areas in the North East Region.
- That appropriate cost-share incentives be available with advice to assist land managers in carrying out tree establishment around discharge areas in priority areas in the North East Region.
- That appropriate cost-share incentives be available to assist land managers to fence out remnant vegetation on identified discharge areas to protect trees and understorey species from grazing stock.

### 4.13 Groundwater pumping and drainage program

#### *Within salinity strategy*

#### 4.13.1 Drainage

Waterlogging is a major issue in the North East Region. Economic loss from waterlogging of soils is estimated at \$10 million annually for cropping alone. Drainage is seen as one way of alleviating waterlogging, along with introducing high water using species and improved water movement at farm level. However the potential downstream impact of drainage works (including sub-surface and surface drainage) is generally unknown at a regional level, although some research on the potential impact has been conducted in the Kiewa Valley by the Institute

for Integrated Agricultural Development, Rutherglen. The NE Regional Catchment Strategy has identified the need for some control, not only from a salinity perspective, but also from a nutrient and water quality perspective.

Both the Murray Darling Basin Commission (MDBC) and Victorian Government recognise that drainage in dryland areas is of increasing concern. Although most isolated drainage works have minimal local impact, there may be a significant cumulative affect downstream.

Much activity is currently happening on this front with many changes mooted in the near future. The Goulburn Broken Dryland Salinity Management Plan has developed saline drainage guidelines that have both State and Federal endorsement, and is now being trialed.

The main aims of the Goulburn Broken Drainage Strategy are:

- ◇ to identify and control all drainage activities which require off-site salt discharge in order to satisfy both State and MDBC;
- ◇ to protect downstream water resources (both local and regional) from any adverse impacts of saline discharge;
- ◇ to encourage groundwater pumping with local reuse in those areas where pumping can assist in salinity control, and is economic, by developing a Groundwater Management Plan.

Basically the policy outlines those works that can or cannot proceed without planning approval. For those works requiring planning approval, it puts in place a process to achieve this.

At the same time, the Victorian Government is reviewing rural drainage. It is anticipated that CMAs across Victoria will be asked to take a far greater role in addressing the drainage issue. The NE CMA will have a role in coordinating the development of a drainage strategy in the North East Region that aims to account for all drainage works.

### Recommendations

- That the NE CMA coordinate the development of a drainage strategy for the Region by initiating a scoping study to assist in setting future directions for drainage management. Crucial to the success of this strategy will be broad community involvement including the two river management authorities, local government, water authorities, Landcare, VFF, EPA, GMW and DNRE research and extension.
- In the interim period of developing the drainage strategy, that monitoring of salinity be carried out on a range of drainage activities to assess downstream impact.
- That sub-surface drainage be investigated as a salinity control option in areas where these practises are expected to significantly alleviate groundwater rise.

### 4.13.2 Groundwater pumping

Groundwater pumping as a salinity control option in dryland areas is currently being implemented in parts of the Goulburn Broken dryland and trialed in other parts of the State. Given the favourable indications from initial investigations, the NESWG sees that this option has great potential in the North East Region and is very interested in investigating groundwater pumping further.

Irrigated commercial farm forestry is seen to have potential for development, especially in lower rainfall areas on the Riverine Plain. The close proximity to markets, improved tree species and current high level of promotion of this activity has resulted in interest by the community.

### Recommendation

- That groundwater pumping be investigated as a salinity control option in areas where these practises are expected to alleviate groundwater rise (eg. Riverine Plain Upper Terrace and Gneisses and Schists LMUs).

## 4.14 Implementation Program

### *Within salinity strategy*

The extension and community education program aims to improve land management practises to utilise the full potential of available water on all land.

### 4.14.1 Community education

Community education has been identified by the NE CMA as the first crucial step in addressing all the natural resource issues. From a salinity perspective, community understanding and ownership will be the key to successful implementation of the Strategy in the long-term.

### General community

Over 40% of the North East community live in urban areas making general community awareness an essential component of the community education program. General awareness will be raised through field days, news articles and the promotion of such programs as Saltwatch, Watertable Watch and Waterwatch. In particular, schools and tertiary institutes will be encouraged to be involved in the different programs.

### Landcare

The Community Education Program to date has successfully focused on raising awareness of salinity within Landcare group in priority areas. More than 6 Landcare groups have actively been involved in bore monitoring and EM31 mapping work currently used in farm and catchment planning. The NESWG will continue to work with Landcare groups in this area (See 4.14.2).

Landcare groups are keen to continue monitoring in their own areas and see opportunity to further contribute to community monitoring programs such as the Water Watch, Saltwatch and Watertable Watch programs.

### Small farms

The number of small farms across the Region continues to increase making it necessary to target this group for on-ground works, particularly in farm forestry and conservation tree growing.

## ADDRESSING THE ISSUE

### **Recommendations**

- That funding be sought to build on the existing Community Education Program to develop community understanding and ownership of the salinity issue in the North East Region.
- That the Waterwatch, Saltwatch and Watertable Watch programs be promoted throughout the Region.

### **4.14.2 Extension**

Focus for implementation will be through community groups (Landcare, VFF, Farm Tree groups). Individual land managers will be encouraged to work in partnership with neighbours in priority areas to maximise the use of limited agency resources. There is considerable interest within the community to address land degradation issues from a sub-catchment perspective. Some Landcare groups have already started this process, and this program aims to assist in their development.

There will also be a shift in extension practises to involve industry groups and local government.

### **Timber and other Industry**

As discussed in the farm forestry section there is huge potential to develop a profitable timber industry. Innovative programs to attract land managers to establish farm forestry sites (such as joint ventures) are being developed by the timber industry. Opportunities to link with other industry groups will also be sought.

### **Local government**

Local government will also be encouraged to participate in catchment management programs. In other areas of the State, rate rebate is being used to encourage land managers to revegetate high recharge areas. Some Shire in the North East are also considering rebates as part of their Environmental Program. Also areas such as roadside management, drainage, subdivision and clearing controls can influence recharge control.

### **Recommendation**

- That the Salinity Strategy employ 2 extension staff with skills in tree growing, forestry and pasture management.

## ADDRESSING THE ISSUE

### 4.14.3 Targets

The on-ground works program is a balance between the amount of high recharge and discharge area to be treated or protected, what the NESWG thinks is actually achievable for each priority area and availability of funding.

This strategy will focus on the treatment and protection of high recharge areas in identified priority areas with the aim of treating between 5-20% of cleared high recharge in each priority area over the next 30 years. Table 16 outlines the area and percentage targeted for works. Targets will be reviewed annually and adjusted to reflect community needs.

High recharge for treatment was identified using the land systems maps available on the GIS, identifying steep and moderate terrain without tree cover, calling this high recharge, and overlaying this with the priority areas. Although this is not the most accurate method to identify high recharge areas, given the limited resources available and the Statewide shift toward 'whole of catchment' management, it was seen as a cost-effective method of getting **an indication** of recharge for on-ground works. Since grants administered through the GAITS require an on-site inspection, staff can more accurately define high recharge areas when assessing the grant.

Rutherglen and Springhurst/Byawatha priority areas have the highest percentage (20%) of cleared high recharge to be treated as these are in the 600mm rainfall zone making phalaris and cocksfoot an option. The Riverine Plain priority area has only a target of 5% as it is a very large area and community involvement to date has been minimal. A community education program will be required to increase understanding of salinity in this area. In other priority areas the target will be to treat 10% of cleared high recharge.

The EM survey work carried out by Charles Sturt University can help to define high recharge areas in priority areas. Unfortunately work to date only covers a small proportion of the priority areas. In areas where it has been carried out, the EM mapping will be used by on-ground staff to define high recharge areas. This will eventually be available in GIS format and will be invaluable in assisting farmers to develop property management plans.

**Remnant vegetation** areas were calculated by using local Landcare group and DNRE staff knowledge of

remnant vegetation in private management. The Flora and Fauna Branch of DNRE are currently mapping onto GIS remnant vegetation sites under private management. In the future this will be available and overlain with the Salinity Strategy GIS data to accurately map areas of remnant vegetation on high recharge in private ownership.

**Conservation Planting** refers to revegetation works where trees an understorey will remain a permanent part of the landscape (See 4.9.2).

**Farm forestry** refers to tree plantations that will be harvested for a particular purpose for example wood for pulp, veneer or sawlog. The uncertainty of the impact of interception planting and alley farming on watertable in the North East has made it necessary to further investigate this area. Demonstration sites will be established within priority areas particularly those identified by CLPR (see 4.9.3 and marked with a asterisk on Table 17) These figures may need to be revised as information from these demonstrations becomes available.

**Phalaris and cocksfoot pastures** have been included in the 600 rainfall mm zone.

**Lucerne** targets have not been set for 6 of the priority areas. Lucerne on high recharge areas has only been adopted in limited areas of the North East Region. A pastures extension program, along with demonstration sites, will promote the establishment and management of lucerne in high recharge areas. This is expected to see an increase in the uptake of lucerne as the Strategy progresses into implementation.

**Discharge** sites was identified using Anthony Fanning's Report done through Charles Sturt University on discharge mapping in the North East Region. Targets for salt tolerant pastures have been set from local understanding of the area. Tree establishment around the margins of discharge sites has not been given a target as community support for this option is unknown. As our understanding of community interest in this option increases, additions to the targets may be required.

#### Recommendation

- That the targets for on-ground works set in Table 17 be adopted for the North East Salinity Strategy.

## ADDRESSING THE ISSUE

**Table 16** Percentage and annual targets for priority areas.

Priority area	Area of cleared high recharge (ha)	Cleared high recharge in priority areas treated over 30 years (%)	Annual target recharge treatment (ha)	Annual target recharge protection (ha)	Annual target discharge treatment (ha)
Riverine Plain	31,960	5	55	5	10
Rutherglen	6,560	20	45	5	2
Springhurst/ Byawatha	7,260	20	50	5	4
Indigo Valley	5,210	10	15	5	5
Wodonga /Baranduda	4,670	10	15	5	4
Everton / Tarrawingee	6,120	10	20	5	5
Carboor / Bobinawarra	6,980	10	25	5	5
Greta	4,400	10	15	5	10
Murmungee	2,520	10	10	5	1
Other areas	-	-	-	5	-
<b>Total</b>	<b>75,680</b>	<b>12 ave</b>	<b>250</b>	<b>50</b>	<b>46</b>

1. *Annual target recharge treatment* refers to the treatment of identified cleared high recharge through agronomic options such as tree or pasture establishment.
2. *Annual target recharge protection* refers to the protection of existing remnant vegetation through fencing.
3. *Annual target discharge treatment* refers to the discharge area to be treated.

## ADDRESSING THE ISSUE

**Table 17 Annual targets for the North East Salinity Strategy**

Priority area	Protection of existing remnant vegetation (ha)	High density tree establishment (ha)	Farm forestry (ha)	Perennial grass pastures (ha)	Pastures - lucerne (ha)	Discharge treatment - pastures (ha)	Discharge treatment - trees (ha)
Riverine Plain*	5	10	5	20	20	10	tbd
Rutherglen	5	10	5	25	5	2	tbd
Springhurst/Byawatha*	5	10	5	30	5	4	tbd
Indigo Valley*	5	10	5	ni	tbd	5	tbd
Wodonga/Baranduda*	5	10	5	ni	tbd	4	tbd
Everton/Tarrawingee	5	10	10	ni	tbd	5	tbd
Carboor/Bobinawarrah	5	15	10	ni	tbd	5	tbd
Greta	5	10	5	ni	tbd	10	tbd
Murmungee	5	5	5	ni	tbd	1	tbd
Other	5	ni	ni	ni	ni	ni	tbd
<b>Total</b>	<b>50</b>	<b>90</b>	<b>55</b>	<b>75</b>	<b>30</b>	<b>46</b>	

**tbd** = to be determined as the strategy moves into implementation.      **ni** = not included

\* = potential sites for demonstrations of interception plantations

**Targets will be reviewed annually and adjusted to reflect community needs. New priority areas may need to be included as our understanding of groundwater processes develops (particularly in the Kiewa and Upper Murray area).**

## ADDRESSING THE ISSUE

### 4.14.4 Strategy co-ordination

Strategy co-ordination will require a high level of input particularly in the first two years of implementation.

Areas to be addresses include:

- ◇ development of Action Plans
- ◇ the provision of executive support to the NESWG
- ◇ fulfilment of government reporting requirements eg. business plan and annual report
- ◇ preparing budgets
- ◇ establishing and maintaining links with other programs such as farm forestry, Regional Development and Local Government
- ◇ co-ordination of the development of the Research and Investigation Strategy
- ◇ establishing a salinity monitoring program
- ◇ sourcing funding opportunities

#### **Recommendation**

- That a Strategy Co-ordinator be employed to fulfil the above requirements of the North East Salinity Strategy.

### 4.14.5 Integration with other programs

#### **Other natural resource programs**

The need and opportunity to link with other natural resource programs has been highlighted throughout this document. The following table gives a snapshot of the on-ground works carried out under a range of these programs. These are not necessarily on identified high recharge areas, but as highlighted by CLPR, there is a need to move toward whole catchment approach to salinity control with the adoption of high water use activities across the whole catchment. The impact of these programs on groundwater recharge is significant.

#### **Changed management programs**

A range of changed management programs for cropping and grazing areas are currently available through DNRE and industry. These programs aim to promote the effective and efficient use of water linking productivity and natural resource management. The promotion of these practises also has a significant impact on water use and therefore groundwater recharge.

#### **Property management planning**

Salinity control needs to be tackled from a whole farm/sub-catchment perspective looking at the whole range of land and water management issues while still maintaining a productivity focus.

Property management planning will have a key role in this management, identifying the broad range of options to maximise rainfall use before it enters the watertable as recharge. Issues such as waterlogging and water movement around the farm will be crucial to the long-term control of salinity on farms.

Landcare groups are showing increasing interest in sub-catchment planning with some groups taking the first steps in developing a catchment plan. Sub-catchment planning gives Landcare groups the opportunity to address the broad range of environmental and productive issues that face land managers currently.

The use of Electromagnetic Induction mapping techniques (EM) will assist land managers in developing their property management plans and sub-catchment plans. Some more innovative land managers are now moving toward increasing farm production though increasing inputs on their better land, while accepting lower outputs from their steeper less productive, environmentally sensitive land. This is seen as a way to maintain productivity but while still protecting high recharge areas.

#### **Recommendations**

- That funding be sought (eg. Farm\$mart) to promote property management planning activities that assist in developing management strategies related to improving natural resource management and farm viability.
- That funding be sought to improve management practices related to water movement on farms.
- That opportunities for funding be sought to carry out EM mapping in areas outside the salinity priority areas to assist farmers in the development of property management planning.

## ADDRESSING THE ISSUE

### Local Government

Local government has all or part responsibility for many land management issues including vegetation clearance, some dam construction and drainage controls, roadside management and subdivisions. Initial discussions with local governments on the salinity issue highlighted their concern. Opportunities exist for the five local governments and DNRE to work together to develop these links to address land degradation on a regional level.

The Native Vegetation Retention Controls in the State Section of all Planning Schemes controls further clearing of native vegetation on private land in Victoria. Local government plays an essential role in managing this issue. Salinity management is greatly influenced by tree cover, and the Strategy

regard the retention of native vegetation as integral to its success. A database of tree cover linked to the risk of future salinity areas will allow for more informed decisions on applications. DNRE is developing a GIS based system to link tree cover to salinity risk.

### **Recommendations**

- That all shires be encouraged to link into the database of tree cover in association with DNRE. This will assist in assessing further applications for native vegetation removal.
- That the 5 shires of the North East Region be encouraged to work together to address planning control issues.

**Table 18 Estimate of the amount of works that have been carried out under other Government natural resource programs across the whole region.**

Natural Resource Program	Annual impact estimate (ha)
Natural Heritage Trust (including National Vegetation Initiative, National Landcare Program, National Rivercare Program)	65
LPIS	41
Forestry North East /North Farm Central Project (FFORNE)	350
Corridors of Green	80
<b>Total</b>	<b>536</b>



# BUDGET

## CHAPTER 5

### BUDGET

#### 5.1 Cost Sharing for on-ground works

The principal of beneficiary pays has been used to determine the level of cost-share incentive through the Strategy. Under this principle, anybody who receives a benefit from the implementation of on-ground works should contribute to the cost of these works.

This principal has been adopted by other salinity management plans across the State. A similar cost share has been adopted for this Salinity Strategy. (Table 19) This ensures that the burden of costs does not fall on only those with recharge or discharge sites on their properties.

Most of the community share of the costs is included as 'in-kind', predominantly in the form of labour input to carry out these works.

**Table 19 Cost Share for salinity works adopted by the North East Salinity Strategy.**

<b>On-ground works</b>	<b>Private %</b>	<b>Public %</b>
<b>Protection of existing remnant vegetation</b>	<b>50</b>	<b>50</b>
<b>High density tree establishment</b>	<b>50</b>	<b>50</b>
<b>Farm forestry establishment</b>	<b>50</b>	<b>50</b>
<b>Perennial grass establishment</b>	<b>50</b>	<b>50</b>
<b>Lucerne pasture establishment</b>	<b>50</b>	<b>50</b>
<b>Discharge treatment -pasture establishment</b>	<b>75</b>	<b>25</b>
<b>Discharge treatment - tree establishment</b>	<b>75</b>	<b>25</b>

# ECONOMICS

## **Recommendation**

- That the cost share for salinity works outlined in Table 19 be adopted for the North East Salinity Strategy.
- That Table 20 be adopted as the 5 year budget for the North East Salinity Strategy.

## **5.2 Five year budget - Government Investment**

**Table 20 Five year budget**

Government Investment	1997/98	1998/99	1999/00	2000/01	2001/2002
Improved Farm Management					
• Perennial Pasture Establishment	13,050	13,050	13,740	13,740	13,740
• On-Farm Environmental Rehabilitation inc. fencing for environmental protection	25,000	25,000	26,250	26,250	26,250
• Salt Tolerant Pastures	1,748	1,748	1,840	1,840	1,840
• Tree Planting (inc. Agroforestry)	148,355	148,355	155,835	155,835	155,835
• Fencing of discharge areas	2,875	2,875	3,013	3,013	3,013
Sub Total	191,028	191,028	200,678	200,678	200,678
Facilitative Activities					
• Extension	93,952	93,952	98,650	98,650	98,650
• Property Management Planning					
Plan Management	58,138	58,138	61,045	61,045	61,045
Monitoring	100,000	100,000	105,000	105,000	105,000
Research & Investigation					
Other (7% Administration costs)	31,019	31,019	32,576	32,576	32,576
<b>TOTAL GOVERNMENT INVESTMENT</b>	<b>474,137</b>	<b>474,137</b>	<b>497,949</b>	<b>497,949</b>	<b>497,949</b>

**The increase in budget in 1999/00 allows for a 5% inflation adjustment.**

## CHAPTER 6

### ECONOMIC EVALUATION

#### 6.1 Benefits of the Strategy

The benefits to the community of implementing the North East Salinity Strategy (NESS) have been calculated over a thirty year period (1997/98 - 2026/27).

##### 6.1.1 Decreased salt loads

**Murray river at Morgan.** Without intervention, it is estimated that there will be a 2.8% annual increase in Murray River water EC (salt) levels at Morgan (SA), due to the deterioration of the quality of the North East Catchment's water. The present level of 30.7 EC input would thus increase to 41.5 EC by the year 2027.

Implementation of the NESS will achieve a mitigation benefit of 0.8 EC valued at \$100,000/EC (MDBC figures).

**Other irrigation areas.** Other areas which draw water from the North East river systems, may also be affected by the NESS. Quantification of the costs to these areas was not possible due to the highly dynamic and interrelated nature of the Murray Darling Basin and production within it.

**Catchment Household.** "Without plan" household EC levels are expected to have an annual increase of 0.25% from the present EC level of 100EC. This benefit is valued at \$0.32 / EC increase / household based on MDBC estimates of the cost of increased water pipe corrosion particularly in hot water services, soap usage and health benefits. At present around 25,000 households rely on North East water for household supply.

##### 6.1.2 Salt affected land.

###### Prevention.

The land directly affected by salt is predicted to increase at 5.83% pa. from the present 2,161 ha, reaching 11,700 ha by 2027 without the plan being implemented. The analysis assumes 80% of this increase will be prevented as a result of plan implementation.

###### Reclamation.

3% of the salt affected land in the North East is to be recovered annually as a result of the plan, reducing the expected increase in salt affected land by 750 ha by 2027.

##### 6.1.3 Agricultural benefits.

The introduction of perennial pasture species allows increased stocking rates given appropriate management. This has benefits to agriculture in the North East Region. It was assumed that stocking rate increased, on average, from 6 DSE (dry sheep equivalents) /ha to 12 DSE/ha following perennial pasture establishment. A livestock gross margin of \$15/DSE was then applied to these livestock to measure the overall benefit. The areas of establishment, and thus benefits, are based on targets given in Table 17 in Section 4.

##### 6.1.4 Forestry benefits

Production from commercial forestry, resulting from initiatives in place will allow commercial returns from the Farm Forestry and other programs. These benefits were valued at \$10M. The expansion of local processing facilities will increase the potential of farm forestry in the Region.

No benefits have been included for private or government forestry operations, though they would be significant.

##### 6.1.5 Groundwater Pumping benefits

The introduction of groundwater pumping and drainage as a means of reducing the watertable level and accessions are being considered by the NESWG. An amount of \$3,447/yr has been allocated to these activities. As prevention works of this nature would not be supported by the plan if they were shown to be uneconomic, benefits have been assumed to match the cost.

##### 6.1.6 Infrastructure benefits

The benefit to infrastructure is based on reduced need for road maintenance and replacement. Without the plan, roads in salt affected areas are expected to need replacement within two thirds the usual replacement time while incurring twice the annual maintenance cost. This will provide the Region with around \$3M of benefits.

## ECONOMICS

**Table 21. Present Value of NESS costs**

Program	Government	Landholder	Local Government
Plan Support	\$1,847,550	\$0	\$0
Research & Investigation	\$1,262,900	\$144,000	\$0
Monitoring	\$3,103,410	\$360,000	\$0
Environmental	\$703,410	\$1,035,000	\$0
Farm Tree	\$2,713,410	\$7,826,250	\$0
Pastures	\$292,410	\$37,589,528	\$0
Cropping	**	**	**
Saline Agriculture	\$144,810	\$324,300	\$0
Groundwater pumping & drainage	\$300,583	\$0	\$0
Implementation	\$2,921,970	\$600,000	\$0
<b>Total</b>	<b>\$13,290,453</b>	<b>\$47,879,078</b>	<b>\$0</b>
<b>Cost Share</b>	<b>22%</b>	<b>78%</b>	<b>0%</b>

**Table 22. Present Value of benefits to the NESS**

Program	Agriculture				Other			Not Funded Under NESS	
	Prevention	Reclamation	Pastures	Ag Forestry	Infrastructure	Industrial	Domestic	Ag Forestry	Pastures
Plan Support	**	**	**	**	**	**	**	**	**
Research & Investigation	**	**	**	**	**	**	**	**	**
Monitoring	**	**	**	**	**	**	**	**	**
Environmental	**	**	**	**	**	**	**	**	**
Farm Tree	\$205,009	\$41,216	**	\$3,002,366	\$1,500,000	\$293,249	\$42,017	\$23,205,557	**
Pastures	\$205,009	\$41,216	\$4,126,888	**	\$1,500,000	\$293,249	\$42,017	**	\$42,718,608
Cropping	**	**	**	**	**	**	**	**	**
Saline Agriculture	**	**	**	**	**	**	**	**	**
Groundwater pumping & drainage	**	**	**	**	**	**	**	**	**
Implementation	**	**	**	**	**	**	**	**	**
<b>Total</b>	<b>\$410,019</b>	<b>\$82,431</b>	<b>\$4,126,888</b>	<b>\$3,002,366</b>	<b>\$3,000,000</b>	<b>\$586,498</b>	<b>\$84,034</b>	<b>\$23,205,557</b>	<b>\$42,718,608</b>

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**Table 23. Summary of benefits and costs by NESS program**

Program	PV of Total Benefit	PV of Total Cost	Net Present Value	B:C Ratio
Plan Support	\$0	\$1,847,550	(\$1,847,550)	0.00
Research & Investigation	\$0	\$1,406,900	(\$1,406,900)	0.00
Monitoring	\$0	\$3,463,410	(\$3,463,410)	0.00
Environmental	\$0	\$1,738,410	(\$1,738,410)	0.00
Farm Tree	\$28,289,414	\$10,539,660	\$17,749,754	2.68
Pastures	\$48,926,987	\$37,881,938	\$11,045,049	1.29
Cropping	**	**	**	0.00
Saline Agriculture	\$0	\$469,110	(\$469,110)	0.00
Groundwater pumping & drainage	\$0	\$300,583	(\$300,583)	0.00
Implementation	\$0	\$3,521,970	(\$3,521,970)	0.00
<b>Total</b>	<b>\$77,216,401</b>	<b>\$61,169,531</b>	<b>\$16,046,870</b>	<b>1.26</b>

**Table 24. Summary of benefits and costs as given by priority area**

Priority Area	PV of Total Benefit	PV of Total Cost	Net Present Value	B:C Ratio
Riverine Plain	\$3,968,163	\$8,651,899	(\$4,683,736)	0.46
Ovens/Murray				
Rutherglen	\$1,972,341	\$1,533,348	\$438,992	1.29
Springhurst/Byawatha	\$2,403,126	\$1,508,510	\$894,616	1.59
Indigo Valley	\$1,218,575	\$1,999,568	(\$780,993)	0.61
Wodonga/Baranduda	\$581,819	\$637,076	(\$55,257)	0.91
Everton/Tarrawingee	\$1,472,406	\$1,974,105	(\$501,699)	0.75
Carboor/Bobinawarra	\$1,340,822	\$1,632,184	(\$291,361)	0.82
Greta	\$971,360	\$1,974,105	(\$1,002,745)	0.49
Murmungee	\$502,268	\$1,240,376	(\$738,109)	0.40
Other	\$62,785,520	\$40,018,359	\$22,767,161	1.57
<b>Total</b>	<b>\$77,216,401</b>	<b>\$61,169,531</b>	<b>\$16,046,870</b>	<b>1.26</b>

## 6.1.7 Environmental effect of the plan.

Environmental improvement is a priority of the plan, however, the benefits are too innumerable and immeasurable to quantify in dollar terms. Indirectly the plan will assist and enhance the environment in a number of ways. These include:

- protection and regeneration of remnant vegetation on and off-farm
- increased range and availability of habitat to native fauna
- improved stream environment for fish
- improved survival of salinity affected trees and reduced effect in the future
- improved soil structure, reduced wind and water erosion (and potential for erosion) and reduced potential for soil acidity problems resulting from deep rooted perennial pasture establishment and stabilised water table levels. Legume based annual pastures promote nitrate leaching, resulting in soil acidity through the soil profile. This is increasingly becoming a problem to agriculture in the region. The adoption of perennial pastures will help address this problem.

## 6.1.8 Agronomic effects.

The effect of a number of agronomic factors was unable to be estimated due to the highly complicated interrelationships involved. For example the yield benefit from a reduced watertable in cropping regions is unable to be predicted over large areas, notwithstanding the variable yield effects on different cultivars. These possible influences should be factored into considerations of the overall efficiency of plan implementation. Inclusion of quantifiable benefits would improve the apparent cost effectiveness of the plan considerably.

## 6.1.9 Tourism benefits

Tourism in the Region is a major contributor to the local economy. Naturally any increase in salinity which may degrade the aesthetic value of the Region will be a major cost to the tourism industry. These types of costs are difficult to quantify and have not been included in the benefit cost analysis. However, it is important to realise that were it possible to quantify the monetary benefits gained to the tourism industry as a result of the NESS, then this would contribute considerably to the final benefit cost ratio.

## 6.2 The Benefit:Cost analysis

The State Government, which funds and administrates the State Salinity Program, requires that the NESS (and other plans) be economically feasible on a state-wide basis. Hence the costs of implementation will reap benefits for all Victorians, as well as indirectly benefiting South Australia and New South Wales water users.

Benefit - Cost (B:C) analysis aims to evaluate the economic impact of the NESS in terms of today's dollars (present value- PV), as opposed to the predicted salinity outcome without the existence of a plan over the next thirty years (the with/without analysis). This B:C analysis allows comparison between projects competing for funds and indicates investments, where the likelihood of return is greatest.

Such an assessment has been undertaken with regard to the NESS. The analysis shows that the plan is economically viable. The present value (PV) of benefits to costs is expressed as a ratio (B:C). The current estimate predicts that the present value of total community benefits amounts to \$228M while costing the community \$206M; a B:C ration of 1.11. Given the increase in B:C that would result from environmental and tourism benefits, the plan is worthwhile investment for all Victorians.

Cost sharing in the North East Region has been based on local costs and costs from other salinity plans. The community contributes 100% of the cost of maintenance while their contribution to the capital works costs is dependant on the cost share ratio. These costs will vary but were seen as an average estimate of land-holder contribution to the Plan. These, in combination with known government contributions, form the basis of costs used in the analysis (Table 21). The community contribution is equal to 94% of the total costs of the Strategy, while the government contributes 4%.

The benefits derived from works are estimated from returns to livestock production, returns from commercial forestry, reductions in stream salinity, reclamation of affected land and the prevention of salinity in the next thirty years. Land-holder contributions to the cropping program have not been included due to insufficient information (Table 22).

These costs and benefits are then combined to calculate the overall B:C ratio for the Region. These have been analysed by program (Table 23) and by priority area (Table 24) so we can see the most profitable areas and projected courses of action, while also noting where work will be undertaken. The assumptions behind these calculations are provided at the conclusion of this chapter.

## 6.3 Sensitivity Analysis

The B:C ratio (1.11) is highly dependant on a number of assumptions regarding benefits accruing to the Plan. It is extremely sensitive to changes in stocking rate and gross margin/DSE resulting from perennial pasture improvement.

For example the gross margin of \$15/DSE used in the analysis in reality will be highly variable according to a number of factors such as wool and meat prices, and costs of production. Another major variable will be the increase in stocking rate resulting from perennial pasture improvement. To give a guide to how these changes would effect the B:C ratio, a sensitivity analysis is given in Table 25.

**Table 25. Change in B:C ratio under a range of pastoral economic and agronomic conditions.**

GM/DSE (\$)	Increase in stocking rate (DSE/ha)		
	3	6	9
\$10	0.59	0.76	0.93
\$15	0.85	1.11	1.36
\$20	1.11	1.45	1.80

Also the sensitivity of the B:C ratio to timber prices can be seen by the results of a sensitivity analysis given in Table 26.

**Table 26. Change in B:C ratio under a range of Timber Gross Margins.**

GM (\$/ha/yr)	\$75	\$110	\$210	\$310
B:C Ratio	1.09	1.11	1.15	1.20

At this point it should be noted that all of the benefits in the analysis have been discounted to give a net PV of \$228.2M. The benefits incurred from farm forestry have also been discounted. If the real price of timber was to rise at 4% per annum, then the PV of the net benefits would be equal to \$240M and the B:C ratio would be nearly 1.2.

Therefore it can be seen that the B:C ratio is very sensitive to a number of factors.

However the agronomic and economic conditions used in this analysis give a B:C ratio of greater than one. Hence Plan implementation is predicted to be beneficial, both from an environmental and economical perspective.

It should be noted that the aversion of salinity problems over the horizon of the plan will provide

protection from the effects of salinity for more than 30 years. Thus, the Plan is even more beneficial over time than the present analysis indicates.

## 6.4 Assumptions

### 6.4.1 General

The planning horizon is 30 years with government funding present for 30 years.

A discount rate of 4% was used in the analysis. This is a real discount rate as no inflation is included in the analysis. This allows future values to be assessed in terms of today's value. The discount rate is a measure of the preference for money (consumption) in the present as opposed to the future. The higher the discount rate the higher the preference for money in the present.

The values given in Table 21 were used as the basis of government spending. These were then extrapolated over the thirty years of government contribution to the Plan. The distribution of Government costs was calculated on the basis of cleared land in the priority areas only. No Local Government costs are included as they have had no direct financial input to the plan implementation.

Many costs and benefits are distributed across priority areas on the basis of proportional contribution to recharge mitigation rather than actual expenditure, as it was not possible to apportion individually to each priority area. This may bias the analysis to a degree in some cases. Research and Investigation, Monitoring, Plan Support and Plan Implementation are distributed on this basis.

An average gross margin of \$15/DSE is used, which translates to \$180/ha, assuming 12 DSE/ha on improved pasture and \$90/ha assuming 6 DSE on unimproved pasture. This was used as the basis of the agricultural benefit for perennial pasture establishment. An average gross margin for timber production of \$110/ha is used. Most of the benefits of timber production are not received until at least 12 years after establishment, depending on the type of timber (some varieties are not harvested for over 30 years). However, in the case of this analysis the total gross margin was spread over the 12 years to obtain an annual gross margin of \$110/ha. Regional differences of course will occur, but these gross margin values were seen as a guide based on the best estimates available.

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## 6.4.2 High recharge costings

The following costs were used in the analysis of the NESS. The establishment costs were shared between land holders and the Government according to the cost share figures given in Table 19 in Chapter 5. The maintenance costs are met entirely by landholders.

### Establishment costs (\$/ha):

<u>Works</u>	<u>\$/Ha</u>
Remnant Vegetation	1000
HD Tree Plantings	1175
Farm Forestry	1833
Perennial Pasture	220
Lucerne	320
Discharge Pasture	400

### Annual Maintenance Costs (\$/ha)

<u>Works</u>	<u>\$/ha</u>
Remnant Vegetation	30
HD Trees	30
Farm Forestry	180
Discharge Pasture	30
Perennial Pasture	52
Lucerne	110

## 6.4.3 Ground water pumping

A notional cost to the plan of \$3,447 per year, (10% of government's yearly contribution to the plan) from year 1 to year 30 has been included in the analysis.

## 6.4.4 Research and Investigation

As no allocation or contribution to Research and Investigation activities has been identified within the Strategy, a notional allocation of 10% of the Government's input has been included in the analysis from year 6 to 30. This value is similar to allocations for research and investigation within other Plans and Strategies.

## 6.5.5 Water benefits

The benefit of salinity diversion out of the North East Catchments is based on \$100,000 per 1EC increase at Morgan (SA).



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## Acronyms

ANM	Australian Newsprint Mills
CLPR	Centre for Land Protection Research
COFFI	Co-operative Farm Forestry Initiative
DNRE	Department of Natural Resources and Environment
DPIE	Department of Primary Industry and Energy
EPA	Environmental Protection Authority
EM/EM31	Electromagnetic Surveys
FFORNE	Farm Forestry North Central/ North East
GAITS	Grants and Incentives Tracking System
GIS	Geographic Information System
GMW	Goulburn Murray Water
LCC	Land Conservation Council (now known as Environment Conservation Council)
LPIS	Land Protection Incentive Scheme
LMU	Land Management Unit
NE CMA	North East Catchment Management Authority
NERCS	North East Regional Catchment Strategy
NESS	North East Salinity Strategy
NESWG	North East Salinity Working Group
NHT	Natural Heritage Trust (incorporates the National Landcare Program)
NRMS	Natural Resource Management Strategy
MDB	Murray Darling Basin
MDBC	Murray Darling Basin Commission
R&I	Research and Investigation
RPC	Regional Plantations Committee (Plantations North East)
SKM	Sinclair Knight Merz
SGM	State Groundwater Monitoring
VFF	Victorian Farmers Federation
VPC	Victorian Plantation Corporation