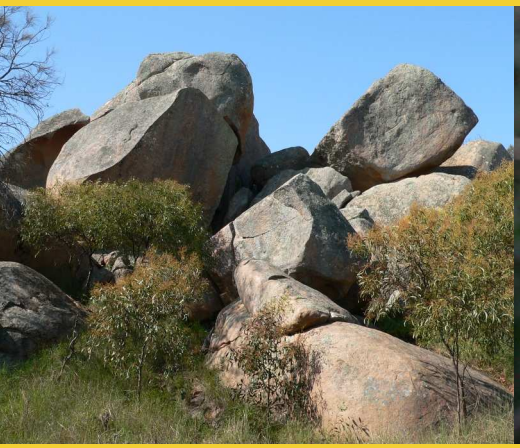
COORONG
DISTRICT COUNCIL

Coorong District Local Action Plan



Sustainability, Agriculture, Environment

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Figure 1 – Swan nesting on the shores of Lake Alexandrina.

1 CONTENTS

2 EXECUTIVE SUMMARY

The Coorong District Local Action Plan covers an area which extends from just above Tailem Bend and Peake in the north, to just above Keith in the Upper South East. The Coorong National Park, Lake Albert and part of Lake Alexandrina form the western boundary. The Local Action Plan shares a common boundary with the Coorong District Council (the largest council area in South Australia)

The Coorong District covers 883,500 hectares of land, plus 46,800 ha of lakes.

The annual average rainfall ranges from just over 300 mm in the north to just under 500 mm in the south.

The population of the district is 5,825 people (2009 ABS).

The District contains 553 farms. The value of rural produce is $162M per year (ABS 2009) Land use (ABS 2006) includes the following;

- 19% native vegetation
- 75% agriculture
    - 80% grazing
    - 15% cereal crops
    - 5% non-cereal crops
    - 1.8% irrigation
    - 0.5% horticulture
- 6% roads, cliffs, urban and other land uses

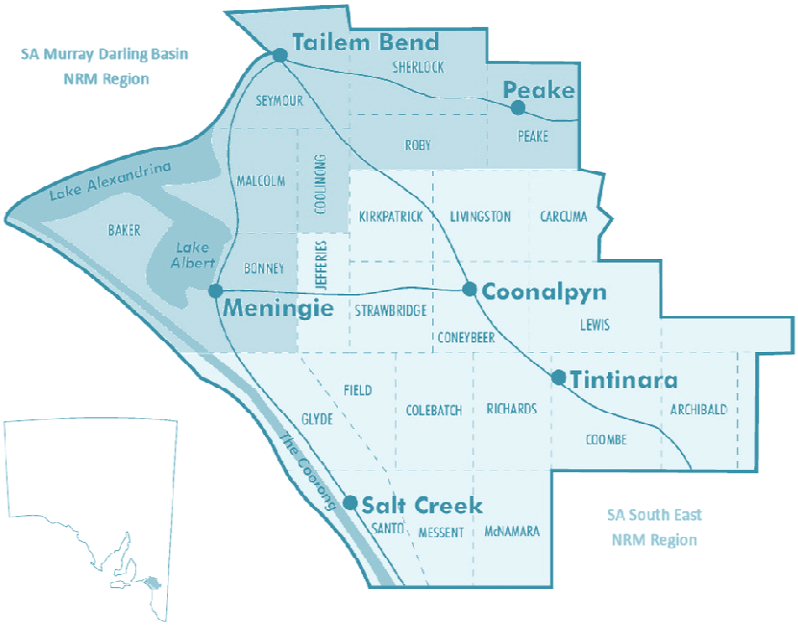
There are a number of significant areas throughout the district, either for environmental or cultural reasons. These include;

- Coorong & Lower Lakes Ramsar sites
- Part of the Watervalley Wetlands
- The Murray Mouth
- Aboriginal Lands, including Raukkan Community, Camp Coorong and Wilderness Lodge
- National and Conservation Parks

Figure 2: The Coorong is well known as the setting for the 1977 film *Storm Boy*.

The area is subject to a range of major natural resources issues which include;

- Dryland salinity
- Native vegetation decline, wetland degradation and loss of biodiversity.
- Sustainable agriculture
- Wind and water erosion
- Water security
- Climate change
- Pest plants and animals



2.1 WHAT DOES THE COORONG DISTRICT LAP DO?

Responding to the threat of natural resource degradation issues often consists of individuals reacting to issues when and where they occur.

The development of a long-term plan to coordinate community efforts over the broader area is vital if threats to agriculture and the natural environment are to be prevented.

Through community consultation, the whole community has had an opportunity to help decide the content of this local action plan.

The Coorong District Local Action Plan identifies the benefits of taking action, compared to the costs associated with doing nothing, and has established a fair way of sharing the cost of on-ground works. This assists stakeholders allocate funds to where they will do the most good.

As a result, the community can be involved in the implementation of solutions outlined in the plan, and will be able to access funding and technical support for projects which contribute to the plan's objectives.

Figure 3: Clay spreading on sandy soils.

By linking this Plan with neighbouring Local Action Plans, other land management plans and strategies, the management of the whole region is undertaken in a coordinated and efficient manner.

The Local Action Plan is monitored and evaluated on an ongoing basis, evolving as more information becomes available and the community's understanding of natural resource management increases.

Figure 4: Workshop on management of farm forestry blocks

Over the life of the Coorong District LAP program, a range of on-ground works incentives have been offered, along with technical advice and in-kind support. The following table shows some of the common activities of the LAP program, along with the areas that have been achieved to date.

Table 1: LAP achievements (1996-2011)

Activity	Achieved
Dryland lucerne	102,298 ha
Other perennial pastures	5,023 ha
Environmental weed management	2,251 ha
Native vegetation establishment	4,686 ha
Fencing of remnant vegetation	389 km
Fencing of wetlands/Ramsar	192 km
Farm forestry	148 ha
Fodder shrubs	1,245 ha
Stabilising sand drift	1,440 ha
Levelling blowouts	666 ha
Clay spreading	5,781 ha

2.2 FUTURE WORK OF THE COORONG LAP PROGRAM

This version of the Coorong District Local Action Plan expands on the issues addressed in previous versions, while also including new issues, such as water security and climate adaptation.

The LAP committee hopes that this plan will help continue the current work of the Coorong District LAP, while adding new actions, such as promotion of water saving systems on dryland farms.

To help landholders adapt to the climate and surrounding policy changes, the LAP program will be hosting a range of workshops and promoting activities to increase soil carbon content.

Best practice land management actions generally address a wide range of natural resource management issues.

Over the coming years, the Coorong District LAP program will continue to promote good management of all natural resources to ensure the optimal outcomes for all concerned.

New actions for the LAP are the inclusion of awareness raising with regard to climate change and carbon sequestration.

Actions	Water	Biodiversity	Soils	Air	Climate	Social
CURRENT ON-GROUND WORKS PROGRAM						
Perennial pastures	■		■	■	■	■
Fodder shrubs	■		■	■	■	■
Native vegetation establishment	■	■	■	■	■	
Wind breaks and alley farming	■	■	■	■	■	■
Farm forestry	■	■		■	■	■
Clay spreading, delving and mapping	■		■	■	■	■
Protecting remnant vegetation and wetlands	■	■		■	■	
Enhancing habitat for threatened flora and fauna	■	■		■	■	
Productive use of saline lands	■		■		■	■
Reclaiming or retirement of wind or water eroded land	■	■	■	■	■	■
Controlling lakeshore erosion	■	■	■	■	■	■
FUTURE ON-GROUND ACTIONS						
Mains water leak detection incentives	■		■	■	■	■
Decommission abandoned, leaking confined aquifer bores	■					
Expand existing weather station networks to cover dryland areas	■		■	■	■	
TRIALS AND INVESTIGATIONS						
Run or promote trials of climate change adaptation practices.	■		■	■	■	■
Investigate and trial alternative water supplies, particularly stock water.	■				■	
Seek funding to provide alternative water	■					■

Actions	Water	Biodiversity	Soils	Air	Climate	Social
supply or water use efficiency incentives, where incentive programs do not already exist.						
KNOWLEDGE AND AWARENESS						
Run workshops to increase community knowledge of new issues, for example carbon trading or water security.						
Raise awareness of existing alternative water supply or water use efficiency incentives						
Distribute information on carbon sequestration and air pollution research.						
Assist NRM Boards engage with the community on animal and plant control, and other NRM issues.						
PARTNERSHIPS						
Work with schools, indigenous organisations, community groups and government agencies to increase NRM understanding and awareness.						
MONITORING						
Monitor the efficiency of all actions.						
Work with government agencies to maintain or resume past monitoring programs, which are needed to assess LAP program efficiency.						

3 FOREWARD

Figure 5: Henry Angas, Chair of the LAP Committee

The Coorong District Local Action Plan Committee was formed in 1995 and released the first version of the Local Action Plan in 1997. This was updated in 2000 with a Plan covering a wider range of issues as much of the first Plan was dryland salinity based.

We have taken the opportunity to update the Plan following the receipt of Commonwealth funding from the Strengthening Basin Communities Program. Since the last review in 2000, issues such as climate change and water security have become national priorities. There have been significant changes to legislation including the introduction of the NRM Act in 2004, and the subsequent introduction of Natural Resources Management (NRM) Boards and Groups. There have also been changes in Government Departments and Government and NRM Board funding programs.

When we started out in 1995, I don't think any of us would have anticipated the success of the LAP Program and that it would still be going from strength to strength in 2012. In that time the LAP committee has received over $17 million in grants.

The main ongoing actions have been incentives for land managers to undertake best-practice natural resource management on mainly agricultural properties, resulting in over 150,000 hectares of on-ground works and 580 kilometres of fencing.

Other LAP activities include promotion of natural resource management education, field days and workshops, and support of community groups and schools.

In 2010 the LAP program was expanded to cover the Tatiara District Council area with of four years of funding from the Commonwealth Caring for Our Country Program. A Tatiara District LAP Committee was established in 2010 following the expansion of the LAP area.

The Support of the Coorong District Council, and more recently the Tatiara District Council, has been a major factor contributing to the on-going success of the LAP. Local Government offers a stable support structure for the LAP Project Officers as well as providing much of the day to day administrative support. In addition the Coorong and Tatiara District Councils make significant cash contributions to this project.

On a sad note, 2010 saw the passing of two long term LAP Committee members Mig Brookman and Councillor Ted Freak.

Figure 6: LAP committee inspecting a major revegetation project.

Mig was well known for her involvement with the LAP and her passion for the environment has resulted in the establishment of thousands of hectares of native vegetation along roadsides, on private land and conservation parks throughout the Coorong and Tatiara Districts.

Mig's enthusiasm and determination encouraged her and others to develop a wealth of knowledge of seed collecting, plant propagation and tree planting which when combined with her hard work ethic was able to demonstrate that large areas of native vegetation can be successfully established. Her legacy of millions of trees remains for the benefit of future generations.

Figure 7: Direct seeding at Salt Creek.

The LAP committee would like to acknowledge the contribution of Ted Freak as the Coorong District Council representative on the LAP Committee. Ted was very much a community minded person with a passion for the environment.

Ted shared a belief that agriculture and a healthy environment can co-exist and that if landowners looked after the natural resources of their farm then the farm would look after the owners. Being a member of the Coorong LAP Committee allowed Ted to take a role that promoted that idea.

The LAP Committee continues to maintain their enthusiasm and more than half of the Committee have been members since 1995 and their continued support ensures that the LAP is a community owned and implemented Plan.

The Plan has no legislative requirement and landholder participation is voluntary. The Plan summarises the NRM issues for the district and through community consultation seeks agreed actions to address the issues. The Plan will also act as an investment prospectus to support future applications for funding support from State and Federal Governments and other funding bodies.

The LAP program will continue to evolve and seek new opportunities while maintaining our current programs but funded activities may vary from time to time in accordance with the priorities of the funding bodies.

Henry Angas
Chairman
Coorong District LAP Committee

Figure 8: Coorong District LAP Committee and staff (L to R: Ken Strother, Tracey Strugnell, Samantha Blight, Gordon Stopp, Henry Angas, Judy Zacker, John Barrie, Cr Andrew Dawes, Graham Gates, Allan Piggott, Jim Quinn, Keith Scobie, Lester Cattle, absent Steve Murray)

4 INTRODUCTION

Figure 9: Fields of yellow flowered Canola are a common sight in the Coorong District.

4.1 WHAT IS THE COORONG LOCAL ACTION PLAN (LAP)?

Initially released in 1997, the Coorong District Local Action Plan (LAP) is a community written and managed plan. The LAP program promotes sustainable use of natural resources whilst maintaining biodiversity and farm profitability.

The LAP committee recognises that management of natural resources starts with individuals. Each community member has the responsibility and ability to improve their land management practices, influencing management surrounding lands and maintaining the health of natural resources. They also need to sustain an income for themselves, which helps to maintain the District economy.

Figure 10: Checking a confined aquifer bore for failed casing near Tintinara.

Despite this, some issues are too large or complicated for individuals to tackle without support. The purpose of this plan is to assist individuals with on-farm action to address these larger issues in an effective and timely fashion.

This plan does and will continue to fit in with other planning structures, adding a range of local natural resource management issues to those covered by Regional, State and Commonwealth plans.

During the planning and renewal stages, the Coorong District LAP committee looked at all known natural resource management issues over a longer term (20-100 years) then documented practical short-term measures to address these issues, which will be implemented over the next five to twenty years, subject to funding.

Figure 11: The Coorong LAP display at a local show

Funding for the Coorong District LAP program has come from more than twenty sources, including landholders, the Coorong District Council, the South East Natural Resource Management Board, the South Australian Natural Resource Management Board, State and Commonwealth grant programs. Without this support, the Coorong LAP program would not be what it is today.

A timeline showing the history of the Coorong LAP program is provided in Appendix 3.

4.2 WHY DO WE NEED A LOCAL ACTION PLAN

Responding to the threat of natural resource degradation issues often consists of individuals reacting to the problems when and where they occur.

The development of a long-term plan to coordinate community efforts over the whole area has provided a unified approach to threats to agriculture and the natural environment. Through community consultation, the whole community has had an opportunity to be involved in the preparation and review of this plan.

Each review of the Coorong District LAP document has indentified the benefits of taking action, compared to the costs associated with doing nothing. The LAP document provides a fair way of sharing the costs of on-ground works and assists stakeholders allocate funds to where they will be of greatest benefit.

By linking this plan with Local Action Plans occurring nearby, and with other natural resource management plans, the management of the whole region is being approached in a more coordinated and efficient manner.

The Local Action Plan is monitored and evaluated on an ongoing basis, evolving as more information becomes available or the communities understanding of issues increases.

4.3 ACHIEVEMENTS TO DATE

As part of the review process, an assessment was made of the Coorong District LAP program achievements to date. This allows the funding bodies, staff and community the opportunity to celebrate achievements and identify where future actions should be focussed.

During the early part of Coorong LAP implementation, the focus of the plan was on

dryland salinity prevention and biodiversity preservation. Due to a run of very dry years, the focus on dryland salinity faded during the last decade, with a greater emphasis on wind erosion.

Despite this change in priorities, the achievements of the LAP program have been reasonably consistent across the entire period of operation, delivering or exceeding most defined goals. This is partially due to the stable staffing arrangements, permitted by the close relationship between the LAP program and the Coorong District Council.

Over the lifetime of the Coorong District LAP program, approximately 75% of landholders have participated in the program.

The numbers within this article are based on incentives paid out over each year.

A majority of LAP incentives are offered for activities where the outputs are long-lived (>20 years), so the work undertaken is generally still visible on the ground. The exception to this is perennial pastures, which

On-ground achievements

- An estimated reduction in recharge by 10-20% across the district
- 107,321 ha of perennial pastures established
- 5,022 ha of salt-tolerant pastures planted
- 5,781 ha of clay spreading
- 1,245 ha of fodder shrubs planted
- 389 km of fencing to protect remnant vegetation
- 192 km of fencing to protect Ramsar sites and other wetlands.
- 4,686 ha of revegetation
- 2,105 ha of sand hills and blowouts stabilised
- 148 ha of farm forestry
- 110 leaking confined aquifer wells decommissioned

only last five to ten years.

4.3.1 UNQUANTIFIED ACHIEVEMENTS

In addition to the figures provided on the previous page, there are a range of unquantified achievements. Over its years of operation, the LAP program has been involved in more on-ground works than they provide incentives for. This is due to two reasons;

Landholders often undertake on-ground works (based on information from the LAP staff) without applying for funds.

Those that do apply for incentives often undertake more work than they were funded for.

The quantity of unfunded works or flow-on varies from year to year and project to project, depending on a range of financial, ethical and aesthetic variables. These unfunded or flow on works are likely to be an additional 50-100% of the incentive works.

Since the Coorong District LAP program started, the LAP area has become larger, to cover the entire Coorong District. This has had an impact on the applicability of the targets.

Clear targets were set for recharge reduction in the previous plan, however targets for other outcomes were not expressed.

Quantification of the LAP efficiency has been complicated by a long period of dry years.

Previous background documents have indicated that there is approximately a 1:1 relationship between the percentage of area covered by recharge reduction works and the percentage of recharge reduction. To simplify the analysis, it is assumed that this relationship will hold across the larger area, therefore the targeted areas for recharge reduction works were 20% to 50% of available land within the Coorong District.

4.3.2 PURPOSE OF ON-GROUND WORKS

The Coorong LAP program has undertaken a wide range of actions to address an even wider range of issues. For the purposes of this assessment, on-ground works were allocated to issues based on the information in Table 2.

These are based on the rationale provided within Coorong LAP newsletters. Interestingly, the actual reasons these actions were undertaken by landholders could be quite different, based on site specific criteria.

In the future, although similar actions are likely to be undertaken by the LAP, they will be done to help address a wider range of issues, including reducing mains water use and to mitigate or adapt to climate change

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Table 2: Historic purposes for on-ground works

	Wind erosion	Dryland salinity	Sustainable agriculture	Biodiversity
Lucerne	♦	♦		
Puccinellia			♦	
Veldt/Primrose	♦		♦	
Saltbush	♦	♦	♦	
Tagasaste	♦	♦	♦	
Farm Forestry		♦		
Sand Stabilisation	♦	♦		
Blowout Levelling	♦	♦		
Clay Spreading	♦	♦	♦	
Native vegetation	♦	♦		♦
Remnant vegetation				♦

4.3.3 ACHIEVEMENTS AND PROGRESS TOWARD TARGETS

Using a percent of available area equals percent of recharge equation, we need to undertake 358,000ha of work to achieve a 50% recharge reduction or 143,000ha of work to achieve a 20% recharge reduction.

Table 3 provides an indication of progress toward these targets, using both raw areas and adjustments to account for the issues discussed above.

Actions not covered by these figures include community education, monitoring and decommissioning of leaking confined aquifer bores. These have not been included in Table 3, as they were not within the targets set by the last Coorong District LAP document.

4.3.4 INCENTIVE POPULARITY

The types and amount of works undertaken with assistance from the Coorong LAP program is highly dependent on a number of factors. These include;

- LAP committee priorities
- Knowledge and skills of staff
- Popularity of issue with media
- Willingness of landholders to undertake particular on-ground works
- Willingness of funding bodies to fund particular works
- Adequacy of available incentives for financially marginal actions
- Saturation of the area for that particular action

Despite this wide range of variables, there are some actions that the Coorong LAP program has managed to achieve a consistent uptake for every year. These include Lucerne, Puccinellia, sand stabilisation, clay spreading, planting native vegetation and fencing remnant vegetation.

Throughout the life of the Coorong LAP program, Lucerne has been the dominant action; however this has been particularly noticeable since 2006. It is likely that this is due to both a change in funding program priorities and limited availability of large remnant vegetation blocks for fencing.

Table 3: Achievements using different calculation methods (as described in Section 4.3)

Calculation method	All works	Salinity	Erosion	Sustainable Agriculture	Biodiversity
Simple incentivised area	22%	16%	16%	1%	5%
Lucerne discounted (5 year life)	15%	9%	10%	1%	5%
Discounting + 50% flow-on	23%	14%	14%	1%	8%

Figure 12: Tree Lucerne (Tagasaste) planted as fodder shrubs.

4.4 ROLE OF THE LAP PROGRAM

The role of the Coorong District LAP program is to;

- Seek funds from a range of Local, State and Commonwealth Government sources, along with industry organisations, to address issues identified in within the Coorong District Local Action Plan.
- Communicate successes to local media and stakeholders.
- Engage with stakeholders to implement on-ground works programs that provide benefits to natural resources and sustainable agriculture.
- Conduct education programs with landholders, students and the public.
- Partner with government agencies and boards to deliver natural resource management and sustainable agriculture outcomes within the region.
- Encourage community participation in LAP activities.

While implementing this plan, the Coorong District LAP program will;

- Distribute funds to landholders for approved on-ground works activities
- Monitor, report and promote the success of these undertakings.
- Conduct or sponsor a range of field days, seminars and other educational events.
- Support school and youth involvement in environmental projects.
- Provide representation, resources, knowledge and experience to other groups or individuals involved in natural resource management.
- Communicate with the Coorong District community, raising awareness of natural resource management issues.
- Foster skills in areas such as leadership, team building and group development.
- Initiate or enhance partnerships between the community, government, industry, educational institutions, indigenous groups, individual landholders and volunteers.
- Receive governance and guidance from the Coorong District Local Action Plan Committee, which is a committee of the Coorong District Council.
- Undertake activities across the Coorong District in conjunction with adjacent LAPs or separately, depending on identified issues and available funding.
- Build on successful working relationships with government agencies and Boards.

4.5 WORKING WITH OTHER LAPS

The Coorong LAP program does not work alone. It has strong ties with both the Tatiara and Goolwa to Wellington Local Action Plans. The Coorong Distict LAP and the Goolwa to Wellington LAP deliver a number of projects together. Goolwa to Wellington LAP staff regularly work in the Coorong District delivering Wetland Management Plan actions and the Lower Lakes Rehabilitation Project.

The Coorong and Tatiara LAPs share staff and jointly deliver the Coorong Tatiara Local Action Planning Project, funded by Caring for Our Country. The Tatiara and Coorong Councils work together to ensure seamless delivery of Local Action Planning outcomes across both Districts, subject to funding.

Figure 13: Joint training of LAP staff (CARE Team)

4.6 HOW TO USE THIS DOCUMENT

The original Plan was to be read in conjunction with the Coorong and Districts Soil Conservation Board District Plan, which contained a description of all of the issues in the district.

The Soil Boards were wound up in 2005 following the introduction of NRM Boards. Soils are now addressed within the Regional NRM Plans, however there is no local soil management document. To address this, the relevant parts of the District Plan have been incorporated into the new Local Action Plan.

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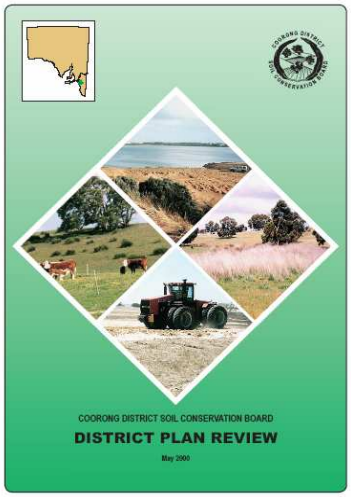

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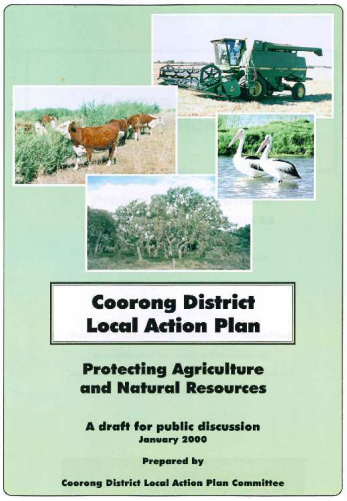

4.7 THE PROCESS OF LOCAL ACTION PLANNING

Following is an outline of the steps involved in preparing the Local Action Plan:

IDENTIFY ALL THE ISSUES, THEIR IMPACTS & INTER-RELATIONSHIPS

The first step in preparing a Local Action Plan involves wide consultation with the community to identify issues of concern, followed by investigations into these issues to assess their extent and severity within the district.

IDENTIFY THE CAUSES OF EACH ISSUE

This involves investigating the biophysical processes operating within the region, and ensuring an adequate understanding of the socio-economic processes.

This step may include reviewing studies and surveys already completed, and conducting further research where necessary.

ASSESS ALL POTENTIAL ACTIONS

Once the issues have been thoroughly investigated, the next step is to identify options for managing the problems and evaluating them in terms of technical feasibility, community acceptance and barriers to adoption, beneficiaries of the implementation, and social, environmental and economic benefits and costs.

IDENTIFY PRIORITY ACTIONS & PRIORITY LOCATIONS

This step involves determining which of the actions should have priority, based on the efficiency of the action to achieve the desired aim, and the economics of the action.

Priority locations are identified on the basis of urgency required for action and opportunity for the actions to be employed.

UNDERTAKE AN ASSESSMENT OF COSTS & BENEFITS

Evaluation of a 'no-plan' scenario enables the magnitude of the impact of the priority issues to be analysed in terms of the likely economic, environmental, and community consequences if there is no further action taken in the area.

This is then compared to the economic analysis of implementing the actions outlined in the Plan.

DETERMINE THE RESPONSIBILITIES, ROLES & COST ALLOCATION

Benefits to stakeholders must be identified and the roles of stakeholders determined.

A recommended cost-sharing framework is then calculated, however the final cost-sharing agreement is decided after negotiation with stakeholders.

RECEIVE APPROVAL FROM COMMUNITY & GOVERNMENT

This involves obtaining funding and also obtaining support from the community in terms of implementing the actions.

ESTABLISH A MONITORING & EVALUATION FRAMEWORK

This involves identifying performance indicators to enable the success of the plan to be measured, and establishing a framework for evaluation.

5 REGIONAL DESCRIPTION

5.1 THE BIGGER PICTURE

The Coorong District covers 8835 km^2. It is on the intersection of two geographical regions – The Murray Darling Basin and the Otway Basin. It is also on the border of two NRM regions, these being the SA Murray Darling Basin and the South East.

Figure 14: Pivot irrigation using groundwater in the Hundred of Coombe

5.2 COMMUNITY RESOURCES

The community is the key asset of the Coorong District Local Action Plan. Members of the community contribute knowledge, commitment, experience and resources to ensure action can be implemented on issues which have been identified for attention. The capacity of people to contribute depends on a range of factors including life stage, education, employment, awareness of issues, cultural attitudes and the financial viability of agricultural enterprises.

5.2.1 POPULATION

In 2009, 5,825 people lived in the Coorong District Council area, which is a 3% decrease over nine years. The population density for the Coorong District is 0.7 people per km^2.

Farm sizes vary significantly, depending on their soil type, rainfall and water availability, however they are generally 350-2000ha.

Approximately 6% of residents are indigenous and 7% were born overseas. The 2009 unemployment rate was 3.8% and the average taxable income per person was $30,102.

Over 80% of businesses within the Coorong District are agricultural enterprises. The management of natural resources has a direct impact on the profitability of these enterprises.

Technology usage in the Coorong District has significantly increased over the last five years. Since 2006, 30% more Coorong District households have internet access. Most of these connections are broadband, using the Council initiated Agile / Internode Communications network.

The average age of the Coorong District was 40.6 years in 2009, which has increased by almost four years over a decade. In comparison, the South Australian average age has increased by only one year.

Figure 15: Despite the aging population, 19.7% of the community is still under 15 years old. Encouraging these youth to engage with natural resource management could have significant benefits to the community.

5.3 CLIMATE

The Coorong District has a temperate climate, with hot dry summers and mild, wet winters.

5.3.1 TEMPERATURE

The average maximum temperatures are reasonably moderate along coastal and lakeside plains, increasing further inland. Temperatures are modified in the coastal and lakeside areas, due to their proximity to these large areas of water.

The average maximum temperatures in three locations are shown in Table 4. Although Keith is outside the District, it is the nearest weather station to most of the south-eastern areas of the Coorong Council District.

Table 4: Snapshot of average temperatures (Australian Bureau of Meteorology).

		JAN	JUL
Meningie	MAX	26	14.9
	MIN	13.7	6.6
Tailem Bend	MAX	29.6	16.7
	MIN	13.9	5.5
Keith	MAX	29.8	14.9
	MIN	12.9	5.4

5.3.2 FROSTS

Frosts occur in the cooler part of the year, generally on calm, clear nights when there is little moisture in the air. The frequency of frost is dependent on local surface features including vegetation, soil moisture and topography.

Frosts have been recorded in all months from April to November, but May to August is the typical frost season. The average frosts per month during this period are four at Keith, three at Tailem Bend and two at Meningie. Frosts tend to be more common and more severe in drought years.

5.3.3 RAINFALL

Average annual rainfalls range from just over 300 mm in the north to about 500 mm in the south. The rainfall averages for selected townships are shown in Table 5.

Table 5: Rainfall (Australian Bureau of Meterology)

Township	Rain per annum	April to October rainfall	
	Av. (mm)	Av. (mm)	% of annual
Tailem Bend	381	265	70
Moorlands	363	255	70
Peake	397	287	72
Cooke Plains	382	278	73
Coonalpyn	457	340	74
Meningie	470	361	77
Narrung	414	318	77
Keith	471	352	75

Most rain falls during the cooler months, with over 70% falling from April to October. The seasonal autumn “break” can vary from March to June, with the long-term average being around the second week of May.

The district generally experiences some summer thunderstorms, which often spark wildfires. The highest daily falls across the district occur during the warmer months.

Figure 16: Weather station being installed at Tintinara (data available from http://se-aws.nrmspace.com.au/)

5.3.4 WIND

Strong recurring winds often occur during late July to early September, predominantly from the northwest to southwest quarter. Areas near the lakes and ocean experience long periods of windy conditions throughout winter and spring. These areas also receive south to southwest sea breezes during summer.

Gale force winds occur predominantly along the coast, but are also known to occur at inland locations such as Tintinara and Tailem Bend.

Figure 17: Wind erosion

5.3.5 EVAPORATION

Average annual evaporation in the Coorong District ranges from 1500mm in the south to around 1800mm in the north.

The average monthly evaporation values for the months of January, April, July and October are shown in Table 6.

Monthly evaporation exceeds rainfall in all months except one or two winter months in the South (Laut, 1977).

Table 6: Estimates of mean monthly evaporation.

Location	Monthly Evaporation (mm)			
	Jan	Apr	Jul	Oct
North	250	125	50	150
South	225	100	50	125

CLIMATE AND AGRICULTURE

Throughout the district, rainfall is the single most important influence on agricultural production.

Soil temperatures will remain high enough for reasonable germination of crops and pastures if the autumnal break arrives in April to May. A late or false break can hamper early germination, leaving areas prone to wind erosion in July and August.

Some areas experience poor pasture growth during the winter season due to low soil temperatures or water logging.

The Coorong District climate lends itself to growing winter cereals and legume crops, annual pastures and perennial deep rooted plants. Perennials have the advantage that they can tap into underground water sources and benefit from occasional summer rains.

Figure 18: Dryland salinity impacts on a Teatree swamp.

Crops can be severely affected by frosts, high temperatures, dry spells and strong winds in the spring. These conditions can significantly reduce crop yields and pasture or hay growth.

Strong cold south-easterly winds in winter can result in the loss of lambs, off shears sheep and calves. For this reason, lambing, calving and off shears sheep should be kept in sheltered paddocks.

Thunderstorms during the summer months can start wildfires, degrade dry feed, stimulate false breaks and encourage summer weeds.

High levels of evaporation can exacerbate areas impacted by dryland salinity. Good ground cover should be maintained, particularly during the summer months, to decrease evaporation rates.

5.4 PHYSICAL RESOURCES

5.4.1 GEOLOGY

The Coorong District is mainly low-lying Coastal Plains. Around the north-eastern margin of the district, higher topography was formed by the Marmon-Jabuk fault line. This Range marks the maximum inland extent of the sea almost one million years ago.

Across the coastal plains, the sea eroded away the deep Loxton-Parilla Sands which underlie the Mallee region to the north and east. In their place, a layer of limestone was deposited (the Coomandook Formation). As the sea retreated in response to uplift of the land surface, a series of coastal dune barriers were formed (Bridgewater Formation).

Underlying the limestone are interlayered sands, silt and clay with occasional brown coal layers (Renmark Group).

Granite outcrops rise above the surface of the Coastal Plain. These outcrops are part of the Padthaway Ridge, which separates the Murray Darling Basin from the Southern Ocean. The Padthaway Ridge intercepts considerable portions of the regional ground water flow, directing it towards the Murray Mouth.

Figure 19: A small damp hollow in a granite outcrop, filled with vegetation and lichen. This is a namma hole, which could have been used as a temporary water source by the Indigenous inhabitants.

5.4.2 SOILS AND TOPOGRAPHY

The district is largely a low coastal plain with a succession of overlying ancient calcrete capped calcareous coastal dunes (>14,000 yrs old). These dunes trend north-west south-east parallel to the modern coastline. The dunes rise to a maximum height of 170m above sea level.

Figure 20: Clay spreading to stabilise sandy soils is a common practice throughout the district

Coorong soils vary in composition, but are mainly sediments of marine origin. There are some areas of riverine or glacial sediments (deep within profile) and other areas formed on basement rock.

Whitish yellow sand hills and sand plains are common. These sands all have moderately to severely water repellent surfaces, are very infertile and susceptible to wind erosion.

Extensive areas of shallow loamy and clayey soils over calcrete occur both on the coastal dune rises and the inter-dune flats. This is underlain by older lacustrine limestone or clay sequences.

More details on soils of the district, including a map of land zones, their characteristics and agricultural limitations are provided in Appendix 1.

5.4.3 DRAINAGE

Surface run-off is minimal throughout the district, due to highly permeable sandy soils. Ancient drainage lines can be seen in some areas, but would have only held water after localised heavy storms, if at all. Areas of non-wetting soils can contribute to localised ponding between dunes.

During wet years, surface water flows north west along the interdunal corridors in the southern end of the district. There are photographs of people skiing over the flats west of Tintinara.

The Upper South East Dryland Salinity and Flood Management Program was engineered to reduce flooding within the project area, which includes the most southern areas of the Coorong District.

Figure 21: Floodwaters around a homestead during the 1989 flood.

5.4.4 GROUNDWATER

Coorong District groundwater resources are part of the Murray Basin. Originating from the high rainfall areas in western Victoria, groundwater moves approximately one metre per year in a westerly direction. Discharge from the system occurs to the lakes, the Coorong or to low-lying salt pans.

There are two distinctly separate groundwater systems under the Coorong District. These are the shallow or unconfined and the deeper confined aquifers.

A brief summary of the two aquifers is provided here, however more detail can be found in the Tintinara-Coonalpyn Land and Water Management Plan or the Tintinara Coonalpyn Water Prescribed Wells Water Allocation Plan, which specifically address groundwater management issues.

5.4.5 UNCONFINED AQUIFER

The salinity of the unconfined aquifer increases as the groundwater moves towards the coast. This is due to dissolution of salts from the surrounding soils and salt deposited by coastal winds, then carried downwards by infiltrating rainwater.

Local variations in groundwater salinity are common and result from locally enhanced recharge or discharge areas.

The unconfined aquifer is only suitable for domestic or irrigation use in the eastern part of the LAP area, where the salinity is below 3000 mg/L. Elsewhere, salinities are more suited to stock or not usable at all.

Appendix 2 contains a map of unconfined aquifer salinities and water table depths at a district scale.

5.4.5.1 CONFINED AQUIFER

Confined aquifers are groundwater resources that are kept under pressure by layers of clay or rock. In the Coorong District, the confined aquifer is a layer of sand or limestone, usually trapped between bedrock and a layer of coal rich clays, usually more than twenty metres thick.

The pressurised water in a confined aquifer can cause water to flow out of a bore under its own pressure. This is known as artesian flow. Prior to significant groundwater extraction, many bores on the coastal plain were artesian, however pressure reductions in the aquifer mean that this no longer occurs.

5.5 BIODIVERSITY

The Coorong District is 19% remnant vegetation. Although not all previous habitats remain, these areas still contain a wide array of biodiversity assets. Habitats represented include coastal dunes and wetlands though to nationally significant threatened flora and fauna. Protected areas include the Ngarkat complex, the Coorong National Park, Mount Boothby, Carcuma and Messent Conservation Reserves.

A map showing the distribution of remnant vegetation is provided in Appendix 3, along with a list of species of national conservation significance.

Figure 22: Orchids flowering at Boothby Rocks

5.5.1 WHAT IS BIODIVERSITY?

The diversity of our native plants and animals is part of our natural heritage. It feeds our curiosity and provides aesthetic benefits.

Beyond these less tangible aspects, remnant vegetation and biological diversity are essential for the maintenance of the earth's life-support systems.

Healthy functioning ecosystems maintain air quality, rainfall patterns, fresh water, soil formation, cycling of nutrients and disposal of wastes.

In a healthy patch of Mallee scrub, up to 90% of the biodiversity can be bacteria and fungi, 9% insects and only 1% vertebrate animals or photosynthesising plants.

This diversity brings with it a vast range of genetic material, potentially useful to a variety of industries including agriculture, medicine and gene technology.

A diverse array of animal and plant species means that our landscapes a resilient, able to recover from natural disasters such as drought, fire, flood, climate change, and disease.

5.5.2 BENEFITS TO AGRICULTURE

Agricultural properties with areas of native vegetation in blocks and corridors are often more productive than totally cleared properties. The retention of native vegetation modifies microclimates in a way which favours greater pasture and crop production and reduces stock losses during severe weather events.

Where biodiversity has been restored on previously degraded properties, some spectacular increases in farm productivity have been achieved. This includes revegetating habitat blocks and wetlands, along with the more obvious wind breaks and forestry blocks.

Soil structure and fertility are highly dependant on a group of poorly understood organisms that constitute soil biodiversity. Loss of these organisms can impact on soil water holding capacity, nitrogen fixation and other types of nutrient cycling.

Other benefits from native vegetation include lowered horticultural pest populations, increased populations of insect predators, lowered wind speeds, slowing flood waters, controlling erosion, increasing rainfall during El Nino periods, improved water quality and reduced dryland salinity impacts.

5.5.3 TYPES OF VEGETATION

The vegetation of the Coorong District is very diverse grading from typical "South East" vegetation (*Eucalyptus arenacea/baxteri* low woodland/low open forest or *Melaleuca brevifolia* wet open heath), to typical Mallee communities in the north.

Figure 23: *Melaleuca brevifolia* wet open heath (Mark Bachmann)

The District straddles both the South East and Murray Mallee botanical regions as defined by the State Herbarium. Biodiversity plans have been prepared for both regions and are available from nrmonline.nrm.gov.au. The Biodiversity Plans contain images and descriptions of all the major vegetation types within each region.

Figure 24: A typical Mallee community (Kay Richardson)

5.5.4 DISTRIBUTION OF REMNANTS

Approximately 54% of all native vegetation blocks are on private land. Of this, almost half is protected under a heritage agreement.

Native vegetation blocks on Crown Lands are generally protected under some form of protective conservation tenure.

Although a significant portion of remnant vegetation blocks in the District are protected, their condition varies greatly.

The size of each area affects its value as habitat. Larger areas are more likely to support healthy, diverse native animal. They have a lower risk of complete destruction due to a single catastrophic event. Small areas generally have a greater ratio of edges to centre, increasing impacts from adjacent land.

The proximity of vegetation areas to each other is also important, as isolation reduces animal movement between suitable habitat areas. This reduces opportunities for breeding, increases predation and the chance of localised extinction.

There are 1,754 blocks of remnant vegetation within the Coorong District (DEH,2004). Ninety-three percent of these are less than 100 hectares in size. However, they only contain 9% of total native vegetation.

The Coorong District LAP area contains three blocks of remnant vegetation which are greater than 10,000 ha, which contain 48% of the remnant vegetation.

The final 43% of remnant vegetation is contained in moderate sized blocks, varying from 100-10,000 hectares.

5.5.5 ISOLATED PADDOCK TREES

Large areas of the Coorong District were parkland or selectively cleared during the 1900s, leaving a significant number of isolated trees for stock shelter and to reduce erosion. These trees were generally the older, larger trees in each area of scrub.

Paddock trees are often the main surviving remnant of habitats that once occurred on heavier soils throughout the Coorong District. The advanced age of these trees makes them excellent habitat for hollow-dwelling birds and resting spots for insectivorous birds, which often consume agricultural pests.

Despite their value, these trees present a range of management issues within a modern agricultural landscape, as discussed within Section 7 of this plan.

5.5.6 WETLANDS AND FRINGING VEGETATION

Wetlands, riparian and littoral zones are some of the most productive and diverse ecosystems on earth. Often called the 'kidneys of the river system', they have many important roles including filtering and purifying water along waterways, reducing erosion on farms, providing protection from floods and fires, acting as breeding grounds and providing important drought refuges for many animals, as well as providing excellent sites for a wide range of recreational activities, including eco-tourism.

Riparian zones are the moist areas on the bank of a river or stream, where reeds and rushes grow. Littoral zones are areas on or near the shore of a lake or the coast. In the Coorong District, this includes the shoreline of the Lower Lakes.

There are more than 250km of freshwater riparian and littoral zones within the Coorong District. Although mainly within the Coorong National Park, there is also 300km of coastal and brackish to highly saline littoral habitats.

The Coorong, Lower Lakes and Murray Mouth (CLLMM) are listed as Wetlands of International Importance under the Ramsar Convention.

Other natural wetlands of interest include a multitude of small groundwater dependant and perched ephemeral wetlands in the southern part of the Coorong District.

Although there are no man made stormwater wetlands, there are a few created wetlands in abandoned clay pits or from drainage water discharge.

Wetlands in the southern part of the LAP region are managed in accordance with the appropriate water allocation plan. Some of the wetlands close to the drainage system are also subject to the Wetlands Reflows component of the Upper South East Dryland Salinity and Flood Management Plan.

Figure 25: The Coorong District has a diverse range of wetlands

PROTECTED MATTERS

The Coorong District contains forty-six threatened species and fifty-three migratory species, protected at a national level (Commonwealth Environmental Protected Matters Search Tool, 2011). These are listed in the Appendix 3, along with their specific threats.

There are forty-eight places on the Register of the National Estate and over one hundred state reserves. These areas include the Ramsar listed Coorong, Lower Lakes and Murray Mouth, the northern portions of the Watervalley Wetlands (Morella Basin), parts of the Ngarkat complex and the Murray Mouth, along with a range of aboriginal lands, conservation parks and reserves.

There are also thirteen invasive species that are considered a threat to biodiversity nationally.

An up-to-date version of this information can be generated at any time by accessing the EPBC Act Protected Matters Search Tool (environment.gov.au/epbc/pmst/index.html).

In addition to matters of Commonwealth importance there are a number of other species of state and regional significance as documented in the South East Biodiversity Plan (1999), the Biodiversity Plan for the South Australian Murray-Darling Basin (2001) and the National Parks and Wildlife Act 1972.

The SA Government Regional Species Conservation Assessment Project has prioritised threatened species within the SA Murray-Darling Basin and this prioritisation is currently underway in the South East. The results are available from the following link;

www.environment.sa.gov.au/Plants_and_Animals/Threatened_species_and_ecological_communities/Regional_and_significant_projects/Regional_Species_Conservation_Assessment_Project

5.6 HERITAGE

The physical remains of past events exist throughout the District, but particularly along the Coorong and Lower Lakes.

The history of the Coorong District is long and diverse, including the histories of the Ngarrindjeri, Ngarkat and European settlers. The comments here represent only a small portion of the information available, in an attempt to provide readers with a historic context to natural resource management issues. More detailed histories listed in the bibliography. Other information can be obtained from cultural and historic information organisations throughout the district.

If you find a site that you believe may be of aboriginal origin, please refer to the guidelines in the Appendixes, which contain contact details for the Aboriginal Heritage Branch.

5.6.1 NGARRINDJERI PEOPLE

The country surrounding the Lakes and Narrung Peninsula was originally occupied by the Ngarrindjeri, literally meaning 'the people who belong to this land'

The Ngarrindjeri are a nation of eighteen tribes or *lakinyeri* who speak dialects of the Ngarrindjeri language.

Ngarrindjeri is the name of the language group. However Europeans have applied it as a collective name for the *lakinyeri*.

Whalers and sealers had been visiting the South Australian coast since 1802. Although they often brought Tasmanian aboriginal women with them, they also raided local indigenous groups for women, using firearms to fend off retaliatory attacks.

The Whalers had two significant impacts on the Ngarrindjeri people. They familiarised them with firearms and introduced Smallpox.

The resulting Smallpox epidemic killed a large portion of the Ngarrindjeri. This had a significant impact on their cultural and land use practices

There were only 6,000 Ngarrindjeri at the time of European settlement (1836) due to the epidemic.

Tailem Bend (*Tagalang*) was a traditional trading camp where *lakinyeri* would gather to trade ochre, weapons and clothing. In the 1900s, Tailem Bend was assigned as a government ration depot supplying the Ngarrindjeri.

During the first fifteen years of European settlement, there were many battles between white settlers and the Ngarrindjeri.

In the early 1860s, a mission and school was established for the remaining Ngarrindjeri at Point McLeay, now known as Raukkan.

In the Ngarrindjeri Nation Yarluwar-Ruwe Plan (2007), it states that it was '*prepared by the Ngarrindjeri people to help government agencies, natural resource managers, researchers, industry and the wider Australian community to better understand and recognise rights and responsibilities to our Sea Country, including the lower River Murray, Lakes, Coorong, adjacent marine and land areas'*. The Ngarrindjeri Nation Yarluwar-Ruwe Plan documents a significant amount of the Ngarrindjeri culture and heritage.

The Ngarrindjeri vision for their Sea Country is based on the relationship between the Ngarrindjeri and their Sea Country which goes back to Creation. The river, lakes, wetlands/nurseries, Coorong estuary and sea have sustained the Ngarrindjeri culturally and physically for tens of thousands of years.

Figure 26: Cultural tour at the Wilderness Lodge

5.6.2 NGARKAT PEOPLE

The inland portions of the Coorong District were the home of the Ngarkat people, which consisted of a number of tribes. Each tribe had different living styles due to the different resources they relied on, and each tribe contained a number of family groups.

Local data on the Ngarkat people is limited. There are several registered Ngarkat sites of known national, state and local significance within the Coorong District. Sites of particular significance to people with kinship ties to this area include burial grounds and campsites. These sites often contain human remains, middens, hearthstones and evidence of stone tool making.

The Ngarkat people used groundwater soaks, rock holes and the roots of Mallee or Hakea as water sources. There are middens near Jimmy's well and other soaks, which provide evidence of regular use of these areas.

Landmarks, such as soaks and rock outcrops are often of religious or cultural significance to those with kinship ties to the land. There are cultural rules and taboos that relate to how and when different aboriginal groups can enter these areas.

Dreamtime stories teach each new generation about how this land was formed, and how to look after it. Most traditional uses of the land were disturbed when the area was cleared for agriculture. The Ngarkat people depended on a wide range of water sources, animals and plants that occurred in the area, which were adversely impacted by the activities of European settlers.

Hunt (2001) described a wide range of tradable assets that existed in the South East prior to clearing. The bark of stringy-bark trees was used to produce a string, which was made into dilly bags. She-oak and Bull-oak roots were used to make spears, and yakka resin was used as a glue.

The original inhabitants had complicated trading structures that evolved to suit the needs of each group. A number of trading routes ran through the Coorong District, from the Lake Hindmarsh through to the mouth of the Murray River. The trade routes existed for more than 10,000 years (Hunt, 2001).

The most traceable item traded into this area was stone for making tools. The Tatiara had some suitable stone, however the most common stone used in the South East came from Mount William (Victoria) along established trade routes. Other stones came from the Grampians, Riverland or Mount Gambier.

A survey in 1840 identified that there were less than 50 Ngarkat people within the Murray Mallee district (Nickels & Angel 2003). There are no Ngarkat people recorded as living within the Coorong District, however there are several people with kinship ties living in surrounding districts.

5.6.3 EUROPEAN SETTLEMENT

The first white settlers were pastoralists, many of whom were employed by large companies based in Adelaide.

Police Inspector Tolmer pioneered a track from Adelaide to the Mt. Alexander goldfields in Victoria and by 1852 Government wells and direction boards were erected along this route.

In 1857, areas of pastoral lease around Wellington and Lake Alexandrina were surveyed and blocks sold for agricultural settlement.

By 1868, the land from Wellington to Tailem Bend inland to the Tatiara and south to the Lakes and Meningie was surveyed and sold as sections.

In 1906, small blocks around Monteith and Narrung were opened up. Few larger pastoralists remained. Periods of drought, flood, crop diseases and bushfires made life challenging on smaller holdings.

Mice, foxes and rabbits were a constant battle for all landholders, even in these early days.

5.6.3.1 THE NINETY-MILE DESERT

Much of the Coorong District was part of the Ninety-Mile Desert. Although the rainfall was adequate, soils lacked trace elements, limiting agricultural potential. This area remained undeveloped for almost a century after the proclamation of the State of South Australia.

The country supported only low heath and mallee vegetation and existed as a barrier between the more fertile settled areas of the Lakes and Murraylands to the north and the Tatiara district to the south.

Small pockets of more productive country around Coonalpyn, Tintinara and Keith were settled in the 1870s. However, most of this land was not developed for agriculture until the 1950s.

Coastal areas had been developed for grazing. Sheep carried on this land had "coastal disease", which is a nutritional disorder. The carrying capacity of the land was very low.

Figure 27: Lands with larger trees were selectively cleared, as they were on more productive soils.

5.6.3.2 Trace elements

In the 1930s, the CSIRO began work on coastal disease of sheep with trials at Robe and Kangaroo Island. They concluded that the poor calcareous sands lacked cobalt and copper leading to deficiencies of these trace elements in the sheep's diet. Trials in 1941-1945 resulted in the development of cobalt pellets which were placed into the animal's rumen for a long term supply of cobalt.

During 1944-1950, Dr Riceman conducted many trials in the Keith district and demonstrated that in addition to superphosphate both copper and zinc were essential for good pasture production. Sub clover and Lucerne were the recommended legumes for the most productive pastures.

Riceman's findings enabled the development of the Ninety Mile Desert. Lime-pelleted inoculated lucerne was developed to enable germination in acid sands. This research also showed that additional trace element (molybdenum and cobalt) were necessary for better nitrogen fixation by Lucerne plants.

By the mid-1950s, the area of development had rapidly increased throughout the area, particularly by the AMP Scheme.

In the 1970s development slowed and only very minimal clearance has occurred since the introduction of the *Native Vegetation Management Act* in 1985 (now the *Native Vegetation Act,* 1991).

Figure 28: Stock and pastures are now provided with trace elements to ensure maximum productivity.

5.6.3.3 WATER REGULATION

Extraction of irrigation water from the Murray Darling Basin started in a significant way in the 1880s. By 1920, flows entering the Lower Lakes were reported as being significantly lower than prior to irrigation development. The lack of flow contributed to rising levels of salinity in the Lakes, which alarmed local farmers.

For ten years the Government was urged to build barrages to control water entering the Lakes from the Coorong. By 1939 barages at Ewe Island, Tauwitchere and Mundoo were underway having immediate impact. The higher water levels and less saline water in the Murray and Lakes allowed large scale irrigation of the reclaimed swamps and pasture lands to develop.

Figure 29: View of Lake Alexandrina from the barrages in June 2008.

5.6.3.4 LUCERNE DEMISE

During the late 1970s, the spotted alfalfa aphid (*Therioaphis trifolii*) invaded the Upper South East of South Australia. These aphids, along with wingless grasshoppers, a series of dry years and over-stocking, all brought about a significant decline in dryland Lucerne strands, which at that stage was the key pasture legume for the deep sands in the area. This lead to significant increase in groundwater recharge, contributing to dryland salinity issues.

Since this time, new aphid resistant varieties of Lucerne have been developed. However, due to the non-wetting nature of much of the sand and unpredictable weather conditions, re-establishment remains difficult.

6 CURRENT RESOURCE USE

Natural resources are highly valuable assets. Most land holders and land users in the Coorong District strive to use resources in a sustainable fashion, while deriving the maximum practicable income from their enterprises.

Figure 30: A newly germinated grain crop near Meningie

6.1 LAND USE

Land uses within the Coorong District are quite diverse, with areas of urban settlement, wetland, agricultural pursuits, native vegetation, sand dunes and cliffs. The table below is derived from some work done by DEH in 2004, as part of a biodiversity plan for the District.

The 'River, lake or wetland' category also covers swamps. The 'Other' category covers area of sand or cliff, which do not fit in the previous categories.

Table 7: Landcover estimates for the entire district (DEH 2004 & ABS 2006)

Type	Ha	%
Urban	180	<1
River, lake or wetland	47,730	5
Agricultural use	660,080	75
Native vegetation	172,180	19
Other	3,330	<1
TOTAL	**883,500**	**100**

6.2 PRODUCTIVITY

Agriculture has historically played a large part in South Australia's economy, and still does. Dryland crops are worth $3,094M in gross product to South Australia annually (ABS, 2006). Livestock or livestock products are worth $1,315M in annual South Australian gross product.

The Coorong District is a highly productive area. In 2006, the census identified that there was 660,080 ha of agricultural land. The table below is extracted from the 2006 ABS District Summary.

Land use	% of agricultural land
Irrigation	1.8
Grazing	80
Cereal crops	15
Non-cereal crops	5
Horticulture	0.5

Figure 31: Breakdown of agricultural land uses

It is likely that the area of cropping has increased since 2006, due to the expansion of canola, lentils and lupins. Horticultural areas were mainly olives, however small areas of other fruit, vegetables and flowers exist.

Total gross value of agricultural production was $162.3M in 2009. Crops accounted for approximately 40% of the total gross value. Livestock for meat production accounted for 36% and other livestock products (such as wool) approximately 24%.

Figure 32: Although less than 0.5% of the area, Olive oil production is contributing significantly to the district economy.

6.3 FISHERIES

Figure 33: Net fishing in the Lakes and Coorong Fishery.

The fishing industry in the Lower Lakes and Coorong has undergone huge impacts as a result of climate change and over allocation of water resources.

The fishery is reasonably diverse. Species caught commercially include: Carp, Black Bream, Callop, Mulloway, Bream, Flounder, Coorong Mullet, Shark and Cockles.

Approximately 2% of the Coorong District population is either employed by or directly services the local fishing industry.

There are currently 22 fisheries licences in the Lakes and Coorong Fishery. Despite low lake levels, the gross value of the catch in 2008/09 was $10.7m. Like most inland fisheries, the value of the industry is hard to identify, as annual catches can fluctuate by a factor of five times, depending on rainfall, water temperature and inflows.

With low freshwater inflows and high salinities, the industry is continuously under threat.

Figure 34: Low lake levels had a significant impact on fisheries (B Gunn, May 2008)

The Southern Fisherman's Association represents professional fishers in the Coorong and Lower Lakes area. The fishers have been very proactive over the last 13 years, working to improve their work practices, to increase the value of the industry by value adding and also to improve fish habitat in this unique area. Projects include fish passage through the barrages, Salt Creek drainage and harvesting, and marketing of introduced European Carp to minimise their presence in the area.

A healthy environment is obviously crucial to the longevity of the fishing industry.

The Southern Fisherman's Association have prepared an Environmental Management Plan for the Lakes and Coorong fishery, which aims to produce a formal, coordinated, industry response to fisheries related issues.

Awards received by the industry include;

First Multi-species, Multi-gear Community Fishery Worldwide to achieve Independent Marine Stewardship Council Sustainability Certification 2008

Winner, South Australian Fishing and Seafood Industry "Fishing for the Future" Environmental Award 2003, 1999 & 1997.

Winner, SA Great Regional Science & Environment Award 2002

More details on the Lakes and Coorong Fishery can be found at www.cooroongfishery.com.

Recreational fishing is a popular past-time in the Coorong and Lakes fishery. Visitors to the area can regularly observe recreational fishermen digging for baits such as polychete worms, razorfish and cockles.

Figure 35: Dredging of the Murray Mouth

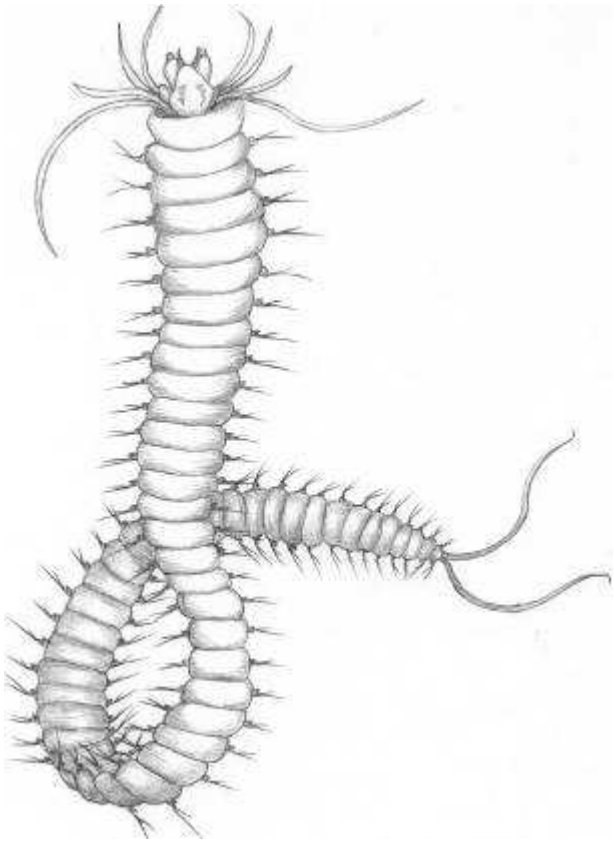

Figure 36: Polychete worms, in particular Bloodworms, are frequently used as a bait for saltwater fish species (Drawing by Cook & Coleman, Delta Environmental Consulting).

6.4 WATER USE

The Coorong District contains a range of potentially usable water sources, including groundwater, rainwater, recycled water, the River Murray and SA Water mains. Each of these water sources has benefits and restrictions to their end users.

Secure access to water is important to landholders, as it enables them to undertake more profitable activities than they otherwise would. Water security is also important from a natural resource management stand-point, as it enables landholders to commit to long-term natural resource management improvements.

Total water use within the Coorong District is not known and is likely to have changed significantly due to restrictions in water availability in the Lower Lakes. Practical estimations suggest that total water use for the district is likely to be in the vicinity of 70-90GL. Of this, the majority is used for irrigation, followed by stock water, recreational and domestic uses.

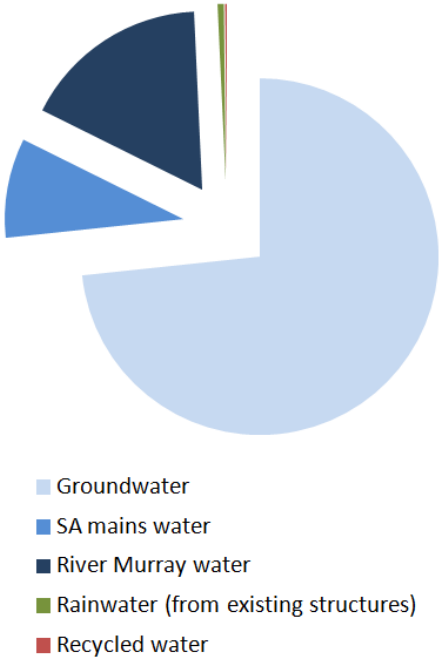

Figure 37: Water sources as a percent of total water available in the Coorong District

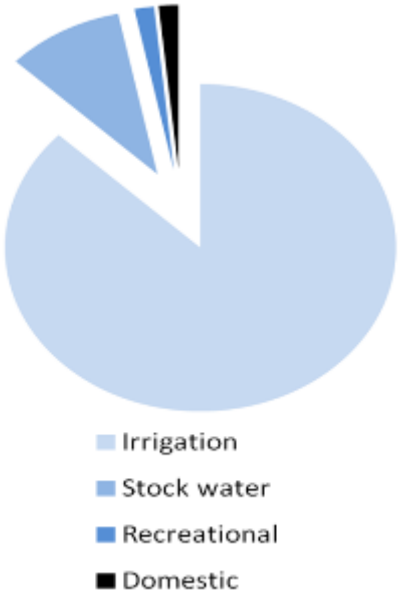

Figure 38: Water use as a percent of total water consumption.

Irrigation systems are quite diverse, including flood, sprinkler, pivot, traveller and drip systems. The most common irrigation systems within the District are pivot and border strip flood irrigation.

Many landholders in the Coorong District reduce their exposure to risk by using several water sources on each property. Unfortunately there are large areas of the District that only have access to one viable source of water and times when all available water resources are being impacted simultaneously.

Figure 39: Coorong District Council water recycling plant, installed 2010.

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Figure 40: Stormwater disposal basin at Tintinara

6.4.1 GROUNDWATER USE

Most usable groundwater is within Prescribed Wells Areas. The maximum permitted volume for allocation is approximately 65GL. The majority of this has been allocated, so purchase of an allocation is required to extract water.

Not all allocated water is used. Current licensed extraction from the unconfined aquifer in the Coorong District is 28 – 47 GL. Stock and domestic water could account for an additional 4GL, however this water use does not require a licence, so is not measured.

Significant areas of saline groundwater (generally >3500 mg/L or 5,000µS) may still be available for allocation. Small freshwater lenses are sometimes used for stock water, while evaporative mineral extraction is being explored between Cooke Plains and Ashville (SARIG,2011) .

Licensed confined aquifer use within the Coorong District is approximately 8-13GL. Stock and domestic use of confined aquifer water is estimated to be 1-2GL. Stock and domestic water users in the Coorong prefer unconfined water due to the cost of confined aquifer well installation, the variability of the resource and the sensitivity of the resource to over use.

More information on groundwater management allocation and licensing can be obtained from your NRM Board office or website.

6.4.2 RAINWATER

Although 2,000 – 3,000 GL of rainwater falls on the Coorong District each year, most evaporates, is transpired, is stored in the soil, or recharges groundwater.

The maximum potential rainwater yield from roofed structures in the district is estimated to be 0.2 - 0.5GL. This is slightly less than potential domestic water demand.

Being a rural area, most houses in the district have at least one rainwater tank, which is usually enough to supply drinking water for the dwelling. Some houses have enough tanks to supply their entire water requirement including surrounding gardens; however this is not usually the case. Rainwater is generally supplemented with lake, bore, greywater or mains water.

Figure 41: Coorong leak detection trial, 2008

6.4.3 SURFACE WATER

The main surface water resource in the Coorong District Council is the River Murray, including the Lower Lakes. This resource is fully allocated, so purchase of an allocation is required to extract water.

Analysis of 2006-08 aerial photography suggests that 2,000-4,000 ha was irrigated with river water, at least occasionally. Practical estimations suggest that 7-11 GL would have been required to sustain this area of irrigation.

Use of water from the Lower Lakes and the lower areas of the River Murray have decreased significantly since 2008-09 due to water access and salinity issues resulting in the sale of many water allocations.

Figure 42: Pivot irrigation of Lucerne occurs throughout the district, using both surface and groundwater sources.

6.4.4 RETICULATED WATER

SA Water extracts and treats River Murray water at Tailem Bend. Treated water is pumped into the Tailem Bend – Keith pipeline, which supplies mains water to parts of the Coorong and Tatiara Districts, including the townships of Meningie, Tailem Bend, Coonalpyn and Tintinara. The pipeline has a design capacity of 11.5GL per year, is 143km long and has over 800km of branch mains.

In 2009 the pipeline was extended to cover the Narrung and Raukkan townships and the areas around the Lower Lakes that had traditionally drawn water from the lakes. This was required due to high salinity levels and a lack of access.

Each year, 2-3 GL of reticulated water is sold within the Coorong District. Of this, 80-90% is used to water stock. The remainder is used to water parks, gardens and for potable purposes.

Recent price increases for reticulated water mean that landholders are trying to reduce their reliance on this water source. This reduced reliance is most likely to come through reduction of wastage and development of alternative water supplies.

6.4.5 RECLAIMED WATER

There are a number of water reclamation projects being undertaken within the Coorong District Council. Three sewage treatment and reuse projects are scheduled to come online in 2011, which will recycle 0.144 GL of sewage per year in Meningie, Tailem Bend and Tintinara

A portion of domestic dwellings use temporary greywater systems to irrigate portions of the surrounding garden. Permanent greywater systems are less common; due to the approvals processes required but may become more popular with the increasing costs of mains water.

Another potential type of reclaimed water within the Coorong District is water from the Upper South East Drainage Scheme, however the quality and quantity of this potential water source is not known.

Figure 43: Reclaimed water is now used on the Meningie oval.

7 RESOURCE MANAGEMENT CHALLENGES

Challenges to managing natural resources within the Coorong District have been grouped into seven major categories within this plan;

- Maintaining soil health
- Sustaining biodiversity
- Managing pest plants and animals
- Balancing water cycles
- Reducing air pollution
- Adapting to climate change
- Supporting social infrastructure

Each of these challenges are discussed within this section. Details of actions to address these challenges are included in the Our Approach section. Further information on how to manage these issues at a farm level is contained within the appendixes.

7.1 MAINTAINING SOIL HEALTH

7.1.1 WIND EROSION

The potential for wind erosion is always present in the Coorong District, due the dominance of highly mobile sandy soils. Exposed sandy soils, combined with drier conditions and soil disturbance provide the greatest potential for wind erosion issues to develop.

Other factors influencing wind erosion potential are:

- soil structure or water repellence
- local wind conditions
- topography of land, and
- land management.

Wind erosion effects can most obviously be seen in the formation of drifting and steep sided sandhills, flats that have been eroded down to the subsoil, sand blasting of crops, and damage to fences, roads, and railways. Less obvious is the removal of fine particles, containing nutrients, clay and organic matter.

During a dust storm these nutrient enriched dust particles are blown up into the atmosphere and lost forever. This reduces fertility and hence productivity of soil, therefore making it even more prone to erosion, because it will grow less cover.

Loss of fine particulates reduces the soils capability to store carbon. Less soil carbon leads to less vegetative growth, which reduces carbon dioxide sequestration in these soils.

Table 8 shows the high losses in fertility caused by wind erosion and the effect of different management practices on soil cover and soil loss.

The Department of Environment and Natural Resources (previously DWLBC) has been undertaking telephone surveys and visual erosion protection surveys since 2000. The Coorong District had an improving trend in protection from erosion between 2002 and 2010, with 10% more days of protection.

Since 2000, the proportion of landholders using long fallow has significantly reduced, accompanied by an increase in use of stubble retention, no-till and zero-till practices.

The sections below discuss some of the contributing factors for wind erosion.

7.1.1.1 SURFACE COVER

Bare ground is very prone to wind erosion. The most effective way to prevent wind erosion is to keep a protective cover of vegetation on the soil surface. This can be achieved through retaining stubble or sustainable grazing management.

Table 8: Effects of exposing Class III loamy sands to 75 km / hr wind for 1 minute (Pinnaroo Wind Tunnel Research, 1993)

Site and preparation	Cover (%)	Erosion (t/ha)	Nutrient loss	
			Total N (kg/ha)	Total P (kg/ha)
Cultivated pasture	15	9.4	1.31	0.17
Vetch stubble, Blade ploughed and grazed	39	4.4	0.74	0.1
Blade ploughed pasture	60	0.7	0.21	0.02

7.1.1.2 SOIL TYPE AND STRUCTURE

Sandy soils have the highest potential for wind erosion. These soils lack cohesion because of the low content of the clay and organic matter. Many of the sands in the district are water repellent also increases wind erosion potential. Other soil types have lower wind erosion potentials; however they will still erode if managed inappropriately.

7.1.1.3 RAINFALL

During summer and drought periods, the potential for wind erosion is higher due to decreased vegetative cover. The growing season (April-October) rainfall is a critical factor, as this has a large influence on the total amount of vegetative material produced by crops and pasture.

7.1.1.4 WIND

Wind velocity, direction, duration and seasonal occurrences have an influence on erosion potential. Strong south westerly winds in July to September can cause significant damage, particularly where crops have been sown late and not into stubble.

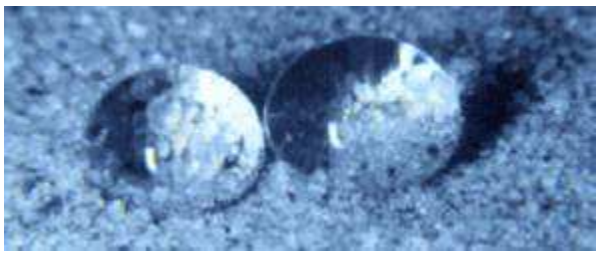
Figure 44: Prevention is the best cure for wind erosion. Once a blowout like this starts, it can expand rapidly.

7.1.1.5 MANAGEMENT OF THE LAND

Poor management practices, including high stocking rates, uneven grazing pressure, excessive cultivation, uncontrolled rabbits and stubble burning can all leave soil bare and therefore prone to wind erosion and weed invasion.

7.1.1.6 TOPOGRAPHY

Land which is more exposed due to height, steepness, a westerly aspect or has a lack of trees, has a higher potential for wind erosion.



7.1.2 WATER REPELLENCE

Water repellence is caused by waxes, produced by decaying organic matter, which coats soil grains. These waxes prevent water penetrating or wetting the soil when it is dry.

Water repellence is common in sandy soils throughout the district. Unless managed well, it makes pasture establishment difficult and reduces the germination of winter-producing annual pastures.

Non-wetting sands are fast drying, with very low fertility. Factors that influence water repellence include soil type, temperature, rainfall, time since clearance, cultivation type or frequency, organic matter and land use.

In areas subject to water repellence, rainfall remains on the surface, evaporating or draining across the surface into depressions. This results in uneven wetting and erosion. Annual plants germinate in the depressions, but unwetted areas stay bare until enough rainfall is received to wet these areas up.

Water repellent soils promote germination of weedy grasses (including Silver grass and African Love Grass) and broad leaved weeds (for example Capeweed). This provides them with a competitive advantage over later germinating plants, which are usually more desirable (for example lucerne and veldt grass).

According to DENR telephone surveys of land managers (2000-2008) there has been a gradual increase in use of techniques to manage water repellent soils.

The most common techniques are clay spreading (36%) and modified tillage (33%). Soil wetting agents

and clay delving were less frequently used (both 11%) mainly due to limited applicability or cost.

7.1.3 SOIL CARBON DECLINE

Soil carbon is generally sourced from fine organic matter in the soil. This organic matter is formed by the decomposition of plant and animal residues by micro-organisms. Soil carbon is important because increases soil fertility, contains almost all of the nitrogen reserves in the soil, along with many other essential trace elements.

The percentage of soil carbon is an indicator of overall well being and fertility of the soil. In areas of low clay content, this fine (often humic) organic matter is also the main soil binding agent.

The amount of carbon that can be contained within soil is limited by soil type and rainfall. Higher rainfall (>500mm) areas generally contain higher soil carbon due to decreased erosion and increased microbial activities. Soils with a high sand content have limited carbon storage potential, however very small increases can make significant differences in crop yields.

Organic carbon content of agricultural soils has recently become data of public interest, due to the advent of the Carbon Farming Initiative.

In the Coorong District, most soils have organic carbon levels of less than 1.5% (McCord, 1994. pers. comm). The Caring for Our Country Business Plan 2012/13 shows that the Coorong District is dominated by areas which will receive a moderate benefit from increased concentrations of soil organic matter.

Most agricultural soils contain less soil carbon now, then when they were initially cleared. Organic soil carbon declines over time, if not maintained. Good farm practice can stop the decline and in some cases actual gains can be achieved.

The effects of a decline in organic matter include increased wind erosion, reduced nutrient or water holding capacity, reduced productive capacity and reduced carbon dioxide sequestration.

Landholders should monitor their organic carbon levels as a regular practice to determine the long term trend of the condition of their land.

Table 9 and Table 10 provide an indication of the amount of organic matter generally contained and achievable levels for the main soil textures within the district.

Table 9: Total soil nitrogen and organic carbon in the top 10cm of fertile soils (Murray Mallee Soil Conservation Board District Plan, 1994)

Texture	Organic carbon		Total nitrogen	
	%	kg/ha	%	kg/ha
Sand	0.75	11 200	0.06	900
Sandy loam	1	15 000	0.12	1 800
Loam	1.75	26 200	0.15	2 250
Clay loam	2.5	37 400	0.2	3 000

Table 10: Soil carbon thresholds, extracted from The Soil Book - Representative Soils of the Upper South East (2011)

Texture	Organic carbon (Walkley Black)	
	Low	High
Sand	<0.5	>1.0
Sandy loam	<0.7	>1.4
Loam	<0.9	>1.8
Clay loam	<1.2	>2.0

The main causes of organic matter decline across the district are cultivation, wind erosion and burning of crop residues.

Cultivation accelerates the decay of organic matter by aerating the soil. It changes the soil fauna composition or distribution and exposes more organic matter to microbial attack.

Wind erosion and burning result in the physical removal of organic matter. While the effects of burning can be damaging in the long term, erosion can have severe effects in the short term.

7.1.4 WATER EROSION

There are two main types of water erosion of concern within the Coorong District. The first is lakeshore erosion, caused by wave movement. The second is gully erosion, caused by non-wetting soils and high intensity summer rainfall events.

7.1.4.1 LAKESHORE EROSION

Lakeshore erosion was and is still a potential problem around the much of Lake Albert and Lake Alexandrina, due to highly erodible Poltalloch soils around the lake margins. Erosion is likely to happen when the lake levels are over 0.5m AHD.

For many years the Lakes have been managed as water storage rather than a wetland, being surcharged prior to summer to allow for extractions and evaporation.

Lake levels need to be managed to replicate the natural seasonal variation of water levels in a wetland. This will reduce the chance of erosion, increase shallow water habitat, allow establishment of lakeshore vegetation and build ecological resilience for future dry periods.

Off-shore reedbeds reduce wave action, so are critical to preventing lakeshore erosion. Without off-shore reeds, increasing shoreline vegetation or excluding stock are ineffective.

During the low lake levels experienced in 2007-10, the Coorong LAP program (in conjunction with the Goolwa to Wellington LAP) has overseen the fencing and revegetation of a majority of the lake edge. This revegetation has included the planting of reeds to reduce lakeshore erosion.

This revegetation will require an extended period of weed control due to the historic dominance of *Kikuyu* and *Paspalum vaganartum* around the lakes.

7.1.4.2 GULLY EROSION

In the Coorong District, gully erosion usually only occurs when heavy summer rains fall on water repellent sandy soils.

During these heavy rainfall events, rainfall pools into small depressions. As these depressions overflow, small rills are created. In water repellent sands, these rills rapidly become gullies, as shown in the photograph below.

Figure 45: Gully erosion in well managed pastures after heavy summer rains

7.1.5 OTHER SOIL MANAGEMENT ISSUES

7.1.5.1 MATCHING LAND CAPABILITY TO LAND USE

Land capability refers to the capacity of the land to support a particular use without degradation of natural resources, and the ability of the land to sustain that use in the long term.

Although this principle sounds simple, land capacity varies significantly from property to property and even from one section of a paddock to another. Managing this level of variation can be challenging.

Where land use and land capability are not matched, steps need to be taken to restore the balance.

7.1.5.2 SALT-AFFECTED SOILS

In 1995 there was approximately 28,000 ha of salt-affected land within the Coorong District, suitable for saltland agronomy.

The area of salt-affected land does not appear to have increased or decreased significantly over the last sixteen years. Although on-ground works would have some effect, this slowing of dryland salinity processes is likely to have been the result of a series of dry years.

Landholders have mixed observations on the spread of salt-affected soils. A detailed analysis using Obswell data and aerial images or a survey of landholders is needed to confirm long term trends.

Telephone surveys by DENR / DWLBC (2000-2008) in the South East NRM region confirm that most salt-affected landholders are undertaking action to mitigate it.

The most popular methods for treating salt affected soils were salt tolerant pastures, installation of drains, perennial grasses and planting trees. Lucerne was less popular however a significant increase in respondent use of Lucerne occurred in 2008.

Productive use of saline lands or revegetation with native species can increase soil carbon, lower areas of shallow groundwater, reduce wind erosion, help preserve nearby remnant vegetation and improve groundwater quality.

7.1.5.3 SOIL PH (ACIDITY AND ALKALINITY)

The Coorong District contains soils that measure both acid and alkaline on the pH scale. Acidity is more likely associated with deep sands and sands over clay in the south and west of the area, whereas the heavier soils around the Coomandook, Coonalpyn and Peake are often alkaline. Where salinity is a problem or under intense irrigation, sands can also become alkaline.

Factors which can result in a lowering of pH include nitrogen fixation by leguminous pastures, particularly subclovers, organic matter build-up and the use of traditional phosphatic, high analysis and nitrogeneous fertilisers. These processes are not always slow and may take less than several decades to occur.

Higher rainfall areas with siliceous sands that contain little clay, low buffering ability and no free lime are generally more likely to become acidic over time.

Telephone surveys undertaken in the South East NRM Region (DENR / DWLBC, 2002-2008) suggest that land manager knowledge on the contribution of fertilisers to soil acidification is low, with less than half of affected landholders identifying nitrogen fertiliser or product removal as a direct cause. Approximately half of land managers incorrectly identified super-phosphate as a direct cause of soil acidity.

According to the DENR survey, most land managers are familiar with the use of lime to control acidity, however many land managers incorrectly identified gypsum as a treatment for this issue.

7.1.5.4 SOIL STRUCTURE, BIOTA AND FERTILITY

Soil structure and fertility problems in the Coorong District are variable and depend on a range of factors such as the basic soil type, crop, rotational history, fertiliser practices and grazing pressure.

Soil structure is defined as the way soil particles are bound into aggregates. Soil structural problems can be in the topsoil or they can occur in the lower layers.

Plant species	pH range (water)	Plant species	pH range (water)
Lucerne	6.0 – 8.5	Sub clover	5.2 – 7.5
Strawberry clover	6.6 – 8.5	Annual medic	6.5 – 8.2
Lupins	5.0 – 7.0	Field peas	6.5 – 8.2
Faba beans	7.0 – 8.5	Wheat	6.0 – 8.0
Oats	4.5 – 7.5	Barley	6.0 – 8.5
Canola	6.5 – 8.0	Grapes	6.5 – 8.0
Potatoes	4.5 – 7.0	Phalaris	6.0 – 8.5

Table 11: pH preferences for various crop and pasture species.

Good structure allows the free movement of air, water and nutrients, enhances germination and emergence of plants and allows healthy growth. Poor structure results in slow rainfall infiltration, waterlogging, stunted root growth, erosion risk and reduced plant production.

Soil fertility decline is an issue on lightly textured soils, which are inherently low in key nutrients and trace elements.

Application of phosphorus to grazing land (6-10 kg of P per ha per annum) promotes the growth of legumes which build up the nitrogen and organic matter content of the soil. Under cropping conditions application rates of phosphorus and nitrogen fertilisers should be determined by estimating the crop yield and taking into account the previous paddock history.

The application of fertiliser to degraded pastures on water repellent sands is economically questionable. The alternative is likely to involve clay spreading or delving (to reduce nutrient leaching) and the establishment of new pasture cultivars.

Soil fertility is also related to animal production. Copper, cobalt and selenium are all common deficiencies in Coorong soils. These are often provided as direct supplements to sheep and cattle.

Nutrients are lost to the system by product removal, leaching and fixation in the soil. Table 12 illustrates how much phosphorus is removed by selected enterprises.

Table 12: Approximate quantities of phosphorus removed by the removal of product.

Product	Kg of phosphorus
Hay (5 tonnes)	
Cereal or grass hay	8
Lucerne hay	12
Grain (2 tonnes)	
Wheat, barley oats	6
Field peas, lupins	8
Canola	10
Wool (5 kg greasy)	0.02
Milk (1000 litres)	1.0
Meat (50 kg liveweight)	0.4

Maintaining fertile soils ensures more production can be obtained from less land and increased plant growth reduces rainfall recharge while increasing carbon sequestration.

Over-application of fertilisers may cause pollution of surrounding water bodies, decreased soil biota, increased greenhouse gas emissions, detrimental effects to native vegetation and flow-on effects to human health.

Research by the CSIRO and other research authorities state that healthy populations of soil microorganisms (bacteria, fungi, insects, earthworms etc) can have a positive influence on paddock nutrient availability, soil carbon content, soil structure and moisture holding capacity.

Farming practices have a direct influence on the health or balance of microflora and fauna in our soils, which in turn impact on natural resource management. Some practices that are frequently mentioned as having a possible influence on soil biota include tilling, fertilisers, chemical use, stocking rates, use of rotational grazing, crop rotations, burning, stubble retention, liming and compaction.

The health of soil biota is one of many management concerns for landholders. Management decisions are dependent on a range of variables including human health, personal attitudes to risk, past experience, climate, site specific issues, financial and sustainability aspects.

Significant research has gone into how best to maintain the biological health of soils without causing undue risks to other aspects of land management. General recommendations include;

- Use cropping rotations to retain organic matter and diversify nutrient sources for soil biota.
- Maintain soil fertility by frequent testing and appropriate fertiliser application.
- Retain stubble to improve soil organic matter.
- Minimise cultivation to retain food sources for soil biota.
- Lime acidic soils to provide a favourable pH for soil microbes and earthworms.
- Reduce compaction by limiting traffic and avoiding overstocking.

Figure 46: Farm machinery has become larger and more complicated, often allowing the landholder to apply fertilisers and wetting agents while sowing into stubble. This reduces the number of passes required, reducing costs and soil compaction.

7.2 SUSTAINING BIODIVERSITY

7.2.1 BIODIVERSITY DECLINE

Only 19% of the districts native vegetation remains, the rest having been cleared for other land uses. The consequences of native vegetation clearance include:

- exposure of the soil to wind and water erosion;
- increased flooding and waterlogging;
- dryland salinity due to increased recharge;
- reduction in the diversity and abundance of native flora and fauna;
- reduced carbon dioxide sequestration
- changed rainfall patterns.

In addition to its role in prevention of land degradation, native vegetation is highly valued for shelter to stock, crops and pastures. The benefits include:

- reduction in cold and heat stress in livestock,
- provision of shade;
- increased crop and pasture yields due to reduced wind, reduced moisture loss, increased insect predators and increased winter warmth.

Other industries also rely on the quality and quantity of remnant vegetation within the District. Beekeepers rely on native remnants to provide a balanced, pesticide free source of nectar and pollen for their hives. Large areas of remnant vegetation are used for native seed collection and ecotourism.

Although the area of remnant vegetation has not changed significantly since the initial LAP document, the quality of smaller unfenced remnant vegetation blocks has declined. As native vegetation declines in quality, its ability to provide beneficial services reduces.

7.2.2 SELECTIVE CLEARANCE

Although no longer occurring, the initial clearance of the Coorong District was selective, clearing habitats that occurred on heavier soils first.

The almost total absence of these habitats has a disproportional affect on biodiversity, despite the large areas of other vegetation types remaining. The selective clearance of heavy soil habitats has flow-on effects on other habitat types, due to reduced pollination, nesting sites or seasonal food sources.

7.2.3 PADDOCK TREES

Between changes to their environment and natural succession most paddock trees are in decline. This decline is exacerbated by borers, lerps, compaction, erosion, trampling, pH modification of surrounding top soils, fertiliser or herbicide use and disease.

Although these trees were originally left for agricultural reasons, paddock trees now present a challenge for landholders who wish to use larger machinery, pivot irrigation or precision agriculture. Many landholders are now seeking to remove these trees, replacing them with younger, better located trees along fence lines, in revegetated blocks, on sand rises, around waterlogged soils or in the corners of paddocks.

Finding appropriate ways to manage, work with and ensure succession of paddock trees is an ongoing issue for both landholders and the Native Vegetation Council.

7.2.4 CLIMATE CHANGE

Climate change is a looming and largely unquantified risk to biodiversity within the Coorong District. In an ideal world, changes would occur slowly, so most species the time to colonise new and more suitable habitats or evolve to suit the current climate. Unfortunately, current changes in the Australian climate appear to be step-wise, meaning that changes occur suddenly then stabilise for a period of time.

Limited connectivity between areas of remanent vegetation is currently preventing the migration of species into more suitable habitats. Small isolated remnant vegetation block sizes contain small genetic pools, reducing the ability of species to evolve.

Figure 47: Rocky outcrops provide cool, damp refuges for species during periods of drought.

7.2.5 WEED INCURSION

Weeds or introduced pastoral incursions into areas of native vegetation can be a major biodiversity issue. These species rapidly colonise areas of bare soil, preventing recruitment of native plants. Weeds compete with native species for light, water and nutrients. In some cases, twining weeds such as bridal creeper can physically smother established native vegetation.

7.2.6 INAPPROPRIATE FIRE REGIMES

The Coorong District is made up of many large public and private remnant vegetation blocks. These landscapes require an appropriate fire regime to maintain functional plant and animal populations.

For some species, such as orchids and Banksias, regular fires are required to allow them access to sun, bare soil and nutrients. For other species, such as Mallee Fowl and Tree Creepers, fire frequencies of more than one every thirty years can significantly reduce habitat value.

Figure 48: Native orchids regenerating after a fire.

Animal and plant control is critical after a fire. Fires encourage the dominance of coloniser species, which include most pest plant and animal species. Weedy plant species can radically increase fuel loads, meaning that future fires will burn hotter, faster and more frequently if these species are allowed to dominate.

Fire Management Plans exist for all major Conservation Reserves and National Parks within the Coorong District. These plans are available from your nearest DENR office.

Landholder interest in prescribed burning on private property is gaining momentum. However, it is important to be aware of the Native Vegetation Act 1991, as burning is considered clearance if it is not for ecological purposes or is a hazard reduction burn more than 20m wide around a structure. For further information regarding prescribed burning on private properties contact the Department for Environment and Natural Resources.

7.2.7 INCIDENTAL CLEARANCE

Under the Native Vegetation Act 1991, clearance of native vegetation is prohibited. However minor clearance which is ancillary to normal farming can be approved by the Native Vegetation Council if a significant biodiversity benefit can be proven.

Unfortunately, some illegal clearance (intentional and unintentional) still occurs within the district. The Native Vegetation Council keeps an eye on this kind of activity by regular aerial photograph analysis, prosecuting offenders as deemed appropriate.

7.2.8 WETLAND MANAGEMENT

Threats to wetlands within the Coorong District include disruption of flow paths, salinity, groundwater rise, acid sulphate soils, overgrazing, soil compaction, land clearance, reduction in water quality, introduced species and a lack of community awareness.

Over the past ten years the major threat to the Coorong and Lower Lakes has been a lack of River Murray flow. Other specific threats to the Coorong and Lower Lakes include resource management changes over more than a century. These changes include building the barrages, tourism and recreation pressures, lakeshore erosion and European carp.

7.3 MANAGING PEST PLANTS AND ANIMALS

7.3.1 WEEDS

During consultation for this plan review, weeds were the second most important issue, after water security.

The spread of weeds across agricultural zones is an issue that requires regional control and compliance, which is the NRM Board's role.

Weeds are spread in many different ways. Identification of how a weed is spread can help to determine what preventative measures can be taken.

Some of the common methods of weed spread include bringing them in with farm inputs (seeds, stock feed, stock), bringing them in on machinery or humans, movement of animals or by wind and water.

Some weeds grow from cuttings or roots, so spread due to cultivation. Many species were introduced into gardens or onto farms and have invade other areas.

7.3.2 PROCLAIMED PEST PLANTS

Proclaimed plants are those plants species that the NRM Board deem to be significant weeds of agriculture or the environment. This is based on assessment of the plant's potential to reduce agricultural production or affect conservation values.

The Coorong District covers parts of two NRM Regions, each with their own list of proclaimed plants. To reduce the confusion of several lists, we have provided the state list of proclaimed plants (with scientific names) in the appendixes.

Table 13 provides a list of proclaimed plants that are known to occur in the Coorong District with details of their occurrence.

Due to financial constraints, it is not possible to address all proclaimed plants. The NRM Boards have developed a prioritisation process for the best use of limited resources. These priorities change, depending on the infestation level and current control method for each species.

A current list of plants that legally need to be controlled in your area can be obtained from your nearest NRM Board Authorised Officer.

Why are some plants weeds?

The definition of what is and what is not a weed is subject to interpretation. Any plant can be considered to be a weed if it is growing where it is not wanted. Justifications include;

- Competition with desirable plants.
- Contamination of produce.
- Harvesting problems.
- Poisoning of livestock.
- Stock injury.
- Harbouring of pests and diseases.
- Invasion of native vegetation.
- Soil erosion.
- Fire hazard.
- Allergic reactions.
- Loss of amenity.
- Allelopathic effect of some weeds.

Declared plants are plants that are significant weed threats to our State's primary production industries, natural environments and public safety. They have legal restrictions on their trade and possession.

7.3.3 OTHER PEST PLANTS

Other plants are species that have not been "proclaimed" under the Natural Resources Management Act 2004 or which are proclaimed but do not require control under this Act. Although not considered a high priority by the NRM Boards, these species impact on agriculture, biodiversity and communities. They are considered pest plants by landholders in the District.

Pest plants can include exotic species which are well adapted to the environment or native plants from another state or region, which have spread and become over abundant.

Table 13: Proclaimed weeds within the Coorong District

Common name	Comments
Golden Dodder	Previous outbreaks controlled
Khaki weed	Small existing infestations
Innocent weed	Very high priority
Silver Leaf Nightshade	Small infestations
Cut leaf Minonette	Small infestations
Caltrop	Wide spread
One-leaf Cape Tulip	Scattered patches
Three Corner Jack	Wide spread
False Caper	Very wide spread
Bladder Campion	Scattered sites
African Boxthorn	Mainly around Meningie and Nurrung but scattered elsewhere.
African Lovegrass	Mainly between Keith, Tintinara and Tailem Bend.
Salvation Jane	Wide spread but in decline.
Horehound	Wide spread
Lincoln Weed	Northern areas
Yellow Burr Weed	Wide spread
Skeleton Weed	Wide spread
Bone seed	Mainly among native vegetation
Bridal Creeper	Mainly among native vegetation
African Rue	Small patches
Creeping Knapweed	Slow to establish. Small patches.
Hoary Cress	Isolated outbreaks
Coolatai Grass	Isolated outbreaks
Bathurst Burr	Mainly lake front
Artichoke	Heavy clay areas

There are a number of unproclaimed pest species, which are causing;

- Economic costs such as crop yield reductions and increased control and management costs
- Stock injuries or poisoning
- Loss of biodiversity and ecosystem function
- Increased fire risk.

Common unproclaimed pest plants in these regions include Onion weed, Star thistle, African Daisy and Aleppo pine.

Other species of interest are alert weeds, such as Chilean Needlegrass, which does not occur in the area, however it is likely to invade from other regions.

7.3.3.1 SILVER GRASS

Silvergrass (*Vulpia fasciculate*) is a major weed in farming and grazing systems throughout the district. Silvergrass became widespread in South Australia following the decimation of perennial Lucerne pastures by the spotted alfalfa aphid in 1978-79. It has persisted to become a serious impediment to agricultural and grazing enterprises.

The economic impact of this species significantly reduces the profitability of Merino wool, reducing gross incomes by 24.3% in areas of medium to heavy infestation. Prime lamb producing enterprises reported that gross income reduced by 28.2% due to the influence of Silvergrass. Cattle-based systems reported a decline in gross income of 13.5% due to Silvergrass infestations (Matthews, Hillier and Krause, 1998).

From a natural resources perspective, Silvergrass dominated pastures are 20-50% less productive than other pasture types. They generally have a lower water use than more productive pastures, allowing aquifer recharge, which exacerbates dryland salinity issues.

7.3.3.2 GARDEN ESCAPES

Weeds are plants growing where they aren't wanted, and they aren't just sour sobs and thistles! Some plants escape from gardens and become serious environmental weeds which pose a major threat to the health and value of our natural environments.

Plants that cause problems often originate from regions with similar climates. Thriving in similar conditions, they out-compete local natives as they don't have the pests and diseases that controlled them in their original environment.

Impacts of garden escapes include:

- They compete with local native plants
- Can alter soil conditions.
- Clog up waterways and effect water quality
- Alter coastal dune shape.

Garden escapes are costly to control and take resources away from other important issues.

Common garden escapes in the Coorong District include Gazanias, Diosma, Cotoneaster, Scabiosa, Pampas grass, Blackthorn, Asparagus fern and English broom.

If you have any questions, contact your local NRM Authorised Officer or NRM Board office.

7.3.4 PEST ANIMALS

Rabbits, hares, foxes, deer and other pest animal species impact significantly on native vegetation and the productivity of agricultural lands. They also carry diseases. Most pest animal species are declared under the Natural Resources Management Act (2004).

RABBITS AND HARES

Rabbits were introduced into Victoria as a game animal in 1859. They spread rapidly across the continent, with devastating consequences to ground vegetation and the land generally.

Rabbits have done and continue to do a large amount of damage throughout the Coorong District. Damage done by rabbits includes: stripping of vegetation cover, leaving land vulnerable to soil erosion, and allowing weeds to invade; yield losses in crops and reduced stock carrying capacity in pastures due to gazing by rabbits, wind erosion and weed invasion; destruction of seedlings, making revegetation difficult.

The introduction of Myxomatosis and Calicivirus both had a significant impact on rabbit populations. This can be seen in the age cohorts of Native pines, which are selectively grazed by rabbits. Unfortunately, the rabbit populations have built resistance to these diseases.

Figure 49: The sandy soils and scattered remnant vegetation of the Coorong District provide ideal rabbit habitat.

OTHER PEST ANIMALS

Since the initial Coorong District Local Action Plan, a number of other animal species have become increasing prevalent. The increasing scope of the LAP document has also highlighted pests which were not appropriate within the initial document.

Other vertebrate pest animals within the Coorong District now include foxes, mice, deer and goats. Invertebrate pests include snails and locusts.

7.3.5 THE IMPACTS OF MANAGEMENT

Control of weeds and pests can also have an adverse impact, so infestations are best prevented or treated when control measures are minimal.

Sometimes in heavily weed infested areas, control of the weeds can lead to increased recharge and erosion impacts.

Excessive spray drift can impact on biodiversity and human health. Care must be taken when spraying weeds or pest invertebrates, to ensure that overspray does not impact on nearby residences or areas of remnant vegetation. If in doubt, find a less harmful manner of control, consult the label of the product being used and speak with your agronomist or NRM Board Authorised Officer.

7.4 BALANCING WATER CYCLES

7.4.1 WATER QUALITY

Deterioration in water quality within the Coorong District can be attributed to both upstream sources and activities within the District.

These activities are causing an increase in surface water salinity along the River Murray. Increased salinity reduces the life of water supply infrastructure and the potential water uses.

The water quality of water from the Tailem Bend to Keith pipeline is already often less than ideal, having reached a salinity of 770 mg/L (1200 µS) in 2009. Australian Drinking Water Guidelines recommend for aesthetic reasons (scale production and taste) that the salinity should not exceed 500mg/L, although up to 1000mg/L is acceptable.

In the past, sediments in mains water have caused damage to pipes and infrastructure, however this water supply is now filtered before it enters the pipeline.

In some areas, there has been an increase in nutrient concentrations in both surface and groundwater supplies. This promotes algal blooms which may be toxic for livestock and make water unsuitable for domestic use.

Although groundwater resources have a higher degree of protection than surface water, the quality of groundwater within the District is under threat from two main sources. These are the increase in salinity in low-lying areas due to the process of dryland salinisation, and the possible contamination by effluent from intensive agriculture e.g. dairies. (Barnett 1995, pers. Comm.)

Figure 50: Groundwater being used for surface irrigation

7.4.2 WATER SECURITY AND USE

Water security is a major resource management issue within the Coorong District.

There have been significant changes in water availability over the last decade. Recent shortages in water from the Murray, reductions in groundwater allocations and increases in reticulated water costs have led to many landholders seeking alternative water management options. Affected landholders are seeking more location and method specific information to assist with decision-making processes.

The sections below discuss the issues arising from surface water and groundwater supplies.

SURFACE WATER

Significant quantities of water transported by the Tailem Bend – Keith pipeline is used for stock water. Preliminary data from leak detection trials and landholder observations have suggested that most landholders using mains water for stock are losing 4-25% of the mains water that enters their property, through leaks in pipes or overflowing troughs. Leakage often occurs in areas of shallow groundwater, exacerbating existing dryland salinity issues.

Recent increases to mains water pricing have financially stressed livestock owners throughout the District. Combined with other financial stressors, water prices may cause wide-spread changes in land use, from cattle to sheep or cropping.

There is a significant risk that running stock (particularly cattle) may become economically unviable due to high water input costs, potentially causing a shift from cattle to sheep, or into to cropping. This will have significant changes to the state of natural resources within the District.

Sheep tend to rip newly established perennial pastures out of the ground rather than simply removing the growing tips, which decreases pasture longevity. They also preferentially graze higher land, which increases the likelihood of wind erosion on dune ridges, while under grazing the heavier, more fertile flats.

New cropping areas are likely to be in lighter soils than the current cropping areas, leading to a significant erosion, groundwater recharge and water quality risks. This will reduce the District's capacity to adapt to climate change.

GROUNDWATER

Use of unconfined aquifer water for irrigation may make a very small, localised contribution towards lowering the watertable but this is generally outweighed by increased recharge elsewhere.

Confined aquifer water use is more of a concern in areas experiencing groundwater level rise, as irrigation drainage can pass through the root zone and recharge the shallow unconfined aquifer.

Irrigation water, from all types of irrigation, may drain to the unconfined aquifer, dissolving any soil stored salts on the way. This is not a large issue in areas with a shallow watertable, as the stored salts are minimal, however it may become a significant issue in highland areas.

Salt flushing from irrigation drainage occurs 5-10 times faster on average than it would under dryland agriculture. However, the effective use of irrigation water may decrease groundwater recharge to a similar level to that occurring under dryland agriculture (Walker & Litticoat, 2004).

Increased groundwater salinity under low-lying irrigation areas is often caused by irrigation water recycling. Irrigation water recycling occurs when irrigation drainage water recharges a shallow unconfined aquifer and then is pumped out and reused.

When irrigation water is recycled, water loss via evaporation and transpiration concentrates existing salt loads. This may cause a rapid rise in groundwater salinity directly below the irrigation area.

High salinity areas or 'hotspots' caused by irrigation water recycling often disperse during winter, but they are of concern in areas where groundwater salinity is marginal to begin with.

All users of water have an effect on the sustainability of the resource. All stock and domestic water users can make a detectable impact on groundwater resources if they do not maintain their infrastructure.

There are landholders within the district with overflowing wells, windmills or tanks, due to a lack of automatic flow shut-off valves. Each facility may not discharge huge amounts of water, but, every litre adds up.

Figure 51: Windmills are still commonly used to supply groundwater to stock, however solar powered pumps are becoming increasingly popular.

7.4.3 SALINITY

One of the major threats to water resources is the distribution and concentration of salt in soil and water resources.

SALINE RECHARGE

Salt from mineral breakdown, erosion and ocean winds continually deposits on the soil surface and vegetation.

Historically, mallee scrublands covered much of the Coorong District. They were very water efficient, and let very little water past the root zone, leaving the salt within or just below the historic root zone of mallee vegetation. Annual crops do not use as much of the annual rainfall, so unused rainfall is flushing salt deposits through the soil profile and recharging the unconfined aquifer with saline water.

In lowlying areas, most of this salt has flushed through into the aquifer already, however there is still significant quantities still stored in areas with a deeper soil profile (Walker & Liddicoat, 2004).

DRYLAND SALINITY

Dryland salinity was the major focus of the 1997 and 2000 revisions of the Coorong District Local Action Plan, along with a range of other soil and biodiversity issues.

Prior to the development of the LAP document, studies demonstrated that dryland salinity in the area was due to increased recharge to the water table, resulting from changes in land use, and most significantly, the removal of perennial vegetation from the landscape. Within the Coorong District, 57,000ha (8-9%) of agricultural land was affected by dryland salinity (2000). If trends continued another 70 000 ha (10-11%) would have been at risk by 2020.

Since that time, the Coorong District has had a long run of dry years and has been involved in recharge reduction works across 14-18% of the District. Groundwater levels have mainly stabilised or dropped, although water tables are still rising in some areas.

During consultation for this LAP review, several landholders reported observing potential dryland salinity affected areas where they had not been observed before, due to heavy rains last summer.

Given these observations, it seems likely that dryland salinity may re-emerge as a major issue if efforts to reduce recharge slowed down, the District experiences a period of wetter years or the frequency of heavy summer rain increases.

Actions aimed at slowing dryland salinity processes are often profitable to the landholder, while having a range of other benefits. Other reasons to undertake actions formally considered dryland salinity focused include; restoration of native vegetation, reducing wind erosion, protecting groundwater quality, increasing groundcover and maintaining soil carbon.

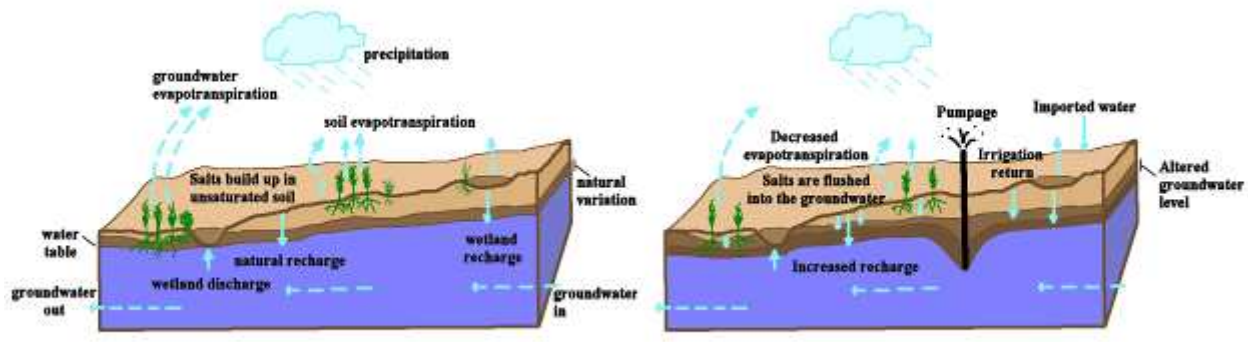


Figure 52: Diagram illustrating some of the water balance issues within the Coorong District

URBAN SALINITY

Urban salinity occurs when there are increasing groundwater salinity and watertable rise directly under urban areas. These problems may be caused by regional groundwater issues, concentrated stormwater recharge, importation of water from another area, or use of confined aquifer water.

The township of Tintinara is close to the watertable. The distance from the soil surface to the unconfined aquifer is generally about 2m, with infrastructure on higher sand dunes up to 5m above the watertable. The lowest areas of the town may be as little as 1m above the watertable during winter. Other townships and hamlets within the district are likely to have similar, if not as immediate urban salinity issues.

High watertables and groundwater salinities in urban areas may affect the structural integrity of town infrastructure, roads and amenity.

Loss of vegetation, including remnant trees, is one of the most pressing threats with regard to urban salinity in Tintinara. The root zone of many trees is greater than the actual height or breadth of the tree. This means that waterlogging may occur if the groundwater rises. Salinity stress may occur with any change in groundwater salinity.

Figure 53: Tintinara has a large number of remnant trees, which are threatened by urban salinity

The SECWMB study on urban salinity risks in Tintinara (AWE, 2005) showed that more long-term data are required to detect trends in the groundwater level under the township. More detailed groundwater monitoring will detect sources of groundwater recharge and discharge.

More information on this issue and mitigation methods is provided within the Tintinara-Coonalpyn Land and Water Management Plan.

IRRIGATION INDUCED SALINITY

Excess irrigation water recharges the unconfined aquifer, dissolving any soil stored salts on the way. This is not a large issue in areas with a shallow watertable, as the stored salts are minimal, however it may become a significant issue in highland areas.

Salt flushing from irrigation drainage generally occurs 5-10 times faster than it would under dryland agriculture (Walker & Litticoat, 2004). Despite this, it is theoretically possible to reduce irrigation drainage to levels similar to dryland agriculture.

Increased groundwater salinity under low-lying irrigation areas is often caused by irrigation water recycling. Irrigation water recycling occurs when irrigation drainage water recharges a shallow unconfined aquifer and then is pumped out and reused.

When irrigation water is recycled, water use via evaporation and transpiration concentrates existing salt loads. This may cause a rapid rise in groundwater salinity directly below the irrigation area.

High salinity areas or ‘hotspots’ caused by irrigation water recycling often disperse during winter, but they are of concern in areas where groundwater salinity is marginal to begin with.

7.4.4 LEAKING CONFINED AQUIFER BORES

The Coorong District has two main aquifer systems. The shallow unconfined system and the deeper confined system. When the bottom of a deep hole fills with water, this is most often due to the unconfined aquifer. Unconfined aquifers are strongly influenced by local rainfall or land cover changes.

The confined aquifer is often more than 100m below the soil surface. The confined aquifer is pressurised, historically flowing out of the top of uncapped bores in low-lying areas, however this no longer occurs within the Coorong District.

Figure 54: Finding older confined aquifer bores can be a challenge. Once confirmed and identified as leaking, this bore was decommissioned.

The two aquifers are not naturally connected within the District. Where linkages occur, it is generally due to human influences, such as poorly constructed confined aquifer bores or rusted-out bore casings.

Under the repealed Water Resources Act 1997 and the current Natural Resources Management Act 2004, landholders and licensed drillers are responsible for building and maintaining wells to a standard where leakage does not occur between the aquifers.

However, many landholders have often never used their wells, do not know where they are, or have no idea that they are leaking.

Leaking confined aquifer bores pose two potential problems to groundwater systems. The first concern is that they could leak saline unconfined aquifer water into the fresher confined aquifer, rendering it unusable.

The second concern is that finite, usable confined aquifer water could be lost into the unconfined aquifer, causing a loss of pressure in the confined aquifer. Neither option is desirable.

A majority of potentially leaking wells were built prior to water resources legislation or installation standards. A large portion of wells built in this period are likely to be either past their usable life or of substandard construction.

In 2006, preparation of the Tintinara-Coonalpyn Land and Water Management Plan raised awareness of this issue at state and commonwealth levels. Initial funding for a pilot project quickly followed.

Since 2008, The Coorong LAP program has assisted with the decommissioning of 110 non-operational, potentially leaking bores. George MacKenzie (Department for Water) estimates that there are approximately 700 more bores in the Coorong District that will need decommissioning within the next ten years. Of these, approximately 35% are likely to still be operational.

Figure 55: Correctly decommissioning a confined aquifer bore can be a time consuming and messy task, requiring specialised equipment.

7.5 REDUCING AIR POLLUTION

7.5.1 WHY REDUCE AIR POLLUTION?

The majority of Earth's atmosphere (80%) occurs within 12km of the earth's surface. Apart from providing oxygen for respiration, these gases absorb ultraviolet radiation, warm the surface through heat retention and reduce the incidence of meteor strikes.

One of the most important functions of earth's atmosphere is known as the greenhouse effect. The earth is protected from rapid temperature changes (experienced on planets without atmospheres) by the ability of certain gases to absorb and emit radiation, regulating and warming temperatures on the earth's surface. There are thirty-one known greenhouse gases. Of these, some of the most notable ones are water vapour, carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbons (CFCs). Dust or particulates can also influence the climate.

Figure 56: Crop inspection with air pollution haze visible in background, most likely due to smoke or dust.

Over the last 50 years, the concentration of carbon dioxide in our air has increased by 19%, and is twice as high as pre-industrialisation. Changes to the composition of earth's atmosphere can have a range of non-climate impacts. These impacts can be positive and negative. Several greenhouse gasses (such as carbon dioxide or sulphur dioxide) have been identified to have human health impacts, such as increasing the frequency of allergies and asthma or affecting brain function.

7.5.2 COORONG DISTRICT CONTRIBUTION

Agriculture in the Coorong District emits greenhouse gases in the form of carbon dioxide, methane, nitrous oxide and particulate matter sources. These Environmental impacts of air pollution include smog, acidification of the sea and acid rain. Increased carbon dioxide concentrations are known to increase the efficiency of plant gas exchange, improving plant growth and water efficiency.

Greenhouse gases are emitted by farming machinery, chemical use, dust, waste disposal, livestock digestion and controlled burning.

For the purposes of measuring potential greenhouse impacts, these emissions are measured as carbon dioxide equivalents. Using 2006 ABS data, the Australian Farm Institute FarmGAS software indicates that agriculture from the Coorong District is likely to directly emit 300,000 – 400,000 t CO_2e per year. This does not take into account indirect or secondary emissions.

Approximately 67% of the modelled Coorong District agricultural emissions are due to the digestion process of sheep and cattle, with fertiliser use and livestock waste management taking second and third place.

According to FarmGAS modelling, air quality services offered by areas of remnant vegetation within the District are likely to include consumption of approximately 300,000 t CO_2e per year. Environmental plantings sponsored by the Coorong District LAP program are likely to consume up to 10,000 t CO2e per year.

Figure 57: Revegetation in the Coorong District consumes approximately 6 CO2e t/ha/annum (range 3.5-10.6) (DWLBC 2010).

7.5.3 LIVESTOCK EMISSIONS

Ruminant livestock emit significant quantities of methane and nitrous oxide as by-products of their anaerobic digestive systems. Although this is a natural and unavoidable process, there are ways of reducing methane emissions.

Gas emissions are kept to a minimum when stock are provided with a balanced intake of the energy, protein and fibre components in their diet. Making rapid changes in the diet of grazing or hand-fed ruminants requires the rumen micro-organisms to adjust and this jeopardises feed conversion efficiency and triggers the release of extra greenhouse gases. Prolonged grazing of energy and protein-poor pastures and stubbles also exacerbates the problem.

Figure 58: Careful management of pastures is the key. If grazed as a monoculture, Saltbush can increase methane emissions by 400%. If it is used as a mixed pasture or as a supplement to dry food, it can decrease methane emissions (Aust Farm Journal, 2009).

Seasonal variation in pasture quantity and quality on offer cannot be avoided in most grazing enterprises. However some evidence exists that perennial pastures such as Lucerne provide an overall better feed balance than annual pasture systems. Recent research suggests that perennial pastures also have a significant influence on a regional carbon balance by increasing standing carbon and soil carbon levels.

The condensed tannins in legumes have been shown to suppress the production of methane in ruminants.

Figure 59: Well managed, diverse perennial pastures appear to be the key to reducing livestock methane emissions.

The practice of supplementary feeding sheep and cattle during the late summer and autumn period (or feedlotting in extremely dry years) not only maintains animal productivity but also contributes to an improved annual dietary balance.

Although not all the science is in yet, it appears that selective breeding, feed supplements and vaccines for livestock are also promising methods for methane reduction.

7.5.4 PROGRESS TO DATE

Although the contribution of agriculture to national greenhouse gas emissions may seem large, progress in reducing the proportion attributable to the sector has been made. Since 1990 the combined emissions for Agriculture and Landuse change, including forestry, has fallen by approximately 40% while those for the other sectors in the National Greenhouse Gas Inventory have risen by approximately 30%.

7.6 ADAPTING TO CLIMATE CHANGE

Climate variability is an ongoing and ever-present phenomenon. Human populations, along with their farming practices, have always continually adapted to their environmental conditions.

Climate-focussed debate has focussed on the causes, extent and consequences of changes or trends in climate over the past century. This Plan takes no position on the cause of climate change but recognises that changes are occurring and will need to be managed.

There is empirical evidence that the climate within the Coorong District is not the same as it was fifty or more years ago. Analysis of local rainfall data suggests that annual rainfall has been steadily decreasing since the 1950s, particularly in the more inland areas, resulting in annual rainfalls of up to 60mm less than they were in the earlier part of the 20th century. These trends are supported by long-term, high quality data from the Bureau of Meteorology.

Looking at local daily data, the autumnal break appears to be arriving later and is less regular. The spring months appear drier and the total number of months without rain appears to be increasing.

The charts below show two types of analysis done on rainfall data from Tintinara. Figure 58 shows the long-term rainfall deficit at Tintinara (1995-2010) compared to the pre-1950 average rainfall for each month. The graph shows that Tintinara has received almost one metre less rain over a 16 year period, than it would have received over a period of average rain, prior to 1950.

Figure 59 shows the same data in a different way. It compares average monthly rainfall for two periods (pre-1950 and post-1991) at Tintinara. The chart clearly shows the later seasonal breaks and shorter period of winter rainfall. This type of change in climate is likely to challenge existing agricultural practices and reduce biodiversity unless steps are taken toward adaptation.

Similar charts can be constructed for other rainfall sites throughout the Coorong District, however the size of these effects varies due to latitude and proximity to the sea (or other large water bodies).

There is limited long-term temperature data for the Coorong District, however long term (50-120 year) temperature data from Robe, Nhill, Lameroo and Murray Bridge suggest that there has be an increase in extremely hot days (>40^{o}C), a decrease in frost events and an increase in average night-time temperatures. This is supported by shorter term (20-50 yr) temperature from the Coorong District.

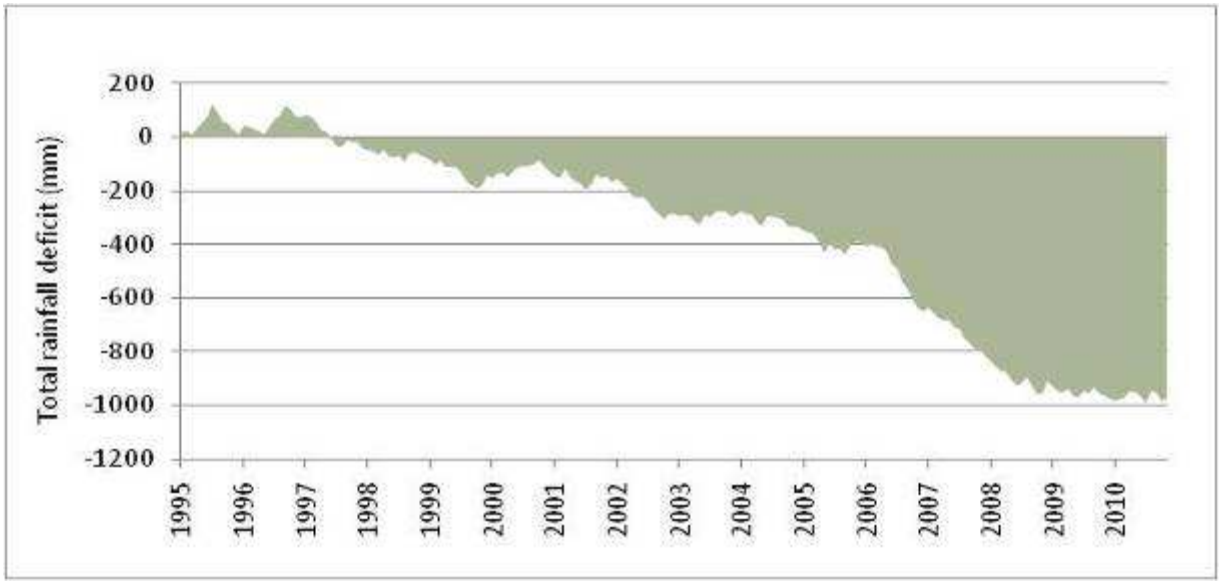


Figure 60: Cumulative monthly rainfall deviation at Tintinara (based on BOM data).

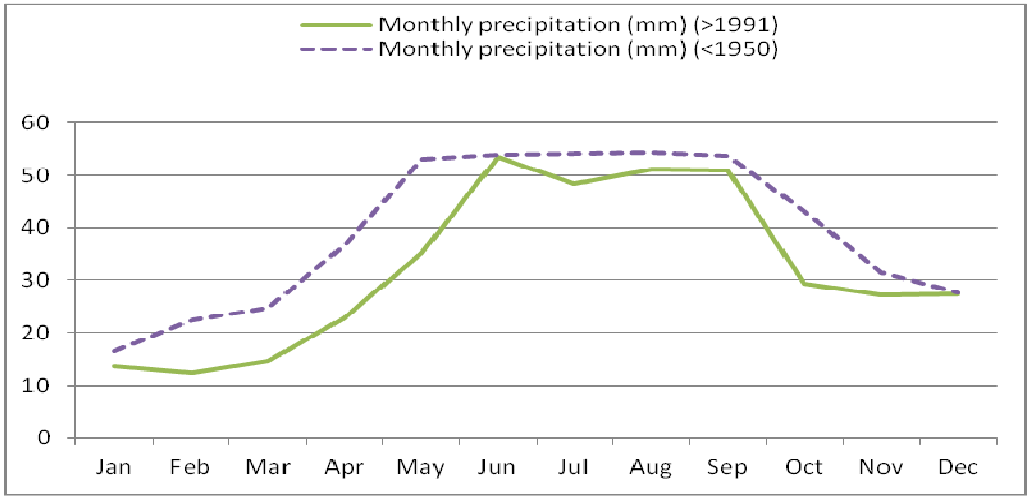


Figure 61: Average monthly rainfall at Tintinara

Although the community is unlikely to reach a consensus on the causes of climate change, the LAP committee recognises that these trends are unlikely to change in the short to medium term. These changes could have both positive and negative outcomes for the Coorong District, which need to be assessed and accounted for when undertaking long-term actions.

The committee also understands that actions to reduce possible climate change causes or to adapt to observed climate trends will have other benefits. Secondary benefits of adapting to climate trends include increased primary production resilience to natural climate variation, water use efficiency, water quality improvements and rural aesthetics. A proactive approach to managing impacts of climate change will help stabilise our local economy, maintain the viability of our enterprises and supporting infrastructure.

7.6.1 WHERE ARE THE TRENDS POINTING?

Extrapolation of existing Tintinara rainfall trends suggests that if they continue, annual rainfall is likely to decrease at that site by 3-11% before 2030. This data is not as strong at some sites, such as Cooke Plains and Meningie, however the general trend is still present.

A range of government agencies (CSIRO, Australian Bureau of Meteorology, South Australian Research & Development Institute) have looked at these long-term trends in climate. Table 14 and Table 15 show the results of their more sophisticated extrapolation of climate data, done for four other towns within or near the Coorong District.

Table 14: Projected changes from current (<2000) conditions by 2030 (CSIRO, 2009)

Town	Temperature increase (°C)	Rainfall reduction (%)	Rainfall reduction (mm)	Evaporation increase (mm)
Lameroo	0.74 – 0.98	2.1 – 12.6	8 - 49	33.2 – 48.6
Tailem Bend	0.72 – 0.91	2.5 – 12.0	12 - 56	32.9 – 47.6
Meningie	0.69 – 0.86	2.7 – 11.5	10 - 43	39.4 – 50.8

Table 15: Number of days likely to experience high or low temperatures (CSIRO, 2009)

Site	Minimum below 0°C			Maximum above 35°C			Maximum above 40°C		
	Present	2030	2070	Present	2030	2070	Present	2030	2070
Tailem Bend	3	1-2	0-1	25	25-31	28-55	5	5-9	7-22
Keith	4	1-3	0-2	23	24-30	26-53	4	5-7	6-19

7.7 SUPPORTING SOCIAL INFRASTRUCTURE

This LAP document addresses both urban and rural natural resource management issues within the Coorong District. In regional areas, these land uses and communities are co-dependent. Rural communities depend on the support infrastructure provided from urban areas. As populations decline, so do the services offered from these sources.

Urban communities depend on healthy, profitable rural lands. Well managed rural settings can provide urban residents with income, aesthetic and environmental services, such as wind reduction, dust suppression, improved water quality or decreased urban salinity.

A high level of community capacity and engagement allows communities to manage their natural resources in the most sustainable manner. Community capacity for natural resource management generally increases as other pressures reduce, such as financial or health stressors.

Supporting productivity in the region has been an on-going aspect of supporting social infrastructure for the Coorong District LAP program. Landholders can not undertake sustainable natural resource management or biodiversity works without long-term financial security.

Productive agricultural land currently provides raw materials, food and clean water supplies for urban Australians. In the future, agriculture may also play a critical role in the production of alternative fuels and the sequestration of carbon.

The need to support and maintain sustainable regional productivity may expand with future changes to government policy, potential for food security concerns and climate change.

The provision of whole-of-farm productivity and economic viability advice is outside the LAP scope. However, the Coorong District LAP document attempts to ensure that its actions demonstrate a combination of biodiversity, sustainable productivity and natural resource management benefits.

The LAP program newsletter currently provides an outlet for information on animal and plant control, biodiversity information and agricultural research findings. Future editions may include localised climate data, soil carbon monitoring methods or results, results of land condition monitoring and discussions on how to reduce input costs through sustainable land management.

The Coorong LAP program also has regular articles in NRM Board newsletters and on the Coorong District Council website.

Greater coordination with agricultural research, regional development and health organisations may raise awareness of the LAPs contribution to this issue, while providing community members with a greater awareness of more productivity, health and economy focused programs.

7.7.1 CHANGES IN OUR COMMUNITY

There have been significant changes in the structure and perceptions of the Coorong community since the initial Local Action Plan. These changes impact on community use of natural resources and its ability to adapt to changes in resource availability. Some of these changes have included;

- Productive farms are becoming larger and more automated.
- The number of people working on each farm is decreasing.
- Ageing population.
- Increased incidence of lifestyle farmers.
- Increased groundwater irrigation in the early to mid 2000's.
- Reduced River Murray irrigation.
- Increased focus on effective water use.
- Increased reliance on independent agronomists.
- Productivity has increased (per ha).
- Prices are set by external markets.
- Input prices are increasing due to limited resources (petroleum, water, fertilisers etc).
- Reduced support for community infrastructure.

Many of these changes are common to many regional areas of Australia. It is likely that these changes will continue over the coming decade.

8 MANAGEMENT OF NATURAL RESOURCES

The Coorong District LAP document covers the Coorong District Council area. This area was selected because of the support provided by the Coorong Council and to minimise administrative considerations.

The Coorong District is subject to a range of other natural resource management plans. These have been instigated by government agencies, local government, regional boards and community groups.

The LAP document fits in with the current planning structure, bringing together and providing practical implementation of many of the principles and direction identified in these other plans. The LAP document also provides a local, community perspective on these issues.

Some of the organisations and plans applicable to the plan are shown on the organisational chart below. More information on the roles and responsibilities of these organisations can be found in the appendix 13.

This project is consistent with and complementary to the following plans and strategies.

- The SA Murray Darling Basin NRM Plan
- South East NRM Plan
- USE Dryland Salinity and Flood Management Plan
- State NRM Plan
- Tintinara Coonalpyn Land and Water Management Plan
- Ramsar Management Plan for the Coorong & Lower Lakes
- Biodiversity Plans for the SA Murray Darling Basin and the South East of SA
- Strategy for Aboriginal Managed Lands in SA.
- The South East Coastal Management Strategy.
- Limestone Coast and Coorong Coastal Action Plan
- Limestone Coast Region Plan 2010.
- Water Allocation Plans for Peake-Roby-Sherlock and Tintinara – Coonalpyn PWAs
- Council Development and Strategic Plans.

LAP document alignment with NRM Board targets is provided with Appendix 13.

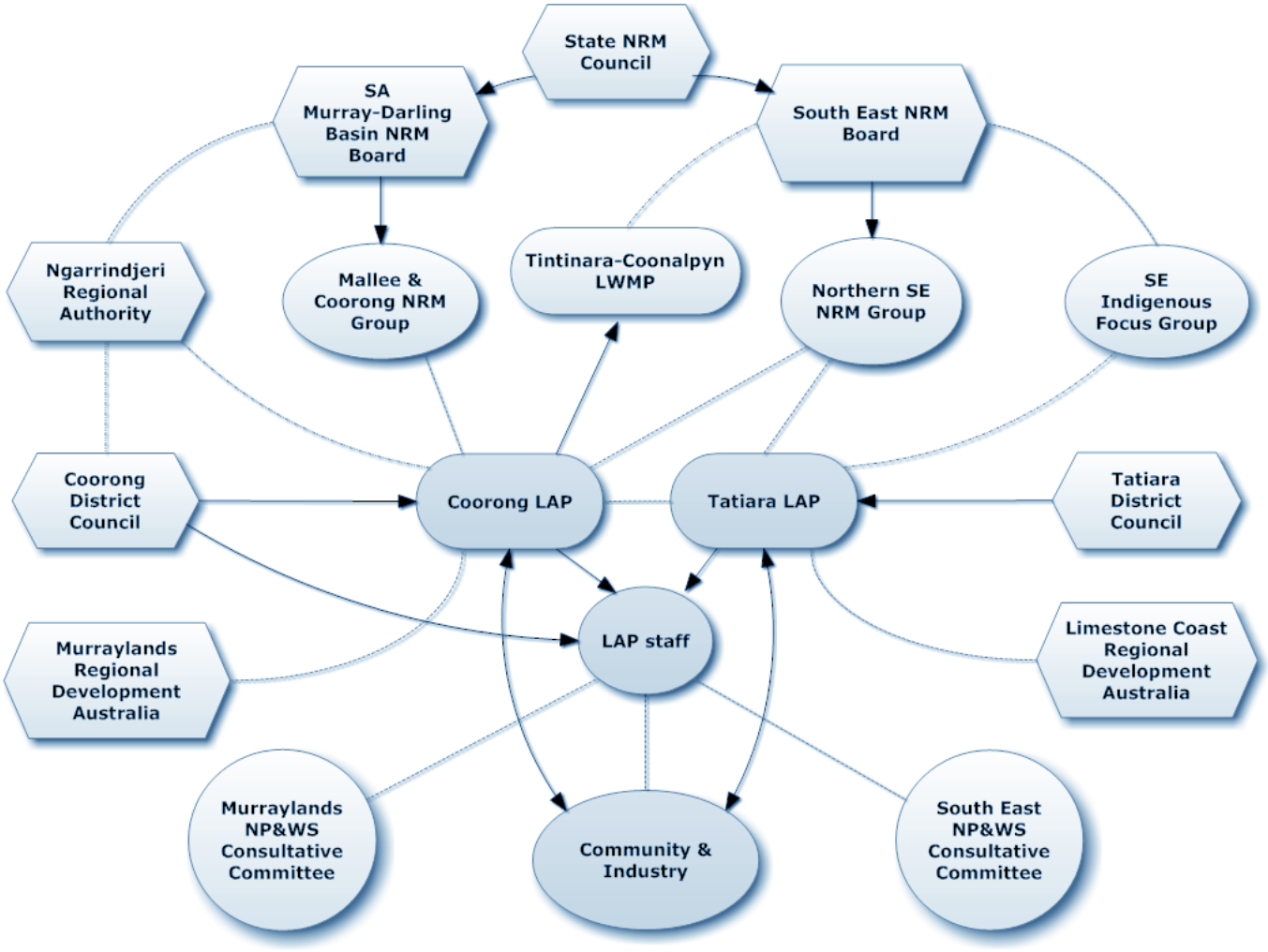


Figure 62: Interactions between NRM organisations

8.1 NRM BOARDS

Since inception of the Coorong District LAP program natural resources (biodiversity, soil, water, weeds and pests) have gone through a range of legislative transitions.

When the original LAP document was written, these issues were addressed at the district scale, by the Soil Conservation Board and the Animal & Plant Control Board.

The LAP program was created to complement the work of the Coorong and Districts Soil Conservation Board, with non-legislative on ground action. It also provided financial and technical support for a range of smaller community groups. In 1997, the Water Resources Act allowed for the establishment of Catchment Water Management Boards.

In 2004-05, all district level boards were disbanded and eight Regional Natural Resource Management Boards were established across South Australia.

The Coorong District ended up split between the South Australian Murray Darling and the South East Natural Resources Management Board areas, as shown in Figure 63.

A state wide Natural Resources Management Council was established to ensure a uniform approach on resource management across the state.

In July 2010, the new Department of Environment and Natural Resources (DENR) was formed, which combined several environment and natural resource management departments and groups into one agency. A key element of the new agency is to develop a single workforce to support NRM Boards, the community and other government agencies.

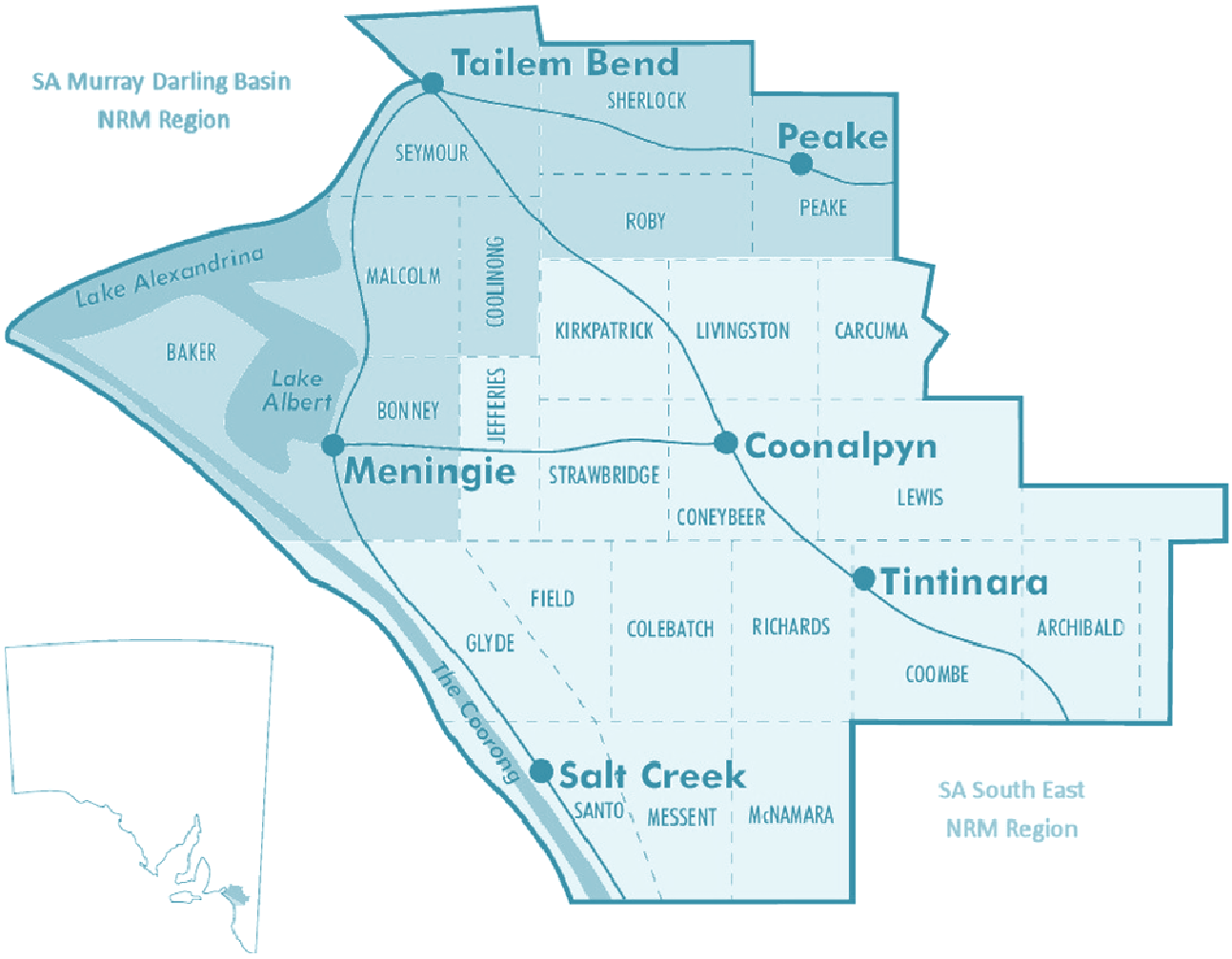


Figure 63: Map of the Coorong District, showing NRM Regions.

These changes in Natural Resource Management have been accompanied by changes in the protection of remnant vegetation.

Despite the amalgamation of previous organisations, there is still a wide array of government agencies, departments, boards and other organisation involved in the management of agricultural lands within the Coorong District. Most of these now work closely together.

At a local level, there have been changes to natural resource management structures. At the time of the last review (2000), the Tintinara-Coonalpyn and Peake-Roby-Sherlock groundwater resources were not yet prescribed. These areas are now both prescribed, with approved Water Allocation Plans.

Both NRM Boards have established local NRM Groups that cover parts of the Coorong District. These groups were established to assist with engaging communities in Natural Resource Management.

The NRM Groups build community awareness and provide local input into Regional NRM plans and programs. The LAP program has a close working relationship with the Northern South East NRM Group and the Mallee and Coorong NRM Group.

8.2 OTHER MANAGEMENT PROGRAMS

There are a range of other plans and programs that have or are being implemented within the Coorong District. The following subsections provide an introduction to some of the plans and programs that have a direct interaction with the Coorong District Local Action Plan.

A table has been provided in Appendix 9 to help landholders understand the roles and responsibilities of each of the main natural resource management organisations in the area.

8.2.1 NATIONAL

WATER

South Australia is part of the National Water Initiative (NWI). The NWI is a commitment to identifying over-allocated water systems, and restoring those systems to sustainable levels.

The NWI encourages the trade of water to more profitable use of water and more cost-effective and flexible recovery of water to achieve environmental outcomes.

ANIMAL AND PLANT CONTROL

The National Weeds Strategy (NWS) was launched in 1997. The NWS takes a strategic approach to weed management problems of national significance, addressing environmental and agricultural weeds equally. It describes the issues, discusses why existing weed management measures are not adequate, lists the roles and responsibilities of government, community, landowners and land users.

Other weed and pest lists kept by the Commonwealth Government include the National Environmental Alert list and Weeds of National Significance.

BIODIVERSITY

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act) is the primary piece of Commonwealth legislation relating to the environment. All actions that are likely to have a significant impact on a habitat or species of national significance or are on Commonwealth land are managed through this legislation.

Threatened Species Management Plans are prepared for all species listed in the EPBC Act. These may be prepared at a national, state or regional level, are designed to protect individual species, and enhance or expand the habitats in which they occur. Several of these plans are applicable within the Coorong District.

8.2.2 STATE

State efforts to conserve soil, land and water management while improving their productivity have been underway for a considerable time.

SOIL

When the Murray Mallee was originally surveyed, the Surveyor General declared that all roads should be at least three chains wide (60m) to allow for a strip of standing timber on either side. This remnant vegetation was left to prevent wind erosion, and

reduce long term costs associated with clearing the roads of sand drift (Nickolls & Angel, 2003).

WATER

All water-related plans in South Australia are intended to support the principles of the State "Water for Good" Plan, which in turn supports the National Water Initiative.

The Water for Good plan states that through its implementation, South Australia will lead the country in water supply innovation and be recognised as the 'Water-sensitive State'.

ANIMAL AND PLANT CONTROL

The Department for Primary Industries and Resources SA (PIRSA) has a Biosecurity Group, whose mission is protecting agriculture, the environment and public safety from the impacts of pest animals to plants. This group provides technical support the State NRM Council and directly to Regional NRM Boards.

BIODIVERSITY

There are a number of Acts that have impacts on biodiversity management within the Coorong District. These include the Native Vegetation Act and the National Parks and Wildlife Act. The first Native Vegetation Act was brought out in 1985. In 1991, the Act was amended to include more stringent controls on the clearance of native vegetation and to bring into effect the Native Vegetation Council.

In 2003, the Native Vegetation Regulations were significantly altered, with inclusions relating to the assessment of paddock trees with significant environmental benefit. A Fire subcommittee was established in 2006 to assist with the development and review of Bushfire Prevention Plans.

State biodiversity plans applicable to this area include the Wetland Strategy for South Australia. It is the aim of the Wetland Strategy to see wetlands recognised and managed as ecological and community assets for the benefit of present and future generations.

Habitat 141 and Naturelinks both apply to the Coorong District and are looking at targeted biodiversity conservation works.

LAND USE AND INFRASTRUCTURE PLANNING

Planning SA and Local Government bodies apply the Development Act 1999, Local Government Act 1993 and a number of other acts related to land use and infrastructure developments. Planning SA generally works at a high level, preparing policies and planning documentation, whereas Local Government bodies apply these State Acts on-ground.

8.2.3 REGIONAL

ANIMAL AND PLANT CONTROL

Regional and local animal and plant control activities are controlled by the NRM Boards. Each NRM Board have their own animal and plant control planning documents.

SOIL

There have been a number of clay-spreading trials and other soil conservation measures, such as the Salt to Success scheme in the Upper South East Drainage area, which was run through the PIRSA office at Keith, however none of these are still operational.

BIODIVERSITY

At a regional level, the Coorong District straddles the boundary of two regional biodiversity plans – The Biodiversity Plan for the South East and the Biodiversity Plan for the SA Murray Darling Basin. These plans describe threatened species or habitats within each area, and set out a range of priorities dependant on the biodiversity resources of each area.

There is a National Parks Consultative Committee for each biodiversity region. Members of these committees include local landholders, tourism operators, councils, ecologists and a range of other stakeholders.

INTEGRATED NATURAL RESOURCE MANAGEMENT

The two NRM Plans, described earlier, cover a wide range of NRM issues. Both regions have slightly different priorities, but they are both aligned with the State NRM Plan.

Both NRM Plans contain challenging targets, which will be assisted through implementation of the Coorong LAP.

8.2.4 LOCAL

Landholders within the Coorong DIstrict have participated in all available soil conservation programs, and have undertaken considerable work on their own properties, often without any external assistance. One of the major works undertaken by landholders is sand hill stabilisation, which requires constant effort in areas with deep sands.

These Local plans and actions are only as strong as the support it receives from community members, government agencies and other organisations. Although it has no legal power, there is much that can be achieved through cooperative means.

As well as the LAP document, there are also plans for local Landcare Groups, Schools and corporate enterprises that contain a significant amount of natural resource planning within them. Where possible, the LAP provides support with the implementation of these.

WATER

The Tintinara-Coonalpyn Land and Water Management Plan was initiated by the South East NRM Board, but the content of the plan was decided by a group of community members. This plan is now being implemented by the Coorong District LAP Committee.

Water allocation plans including the Prescribed Wells Areas contain detailed assessments of the resource and identify the threats to water resource management in these areas.

BIODIVERSITY

Reserve or Park Management Plans, such as the Ngarkat Complex Management Plan and the Coorong National Park Management Plan are prepared to guide the management of a specific area of conservation significance. These plans document species found within the reserve, threats to biodiversity, and detail how the park should be managed in the future.

Issue or site specific plans for areas larger than an individual park also exist, such as the Coorong, and Lakes Alexandrina and Albert Ramsar Management Plan.

The Coorong District Council has a Roadside Vegetation Management Plan, written in accordance with the Native Vegetation Councils 'Guidelines for the Management of Roadside Vegetation'. These plans contain the councils' plans to maintain biodiversity, perform roadside maintenance, undertake clearance of vegetation for new roads, control pest animals and plants and other general management practices.

Heritage management agreements are available to protect significant remnant vegetation areas on private land. This is a State-wide program, implemented at a local level. Heritage Agreements are entered into on a voluntary basis.

LAND USE AND INFRASTRUCTURE PLANNING

The role of Local Government includes developing their community and resources in an environmentally sensitive manner, initiation and promotion of effort within their community, establishing programs to benefit the local area, protecting the environment and improving amenity.

Within the Coorong District Development Plan, the principles of development control look at managing waste, water resources, stormwater and native vegetation, while encouraging measures to prevent dryland salinity, lower energy consumption and a range of other natural resources management initiatives.

INTEGRATED RESOURCE MANAGEMENT

Whole farm plans, property management plans and environmental management systems are all management tools increasingly used at a farm level to ensure the best possible outcomes for biodiversity, farm productivity, soil conservation, water resources and other resources of importance to the landholder.

A Property Management Planning program was run in the Coorong District during the early to mid 1990s. These are considered useful tools to help landholders achieve sustainable land management.

8.3 FUNDING SOURCES

Funding for the LAP program is secured from a range of sources, however there is usually one main source at any one time.

The main source of funding for the LAP program in 1997-2008 was the National Heritage Trust (NHT) through the National Action Plan for Salinity and Water Quality (NAP).

In 2008, these programs were replaced by the Caring for our Country (C4OC) program, which has a different focus and funding structure to the previous NHT/NAP programs. In 2011, C4OC continues to be the main source of funding.

The Coorong District LAP program would not have access to this funding without the ongoing support and funding from the Coorong District Council. The LAP Committee is a Section 41 Committee of Council. Both the South East and SA Murray Darling Basin NRM Boards have also provided funding and promotional and partnership opportunities.

In 2009 the Coorong District LAP program partnered with the Tatiara District Council to implement an on-ground works program over both Council areas.

A portion of future LAP funding will come through local implementation of priorities set out in National, State or Regional Natural Resource Management Plans so it is critical that the objectives of the LAP fit within regional priorities.

Over time, it is expected that these major funding sources will continue to evolve. The revised Coorong District LAP document will need to be flexible enough to adapt to these changes without affecting the ongoing effectiveness of project delivery.

A selection of potential funding sources include;

- Commonwealth Clean Energy Futures, including the Carbon Farming Initiative
- Verification and trade of carbon credits
- Industry and research groups
- NRM Boards
- Local Government contributions
- State Government offset funding

8.4 MONITORING

Monitoring the effect of LAP actions is critical to the success and continued funding of the program. Many of the funding programs available to the LAP program do not provide enough monitoring funding to comprehensively monitor the effect of the LAP initiatives on the community or natural resources. Therefore the LAP program relies on external monitoring programs to provide an indication of performance.

Further details of external monitoring programs are provided in Appendix 11.

8.4.1 STATE MONITORING PROGRAMS

State-wide monitoring programs have been consistent and enduring for a long time, however there have been significant cuts to these over the past three to five years. These monitoring programs include the Department for Water observation well network, wind erosion potential surveys and South Australian Biological Survey sites.

Within the Coorong District, there are 150 observation bores, which are monitored for water level twice a year. Where possible, salinity samples are also taken. Data from this monitoring is available from https://obswell.pir.sa.gov.au/new/obsWell/MainMenu/menu

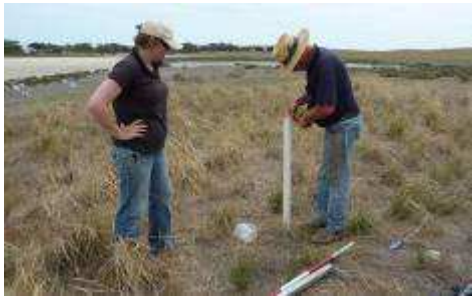


Figure 64: Installation of a new observational bore.

Annual surveys of wind erosion potential are undertaken in the Coorong District. Transect routes are driven, assessing the visible ground cover.

There are a large number of SA Biological Survey sites within the Coorong Council District, due to several significant biological assets.

There are more than 400 vegetation survey sites and 185 sites where animals have been surveyed as part of the BioSurvey SA program. In some locations, the site has been surveyed more than once.

In the 1990s, a series of baseline assessments were undertaken, identifying land use, biodiversity cover, dryland salinity impacts and a range of other practical map-based studies. These baselines were very useful during the formation of the Coorong District LAP, however they have not been repeated to identify if change is occurring.

8.4.2 REGIONAL MONITORING PROGRAMS

Regional monitoring in the Coorong District varies depending on the region undertaking the work.

Several regionally-orientated programs, such as Waterwatch community monitoring and land use assessments are conducted by two different regions within the Coorong District. These vary significantly, depending on regional priorities.

Figure 65: Waterwatch monitoring at Salt Creek.

Most regional monitoring is available from either the South East NRMSpace website or the South Australian Murray-Darling Basin Resource Information Centre Inc.

8.4.3 LOCAL MONITORING PROGRAMS

There are a number of local monitoring programs. These include monitoring of urban salinity in Tintinara and bush condition monitoring performed at biodiversity incentive sites by the Coorong LA Program.

Figure 66: Monitoring fish populations within the Lower Lakes and Coorong.

9 OUR APPROACH

9.1 VISION

Sustainability, Agriculture & the Environment

9.2 PURPOSE AND GOALS

The purpose of the Coorong District LAP program is to maintain and improve the physical resources for agriculture and to protect and enhance the natural environment by working toward these goals;

- Maintain and enhance sustainable and productive capacity of natural resources.
- Increase perennial vegetation.
- Assist with the conservation of remnant native vegetation.
- Identify and manage important wetlands.
- Improve irrigation practices and infrastructure.
- Reduce contamination and wastage of water resources.
- Increase soil carbon and decrease carbon emissions
- Promote ecologically sustainable development to maintain ecosystem function and control threats.
- Assist NRM Boards with the control of roadside and environmental weeds.
- Support landholders to find alternatives to mains water supply or reduce their use of it.

9.3 OBJECTIVES

To achieve these goals, the following objectives have been identified for the next five to ten years (dependent on funding);

- Establish 4,500 ha of additional perennial vegetation per year and renovate 7,000 ha of old perennial pastures.
- Install another 200km of fencing to protect biodiversity remnants by 2020.
- Reclaim or rehabilitate 130 ha of degraded land per year.
- Decommission another 100 leaking confined aquifer wells by 2021.
- Control new areas of lakeshore erosion or other water erosion sites.
- Promote sustainable agricultural production by; balancing land use and capability with increased water use efficiency, implementing works to control non-wetting sands, stabilising bare and eroded land.
- Investigate and start implementing programs to increase soil carbon and vegetative growth.
- Support NRM Boards with roadside and environmental weed control
- Find viable alternatives to mains water supply for stock water
- Identify ways to reduce stock use of potable reticulated water.
- Promote use of pastures that reduce livestock methane emissions.

9.4 CONTINUING LAP IMPLEMENTATION

A community or bottom up approach to managing our natural resources is vital.

Because of the widespread nature of the effects of the issues described within this plan, there has to be community ownership of these problems and commitment to their management. Individual efforts will help reduce the problems and improve farm productivity, but the impact will be limited by the extent to which neighbouring properties and other areas adopt similar measures.

Without a whole of District approach, salinity and related land management issues will increase in their extent and severity, native vegetation will decline, biodiversity will be threatened, and the quality of our groundwater will continue to decline.

There are no ‘quick-fix’ solutions available, therefore changes in land and water management are required. It is unrealistic to suggest that broadscale changes to land use, or the types of agricultural enterprises, be made. The current cropping and grazing enterprises are unlikely to be replaced as the major agricultural enterprises in the near future.

It is necessary therefore to adopt alternative practices and systems under these enterprises that will prevent or reverse natural resource degradation, while assisting to create a community which is more resilient to climate challenges.

If salinity, erosion and related land degradation problems are to be controlled, for example, farming systems need to be established that maintain a healthy level of groundcover and use all of the available rainfall in all but the wettest years.

These systems must then be maintained permanently if salinity, soil carbon decline and other issue within this plan are to be halted, not just hindered.

9.5 RECOMMENDED ACTIONS

A number of recommended options for achieving the Local Action Plan objectives are described below. All of the options have been discussed at community consultation meetings to determine their feasibility and practicality, and the likely support of local landholders in carrying out works based on these recommended options.

If implemented on a broad scale and in a targeted way, these options will all contribute to the Local Action Plan objectives.

Because of the complexity of the relationships between the major environmental issues in the region, each of these recommended options will address more than one of these objectives.

Common sense must also be used when trying to apply these actions across the district. Inappropriate application may lead to unforeseen impacts on other natural resource management issues.

9.5.1 PERENNIAL PASTURE SYSTEMS

This option involves the replacement of annual pasture systems with perennial pastures. Annual pastures have a limited capacity to use water, sequester carbon or stabilise soils due to their shallow root systems, and short growing season.

The establishment of perennial pastures would increase water use efficiency, reduce wind erosion problems, improve soil organic matter content, and once established would reduce the impacts of non-wetting sands. Where perennial legumes were used, there would be a decrease in the amount of nitrogen-rich fertilisers being used, further reducing atmospheric pollution and farm input costs.

Implementation of this action could be hindered by stock water costs, so should be implemented in conjunction with efforts to identify a more fit-for-purpose water supply.

9.5.2 REVEGETATION

The presence of native vegetation has many benefits, from soil stabilisation and buffering of hydrogeological processes through to the creation of microclimates and increased pest insect predators.

Planting trees and shrubs will benefit the area by increasing water use efficiencies, preventing deep-drainage from irrigation and a range of other benefits including biodiversity conservation.

Many landholders are already experimenting with such things as fodder plantations, windbreaks, alley farming and farm forestry.

There is a large range of revegetation options available which will decrease recharge.

The preferred options in most cases will be those which have the most economic benefit, have the greatest benefits to natural resources, and are most suited to the farming system on the land that is to be revegetated.

There are many variables that should be assessed when undertaking a revegetation action, as it is a long-term solution. LAP staff are able to provide advice and ideas of how best to undertake revegetation work on your property, or refer you to someone who will be able to. Guidelines for how to improve the value of your revegetation proposal are provided in Appendix 9.

MANAGING REMNANTS

Maintenance of remnant native vegetation is easier and more economic than to replace it once it has been degraded. In order to maintain the vegetation in good condition, it is necessary to adopt a management regime which will ensure its long term viability.

There are a number of threats to the long-term viability of native vegetation. These include clearing, salinisation, weed invasion, overgrazing, insect attack, fire frequency, fertiliser practices, fragmentation and inadequate knowledge.

The main management practices required to maintain and, where necessary, rehabilitate native vegetation involve:

- fencing remnant vegetation to control stock;
- eradicating rabbits;
- controlling weeds;
- maintaining fire breaks;
- minimising pesticide drift into native vegetation;
- confining recreational activities to specified areas; and
- re-establishing plant species that are absent from the ecosystem.

NATIVE VEGETATION CORRIDORS

Linking islands of remnant vegetation together with blocks and networks of vegetation corridors will help to maintain the conservation value of remnant vegetation, over the longer term. This will involve:

- planning vegetation corridors to link island remnants within and between properties;
- planting locally indigenous plants in the corridors, where possible;
- Designing vegetation corridors to optimise conservation value; and
- planting native buffer zones around remnants to minimize weed invasion.

Figure 67: A shelter belt, planted to reduce wind erosion and provide habitat for wildlife.

WETLAND MANAGEMENT

Land managers with wetlands on their properties are encouraged to;

- fence wetlands;
- prevent run-off from entering the wetlands;
- revegetate degraded wetlands with local native species;
- control pest animals and plants; and
- Prevent rubbish dumping in wetlands.

9.5.3 LAND STABILISATION AND REHABILITATION

The following strategies will assist in the control of wind erosion:

- improved management of annual crops and pastures to prevent wind erosion occurring;
- stabilise eroded areas with cereal rye and then establish perennial plants to provide long term protection;
- level severe 'blow-outs' and revegetate;
- retire steep areas – fence off and revegetate; and
- establish alley farming systems to reduce wind velocity and provide shelter.

9.5.4 NON-WETTING SANDS AND SILVER GRASS

Sowing crop or pasture seeds into the bottom of a furrow, applying wetting agents along the sowing rows and then covering the seeds with press wheels has proven a useful strategy for improving germination in non-wetting sands.

Spreading clay and incorporating this into the water repellent topsoil, thereby increasing the evenness of water absorption, is another strategy which can increase production by up to 100%.

Clay spreading is a long term solution, so is therefore very desirable in areas where suitable clay is available.

Silver grass (*vulpia* spp.) is often associated with areas of non-wetting sand throughout the LAP area. This weed is a major agricultural pest; however it can be out-competed by Veldt Grass and Lucerne.

9.5.5 MATCHING LAND USE TO LAND CAPABILITY

This involves encouraging landholders to develop a long term farm plan, preferably by participating in a Property Management Planning course. Fencing to land type to ensure that land use is matched with land capability is a desirable outcome of this planning process.

9.5.6 SALTLAND AGRONOMY

Many examples of salt-tolerant pastures and saltbush/grass pasture mixes have been established in saline soils in the Coorong District. This provides soil cover on these areas, reducing wind erosion while increasing carbon sequestration, productivity and habitat value.

9.5.7 LAKESHORE AND WATER EROSION

This option involves stabilising shorelines and re-establishing reeds. In carrying out this option, the Environmental Protection Authority has strict regulations which must be adhered to. Details of how to manage the lakeshore is provided in the land management section of the appendixes.

Careful management of inflows is required to provide natural variation within lake levels.

9.5.8 CROPPING SYSTEMS

Cropping systems occupy a significant portion of the Coorong District and this area is increasing. Improving natural resource management outcomes from these areas is critical if a whole-of-landscape solution is to be found.

Average crop yields in the LAP area are still well below the potential expected if all of the available water supply was used effectively by the crop. There is a significant opportunity to improve the water use efficiency of crops in the LAP area, increasing their resilience to climate challenges while decreasing deep drainage and fertiliser leaching.

Ways to increase positive outcomes from annual cropping include improving crop agronomy, improved crop rotations, improved pasture phase management and alley cropping.

9.5.9 REDUCING AIR POLLUTION

Reduction of agricultural emissions to air makes sense, as it reduces the amount of soil nutrients, carbon, fertilisers and other assets leaving the property.

Ways to achieve this include;

- Adopt farming practices which maintain and improve soil carbon, for example minimum tillage, stubble retention and avoiding burning residues.
- Modify soils to improve moisture holding capacity and structure by clay spreading, delving and adding gypsum or lime.
- Use perennial pastures for grazing animals on non-cropping country.
- Supplementary feed ruminant livestock during late summer and autumn.
- Plant trees and shrubs as block plantations, shelter belts and connecting corridors.
- Preserve and enhance remnant vegetation
- Rethink the economic potential of farm forestry in light of biofuel and biomass production developments.

9.5.10 ADAPTING TO CLIMATE CHANGE

Regardless of the cause, climate change and climate variability are here to stay. Increasing on-farm resilience to both of these processes can be achieved by;

- Adopt farming systems to maximise crop and pasture water use efficiency.
- Adapt farm management practices to accommodate a shorter growing season. This may involve time of sowing or developments in plant breeding.
- Assess the economic benefits of growing different crop and pasture species, including crops for biomass or biofuel production.
- Consider introducing different, more feed efficient genotypes within current livestock.

9.5.11 WATER SECURITY

Water security is a major natural resource management issue in the Coorong District. This issue is likely to become more significant due to policy and climate impacts. Actions to address this include;

- Evaluate potential alternative water sources, such as on-farm desalinisation plants and lined catchments.
- Implement leak detection programs and equipment
- Investigate the potential for shandying reticulated water with local groundwater.
- Regularly test and record water salinity, particularly during summer.

9.5.12 SUPPORTING SOCIAL INFRASTRUCTURE

To achieve the most out of this plan and the funds it generates, it is important that the community is on-board. To achieve this, the following actions are recommended;

- Celebrate and acknowledge volunteers
- Training opportunities in civic affairs and rural leadership
- Active support of regional economic development initiatives, including tourism,
- Continued publicity of local achievements
- Business and social mentoring programs
- Provision of support for on-ground works, which takes into account the social needs of landholders, as well as the technical advice required for successful implementation.
- Raising awareness of the needs of the Coorong District community with higher levels of government.

Figure 70: Tailem Bend Bush Tucker Garden

The Tintinara Water Security Forum was held on the 29th of February, 2012.

Attendance at each of the sessions varied from 140 – 200 people, with a total of approximately 260 people participating in the event. Participants mainly came from the Coorong and Tatiara Districts, however there were also people from the Riverland, Murray River and South East.

Eighteen companies either had trade displays at the event or provided leaflets for the satchels.

Figure 68: Discussing the membranes used in desalinisation. L-R Brian Schulz (Saltfree), Adam Merry and Glenn Merry.

There was significant interest in;

- Leak detection and finding
- Water use monitoring
- Desalinisation
- Lined catchment dams.

Feedback forms were obtained from eighty-eight participants. All responses were very positive. Most participants asked for more information via similar events, they were interested in implementing one or more of the solutions. However, they would appreciate assistance via incentives and case studies, if possible.

Figure 69: Landholders and trades representatives at the Water Forum. L-R, Henry Angas, David Altus, Shane Oster and Michael Guthrie.

9.5.13 ACTION TABLE

The table below provides a summary of the major recommended actions for implementation by the Coorong District LAP program. It also provides indications of the issues addressed by each action. Some actions address issues from only one theme, while other actions assist with all six themes in some way. A mixture of general good practice and targeted actions is needed to ensure that the best practicable outcomes are achieved.

Actions	Water	Biodiversity	Soils	Air	Climate	Social
CURRENT ON-GROUND WORKS PROGRAM						
Perennial pastures	■		■	■	■	■
Fodder shrubs	■		■	■	■	■
Native vegetation establishment	■	■	■	■	■	
Wind breaks and alley farming	■	■	■	■	■	■
Farm forestry	■	■		■	■	■
Clay spreading, delving and mapping	■		■	■	■	■
Protecting remnant vegetation and wetlands	■	■		■	■	
Enhancing habitat for threatened flora and fauna	■	■		■	■	
Productive use of saline lands	■		■		■	■
Reclaiming or retirement of wind or water eroded land	■	■	■	■	■	■
Controlling lakeshore or other water based erosion		■	■	■	■	■
FUTURE ON-GROUND ACTIONS						
Mains water leak detection incentives	■		■	■	■	■
Decommission abandoned, leaking confined aquifer bores	■					
Expand existing weather station networks to cover dryland areas	■		■	■	■	
TRIALS AND INVESTIGATIONS						
Run or promote trials of climate change adaptation practices.	■		■	■	■	
Investigate and trial alternative water supplies, particularly stock water.	■				■	
Seek funding to provide alternative water supply or water use efficiency incentives, where incentive programs do not already exist.	■					■
KNOWLEDGE AND AWARENESS						
Run workshops to increase community knowledge of new issues, for example carbon trading or water security.	■			■	■	
Raise awareness of existing alternative water supply or water use efficiency incentives	■					■
Distribute information on carbon sequestration and air pollution research.			■	■	■	

Actions	Water	Biodiversity	Soils	Air	Climate	Social
Assist NRM Boards to engage with the community on animal and plant control issues.						
PARTNERSHIPS						
Work with schools, indigenous organisations, community groups and government agencies to increase NRM understanding and awareness.						
MONITORING						
Monitor the efficiency of all actions.						
Work with government agencies to maintain or resume past monitoring programs, which are needed to assess LAP program efficiency.						

9.6 ENSURING SUCCESS

One of the reasons for the success of the Coorong District LAP program has been the fair and equitable way in which landholder efforts are recognised, respected and supported. To ensure this level of implementation into the future, all Coorong LAP program actions will be supported by;

An increased understanding by landholders of the importance of each of the options in tackling natural resource management issues in the area.

- Committed efforts by landholders to adopt techniques that will achieve the objectives outlined in this plan.
- Community education and awareness on natural resource management issues and priorities.
- Involvement of Indigenous groups in the implementation of high priority actions.
- Recognition, incorporation and protection of indigenous assets, values and knowledge.
- Financial incentives to overcome any short term economic costs of loss of production whilst establishing improved management practices, and to assist with higher initial costs associated with some options.
- The provision of support for on-ground works that takes the social needs of the landholder into account as well as the technical advice needed.
- Other incentives such as the provision of labour or specialised machinery to overcome other barriers to implementation.
- Better utilisation and promotion of current research, existing experience and local knowledge from a wide range of sources toward the establishment and management of the systems outlined above.
- Readily available on-ground assistance and expert advice on aspects of establishment and management of the various systems across the range of local conditions.
- Better co-ordination and input to existing land management groups to ensure that research and extension programs and demonstrations are set up with maximum levels of community input and involvement.
- Enhanced partnerships operating between community, Government, statutory bodies, Local Government, indigenous groups and industry.
- Provision of support to landholders, community conservation groups indigenous communities and individuals
- On-going development of expertise in each of the options, and better recording and publication of information for the local area.
- On-going research to develop systems and techniques that are suited to local soils and rainfall.
- Monitoring, analysis and education on a wide range of related issues and actions, including the efficiency of revegetation or pasture establishment methods, comparison of sowing dates or methods, remnant vegetation health, changes in climate indicators, groundwater quality, what adaptation works or does not, and how to reduce 'mains' or portable water requirements or heat effects on livestock.
- Promote actions to reduce dependence on limited resources, for example phosphorus deposits, oil, coal and natural gas. Example actions would include the use of alternative fertilisers or increasing soil carbon levels.

As a result of consultation with the community, we consider that the following types of support (Table 16) are necessary to encourage accelerated and widespread uptake of solutions.

Table 16: Support required to implement actions

Activity	Financial support	Knowledge and awareness	Physical resources
Perennial pasture systems	●	●	●
Revegetation			
- Native species	●	●	●
- Farm forestry	●	●	●
Maintenance of native vegetation	●	●	●
Native vegetation corridors	●	●	●
Understanding biodiversity		●	●
Wetland management	●	●	●
Land stabilisation and rehabilitation			
- wind erosion	●	●	●
- management non-wetting sand	●	●	
- land capability/land use balance	●	●	●
- lakeshore and water erosion control	●	●	●
Leak detection systems	●	●	●
Alternative water supplies	●	●	
Carbon sequestration and trading		●	
Adapting to climate change	●	●	●
Reducing air pollution	●	●	

9.7 ABORIGINAL HERITAGE ACT AND NATIVE TITLE

It is an offence under the Aboriginal Heritage Act 1988 to knowingly remove, disturb or interfere with any Aboriginal sites, objects or remains. Discovery of any Aboriginal sites, objects or remains must be reported to the Aboriginal Heritage Branch.

Any disturbance of previously undisturbed areas, such as remnant vegetation, or activities which are likely to cause disturbance near a known Aboriginal site, should not proceed without advice from the Aboriginal Heritage Branch.

Appendix 8 contains a summary of how and what to report to the Aboriginal Heritage Branch, along with their contact details.

The LAP Committee recognises that registered native title claims exist over much of the LAP area. Every effort will be made to consult with the relevant Aboriginal Communities during the LAP planning process and before the commencement of on-ground works in any known culturally sensitive area.

9.8 INCENTIVES

Incentive payments made to landholders under cost-sharing arrangements have been readily taken up and cost effective over the last fifteen years of LAP program operation.

Incentives are set at equal to or less than the portion of public good that arises out of any action.

The incentives paid and thresholds for on-ground works are reviewed and refined by the Committee each year.

Two conditions on the provision of incentive funding is that the work be inspected and that it be managed appropriately for a set time period, as identified in the funding guidelines.

9.9 COST SHARING – WHO PAYS?

The overall economic benefits of many LAP actions are compelling, however ensuring that all stakeholders contribute to these works at a level reflecting the benefit received can be challenging.

It is clear that actions taken on ground will result in benefits being received by all stakeholders in the region. Some examples are provided in Table 17.

Therefore a recommended cost sharing ratio has been developed to provide a basis for the negotiation of the sharing of costs between stakeholders.

The Beneficiary Pays Principle (BPP) has been used in calculating this cost sharing ratio.

The BPP states that costs are distributed to stakeholders in direct proportion to the benefit they receive.

Beneficiary Pays takes into account that there are two types of benefits, direct benefits (e.g. increased on-farm production) and indirect or intangible benefits (e.g. enhancement of biodiversity or aesthetics).

Under the BPP, anyone deriving a direct benefit should pay for the works, however anyone deriving an indirect benefit should also contribute.

In previous assessments of Coorong LAP actions, the ratio of benefits has been;

- On-farm 60%
- Local 20.6%
- Wider 19.4%

Table 17, on the following page, lists some of the types of benefits which have been attributed to each of the stakeholder groups within this benefit distribution.

'On-Farm' benefits are private in nature. They are received by the landowner or property rights owner implementing on-farm works.

'Local' refers to the benefits received by the local community as a whole who are represented by the Local Government.

'Wider' refers to benefits that are highly public in nature and that flow to stakeholders throughout the catchment, in distant areas of the catchment, outside the catchment or over time to future generations. The NRM Boards, State or Federal Government represents these stakeholders.

The division of benefit ratio is heavily skewed towards landholders. This is due to the large production benefits received on farm by implementing the strategy.

If on-ground works are not implemented fast enough under cost sharing, public incentives and subsidies may be needed to accelerate the action. These are additional contributions by governments, above their cost share.

9.9.1 COST SHARING FRAMEWORK

The true cost-share ratio has been calculated based on the benefits that each stakeholder receives from the implementation of the Plan.

Even the most thorough analysis could not accurately value every possible benefit and cost, particularly as many (such as aesthetics and maintaining biodiversity) are non-market benefits which are rather intangible.

There are other issues, such as the stakeholder's ability to pay, dependence on agricultural industries, and the moral obligations of Government that will need to be considered.

Therefore a process of negotiation is used to agree on the final cost sharing ratio for the strategy as a whole, and also the responsibility for individual options. This enables the issues described above to be taken into account.

Table 17: Examples of some of the benefits received by stakeholders, as a result of LAP actions.

On-farm	Local	Wider	Wider still...
Private benefits	*Services to local community*	*Regional and state NRM*	*National benefits*
Higher yield, increased plant growth, decreased predation or livestock losses. Increased shelter for stock during heatwaves or storms Rating or tax breaks due to land care works Reduced fencing costs, reduced need for irrigation or fertiliser, lower animal and plant control costs, reduced feed costs. Improved aesthetics and quality of life Less early mornings, lower dust levels, health improvements, buffering of the house from pollen or overspray, career or educational opportunities for children.	Reduced erosion or sand deposition, less salt or inundation damage. Flood plain management Lower groundwater levels and increased water use efficiencies, reduced erosion. Reduced impacts from groundwater mounding around plant, reduced saline ingress into sewers. Reduced need for sewage infrastructure upgrades. Lower water consumption, reducing need for infrastructure improvement. Less pollution of groundwater, cleaner surface water bodies, and fewer algae blooms. Local recreation and amenity resources. Vegetation plantings at local reserves, improved roadside aesthetics, and reduced mains water use. Protects rateable values. Social change and education Better relationships between communities.	Public water resource management Public land resource management Conservation of regional significance Delivery of state or regional biodiversity goals. Social change and education Conservation of resources through changed behaviour. Increased social awareness of potential resource management issues. Positive, engaged community. Restoration of areas affected by state-imposed land management practices in the 1940s-1970s. Improvement of land values and production outputs to improve the state economy. State roads and rail Reduced salt and groundwater damage. Reduced inundation. Reduced erosion or sand deposition.	Reduced greenhouse gas emissions Increased carbon sequestration Increased revegetation, and protection of remnant vegetation. Compliance with international conventions Kyoto, Ramsar, Bonn, JAMBA / CAMBA, Apia, Biological diversity etc. Conservation of species with national or international significance. Targeted conservation of EPBC Act species such as the Metallic sun-orchid, Mallee fowl, Orange-bellied Parrot etc. Improvement of land values and production outputs to improve the national economy. Macro-economic reform Increased adaption of alternative production systems. Increased employment and skills, sustainable production, increased yields, less variable annual production.

This adapted BPP approach is in line with that used in the Upper South East Dryland Salinity and Flood Management Plan and the Murray-Darling Basin Commission publication 'Cost-sharing for On-ground Works'.

Involvement in the negotiation process should develop a sense of ownership of the strategy in the community, thereby increasing the likelihood of successful implementation.

9.9.2 COST-SHARING OF INDIVIDUAL OPTIONS

The recommended ratio of 60% regional community and 40% government (Local, State and Federal) is for the strategy as a whole and is essentially the starting point when negotiating the individual option cost sharing arrangements.

The aim is to ensure that the sum average of individual cost shares resembles the recommended ratio.

9.10 INDICATORS OF SUCCESS

For the plan to be viable a number of key performance indicators need to be met. Some will be short term while others may extend over several years. The indicators provide a guide to factors that can be measured along the way.

9.10.1 FINANCIAL

- The amount of external funds attracted to the district for use in implementing the plan.

9.10.2 ON-GROUND WORKS

- Hectares of land or kilometres of fencing covered by the on-ground works component. Eg clay spreading, perennial and saltland pastures, fodder shrubs, windbreaks and revegetation, sand drift stabilisation, protection of remnant vegetation and wetlands.
- The number of landholders implementing on-ground works options via the financial incentives on offer.
- The estimated value of landholder funds invested in on-ground works as their share of total costs.
- New on-ground works options planned, funded, established and implemented.
- Hectare, kilometre or dollar measures of the plan's contribution to community based environmental projects.
- Number of leaking or abandoned bores decommissioned.

9.10.3 KNOWLEDGE AND AWARENESS

- The numbers or newsletters, fact sheets, media articles and other publications produced and distributed.
- The number of field days, seminars and other public events conducted and the number of landholders, students or other interested persons attending.
- An estimate of volunteer hours contributed to community natural resource management activities.

9.10.4 PARTNERSHIPS

- The number and scope of partnership programs conducted in natural resource management and sustainable agriculture within the district via the Local Action Planning Committee.
- Sharing and utilising data collected by other agencies or organisations to demonstrate the effectiveness of the plan.

9.10.5 GUIDING PRINCIPLES

To achieve success of the plan several guiding principles need to be addressed. The principles set the scene for community support and involvement.

These guiding principles are;

- Engagement with landowners or other stakeholders, to improve their understanding and commitment to acting on issues raised in the plan.
- Continued community education and awareness of natural resource management and sustainable agriculture priorities and developments.
- Utilisation and promotion of current research, existing experience and local knowledge from a wide range of sources in addressing matters of importance.
- Co-ordination and input to other land management groups, agencies or organisations operating in the district to ensure that programs and demonstrations are set up with suitable levels of community involvement and local relevance.
- The distribution of public funds to private landholders via incentive payments for on-ground works should be based on a principle of community benefit. Eg reduced groundwater recharge, minimising erosion or salinity potential, enhancing biodiversity or other district and regional scale influences.
- A flexible approach and an ability to adapt to changing circumstances concerning environmental issues, community structures, government and partner agencies and opportunities for funding.

9.11 MERI PLAN

A condition of Commonwealth Caring for Our Country funding is the preparation of a Monitoring, Evaluation, Reporting and Improvement Plan (MERI). This Provides a base from which to review the progress the project is making towards the agreed Caring for our Country targets and outcomes and from which to learn about successful implementation strategies and to adapt in response to lessons learnt.

The key elements of this Plan are;

- Monitoring—the regular collection and analysis of information to assist timely decision making, ensure accountability and provide the basis for evaluation and learning.
- Evaluation—in the natural resource management (NRM) context, periodic assessment of the impact, appropriateness, effectiveness, efficiency and legacy of a program or project.
- Reporting—communication of the findings associated with the evaluation process.

Improvement—the use of the evaluation findings to inform decision-making about whether and where adjustments might be made to ensure achievement of intended results or the longer-term objectives of the program.

9.11.1 PROGRAM LOGIC

Program Logic is a key element of an evaluation process as it shows a series of expected consequences, not just a series of events, at different outcome levels within the logic. The program logic describes the relationships between activities and desired outcomes.

9.12 STAKEHOLDER ROLES IN THE LAP PROGRAM

Table 18: Stakeholders and their roles in the planning and implementation of the Coorong District Local Action Plan

STAKEHOLDER	ROLE
Landholders and manager	• To carry out planned works. This will mean providing labour, time, commitment and some funds. • To comply with legislated land management requirements.
LAP Committee	• To identify and consult with other stakeholders. • To develop and promote the LAP. • To co-ordinate implementation of the Plan. • To monitor, evaluate and review the Plan.
Local agricultural groups	• To provide a medium for community education. • To carry out planned works.
Non-agricultural groups	• To familiarise themselves with the LAP and ensure that any projects taken are in line with priorities and targets.
Industry and Agribusiness	• To work closely with the LAP Committee and provide assistance and technical support to landholders who are implementing works. • To provide funding for further research.
Coorong District Council	• To support the LAP Committee through the provision of office and administration support for the Project Officers. • To administer Government share of costs. • To support actions by individual landowners and community groups through its programs. • To undertake its own programs in a manner consistent with the Local Action Plan, in particular land use planning activities.
Natural Resources Management Boards	• To support the LAP program with funds, in-kind support, regional leadership or links to other bodies, where practicable and when it matches the Board's goals and programs (see Appendix 13). • To promote public awareness of the importance of a healthy catchment • To encourage community involvement in management of water resources and the environment • To ensure a consistent and coordinated approach across the catchment
State government agencies	• To provide technical support to planning and implementation of the Plan where actions match the State Government's priorities and programs. • To provide a proportion of the funds for the implementation of the Plan where the actions match the State Government's priorities and programs. • To implement on-ground works on government land. • To assist in evaluation and review of the Plan. • To develop legislation and policies which support and encourage the management of natural resources. • To fund strategic research.
Commonwealth	• To provide a proportion of the funds via Caring for our Country, Carbon Farming and other grant programs, for planning and implementation of the Plan, where actions match the Commonwealth Government's priorities and programs. • To assist in evaluation and review of the Plan. • To fund strategic research. • To ensure a consistent approach across the basin. • To evaluate Commonwealth outcomes.

10 WEIGHING UP THE BENEFITS

10.1 WHAT IF WE DID NOTHING?

Options are generally evaluated in comparison to a "do nothing" scenario or base case. This provides a benchmark against which the proposed project can be measured. For the Coorong District LAP program, the base case is quite variable. If the LAP walked away, what would happen to natural resources within the district? What would happen if the LAP continued, without additional actions?

The initial Dames & Moore cost-benefit analyses (1997 & 2000) put a strong economic case for initiating the Coorong District LAP program and continuing it indefinitely. Although the weighting of each NRM and economic issue has changed over the period of operation, the value of operating the current LAP program has not changed significantly. Given that there has been strong community support for the Coorong District LAP, thereby allowing it to achieve a large body of work, discontinuing it would not be an appropriate option.

Given this, we have focussed on the implications of the two options currently before us;

- Continue LAP program as it currently exists, to maintain inertia on addressed issues
- Update the LAP program to include a range of new actions, including new ways of addressing soil issues, education, water management and adapting to climate change.

The implications arising from the new issues, as detailed within this plan include;

Increasing water costs. It appears that the district currently uses 2.4GL of mains water, of which approximately 2GL is used for stock consumption. Assuming a 20% leakage factor, 0.4GL of mains water is lost via on farm leakage per annum.

The price of mains water is expected to double over the next 5 years. Without considering future costs, recent mains water price increases (an additional $0.75 per KL) is costing the District $1,800,000 more per year than it did two years ago.

Most water users around the Lower Lakes were unable to access lake water for some time. This is likely to happen again. When access to water is possible, the price of temporary water allocations has been high, varying from $200,000 - $1,000,000 per gigalitre over the past two years.

Rainfall is likely to decrease by up to 12% across the District by 2030, in comparison to pre-2000 average rainfall. This is likely to have a direct impact on production. It is also likely to increase the severity of wind erosion. A 12% decrease in district production would be worth approximately $19,500,000 across the district. This would render low profit enterprises unviable.

Using data from the Wimmera and Victorian south-west, it is possible to estimate that a production decrease of 12% across all enterprises is likely to result in a 60% reduction in net profits, if inputs and overheads are stable (DPI,2010).

Increased hot days (>40^{o}C) will have direct impacts on livestock grazing patterns, weight gain and finishing of crops. Current models suggest that by 2030 there is likely to be an extra 6 days per year over 35^{o}C and an extra 3-4 days over 40^{o}C across the Coorong District.

Southern Australian bushfire management planners are expecting a 5-12% increase in very high to extreme fire risk days by 2020 (Hennessy, CSIRO 2003). This comes at a sizable cost financially and in human lives. Bushfires have cost South Australia approximately $1,000,000 per year for the last 30 years and taken the lives of two people every three years, on average (since 1935).

Carbon trading and taxes. Placing a value on carbon could have both positive and negative impacts on the district. The impacts are highly dependent on the fine-print of the legislation and how the community (or the LAP program) responds to it.

Using 2006 ABS data, agriculture from within the Coorong District is likely to emit 300,000 – 400,000 t CO_2e per year. Approximately 67% of this is due the digestion process of sheep and cattle, with fertiliser use and livestock waste management taking second and third place. This does not include emissions from fuel, gas, electricity or input use, which are counted and being addressed by the industries responsible for supply of these inputs.

Air quality services offered by areas of remnant vegetation within the District are likely to include consumption of approximately 300,000 t CO_2e per year, which is already counted in Kyoto accounting. Environmental plantings sponsored by the Coorong District LAP program (which may not already be counted) are likely to consume an additional 10,000 t CO_2e per year.

Lucerne or a range of other perennial pastures have the potential to reduce CO_2 emissions and sequester carbon, increasing soil organic carbon levels.

Studies by a range of reputable research agencies, including the CSIRO, the Western Australian Department of Agriculture and the Victorian Department of Primary Industries suggest that CO_2 emission reductions of up to 30% are feasible by improving pastures with perennial legumes.

A risk assessment has been undertaken and has been provided in the appendixes.

10.2 ECONOMIC CONSIDERATIONS

10.2.1 QUANTITATIVE AND QUALITATIVE COSTS AND BENEFITS

Significant effort has been put into trying to analyse the costs and benefits of community NRM works and the universal conclusion is that it is not possible to put a monetary value on everything. Unfortunately for the LAP program, this includes the value of many of its actions.

When the Coorong District LAP was first formed, a lot of effort and expense went into valuing the costs and benefits of LAP actions. Although this information was fascinating, the eventual funding of LAP actions had very little to do with the monetary value of each action and a lot more to do with risk management, stewardship, scientific or political imperatives.

In the end, we can only assume that if an action is justifiable entirely on short-moderate term (0-5yr) production grounds, that landholders will undertake these actions without additional external assistance.

During the drafting of the plan, we have considered a range of other costs and benefits;

- What other actions will be enabled or disabled if we undertake this project?
- What opportunities does this project provide for members of the community or other stakeholders?
- Will we have an asset left at the end of this project, which we can use on something else, or sell?
- Will stopping this project or decommissioning this trial cost us anything?
- Will this project be a catalyst to stimulate other investments in natural resource management?
- Does this project provide members of the public with options that they would not have otherwise?
- Will this project increase or decrease external or spill-over costs, such as air pollution, noise, greenhouse gas emissions and other environmental effects?
- Is there a difference in the economic life of each action? Biodiversity plantings and clay spreading have life expectancies of more than 30 years, whereas Lucerne stands are only expected to survive for 8-10 years.

10.2.2 PAYBACK PERIOD

In an ideal world, the LAP program would like to see the payback period to participants be within five to ten years, however this is not always possible. Measurable impacts of some actions (such as biodiversity plantings) can take more than ten years to become apparent, so participation in

these is assumed to be due to either expectations of a future carbon value or non-financial reasons, such as land stewardship, succession planning and aesthetics.

10.3 BENEFITS OF COST SHARING

The benefits of on-ground works are frequently received by all stakeholders in a region, while the costs are bore solely by those implementing the works. The current cost-sharing approach being applied by the Coorong District LAP is aimed at rectifying this, at least in some small measure (AACM International, 1997, now Dames & Moore).

To maintain a positive community mindset, the LAP document uses a beneficiary-pays principle, rather than the polluter-pays principle used in many compliance organisations. This is tempered with other community considerations, such as the stakeholder ability to pay and perceived moral obligations.

The 1997 AACM report recommended an allocation of benefits over all proposed actions of 87% on-farm, 2% to the local community and 11% to the wider South Australian or Australian community, often over generations.

For individual projects, this ratio will vary, depending on the nature of each of the proposed actions. The details of benefits for a range of possible actions are provided in the table below (AACM International, 1997). Although the value of costs and benefits have changed significantly from the AACM report, along with the types of issues targeted by these actions, the level of benefits assignable to each stakeholder group is relatively similar.

The Coorong District LAP program takes a practical approach to implementing this strategy, to reduce the cost of implementing their programs. This is highly dependent on the funding sources available at the time, landholder skills and community resources. Table 19 provides some examples of benefits that each stakeholder could receive from implementing a few of the existing LAP actions.

10.4 CHANGING DIRECTIONS

The mix of on-ground work versus education and investigation within this LAP document has shifted slightly from that in previous versions of the Coorong LAP document. This is due to the new and evolving nature of some of the wider issues addressed within this plan.

It is also due to changes within government agencies and the community, where information distribution and coordination is playing a greater role in the work done by the LAP.

This directional shift means that a higher number of staff will be required as time passes, even with a relatively stable operational budget. This shift will also decrease direct landholder contributions, while increasing indirect or flow-on achievements.

If all proposed actions were to be undertaken on a consistent basis, the Coorong LAP program will need an annual operational budget of two million dollars per year and at least five full time equivalent staff.

Figure 71: Expanding areas of dryland salinity affected land affect everyone in a rural community

Table 19: Cost sharing for traditional LAP actions

On-ground works option	Percentage (%) of benefit		
	On-farm	Local	Wider
Perennial pasture	98.75	0.64	0.61
Alley grazing	98.11	0.97	0.92
Land stabilisation	38.22	5.24	56.54
Maintain remnant vegetation	0.36	0.01	99.63
Corridor plantings	24.92	0.99	74.09

11 APPENDIXES

APPENDIXES

1 Landzone map and descriptions

2 Groundwater maps

3 Biodiversity maps and lists

4 History of the Coorong District LAP

5 Funding Guidelines

6 Community involvement and roles of stakeholders

7 Land management advice

8 Guidelines for reporting an indigenous historic site

9 Conserving biodiversity

10 Organisation roles and responsibilities

11 Monitoring and evaluation programs in the Coorong District

12 Declared plants in South Australia, August 2008

13 Risk assessment

14 Coorong LAP and NRM Board linkages

15 Glossary

1 LANDZONE MAP AND DESCRIPTIONS

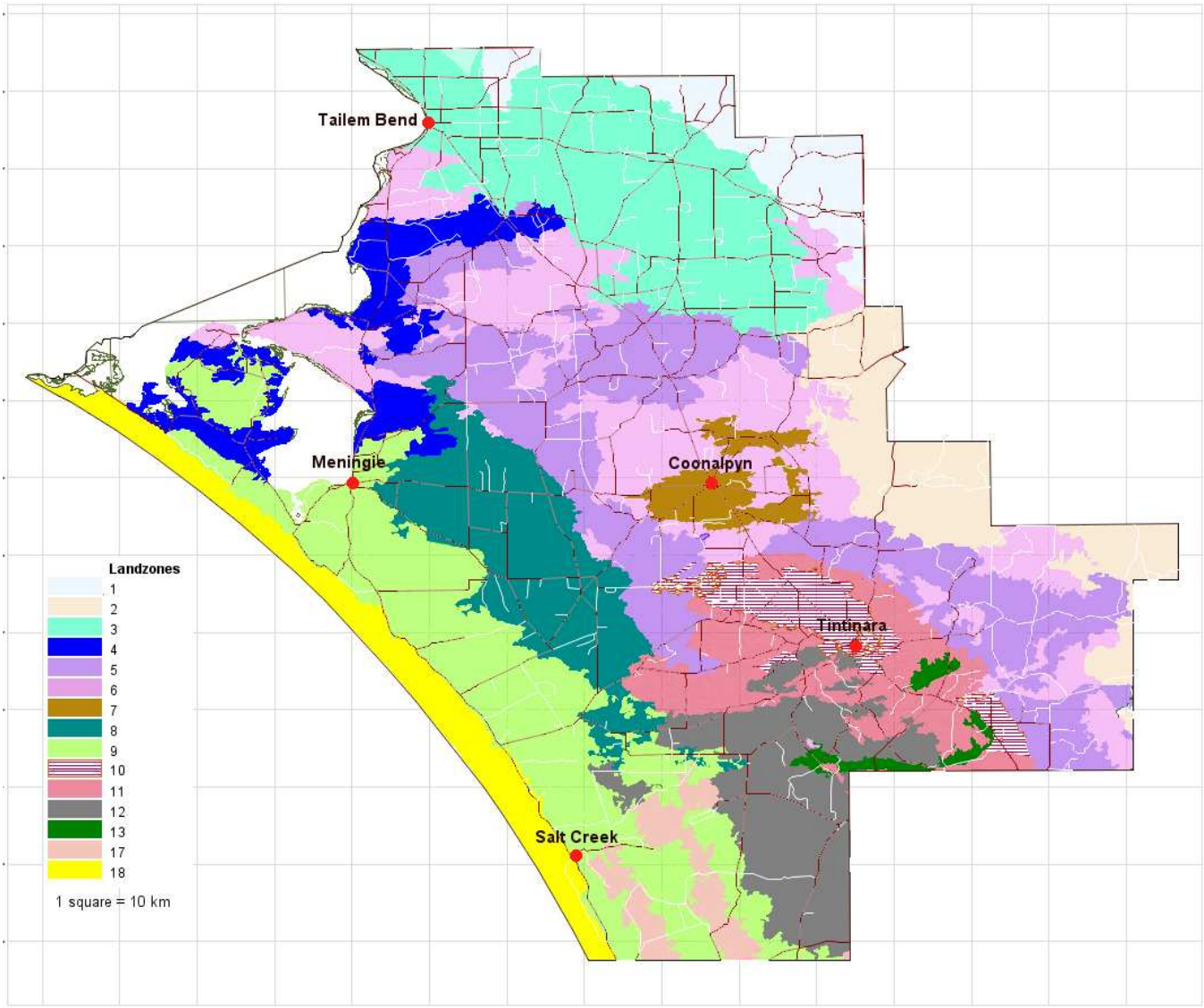


Figure i: Landscape features, based on data from the Land and Soil Spatial Data CD (DWLBC, 2007) and the Coorong DIstrict Soil Plan (1995)

	Description	Landscape Feature	Soil Types	Productivity limitations						
				Water holding capacity (● = low, ●● = moderately low)	Stoniness	Fertility (● = low, ●● = moderately low)	Erosion potential	Water repellence	Water-logging	Salinity
ZONE 1	This zone is an ancient coastal foreshore comprising of an undulating plain of stony (calcrete) flats and rises, broad swales and occasional sandhills overlying the main landscape.	Stony Rises, Flats and Slopes	Shallow sandy loam over sandy clay loam on calcrete	●	●					
		Loamy Flats	Shallow red or brown sandy loam over sandy to medium clay and soft carbonate							
		Low to Moderate Sandhills	Moderately deep white to yellowish sand overlying a layer of clay	●		●	●			
		Rubbly sandy slopes	Grey or brown sand to loamy sand over sandy clam loam to sandy clay on calcrete rubble	●●						
		Rubbly loamy slopes	Shallow brown sandy loam over sandy clay loam on calcrete rubble							
ZONE 2	This zone is a gently undulating dune field with low to moderate sandhills, concentrations of high U-shaped sandhills, extensive sand plain and isolated broad loamy to clayey flats	Sandhills	Deep white to yellow sand	●		●	●			
		Sandy Flats	Shallow grey or brown sand over white to yellow sand on yellow brown sandy clay	● to ●●		●	●	●		
		Loamy Flats	Shallow red or brown sandy loam over reddish sandy medium clay	●						
ZONE 3	This zone is a flat to gently undulating stone (calcrete) plain with occasional low to moderate irregular sandhills overlying the main landscapes	Red stony flats and rises	Shallow sandy loam over shallow sandy clay loam on calcrete	●						
		Brown stony flats and rises	Shallow brown sandy loam over shallow brown to red or brown sandy clay loam on calcrete	●	●					
		Sandhills	Deep white to yellow sand			●	●	●		
		Grey flats	Grey highly calcareous sandy clay loam over limestone			●				

	Description	Landscape	Soil Types	Productivity limitations						
ZONE 4	This zone is a low lying salinised lacustrine limestone plain overlain by extensive areas of alluvial clay, occasional low sandhills, and isolated gypsum lunettes near Cooke Plains. The zone is underlain by a shallow saline water table and saline lakes and soils occur in many of the lowest areas.	Clay Flats	Shallow dark grey silty clay loam over blackish grey and grey blocky medium clay. Saline water table usually > 100cm below soil surface (seasonally variabgle). At Cooke Plains gypsum occurs in profile at around 60cm.						♦	♦
		Saline Clay Flats	Shallow dark grey silty clay loam over blackish grey and grey blocky medium clay. Seasonally variable saline water table within 100cm of the soil surface, causing saline lakes and scalds.						♦	♦
		Low to Moderate Sandhills	Moderately deep white to yellow sand over clay	♦		♦	♦	♦		
		Stony flats and rises	Shallow red or brown sandy loam over reddish sandy clay loam on calcrete	♦	♦					
		Sand flats near Lower Lakes	Shallow dark grey silty clay over blackish grey blocky medium clay grading to a buried soil of grey white sand over grey medium clay in a seasonally variable water table. Some of the flats have a calcrete base.				♦			
ZONE 5	This zone comprises low to high early Pleistocene calcareous coastal dune ranges of undulating stony (calcrete) flats and rises with occasional irregular sandhills superimposed over the main landscape and alluvium in some flats.	Stony flats and rises	Shallow brown sandy loam over red or brown to red sandy clay loam or sandy clay on calcrete	♦	♦					
		Low to Moderate Sandhills	Moderately deep white to yellow sand	♦to♦♦		♦	♦	♦		
		Sandy flats and slopes	Shallow greyish loamy sand to sandy loam over white sand and brown to red sandy clay on calcrete	♦		♦	♦	♦		
		alluvial clay flats	Shallow brown to red fine sandy clay loam or sandy clay over red or brown sandy to medium clay							

	Description	Landscape	Soil Types	Productivity limitations						
ZONE 6	Gently undulating to undulating calcrete capped ancient calcareous coastal dune ranges largely veneered by low to moderate irregular sandhills, sand plain and occasional concentration of high jumbled to parabolic sandhills.	Sandhills	Deep white to yellow sand	♦to♦♦		♦	♦			
		Sandy Flats	Shallow grey or brown loamy sand over white to yellow sand, then brown to red or brown sandy clay loam on calcrete	♦to♦♦		♦	♦			
		Stony flats and rises	Shallow red to brown sandy loam over red to brown sandy clay loam on calcrete	♦	♦					
ZONE 7	Flat to gently undulating plain of mixed shallow soils over calcrete and limestone, poorly drained clay depressions and occasional low irregular shaped sandhills overlying the main landscape.	Red or brown stony flats	Shallow red or brown sandy clay loam over red sandy clay on calcrete	♦♦						
		Calcareous rubbly flats	Shallow grey or brown sandy clay loam over yellow brown sandy clay on calcrete rubble	♦♦						
		Low to moderate sandhills	Deep white to yellowish sand	♦		♦	♦	♦		
		Sandy flats	Shallow grey loamy sand over white to yellowish sand and sandy clay	♦						
		Clay depressions	Shallow grey or brown fine sandy clay loam over deep grey medium to heavy clay	♦♦					♦	
ZONE 8	This zone is a flat to undulating sandplain with occasional low to moderately high irregular sandhills and isolated low stony (limestone) rises.	Sandy flats	Shallow grey loamy sand over white to yellow sand on brown sandy clay	♦			♦	♦		
		Low to moderate sandhills	Deep white to yellowish sand	♦♦	♦	♦	♦	♦		
		Stony Rises	Shallow grey or brown loamy sand over light brown sand and brown sandy clay on limestone	♦	♦	♦	♦	♦		
ZONE 9	Low limestone ranges (ancient coastal dunes), with associated depressions. Much of the land surface is	Stony slopes	Shallow stony grey brown sand to red loam over limestone	♦		♦				

	Description	Landscape	Soil Types	Productivity limitations						
	covered by windblown sand. This tends to accumulate more on the eastern slopes. The ranges closest to the sea have relatively little sand.	Sandy slopes	Often deep siliceous sand over reddish sandy clay loam on limestone.			♦	♦			
		Lower slopes and flats	Shallow sand over tight yellow brown clay				♦			
		Flats	Shallow sand over friable yellow clay on limestone				♦			
		Swampy depressions	Grey clay on calcereous clay loam on pipeclay						♦	♦
ZONE 10	This zone is a flat to gently undulating limestone plain veneered by calcrete, sandplain and low to moderate irregular sandhills. Isolated stony (calcrete) rises occur in the west of the zone.	Sandy Flats	Shallow grey or brown loamy sand over white sand and yellow or brown to red or brown sandy clay	♦♦		♦	♦	♦		
		Stony flats	Shallow dark grey or brown sandy loam to sandy clay loam over grey or brown sandy clay on calcrete	♦	♦					
		Low to moderate Sandhills	Deep white to yellowish sand	♦♦		♦	♦	♦		
		Stony Rises	Shallow red or brown sandy loam to sandy clay loam over red medium clay on calcrete							
		Low to moderate sandhills	Deep white to yellow sand	♦♦		♦		♦		
ZONE 11	This zone is a flat to gently undulating sandplain with frequent low to moderate irregular sandhills and isolated stony (calcrete) rises in the west. Isolated low lying areas are being salinised by rising ground water	Moderately deep sandy flats	Shallow grey or brown sand over light brown to white sand and yellow or brown sandy clay	♦♦		♦	♦	♦		
		Shallow sandy flats	Shallow grey or brown sand over white sand and yellow or brown sandy clay on limestone	♦♦		♦	♦	♦		
		Stony Rises	Shallow greyish loamy sand over brown sand and yellow or brown sandy clay on limestone	♦	♦			♦		
		Saline flats	Shallow dark grey loamy sand (where bare, the soil is crusted with salt) over grey sand and yellow or brown sandy clay. A shallow saline water table occurs within 100cm of the soil surface						♦	♦

	Description	Landscape	Soil Types	Productivity limitations						
ZONE 12	This zone is a flat to gently undulating salinised stone (calcrete or limestone) plain interspersed by sandplain and areas of frequent low to moderate irregular sandhills. Widespread saline lakes and soils have formed due to a shallow rising saline water table.	Low to moderate Sandhills	Moderately deep white to yellowish sand over clay	♦♦		♦	♦			
		Moderately deep sandy flats	Shallow grey or brown sand over white sand and yellow or brown sandy clay. A saline water table occurs at 150 to 200cm.				♦	♦		
		Stony flats	Shallow grey sandy loam to loamy sand over yellowish or brown to red or brown sandy clay on limestone	♦	♦					
		Higher sandy rises and dunes	Deep siliceous sand			♦	♦	♦		
		Saline flats	Shallow dark grey loamy sand (where bare, the soil is crusted with salt) over grey sand and yellow or brown sandy clay. A shallow saline water table occurs within 100cm of the soil surface						♦	♦
ZONE 13	Sandy rises and moderate jumbled dunes with minor wet flats	Sandy rises	Deep siliceous sand or Moderately deep sand over sandy clay loam			♦	♦	♦		
		Better drained flats	Shallow sand over friable yellow clay or loam on limestone							
		Lower slopes and flats	Sand over tight yellow brown clay							
		Wet flats	Sand over grey mottled clay						♦	♦
ZONE 17	Wet and swampy flats with about 10% stony rises. Most of these areas are seasonally waterlogged, and significant areas are inundated either annually or at least in wet years. There are the areas where rising saline groundwater tables have had their biggest influence, and much of the land is moderately to severely salinised. Seasonal water movement is from sound to north, and some of the northern portions (eg Messent Conservation Park) are not currently subject to inundation.	Swampy Depressions	Grey clay on calcereous clay loam on pipeclay						♦	♦
		Better drained areas	Shallow sand over tight yellow brown clay						♦	♦
		Better drained areas	Deep sand over limestone or sandy clay						♦	♦
		Stony Rises	Shallow stony loamy sand over limestone						♦	♦

	Description	Landscape	Soil Types	Productivity limitations						
		Southern Areas	Black clay loam over limestone						♦	♦
ZONE 18	Coastal dune system and associated lagoons and samphire flats, sand spreads and low limestone rises.	Dunes	Deep siliceous sand			♦	♦			
		Sand spreads	Deep brown sand over limestone	♦		♦				
		Sandy rises	Sand over reddish sandy clay loam on limestone	♦		♦				
		Stony rises	Shallow stony sand to sandy loam over limestone	♦		♦				
		Lagoons and samphire flats	Swamp clays						♦	♦

2 GROUNDWATER MAPS

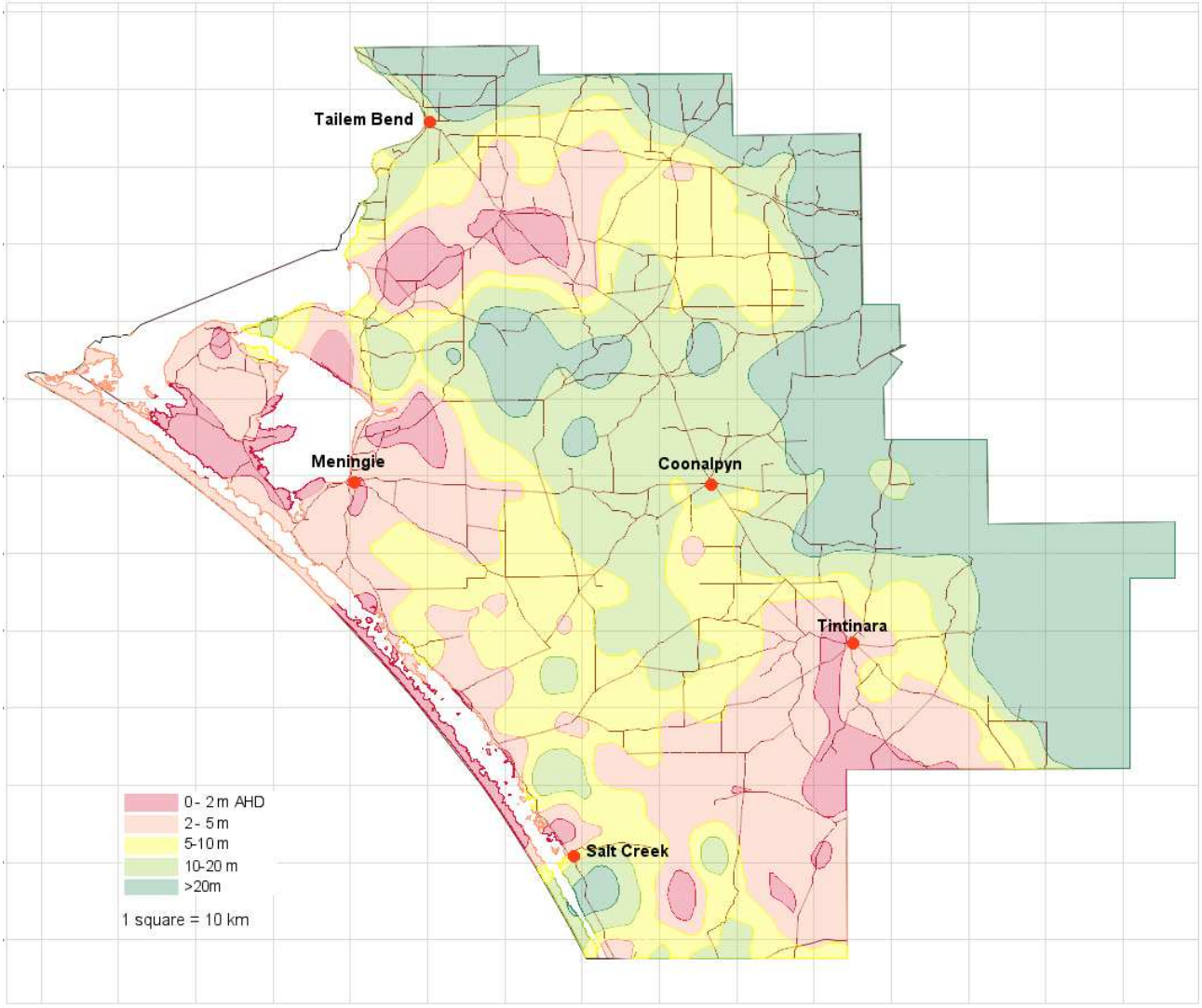


Figure ii: Generalised map of the Standing Water Level (SWL) of the unconfined aquifer, otherwise known as the water table. Based on a GIS layer downloaded from the South Australian Department for Water website (October 2011).

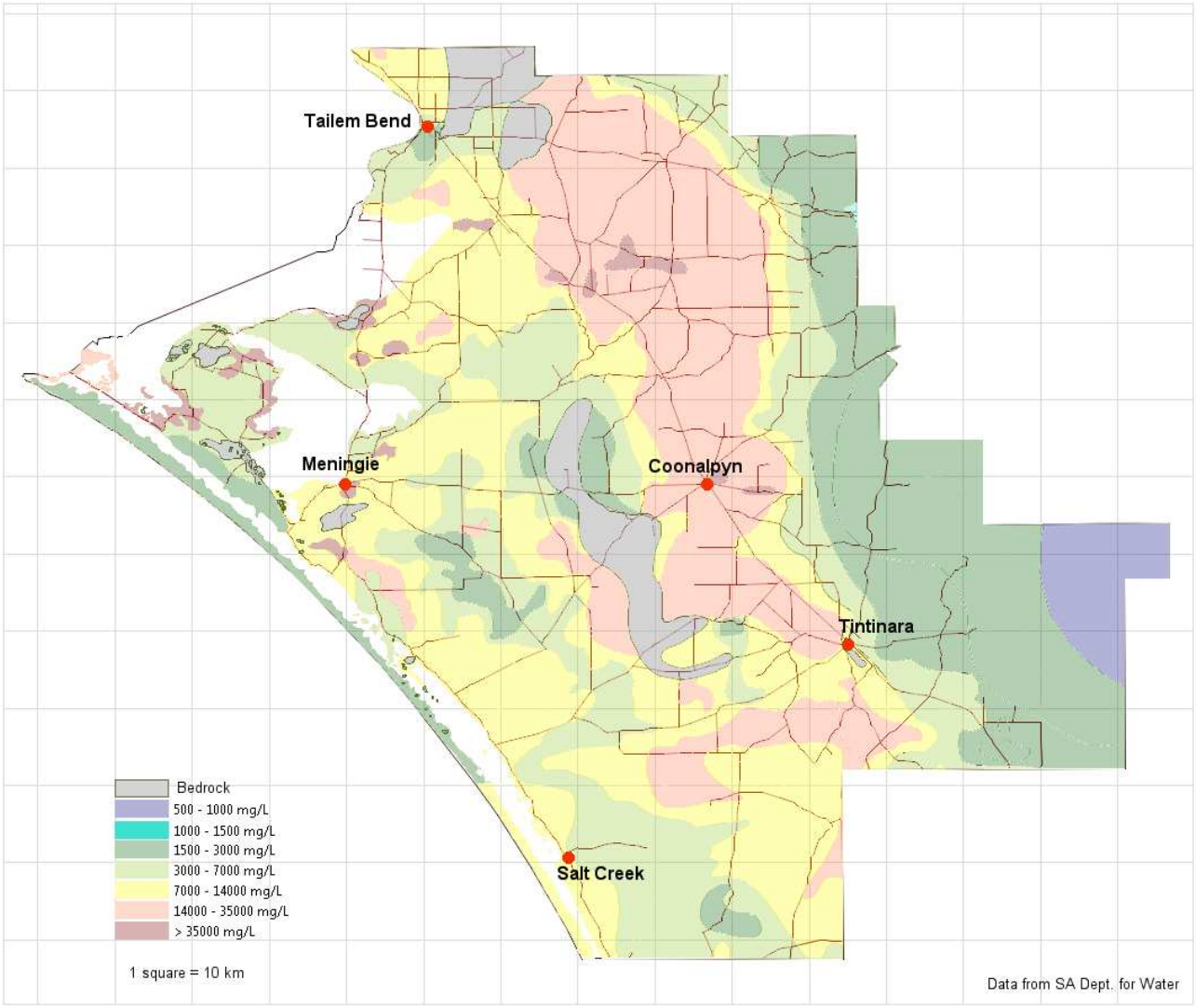


Figure iii: Unconfined aquifer salinities, based on a GIS layer provided by S. Barnett, Department for Water (October 2011).

3 BIODIVERSITY MAPS AND LISTS

DISTRIBUTION OF REMNANT VEGETATION

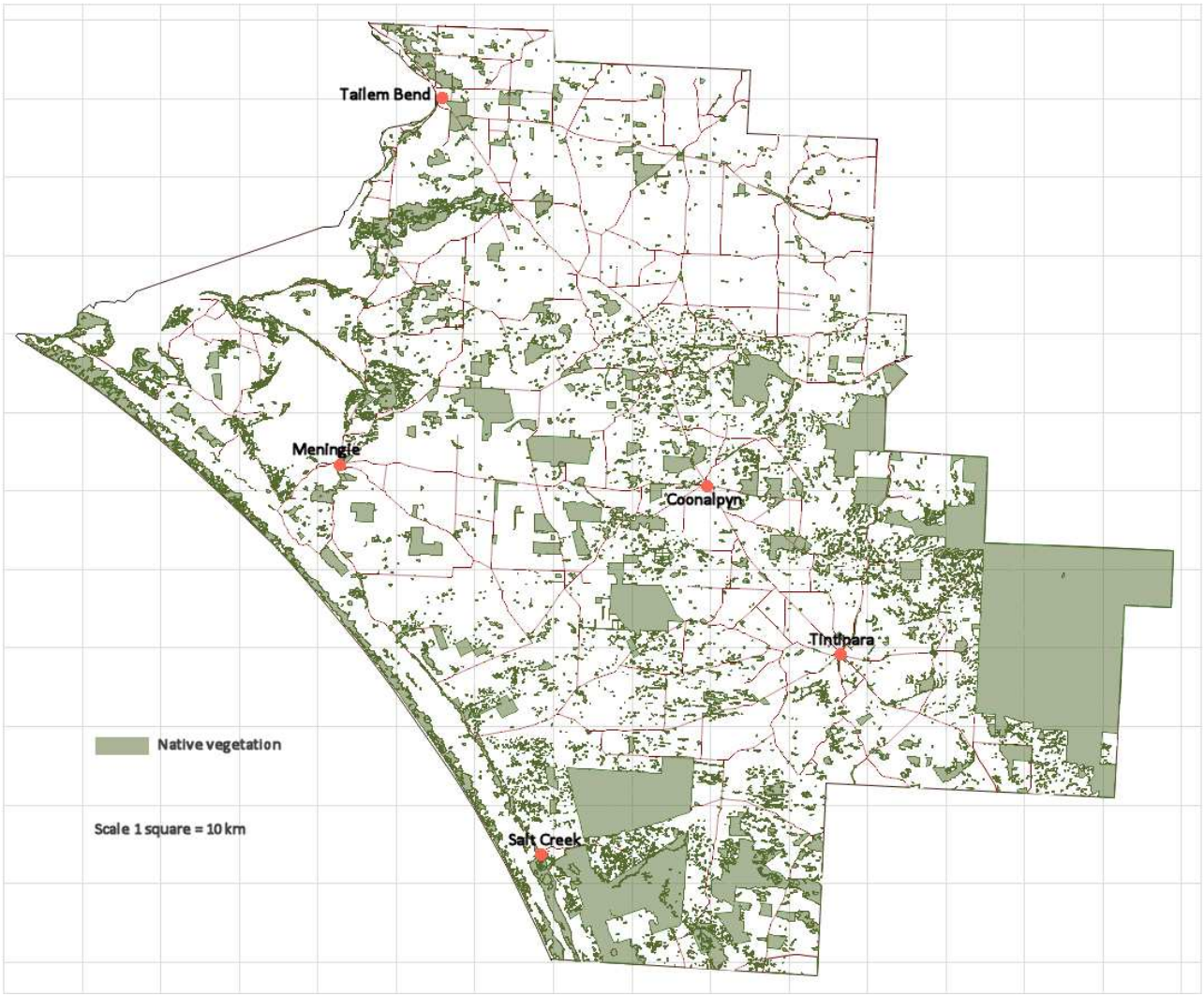


Figure iv: Distribution of remnant areas of native vegetation in the Coorong District, extracted from data downloaded from Nature Maps (accessed October 2011).

MATTERS OF NATIONAL SIGNIFICANCE WITHIN THE COORONG DISTRICT

Description	Status	Location	Threats (Primary)
THREATENED ECOLOGICAL COMMUNITIES			
Iron-grass natural temperate grassland of South Australia	Critically endangered		**Clearance, Grazing**
Peppermint Box grassy woodland of South Australia	Critically endangered		**Clearance, Grazing**
Wetlands of international significance			
Coorong and Lakes Alexandrina and Albert	Ramsar listed	Coastal	**Flow, nitrification, sediment imbalances**
THREATENED SPECIES			
Australasian Bittern	Endangered	Freshwater swamps	**Habitat fragmentation, drainage**
Swift Parrot	Endangered	Occasional visitor	**Habitat fragementation**
Malleefowl	Vulnerable	Mt Boothby, Ngarkat, Coorong, Messent, private land	**Habitat fragmentation, predation, inappropriate fire regimes**
Black-eared Miner	Endangered	Murray-mallee	**Habitat fragmentation**
Red-lored Whistler	Vulnerable	Ngarkat, Mt Rescue	**Clearance of understory**
Orange-bellied Parrot	Critically endangered	Coorong	**Clearance of saltmarshes**
Western Whipbird (eastern)	Vulnerable	Mt Rescue, Ngarkat, Comet Bore	**Fragmented habitat. Fires.**
Mallee Emu-wren	Endangered	Carcuma & Ngarkat	**Inappropriate fire regimes**
Fairy Tern	Vulnerable	Coastal, Murray Mouth	**Predation, disturbance, salinity, inappropriate water management**
Murray Hardyhead	Vulnerable	River Murray, Murray mouth and Lower Lakes.	**Lack of water, salinity, nutrient enrichment**
Murray Cod	Vulnerable	River Murray	**Flow regulation, habitat degradation**
Yarra Pygmy Perch	Vulnerable	Murray mouth	**Habitat degradation**
Southern Bell Frog	Vulnerable	Along Murray River	**Drainage or salinsation of wetlands**
Coloured Spider-orchid	Endangered	Mt Boothby, Cold n Wet Road, private property	**Clearance, grazing, weed invasion**
Coast Spider-orchid	Endangered	Ngarkat, Mt Boothby	**Clearance, grazing**
Little Dip Spider-orchid	Endangered	Coorong NP	**Clearance, grazing, Bridal Creeper, African Boxthorn, Perennial Veldt Grass and other invasive grasses.**
Coloured Spider-orchid	Vulnerable		**Clearance, grazing, weed invasion**
Greencomb Spider-orchid	Endangered	Mt Boothby	**Clearance, grazing, weed invasion**
Avenue Cassinia (Cassinia tegulata)	Critically endangered	Potentially along the Coorong.	**Change in hydrology, habitat fragmentation**
Trailing Hop-bush	Vulnerable	Potentially on Coastal Plain.	**Lack of knowledge**
Osborn's eyebright	Endangered	Lutze HA (near Mt Boothby) and SW of Yumali	**Clearance, lack of knowledge**
Sandhill Greenhood Orchid	Vulnerable	Tailem Bend, Poltalloch,	**Bridal Creeper, African Boxthorn,**

		Potters Scrub and Narrung Peninsula	**Perennial Veldt Grass and other invasive grasses. Grazing and inappropriate fire regimes.**
Large-fruited Groundsel	Vulnerable	Messent CP	**Change in hydrological and fire regimes**
Silver Daisy-bush	Vulnerable	Sandy rises	**Habitat fragmentation, weeds**
Lowan Phebalium	Vulnerable	Ngarkat, Mt Rescue	**Inappropriate fire regimes**
Fan Samphire or Beaded Glasswort	Vulnerable	Likely to occur on salt pans between Meningie and Salt Creek.	**Lack of knowledge. Hydrological change.**
Metallic Sun-orchid	Endangered	Mt Boothby, Tintinara, Meningie, Coorong, Cold & Wet Road	**Clearance, grazing, Bridal Creeper, African Boxthorn, Perennial Veldt Grass and other invasive grasses.**
Spiral Sun-orchid	Vulnerable	Southwest of Keith and South of Messent	**Clearance, grazing**
Jumping Jack Wattle	Endangered	Private property north of Mt Boothby	**Clearance, grazing**
Resin Wattle	Vulnerable	Roadside north of Mt Boothby	**Clearance, grazing**
Little Tern	Migratory	Coastal, Murray Mouth	**Coastal development, predation, off-road vehicles**
White-throated Needletail	Migratory		
White-bellied Sea-Eagle	Migratory	Coastal and permanent water	**Coastal development, loss of habitat, predation**
Rainbow Bee-eater	Migratory	Permanent water	
Great Egret	Migratory	Seasonally inundated wetlands, permanent water	**Drainage of wetlands, change in hydrology**
Cattle Egret	Migratory	Seasonally inundated wetlands, permanent water	**Drainage of wetlands, change in hydrology**
Latham's Snipe	Migratory	Seasonally inundated wetlands, permanent water	**Drainage of wetlands, change in hydrology**
Black-eared Miner	Migratory	Mallee scrub	
Fork-tailed Swift	Migratory		
Australian Painted Snipe	Migratory	Seasonally inundated wetlands, permanent water	**Drainage of wetlands, change in hydrology**
Twenty species of migratory shorebird, subject to international treaties.	**Migratory**	**Coorong**	**Coastal development, predation, off-road vehicles**

4 HISTORY OF THE COORONG DISTRICT LAP

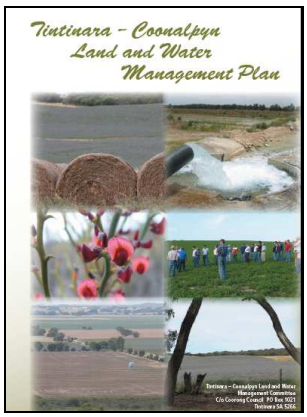
BACKGROUND – LAP TIMELINES

1989	Meningie Council employed a Landcare Officer which evolved into the LAP Project Officer position in 1995.
1995	Coorong District Soil Board District Plan released
1995	LAP Committee formed
	Meningie Council employed a Landcare Officer which evolved into the LAP Project Officer position in 1995.
1997	District Councils of Meningie, Peake and Coonalpyn Downs amalgamate to form the States largest Council
	First edition of the LAP released
	On-ground works incentives commenced
1999	LAP Committee and Soil Board formally amalgamate
2000	Second Edition of LAP released
2005	Two thirds of LAP moves to the SE under new NRM Act 2004
	Tintinara Coonalpyn L&WMP commenced
	Soil Boards wound up at end of 2005
2006	L&WMP launched by Minister Gago in July
	Agreement with SENRM Board for the LAP to deliver the TC L&WMP
	LAP on-ground works extended to cover part of the Tatiara District council
2009	Joint Coorong Tatiara project funded by CfoC
	Boundary changed to cover all of the Coorong & Tatiara District Council areas
2010	Tatiara LAP Committee formed

Community Action for the Rural Environment
Murray Darling Basin South Australia

PREVIOUS MAJOR PROJECTS

TC L&WMP



Background

In 2006 the Tintinara Coonalpyn Land and Water Management Plan (LWMP) was released, covering the Tintinara-Coonalpyn Prescribed Wells Area.

A Land and Water Management Plan (LWMP) is a community-driven plan that addresses the management of natural resources. The goal of a LWMP is to ensure sustainable use of land and water resources whilst maintaining biodiversity and farm profitability. L&WMPs complement and add to pre-existing Local Action Plans.

In July 2006 a Service Level Agreement with the SE NRM Board saw the implementation of the Tintinara Coonalpyn L&WMP being undertaken by the Coorong District LAP.

Tintinara - Coonalpyn Confined Aquifer Well Decommissioning Scheme

In November 2007, a proposal submitted to the South East Natural Resource Management Board by the Coorong District LAP was successful and received $220,000 funding from the 2007-08 Strategic Reserve to undertake a trial confined aquifer well decommissioning scheme in the Tintinara Coonalpyn region. An additional $133,000 of funding was secured the following year.

Figure v: The LWMP established a salinity test facility at Tintinara, for use by landholders.

This scheme is aimed at protecting the groundwater resources of the confined aquifer within the Tintinara Coonalpyn area through the decommissioning of a number of disused, leaking and poorly constructed confined aquifer wells.

The scheme has resulted in **110** confined aquifer bores being backfilled and a survey of **172** other bores to determine if they are leaking. According to Department for Water estimates, there is likely to be another 700 bores to go within the Coorong District, which would require approximately $2.3M in additional funding. This does not include replacement of currently operational bores, which require decommissioning.

Figure vi: Decommissioning of a confined aquifer bore.

Sustainable Urban Living Project

Urban salinity is a concern for many small townships in the Coorong District, including Coomandook, Coonalpyn, Tintinara and Culburra. In 2005 the South East NRM Board commissioned a team of consultants to look at salinity risks for Tintinara.

The risk assessment was well received by most landholders. The Coorong Council has helped implement a range of urban salinity mitigation measures in the town, and is using plants with low irrigation requirements in town landscaping. Residents in domestic properties can make a significant difference to town water use, and therefore reduce urban salinity risks.

Toward this end, a group of concerned residents and the Coorong LAP have obtained $22,534 of external funding from Envirofund to run a sustainable urban living program in Tintinara and Coonalpyn.

Weather Stations

The SE NRM Board has recently expanded its Automatic Weather Station (AWS) network. Weather stations are Located at Tintinara, near Coonalpyn and Narrung.

Several meteorological measurements are regularly recorded by each of the AWS, including rainfall, air and soil temperature, relative humidity, & wind speed/direction. All AWS data is publicly available via the blue nrmWEATHER icon on the SE NRM Board's website http://www.senrm.sa.gov.au. The Narrung weather is accessible on the web site http://samdbnrm.sa.gov.au.

Leak Detection Project

Most dryland farmers in the Coorong District check their water meters regularly, however estimates of water loss are usually around 20% of total water purchased.

The usual way to detect leaks is by manually checking the mains water meters after dark, then at first light. As many have 5-7 meters, which cab be over 10 km away from the house, the labour component involved means that meters are only checked 1-6 times per year.

$168,000 was obtained from the Commonwealth Water Grants and the National Landcare Program to research, develop and trial a leak detection system that would enable landholders to remotely access water meter data from their homes, resulting in early detection of leaks and the ability to find minor leaks, resulting in substantial savings.

OTHER LAP PROJECTS

Fodder shrubs project

The LAP committee was successful in getting a grant of $657,500 from the National Landcare Program and Caring for Our Country for its project to develop shrubs-based grazing systems. This project is run in partnership with SARDI.

A major activity in the project has been to develop demonstration sites in the Coomandook area. The sites provided an opportunity to develop forage grazing systems, based on fodder shrubs, as well as a resource for developing skills in managing and using these perennial forage systems.

The trials will improve knowledge on the design, management, inter row crops, species selection and nutritional information available for landholders.

Lakes Bioremediation

The decline in flow, and sustained low water levels experienced in the Lower River Murray reaches, Lake Alexandrina, Lake Albert, and the Coorong over the late 1990's has seen the emergence of a wide range of environmental, social, and economic issues. The Federal Government's investment through the Bioremediation and Revegetation Program saw a range of acid sulphate soils mitigation and ecological works undertaken to address these issues, with community engagement and participation a key platform of the this program. Community members were engaged through this program to undertake a wide range of activities including lakeshore fencing works, monitoring of acid sulphate soils, establishment of lake bed vegetation establishment trials, establishment of community nurseries, propagation of native plants for the program, and implementation of revegetation activities.

Lower Lakes and Coorong Community Revegetation Program

The community revegetation program follows on from the Bioremediation Project and will see community members living in the Lower Lakes area engaged to implement key components of the Coorong, Lower Lakes and Murray Mouth (CLLMM) Long Term Plan Revegetation Strategy.

The project provides a means for community members to address activities which have been identified as being necessary and desirable through the CLLMM Long Term plan revegetation strategy.

The Goolwa to Wellington LAP and CDLAP will work co-operatively with other organisations delivering elements of the CLLMM Long Term Plan Revegetation Strategy.

The key objectives for this program are to;

Implement and deliver a community based and managed revegetation program and undertake monitoring and evaluation of selected vegetation and revegetation works and natural regeneration.

Provide education and training opportunities for community members to become more familiar with practical and best practice revegetation planning and implementation techniques and methodologies.

Lakes Hub at Meningie

Although not a LAP project, the LAP works closely with the Lakes Hub at Meningie. Following on the success of the Lakes Hub at Milang, the Meningie Hub provides a central point for people to find out more about the vegetation program and other initiatives aimed at building resilience into the local environment.

The Lakes Hub is managed by the Milang and District Community Association and initially funded through the Lower Lakes Bioremediation and Revegetation project.

It was officially opened at the Lake Albert water celebration in November 2010

LAP / NRM Board Group projects

The Coorong and Tatiara LAP Committee's have a very close working relationship with the South East Northern NRM Group and the Mallee & Coorong NRM Group. We have run a number of successful events jointly with the Northern NRM group including the Mundulla, Keith and Coonalpyn shows, workshops and field-days.

The LAP has contributed to printing Board publications such as the SE Coastal Gardens Book, Bridal creeper fact sheets and displays and contributes to youth education programs run by both NRM Boards

Community groups and group projects

The Coorong LAP Committee supports over 24 community groups. Support includes;

- Funding for projects that address the LAP priorities, for example revegetation, threatened species, erosion etc.
- Funding for workshops, field days, bus hire, trials, speakers and on-ground works.
- Technical advice.
- Administrative support.
- Equipment eg Water Watch kits, salinity meters, propagation and tree planting needs.

Above, supply and erection of a new shade house at Orana, Meningie. Below is a picture of the structure being used.

Volunteers

The Coorong LAP Committee supports a wide range of volunteers. Volunteer activities include:

- Tree planting and propagation
- Weed control
- Feral animal control
- Wetland monitoring
- Groundwater monitoring
- Walking trail construction
- Threatened fauna and flora protection
- Native vegetation protection.

Community revegetation at Narrung, SA. MDB NRM Region

Chris Koolmatrie (Aboriginal NRM Project Officer SAMDB NRM Board) at the Tailem Bend Primary School

Indigenous Support

The Coorong LAP Committee supports a wide range of indigenous projects including;

- Sandhill stabilisation at Raukkan.
- Revegetation projects on Indigenous Land.
- Fodder shrubs trail at Raukkan.
- Farm forestry trial at Raukkan.
- Wetland and fish monitoring.
- Native food gardens at various local schools.
- Cultural awareness at various local schools.
- Conservation and land management training through the Aboriginal Learning on Country (ALOC) Program.

School projects and support

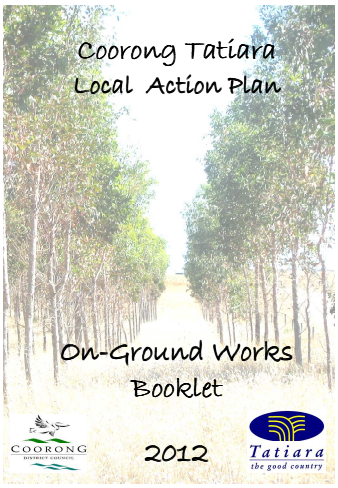
The Coorong District LAP Committee supports the 8 schools in the area. Support includes:

- Revegetation projects
- Plant propagation
- Plant ID workshops
- Indigenous food gardens
- NRM Education Program
- South East Environmental Education Working Group
- River Murray Youth Council

NRM Education program

5 FUNDING GUIDELINES

The on-ground works funding guidelines are published each year in the Coorong District Local Action Plan On-Ground Works booklet and is available on the Coorong District Councils website or from the LAP Project Officers.



Funding Guidelines vary from year to year because:

- Changes in the amount of available funding
- Priorities of the funding bodies varies
- Demand for incentives for some actions changes from year to year because of seasonal conditions, commodity prices etc.

The grants process;

1. Advertise for projects,
2. Technical advice is available at any stage of the project,
3. Maintain project database,
4. Expression of interest forms returned by landholders,
5. Works proposals sent out along with an on-ground works booklet which has incentive rates, funding terms and conditions and technical information,
6. Landholder workplans assessed,
7. Letter of offer, GST requests and agreement forms sent, which includes terms and conditions and maintenance periods,
8. On-ground works undertaken,
9. Landholder notifies LAP that the project has been completed
10. Site inspection,
11. Payments made to successfully completed projects,
12. Appropriate reporting, communications and publicity.

Technical Support for On-ground Works

Adequate technical support is provided by;

- LAP Project Officers
- Contractors
- NRM Board Staff
- Industry Agronomists
- One on one support given as required
- Specialist support obtained if required

Other support is available via;

- Workshops
- Field days
- Fact sheets, brochures etc
- Subsidised resources such as lucerne & farm forestry manuals

6 COMMUNITY INVOLVEMENT AND ROLES OF STAKEHOLDERS

COMMUNITY CONSULTATION PLAN

Figure vii: Community consultation at Salt Creek

A Community Consultation Plan was prepared to provide committee members and funding bodies with an overview of the proposed community consultation process for the 2011 Coorong District LAP review.

Given the scale of the review, it was critical that the local community was involved in the process, having a direct impact on the future directions of the Coorong District Local Action Plan. On the scale of community involvement (going from least involvement to most, the stages are inform, consult, involve, collaborate and empower) we planed to collaborate or empower LAP committee members and involve other interested parties.

The Coorong District LAP staff and contractors also consulted with academics, professionals, interest groups, regional, state, commonwealth and local government stakeholders to aid in gaining acceptance of the Plan and achieving the best possible outcomes for natural resources within the Coorong District.

Fourteen consultation meetings were held during the initial consultation phase. Community consultation meetings held at:

- Coonalpyn.
- Meningie.
- Salt Creek.
- Netherton.
- Coomandook.
- Tintinara.

Presentations given to and comments sought from:

- Coorong District Council.
- SE Northern NRM Group.
- Mallee & Coorong NRM Group.
- SE NRMB, DENR & DFW Staff.
- The SA Hydrological Society

Figure viii: Community consultation at Coonalpyn

No presentation was given, but comments were sought from;

- SAMDB NRMB Staff
- Ngarrindjeri Regional Authority.

The most common new issues to come out of the meetings to date have been;

- The price of mains water.
- Weeds, particularly on roadsides.
- The price on carbon, particularly costs and opportunities.
- Pests such as snails, mice and locust.
- Alternative fertilisers use.
- Lack of local agricultural information previously available from PIRSA etc

These issues have been addressed (where possible) within this revised LAP.

Figure ix: The LAP regularly attends field days to promote the work of the program and consult with landholders.

7 LAND MANAGEMENT ADVICE

The Soil Board District Plan (1993) was full of practical land management advice for property managers, addressing each of the natural resource management issues described within the plan. To enable landholders to access this advice, we have reproduced this information here.

WEEDS

The most cost effective way of managing weed incursions is to prevent them. Some strategies for weed prevention include;

- Before purchasing crop or pasture seed, check whether any weed seeds are present.
- Where possible try to buy stock feed which is grown locally to reduce the chance of introducing new weeds.
- To reduce the likelihood of seed being spread, feed out in a confined area or in one paddock. Keep a watch for any unfamiliar plants that germinate in the areas where purchased feed has been fed out.
- Check any new stock for weed seeds. Where possible buy sheep off shears. Confine new stock to one paddock for a week after arrival to allow time for any viable seeds still in the digestive tract to be expelled.
- Clean machinery down thoroughly after use in a weed infested paddock, and check tyres for weed seeds when moving between properties.
- Notify NRM Board Authorised Officers if any new, strange or unidentified plants are found. Eradicate any new weeds before they seed to prevent further spread. Co-operation between neighbours can help to minimise weed spread.
- Encourage the establishment of healthy crops and pastures which will out compete weeds.
- Where weeds are removed from a native scrub situation, ensure that suitable species are planted in their place.

If prevention is not possible, control weeds early in the growing season. Early control is usually the most economical. If weeds are allowed to spread, control becomes far more expensive and difficult in the long term.

Consider the use of several methods of weed control. Avoid too much reliance on any one method as weeds are known to develop resistance to any management practice that is over-used.

The following methods of control should be considered;

Cultivation

Be aware that some perennials i.e. those containing runners or underground stems, may be spread by this method;

Mowing and Slashing

Mowing or slashing can be used to prevent annual weeds from setting seed.

Grazing Management

Hard grazing can be used as an aid to weed control. Sheep feed closer to the ground than cattle and are therefore more destructive to plants under hard grazing, however sheep are more selective than cattle and so will leave unpalatable plants ungrazed, unless stocked very heavily. Cross grazing different types of livestock through paddocks can lead to more evenly grazed pastures.

Pasture competition

The establishment of thick, strong healthy crops will discourage weed growth.

Burning

Burning can assist weed control, by destroying some seeds, and encouraging others to germinate, allowing a maximum number of weeds to be killed by cultivation/spraying etc. However burning will also reduce valuable organic matter content and may leave soil prone to wind erosion so should be used as a last resort only, and should not be used on exposed sites.

Biological

This is a long term method whereby natural enemies of the weed are used to control the weed to a level where it is not longer considered a problem. Biological control cannot eradicate a weed species entirely because a natural balance is eventually reached between the control agent and the weed. However used in conjunction with other control methods e.g. cultivation, spraying etc it may mean that these methods can be used less often and at lower levels. Recent examples of successful biological controls in weeds are the Crown Borer Weevil in Salvation Jane, a combination of Rust and Leaf Hoppers on Bridal Creeper and the Plume Moth in Horehound.

Herbicides

There is an enormous range of herbicides available, and no attempt will be made to discuss these here. For further information speak to your local NRM Board Authorised Officer, local agronomists and farm advisors. Current phone numbers and locations of NRM Authorised Officers are;

Murray Bridge: 08 85329100

Meningie: 08 85751063

Keith: 08 87551083

LAKESHORE EROSION

Much of the Lakes shoreline is now fenced to prevent stock access, but in areas where lakeshore erosion is occurring, the following strategies should be considered;

- Prevent stock access to the shoreline.
- Establish off shore reed beds to reduce wave action to prevent further erosion and enable lake edge vegetation to re-establish.
- Once offshore reed beds have established, steps should be taken to encourage weed control then revegetation.

Landholders who have had success with stabilising the shoreline and re-establishing vegetation have found that it has the added benefit of enhancing wildlife habitat. Contact the LAP staff for more information.

Grazing guidelines

The South Australian Environment Portection (Water Quality) Policy 2003 requires that a person will not discharge or deposit a listed pollutant (including animal faeces) into any waters or onto land in a place from which it is likely to enter any waters. These processes include seepage, infiltration, carriage by wind, rain, sea spray, stormwater or by a rising water table.

Grazing can currently occur in the 15m gap between the fence and the lake edge. Grazing the lake bed is not permitted.

Grazing should only occur for short periods (no more than 48 hours) when the soil is dry and invasive species dominate. This should only be done up to three times per year. Contact the LAP staff for more information.

WATER EROSION

Although this is not a high profile issue in our region compared to higher rainfall areas, water erosion in paddocks can occur in high intensity rainfall events.

Several properties suffered severe water erosion following heavy rains in early 2011.

A few management options to prevent water erosion include:

- Use land in accordance with its capability
- Maintain good ground cover and soil structure
- Consider contour banks on steeper land
- Do not cultivate natural drainage lines
- Control runoff before it develops into an erosive force
- Use cover crops when there is insufficient groundcover
- Grassed waterways
- Vegetation barriers to slow down runoff

WATER RESOURCE MANAGEMENT

Water management issues in the Coorong includes both water security and water quality. Strategies for dealing with water quality decline can be divided into two broad categories;

- **Strategies which reduce the impact of different land uses on the water resource**. Such as improving dairy wastewater management, appropriately disposing of used chemical containers, improving irrigation and drainage management, or improving the management of wetlands and the river/lakes edge.

- **Strategies for preventing or dealing with water quality problems as they arise**. These include cleaning troughs, keeping storage tanks covered, identifying the source of contamination, identifying alternative water supplies and developing co-operative strategies with neighbours.

Management of irrigation water

Concentrated areas of irrigation or industrial water use in the Coorong District are managed by one of the three Water Allocation Plans. These include details of water licenses as well as information on the management of the resource including water allocations transfers, monitoring etc. Details on these plans, as well as associated water use efficiency programs can be found on the appropriate Board website.

The Tintinara Coonalpyn Prescribed Wells Water Allocation Plan is managed by the South East NRM Board (www.senrm.sa.gov.au or (08) 8724 6000). The Peake Roby Sherlock Prescribed Wells and River Murray Prescribed Water Course Water Allocation Plans are managed by the South Australian Murray Darling Basin NRM Board (www.samdbnrm.sa.gov.au or (08) 8532 9100).

Water security

There has been a significant concern raised by landholders about the large increases in the cost of SA Water mains water, particularly relating to stock water.

This has also been the biggest issue that has come from the community consultation meetings held throughout the district for the review of the Coorong District Local Action Plan. Approximately two thirds of the LAP area has saline groundwater. This can vary from marginal quality stock water to water saltier than sea water.

There is not a lot that the LAP can do about the price of water but we may be able to have a significant influence on reducing the amount of mains water being used. It will also help reduce the areas dependency on the River Murray by using alternative water supplies.

If running livestock becomes unviable, there is likely to be a major shift in landuse. If there is a significant increase in cropping this poses a major wind erosion threat as most of the area is fragile undulating non wetting sand. As a result this could lead to large areas of bare eroding soils.

There are a number of potential options to reduce dependency on mains water.

These would need to be addressed on an individual property basis and there are a number of variables to consider including ground water availability and quality, power availability, terrain etc.

Potential options include

- The use of leak detection equipment, e.g telemetry, electronic meters
- The use of leak finding equipment.
- Effective shandying of mains and bore water.
- Magnetic ionising water conditioners.
- Using off-peak water & storage.
- Rainwater harvesting techniques/methods.
- Upgrading farm pipes, tanks and troughs
- Considering animal nutrition & determining water quality that is 'fit for purpose'.

PEST ANIMALS

Rabbits

The Myxomatosis virus had a dramatic impact on rabbit number when first introduced during the early 1950s. However, resistance to the virus has developed and it can no longer be relied on for effective rabbit control.

Rabbit Calicivirus Disease (RCD) is a viral disease which affects only European rabbits.
During field trials in 1995 it escaped from Wardang Island, South Australia. The virus swept across the Flinders Ranges through the arid zone and killed large numbers of rabbits.

By combining traditional control methods such as baiting and the ripping of warrens with RCD releases, its effectiveness can be increased. The spread of RCD is slower when there are fewer rabbits. If rabbit numbers are low, rabbits will be older before becoming infected with RCD and therefore more susceptible to its effects.

Multiple methods of control should be used. As rabbits breed very quickly (*10 rabbits can increase to over 100 within one year*), the most effective rabbit control program will be one that aims for total eradication of rabbits.

While it is the responsibility of each landholder under the Natural Resources Management Act to undertake such a program on an ongoing basis, a coordinated effort among neighbouring landholders is essential for success.

Management strategies for the eradication of rabbits are listed below.

- Conduct a thorough poisoning program in late summer, coordinated with neighbours.
- Provide three free feeds, and poison over a 10 day period.
- Follow up poisoning by destroying all accessible warrens using cross ripping, blasting, discing or by using a vibration roller. This should be carried out when the soil is very dry and able to collapse.
- Fumigate inaccessible warrens and reopened burrows.

For further information and advice contact your local NRM Board Authorised Officer.

Murray Bridge: 08 85329100

Meningie: 08 85751063

Keith: 08 87551083

Foxes

Foxes cause significant environmental and economic damage throughout the LAP Area, resulting in:

- Livestock deaths, particularly new born lambs and attacks on ewes when lambing.
- Attacks on poultry
- A major threat to the survival of native ground dwelling birds and animals

There are a number of fox control methods that are used in the Coorong District. These include;

- Shooting
- Baiting, for example Foxoff
- Fumigation
- Trapping
- Fox proof fencing

For more information, contact your local NRM Authorised officer (see previous page).

Deer

Five species of deer are found in the LAP area. All species pose a threat to agriculture, the environment and public safety in the following ways:

- Damage to infrastructure caused by rubbing antlers.
- Vehicle collisions with deer
- Competition for pasture
- Damage to native vegetation through browsing and rubbing.
- Impacts to native animal species through disturbance of breeding sites,
- Potential disease vector for domestic livestock.

The South East NRM Board have a deer management policy stating the State, Regional and Local priority actions for deer control.

Contact the SENRM Board on (08)8724 6000 or your nearest NRM Authorised Officer

Other pest animals

There are a range of other pest birds, fish and animals in the LAP area. These include:

- Common Myna bird
- Sparrows and starlings
- Cats
- House crow
- Dingo/wild dog
- Feral Goats
- Rats and mice
- European carp

Native animals can also become a pest if they become abundant, e,g Corellas, Kangaroos and Emus. Various management strategies apply, depending on the situation. Advice should be obtained from the SAMDB and SE NRM Boards, local Authorised Officers and Biosecurity SA. At times, the LAP may be able to offer assistance and or incentives, when funding is available.

Biosecurity SA can be contacted on 08 82077900

NATIVE VEGETATION DECLINE

Management of native vegetation decline can be divided into two priorities. These are conservation or rehabilitation of existing vegetation and revegetation.

Conservation and rehabilitation of existing vegetation
To conserve and rehabilitate existing vegetation it is important to exclude stock, usually by fencing.

Consider the location of gateways, stock and vehicle access and stock grazing pressure (e.g. around water points) near remnant vegetation, in accordance with property management planning principles.

The line of the fence will be determined by paddock design and cost efficiency factors. A straight fence is always preferable as it minimises the amount of trampling damage to soil cover and risk of wind erosion.

When fencing remnant vegetation it is advisable to fence a minimum of 5 m from the treeline to allow occasional vehicle access (for rabbit baiting, and weed control around the edge), to reduce the problem of branches falling on fences, and provide a fire break. Regular vehicle or stock movement should be avoided in these areas because of the potential for erosion.

Particular care should be taken when fencing high sandhills that have extreme potential for wind erosion (Class VIIa), to ensure that fences are sited correctly.

Ongoing control of rabbits and other animal pests is essential.

Individual trees in paddocks are susceptible to stress and dieback. Most trees will regenerate if adequately protected from grazing and weed competition.

Fencing off non productive areas (e.g. rocky outcrops & saline wetlands), may be enough to regenerate native vegetation cover, however seed may need to be introduced and weeds controlled.

Landholders are encouraged to consider entering into Heritage Agreements over areas of native vegetation on their properties. Financial incentives are periodically available to assist with protecting and managing remnant vegetation. Where heritage agreement funding is not available or not adequate, the LAP can assist with incentives to fence and protect remnant vegetation and wetlands.

Weed control in native vegetation

It is important to control weeds in native vegetation. Weeds can:

- replace a diverse natural plant community with a less diverse weed community;
- increase the fire risk of an area of native vegetation; and
- reduce the number of native animals which can live in native vegetation.

The best way to control weeds in native vegetation is to keep them out. This will save time, effort and money.

Protect weed-free bushland by:

- minimising tracks, roads, firebreaks etc in the scrub
- preventing drains or water-ways from discharging into native vegetation
- preventing fertiliser from drifting into bushland
- keeping stock out of bushland
- controlling exotic animals such as foxes and rabbits
- maintaining a weed and fertiliser free zone around bushland, and
- checking native vegetation for weed invasion on a regular basis.

Once weeds have colonised an area of remnant vegetation, the best method for removing weeds is one which prevents weed regrowth and affects native plants as little as possible. This keeps the native vegetation healthy and able to regrow into spaces which may otherwise be taken by weeds.

For more information on weed control in remnant vegetation, contact DENR. The main points of contact for this issue are currently;

General 08 82041910
Native Vegetation Branch 08 83039777
Mt Gambier 08 87351177
Berri 08 85952111

Revegetation

A site is revegetated by growing native plants on an area that was once cleared. Where possible, revegetate with species that would have naturally occurred on the site.

Site preparation

Weed and grass competition must be removed to ensure that any moisture is conserved for native plants. This is especially important at establishment. Where some weeds are a problem, a 12- 18 month weed control program prior to planting may be necessary to ensure the success of the revegetation. .

Weed seed supply can be scalped away prior to tubestock planting or direct seeding to establish a clean site. Shaping the soil to form channels or planting basins can assist with initial establishment. Deep ripping in any soils with a hardpan, relatively shallow clay layer or calcreted stony layer will assist good root penetration.

Plant protection

Plantings must be protected from livestock, pest animals and insects. The most effective method is fencing. Ongoing rabbit control is essential. The need for follow up weed and insect control will need to be regularly monitored.

Planting

There are two main ways of planting. These are direct seeding and tubestock planting.

Direct seeding involves sowing the seeds of trees and shrubs directly into the site planned for them using specialised machinery or by hand in smaller areas. Seedlings sown by direct seeding often have a better root system than those raised in tubes, and are therefore hardier and more vigorous. Direct seeding is a less labour intensive technique of establishing trees than planting tubestock, and it enables dense, more natural looking stands to be achieved. Weed and insect control pre and post direct seeding is absolutely essential. This method requires a reasonable level of surface soil moisture to be successful. The LAP can provide a list of direct seeding contractors.

Tubestock planting is when native plant seedlings are raised in tubes or pots and then planted out into the selected sites. In the Coorong District, tubestock need to be planted by the first week in August. Earlier is better, providing the weeds have been controlled.

"Trees for Life" is an organisation which organises for free trees to be grown for landholders, or provides landholders with the seeds, tubes, soil etc. to grow their own. The LAP can provide a list of commercial nurseries that can provide trees and plants native to this area.

There is a variety of tubestock planting machines that can be used for broadacre planting. In some situations (e.g. paddock corners) hand tools will be necessary.

Other methods of planting include assisted regeneration and trashing. Both of these methods can be highly effective, however they are only appropriate in certain situations.

Prior to use in a planting program, some native seeds require pre-treatment prior to sowing. This can include being covered by boiling water, refrigeration, being tumbled with sharp sand or smoke treatment. Check what treatment is required well before the planned sowing date.

The time for sowing or planting varies between different areas and the planting methodologies. Soil types and rainfall have to be considered. As a rule of thumb, in areas of the district with 250-450mm it is best to sow in May-June, as long as weeds have germinated and been controlled. In higher rainfall areas, sowing in July to September is recommended.

For further advice, see the Coorong District LAP Onground Works booklet, contact LAP staff or ring a local revegetation contractor.

WIND EROSION

The key factor in the prevention of wind erosion is the maintenance of ground cover. This may be in the form of annual pasture or crops and their residues, perennial pasture, or native vegetation.

Other factors that have proven to have a significant role in prevention of wind erosion are:

- Maintaining appropriate stocking rates.
- Minimal soil disturbance.
- Maintaining soil fertility.
- Careful planning of property improvements, i.e. fences, tracks, and watering points.
- Control of root disease.
- Control of rabbits and mice.
- Control of other land degradation problems, e.g. salinity.

- Provision and maintenance of adequate windbreaks.
- Spreading of rubble on laneways, gateways and around watering points.

The following sections outline some strategies for managing different land types in order to prevent or reduce wind erosion.

Cropping

Wind erosion can be reduced in areas of cropping by the following practices;

- Maintain crop and pasture residues to provide adequate soil cover and regularly monitor current soil cover levels.Recommended cover is: 20% for land with low wind erosion potential, 50% for land with moderate wind erosion potential, 70% for land with high wind erosion potential.
- Build up soil fertility, including organic matter levels.
- Use no till or minimum tillage systems and stubble retention. Avoid excessive speeds when working the soil. Avoid working when the soil is dry, except with low inversion implements
- Adopt strategies to overcome water repellence.
- Encourage vigorous crop growth by; controlling disease, applying adequate fertiliser, sowing at the optimum time and controlling weeds.
- Avoid burning of paddock residues unless absolutely necessary. If burning, take precautions against wind erosion, e.g. burn in cool conditions to ensure some cover remains.
- If grazing stubbles, monitor closely and remove stock before excessive erosion potential is reached.
- Resow as soon as possible after a failed sowing event, taking into consideration time of season and possible weed cover.
- Establish windbreaks where possible. To provide maximum benefit, wind breaks need to be planted at right angles to the direction of the most damaging winds, contain 3-7 rows of native plants, be at least 10-20 times longer than the expected tree height, with minimal gaps.

Grain Legumes

Grain legumes have specific management requirements, as their roots have poor binding capacity and stubbles break down very readily, leaving the ground exposed over the summer and autumn period, unless careful management strategies are adopted.

Suitable strategies include sowing grain legumes into cereal stubble and harvesting grain legumes as soon as the crop is ripe to avoid grain loss and therefore the need for follow-up grazing.

Graze grain legume stubble sparingly. Pea stubble on light soil represents a very high erosion risk and should not be grazed until the season has broken.

Use of a straw chopper and spreader can be beneficial when harvesting grain legumes.

If cropping of high wind erosion areas is unavoidable, extra care needs to be taken. In addition to the above, strategies for these areas could include:

- Clay spreading or delve on these areas to reduce wind erosion risk and improved production.
- Use direct drill and minimal till technologies.

- Sow with a crop that will quickly provide a high level of ground cover to maintain stability, when the neighbouring area is to be cropped.
- When sowing cereal rye / rye corn, sow early with adequate nutrition, to encourage vigorous crop growth.
- Avoid working when the soil is dry, except with low inversion implements.

Grazing

Grazing management is an art which needs constant attention and adaptation to circumstances, however the following recommendations may be of use;

- Where practical fence land with moderate to extreme potential for wind erosion separately to other land classes.
- After fencing, establish permanent pasture, fodder shrubs or native vegetation.
- Build soil organic matter levels, and maintain adequate soil fertility.
- Control grazing of each paddock to maintain adequate cover on the most susceptible soil.
- Eradicate rabbits.
- Control troublesome weeds like Silvergrass and replace with perennial pastures.
- Limit grazing on spray topped pastures.
- Plant windbreaks wherever possible.
- Use care when siting property improvements e.g. water points, fences and laneways.

Land with extreme potential for wind erosion will need special care. Extra management strategies are listed below.

- If the hill has already suffered from erosion to the extent that it cannot be traversed with a tractor and combine, it may be necessary to use a earthmoving equipment to shape the hill.
- If available, consider spreading clay on these areas to reduce wind erosion risk and improved production.
- Sow with cereal rye when necessary to maintain cover until permanent pasture/vegetation can be established. Sow the cereal rye as soon as possible after the end of March. Sowing rate should be 60 kg/ha with at least 10 kg/ha each of nitrogen and phosphorus. Strips should not be missed as this may create a wind tunnel.
- Resow as soon as possible if wind damage occurs.
- Establish permanent pasture or fodder shrubs.
- Graze with cattle instead of sheep wherever possible.
- If any bare patches appear, exclude sheep, spread straw or brush on the bare areas, until it is possible to resow with cereal rye.
- Establish windbreaks where possible. To provide maximum benefit, wind breaks need to be planted at right angles to the direction of the most damaging winds, have a foliage density of 30%-50% (3-7 rows of native plants), be at least 10-20 times longer than the expected tree height with minimal gaps.

CLAY SPREADING

Techniques of applying clay to water repellent sands have been widely practiced in the Upper South East since the early 1990's. Clay spreading involves sourcing clay through digging pits and spreading gleaned clays across water repellent sands. The clay is then incorporated into the topsoil.

Clay spreading, if done correctly, can have significant benefits for reduction of wind or water erosion potential. It also reduces water repellence, controls low water use weeds and increases productivity. If done incorrectly, other issues can arise.

There is significant potential for clay spreading to be carried out by landholders in the Coorong and Districts. The practice is gradually being adopted, however the availability of suitable clay is tending to be a limiting factor in some areas. Recent trials of spreading rubble or trimmings on sandhills, in areas lacking suitable clay, are proving positive.

It is generally accepted that adding clay to an area can increase production by up to 100%, making it very worthwhile. Specific benefits include:

- improved water-holding capacity
- improved nutrient retention
- increased organic matter
- more even germination, due to even soil surface wetting
- better wettability of the soil which increases the efficiency of herbicides resulting in a more effective weed kill
- earlier soil wetting resulting in better emergence
- improved cropping and grazing potential
- reduction in wind erosion
- improved land capability providing the opportunity to diversify into more profitable enterprises.
- increased profitability of the land through increased grain yields, stocking rates and wool clips
- increased water use efficiencies on the water repellent sands, therefore reduced groundwater recharge
- A long term solution

The type of clay used is important. Dispersible clays are best ie. clays that are high in sodium (sodic clays). These are known as kaolinite type clays. Generally any clays that slake in rainwater and disperse can be used.

There are three types of equipment which can be used for extracting and spreading clay: road scrapers, carry grader (or land plane) and spinner type bulk spreader (e.g Claymate). Each has its own advantages and disadvantages, and the most appropriate option will depend on the individual circumstances.

An alternative to extracting the clay from a dam, and applying it to the non-wetting soil, is delving. This involves deep ripping to bring the clay to the surface. The clay needs to be within 500mm of the surface to be really effective.

The importance of incorporation cannot be stressed enough. Inadequate incorporation can result in clay setting on the surface and not allowing rain water to penetrate, creating excessive runoff, small scale gullying and reduced crop or pasture establishment.

The most common method of incorporation is with a scarifier. Disc ploughs, rotary hoes and spaders have also been used, but it is important to travel slowly to allow for effective mixing. In order to be effective, clay must be incorporated to a depth of at least 10 - 15 cm.

WATER REPELANCE

By making some adaptations to seeding machinery, it is possible to use the water repellent nature of the soil to advantage when establishing pastures, crops or revegetation. The aim is to sow seeds into the bottom of furrows, thereby making use of the water which runs into these furrows.

The following strategies have proven to be useful in improving germination.

- Direct drill if possible.
- Increase furrow spacing width on seeding machinery to increase the water harvesting effect.
- Apply wetting agent along the sowing rows.
- Place seeds in the bottom of the furrows and then cover with press wheels.

It is important to ensure the soil is adequately moist for seed germination when undertaking this process, as any form of wind erosion will fill furrows with dry soil, preventing eventual germination.

Other strategies which can help to overcome the problems associated with water repellence are listed below:

- Limit cultivation on water repellent soils to reduce the risk of wind erosion. Use chemicals for weed control where possible.
- Work on the contour to ensure rain is trapped where it falls.
- Grow perennial pastures such as Lucerne and Veldt grass which don't rely on regermination for persistence.
- Undertake clay spreading, as discussed in the wind erosion section.

Figure x: Just after clay spreading.

ORGANIC CARBON DECLINE

Most soils in the Coorong District have a soil carbon level of less than 0.5%. All soils in the district are susceptible to decline in organic carbon concentrations. Good farm practice can stop organic carbon decline and in many cases actual gains can be achieved.

Organic carbon is easier to loose than build up in soils. Unfortunately it is the soils that can least afford to lose it that are most prone to organic carbon decline (ie. less fertile sands). These soils tend to have the lowest ability to grow enough bulk to return to the system to maintain organic matter levels.

Plant residues, both root growth and the residues above ground, are the primary source of soil organic matter. From an organic carbon point of view, it is not important what form the residue comes in, (whether cereal straw, grass or legume pasture), it is the bulk of dry matter returned that is most significant. The form in which carbon is introduced can influence other land management issues, so is important from other aspects.

Although the waxy coating from partially decomposed organic matter (in particular native plants and legumes) can contribute to non-wetting in susceptible soils, the effect of organic carbon on water infiltration and storage is generally positive. Decomposed organic material helps stabilise soil structure, provides nutrients for plant growth and holds several times its own weight in water.

Many other natural resource management issues contribute to organic matter decline.

Wind erosion trials (Leys et al 1994) in the Murray Mallee have clearly shown that the fine dust removed from the system in wind erosion contains a concentration of organic matter. Soils most prone to wind erosion (ie. the less fertile sands) are therefore very prone to organic matter decline.

Burning residues physically removes organic matter from the system. While the very occasional burn or partial burn (to assist in snail control or machinery operations) will not cause significant depletion, continual burning will lead to a decline in organic matter, reduce the soils productive capacity and may also increase the risk of wind erosion.

Removal of organic material has a direct impact on the organic content of the soil.

Overgrazing may cause a decrease in organic matter within your soils. While grazing pastures is not generally viewed as a major removal of organic matter from the system, it may affect the distribution within the paddock, depending on where stock may camp. Overgrazing however can aggravate erosion, resulting in the loss of organic material.

Cultivation accelerates the decay of organic matter by aerating the soil and altering microbial populations. In light sandy soils which are already aerated, this is not a significant cause of organic matter decline, however cultivation of these soils can lead to increased wind erosion with the resultant loss of organic matter.

Poor production of organic matter use to Infertile or unproductive soils (ie. those with high root disease levels etc.) will not produce enough plant growth and residues to return to the soil to maintain organic matter levels.

Once depleted, it is a difficult and long term process to restore organic matter due to a range of limitations, including: inadequate nitrogen reserves to break down stubbles; a depleted population of soil microbes; relatively small amounts of organic matter being produced each year.

For example, stubble for a 2 t/ha cereal crop will increase soil organic carbon by only about 300 kg/ha. Of this, significant portions will be used us by the next crop, so the amount retained in the soil profile is minimal in relation to the total. However, it is the small annual gains and losses that determines the long term soil carbon content.

One common way of increasing soil carbon in the Coorong District is by clay-spreading, which retains water and nutrients in the root zone, increasing the growth of crop or pasture plants, speeding up organic decomposition, reducing carbon oxidisation, stabilising soil microbe populations and retaining more carbon within the soil profile.

The best means of increasing soil carbon is through well managed pastures and prolific plant growth, to the extent that the soil surface is blanketed by a mass of living leaves, protecting it from wind erosion and rain drop impact.

While under pasture:

- Organic matter increases.
- Stable soil aggregates are found.
- Microbial/earthworm populations increase.
- Nitrogen fertility improves.
- There is no cultivation to increase carbon oxidisation.

However where it is not desirable to maintain permanent pasture, the following management practices are best suited to maintaining or improving soil carbon concentrations.

- A rotation that includes a vigorous legume pasture phase. Increasing the length of the pasture phase will help to build organic carbon levels.
- During the crop phase use crops that will provide large amounts of stubble.
- Minimum tillage and stubble retention.
- Adequate use of appropriate fertilisers.
- Use of low speeds (less than 10 km/h) with low inversion implements in moist soils, when cultivation is necessary.
- Prevention of wind erosion.
- Monitoring of soil organic carbon levels by soil analysis (keep in mind, it takes a long time for organic matter to break down enough to show on one of these tests, particularly in low rainfall areas, however it does not take long to lose it).

SALINITY

Dryland salinity in a rural environment

The management of dryland salinity is generally done using a two pronged approach of attacking the cause and mitigating the impacts.

To prevent dryland salinity it is best to make the maximum use of rain where it falls, in order to prevent this water from entering the groundwater system (as recharge).

Preventative works need to be carried out over a large scale to be effective. A reduction in recharge of at least 50% and preferably 90% is needed over thousands of hectares. To achieve this level of adaptation, the recharge reduction solutions need to be cost effective and ideally profitable.

The recommended strategies to achieve this are:

- Establish deep rooted perennial pastures or fodder shrubs
- Increase crop and pasture water use by increasing their health and productivity.
- Establish trees and shrubs as forestry blocks and windbreaks to use up water that drains below the surrounding crop and pastures root zone. The density of plantings will depend on the species, age and health of the trees, climate, soil and landscape position.

Fodder shrubs are also productive options that reduce recharge, provide shelter as well as being valuable stock feed, particularly in times of drought.

The Coorong District LAP has secured 5 years of funding for the project *"Securing soils under productive forage shrub systems"* in partnership with the South Australian Research and Development institute (SARDI)

Perennial forage plantings that include native shrubs can extend ground cover to consolidate fragile, easily eroded soils. The use of forage shrubs for many livestock producers coupled with unfamiliarity of their advantages and short comings can limit the productivity of these plants, their effective use by grazing livestock and their contribution to soil protection. Skilled management of these plants and grazing livestock can buffer feed shortages and protect the environment. Hence, this proposal emphasises capacity building. This project will build and extend skills among farmers using vulnerable soils. Additional LAP incentives may be available to landholders who participate in the trials.

The second approach to managing dryland salinity is to manage affected soils that result from rising water tables. Following are some strategies for rehabilitating, or at least preventing the spread of these salt affected areas.

On cropping land with low to moderate salinity;

- Use salt tolerant crops such as barley or canola.
- Sow salt tolerant pasture cultivars, e.g. Balansa Clover or Puccinellia.
- Grow high yielding crops and pastures to maximise plant water use.
- Aim to overcome other limiting factors ie. low fertility, disease control, weed control and seed bed preparation.
- Maintain crop and pasture residues to ensure the soil surface is covered at all times, reducing evaporation.

On land that is too saline for crops;

- Pastures need to be fenced off to enable the control of grazing pressure. Where possible keep this separate from annual crop and pasture land.
- Establish salt tolerant perennial pastures.
- Encourage and maintain surface cover at all times to reduce evaporation and prevent salt from concentrating at the soil surface.
- Graze perennial pastures in Spring and Autumn and allow them to set seed on a regular basis to maintain stand density.
- In areas suited for revegetation, establish salt tolerant native trees and shrubs around the edge of salt affected sites to increase water use and halt or slow down the rate of spread.
- Rip bare patches to roughen up the soil to promote the leaching of salt.
- Where possible, cover any bare patches with sheep crutchings, hay, straw, or similar material to reduce evaporation, encourage natural regeneration and reduce erosion.

Urban salinity management

In 2006, a study was undertaken in the Tintinara Township, which identified that urban salinity was a threat to some assets in the township and could be an issue elsewhere in the Coorong District.

Urban salinity occurs when groundwater levels rise under town infrastructure due to localised recharge or regional processes.

Rising water tables can have significant impacts on urban areas. As the saline groundwater rises towards the surface it kills grass, shrubs and trees, and can cause water logging and bare patches of ground. It can also result in cracked or collapsed roads and damage to buildings (salt damp), septic tanks, cemeteries, rubbish dumps, and corrosion of water, gas and sewage pipes.

Even though not all urban areas will feel these direct effects, all areas will be affected indirectly and poor water management may aggravate salinity issues elsewhere. The following steps can be taken around homes and in urban areas to reduce the amount of water that reaches the water table:

- Avoid water wastage
- Keep watering of lawns to a minimum or convert to a low water use lawn alternative.
- Group plants with similar water needs together, use an appropriate mulch, and only water when necessary
- Plant deep-rooted plant varieties and have small lawn areas
- Connect roof drainage to the stormwater system or rainwater tanks and not to sullage pits
- Do not empty pool water onto the lawn.

The LAP is able to organise urban water use efficiency workshops by request and has a range of leaflets aimed at increasing awareness of urban water use issues. A number of good books and websites exist on how to reduce water usage in urban areas.

Salinity monitoring

Monitoring groundwater for depth and salinity is the simplest way to determine future areas at risk from dryland salinity processes. Monitoring of piezometers and observation wells is vital to determine salinity trends. The Department for Water have established about 150 bores and piezometers throughout the Coorong District to monitor long term groundwater trends. These historical records provide baseline data against which the effectiveness of any management options that are implemented, can be assessed. Groundwater data is also placed on the Department for Water's Obswell web site, which is publicly accessible (https://obswell.pir.sa.gov.au/)

Localised monitoring can assist in identification of problem areas at the farm scale. A cheap and effective method is to use photo points to monitor changes in percent cover and health of vegetation. Landholders are strongly encouraged to monitor and take note of any changes occurring on their properties. Some suitable methods for landholder monitoring of salinity impacts are included within the Bush Condition Monitoring Manual, used by LAP officers undertaking biodiversity inspections.

8 GUIDELINES FOR REPORTING AN INDIGENOUS HISTORIC SITE

Selected extracts from "Guideline 2, Section 20 of the Aboriginal Heritage Act 1988 - Discovery of sites, objects or remains".

According to Section 20 of the *Aboriginal Heritage Act 1988*;

An owner or occupier of private land, or an employee or agent of such an owner or occupier, who discovers on the land:

(a) an Aboriginal site; or

(b) an Aboriginal object or remains,

must, as soon as practicable, report the discovery to the Minister giving particulars of the nature and location of the site, object or remains.

If a person or body corporate is in breach of this section, penalties may apply.

Certain landforms are more likely to contain evidence of Aboriginal occupation. If your area of planned activity is within such areas, then you are more likely to have some impact on Aboriginal sites, objects or remains.

These areas include:

- Claypans, lakes, rivers and estuaries;
- Areas within 2km of coasts and major waterways;
- Areas within 100m of the banks of all other creeks, rivers, watercourses, lakes, waterholes, rock holes, wells and springs, especially in arid areas;
- Rocky outcrops;
- Dunes, sand hills and sand deposits, especially in the vicinity of water sources,wells, springs, water holes;
- Craters and sinkholes;
- Unusual land features are likely to have mythological significance;
- Areas of bush, forested areas, natural vegetation or intact ground surface suchas parklands, reserves, open space and road verges;
- Place names are a direct link of the association of a society with the land.

If you are the owner or occupier of a parcel of land, or an agent of these (staff, contractor, sub-contractor), you must report the discovery of the Aboriginal sites, objects and remains to the Minister. Additionally, any work or other activities in the vicinity that may disturb the ground surface or otherwise affect the Aboriginal sites, objects or remains must be stopped.

The Aboriginal Heritage Branch will record the site and advise on the process to be followed.

When reporting a discovery, provision of the following information is important:

- Location of site, object or remains (using a GPS or similar)
- Approximate area of the site;
- Description of how to get to the site;
- Your name and contact details;
- Name and contact details of the person who discovered the site;
- When the incident or discovery occurred;
- Photos of the site (if available);
- Any other details which may be relevant.

Discovery of Aboriginal ancestral remains

"Aboriginal remains" are defined as the whole or part of the skeletal remains of an Aboriginal person but do not include remains that have been buried in accordance with the law of the State.

Aboriginal ancestral remains are found under a variety of circumstances. They can be unearthed by development or uncovered through environmental processes, such as erosion. This is particularly common in soft sands and soils.

The preservation of ancestral remains differs according to the degree of exposure. They can be found scattered over a wide area, relatively well preserved or intact.

The discovery of ancestral remains requires a different process to the discovery of other sites, as it must be established that the remains are those of a traditional Aboriginal burial.

When a burial is discovered, the discovery of human remains must be reported to the Police, in compliance with the Coroners Act 2003, and to the Aboriginal Heritage Branch.

The burial should not be disturbed. Not only is the disturbance of Aboriginal ancestral remains offensive to the Aboriginal community; it is an offence under the Aboriginal Heritage Act 1988.

The Police may have to visit the site to determine whether the remains are of a traditional Aboriginal person. If this cannot be determined in situ, the Police may remove part or all of the remains for forensic analysis. In this instance the Coroners Act 2003 overrides the Aboriginal Heritage Act 1988 and the site will be disturbed.

If the burial is that of a traditional Aboriginal person then the Police will contact the Aboriginal Heritage Branch, and any remains that were removed will be transferred from Forensic Science SA to the Aboriginal Heritage Branch for safekeeping and reburial.

The Aboriginal Heritage Branch will check The Central Archive and Register of Aboriginal Sites and Objects for a record of the burial site to determine whether the site has been recorded previously.

The appropriate Aboriginal heritage organisations will be contacted and the site visited, assessed and recorded.

If the area is likely to become further exposed, consideration should be given to moving the burial to a nearby but safer place, or site protection works can be undertaken. These decisions are made in consultation with the Aboriginal heritage organisations and the project manager or landowner. If a decision is made to relocate the burial, advice should be sought from the Aboriginal Heritage Branch to ensure compliance with the Act.

For assistance or further information regarding this issue please contact:

The Aboriginal Heritage Branch

Aboriginal Affairs and Reconciliation Division

Department of the Premier and Cabinet

PO Box 2343

ADELAIDE SA 5001

Phone 08 8226 8900

Facsimile 08 8226 8999

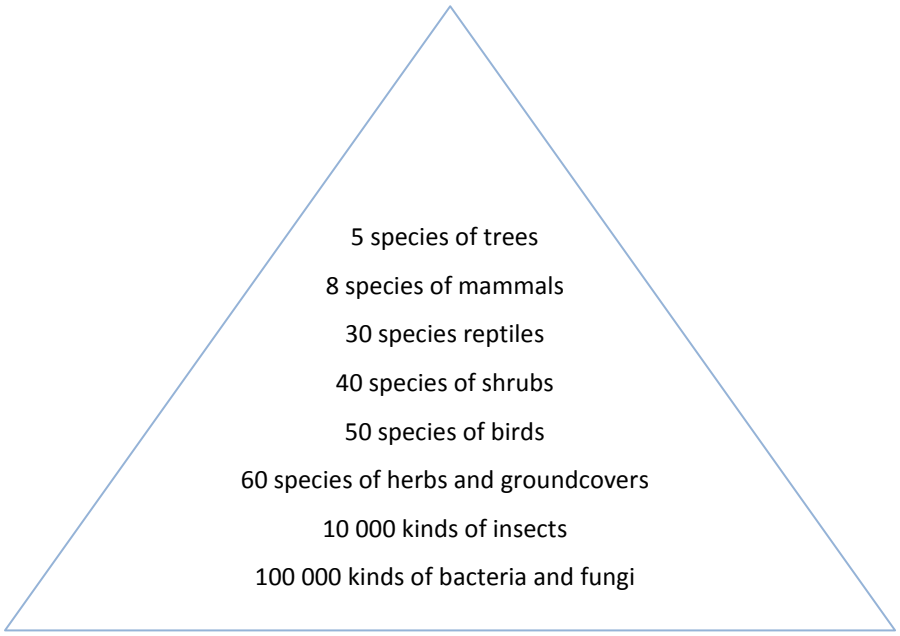
9 CONSERVING BIODIVERSITY

Biodiversity is the variety of all the life forms on Earth. It encompasses all species of plants, animals and micro-organisms, the genes they contain, as well as the ecosystems and ecological processes of which they are a part. Consequently biodiversity is considered at three levels: genetic diversity, species diversity and ecosystem diversity.

Genetic diversity is the variety of genes contained in all the species in a given area. There are so many genes and different possible combinations of genes that, for most types of organisms, every individual is genetically distinct.

Species diversity is the number of species and their relative abundance in a given area. The species in a given area interact with each other and with their environment, to form ecosystems. These differ from place to place and this is known as *ecosystem diversity*.

The diagram below demonstrates the biodiversity found in a natural community (in this case, a conservation reserve containing Mallee scrub). A natural community may appear to be dominated by trees and large animals, but most of the diversity is in fact smaller than these.



The conservation of biological diversity is essential for the maintenance of the earth's life-support systems. These services are often taken for granted. Some of the reasons for preserving biodiversity are listed below:

- Healthy functioning ecosystems are necessary to maintain the quality of the atmosphere and to maintain and regulate the climate, fresh water, soil formation, cycling of nutrients and disposal of wastes.
- The high natural diversity in a healthy ecosystem provides the environment with the ability to recover from natural disasters such as drought, fire, flood, climate change, and disease.
- Biodiversity contributes directly to the economy. Biodiversity is essential for controlling pest plants, animals and diseases, for pollinating crops and for providing food, clothing, medicines, energy, building materials and many other kinds of raw materials, and also attracts tourists. The less obvious contribution of biodiversity is the vast range of genetic material which is used by a

variety of industries including agriculture, medicine and gene technology and may be of critical value in responding to future markets and climatic demands. A loss of genetic diversity would result in a loss of potential for these industries. (State of the Environment Advisory Council, 1996)

- Intergenerational equity - biodiversity belongs to future generations as well. The current generation has an ethical responsibility to ensure future generations have access to the benefits of biodiversity.
- There is growing evidence that agricultural properties which maintain a percentage of native vegetation in blocks and corridors are actually more productive than properties which are completely cleared. It is thought that the retention of native vegetation modifies microclimates in a way which favours greater pasture and crop production and reduces stock losses during severe weather events. Where biodiversity has been restored on previously degraded properties, by putting back "habitat" blocks and wetlands, some spectacular increases in farm productivity have been achieved.
- Aesthetic reasons, such as the intrinsic beauty and tranquillity, the local character of a region and recreation (such as bird watching).

GUIDING BIODIVERSITY PRINCIPLES FOR THE COORONG DISTRICT LAP

The Local Action Plan Committee is using the following General Principles as guidelines to assist in assessing the contributions of revegetation to biodiversity to enable incentive payments to be made.

1. It is better to keep large areas rather than small areas, if possible, probably with a minimum of 10 hectares, so that local species can reproduce and be self-maintaining.

> Research show that about 10 hectares is the minimum size that a single pair of the average sized bird such as a treecreeper can use to breed successfully.

2. It is better to keep large areas rather than small areas, if possible, to increase the chances of maintaining the maximum diversity.

> Research has shown that as the size and quality of a habitat decreases, the number of species decreases. This is known as the Principle of Island Biogeography - "the bigger the island, the more species that can exist on the island".

3. It is better to use seeds or other propagation material from plants that are adapted to the local conditions.

> Specific plants occur naturally in specific locations (provenances). These plants have adapted to the rainfall, soils, temperature, frosts, droughts and other environmental conditions of that locality. Where soils or climate have been modified, local provenance plants may not be adequate. In these situations, propagation material from the nearest area which matches the altered conditions is the best practical alternative.

4. It is better to keep existing areas than to try and recreate new ones. This is because we can only collect seeds for and therefore replant a small sample of the number of species originally there.

> The diversity in any natural vegetation is very hard to reproduce because of the large number of species involved, the difficulty in collecting the range of species in seed form and the difficulty in getting the species "mix" right when revegetating. Most revegetation efforts must rely of recolonisation by additional species over time.

5. If we are to mimic nature, then most of the revegetation should be of shrubs and groundcovers, not trees.

> A ratio of 10 shrubs or groundcovers to 1 tree is used as a guide.

6. It is better to keep a block wide and short rather than long and thin. The same holds for new plantings.

> The boundary to interior area ratio should be kept as small as possible to minimise the "edge effect" (ie. weed and feral invasion, sun and wind, fertiliser and pesticide drift) on the native vegetation viability. Square or circular blocks have the best area to edge ratio.

7. It is better to make a corridor a habitat in its own right, over 100m wide and more than 10 hectares in total, than to make a narrow strip that is likely to be dominated by common aggressive birds.

> Narrow corridors can be a haven for a few birds instead of a variety.

8. It is better to make a corridor join patches of habitats (over 10 hectares) at both ends rather than just at one end.

> A narrow corridor that does not join larger patches rarely has biodiversity value.

A description of the incentive payments available, for biodiversity related projects are available in the Coorong District LAP's Annual on-ground works booklet which is available on Councils website or from the LAP Office at Tintinara.

10 ORGANISATION ROLES AND RESPONSIBILITIES

The table below shows some of the organisations currently involved in natural resource management within the Coorong District. Each of the coloured cells provides an indication of the aspects of NRM each organisation is involved in. These roles change regularly and are not always clear cut, however this table will provide you with a starting point, if you would like to talk to someone about an issue.

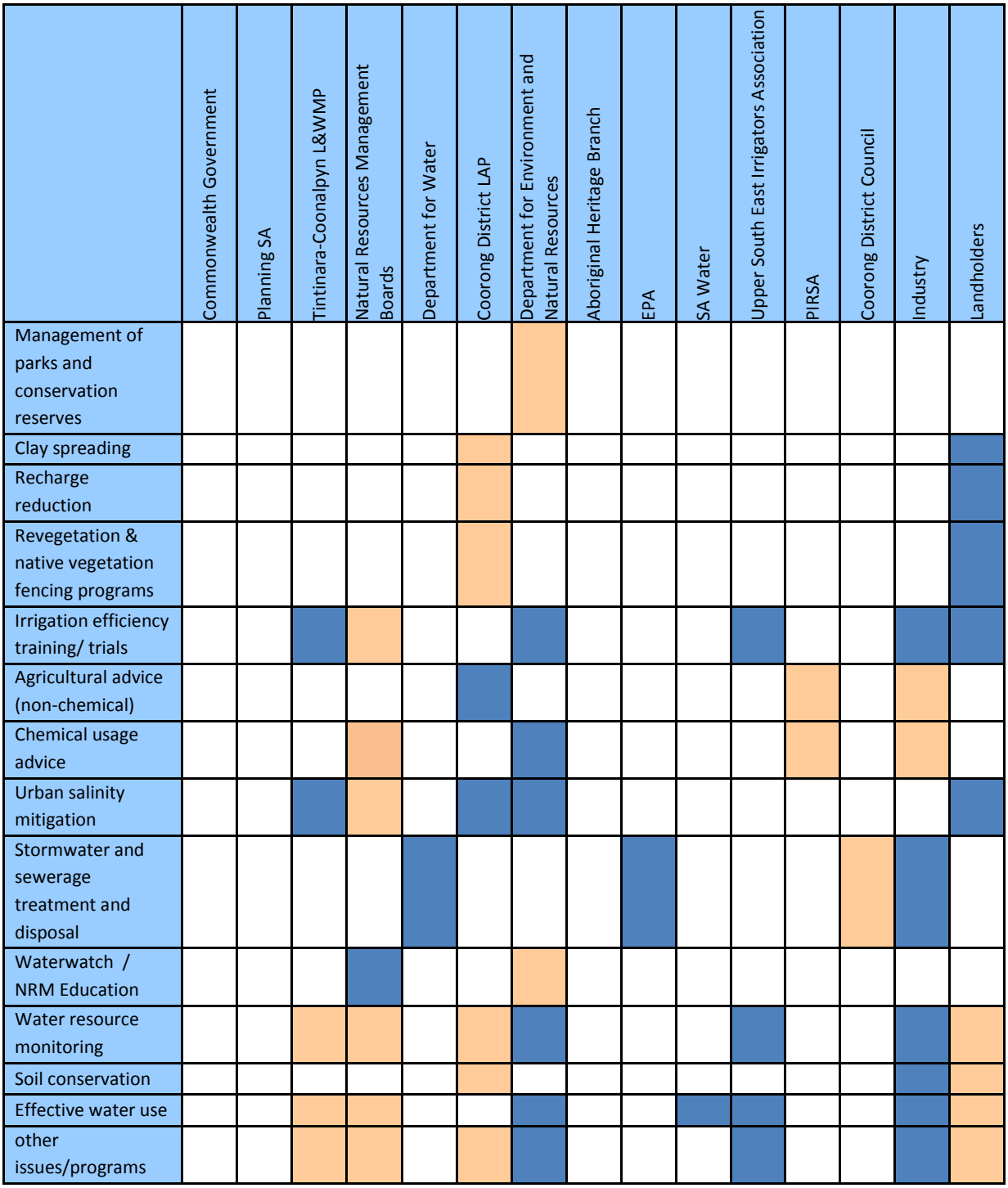
If in doubt about who to contact, please contact the LAP program staff, who regularly speak to people from most of these agencies.

Key:

Lead organisation
Works with the lead organisation.

	Commonwealth Government	Planning SA	Tintinara-Coonalpyn L&WMP	Natural Resources Management Boards	Department for Water	Coorong District LAP	Department for Environment and Natural Resources	Aboriginal Heritage Branch	EPA	SA Water	Upper South East Irrigators Association	PIRSA	Coorong District Council	Industry	Landholders
National Water Initiative															
Animal & Plant Control under NRM Act 2004															
Land Management under the NRM Act 2004															
Preparation of Water Allocation Policy (NRM Act 2004)															
Implementation of Water Allocation Policy															
Well maintenance enforcement															
Comprehensive NRM Plan															

	Commonwealth Government	Planning SA	Tintinara-Coonalpyn L&WMP	Natural Resources Management Boards	Department for Water	Coorong District LAP	Department for Environment and Natural Resources	Aboriginal Heritage Branch	EPA	SA Water	Upper South East Irrigators Association	PIRSA	Coorong District Council	Industry	Landholders
Implementation of the Development Act (1999)															
Native Vegetation Act (1991) Implementation															
Threatened species management plans															
Implementation of the Local Government Act (1999)															
Infrastructure monitoring															
Surface water monitoring															
Groundwater monitoring															
Water quality and soil salinity testing															
Regional Biodiversity Planning															
Administration of Heritage Agreements															
Reticulated Water supply															
Biodiversity/ wetland monitoring/ identification															
Aboriginal heritage															
Property management plans & EMS															
Biodiversity planning and inventory															
Funding															


Commonwealth Government
Planning SA
Tintinara-Coonalpyn L&WMP
Natural Resources Management Boards
Department for Water
Coorong District LAP
Department for Environment and Natural Resources
Aboriginal Heritage Branch
EPA
SA Water
Upper South East Irrigators Association
PIRSA
Coorong District Council
Industry
Landholders
Management of parks and conservation reserves
Clay spreading
Recharge reduction
Revegetation & native vegetation fencing programs
Irrigation efficiency training/ trials
Agricultural advice (non-chemical)
Chemical usage advice
Urban salinity mitigation
Stormwater and sewerage treatment and disposal
Waterwatch / NRM Education
Water resource monitoring
Soil conservation
Effective water use
other issues/programs

11 MONITORING AND EVALUATION PROGRAMS IN THE COORONG DISTRICT

The following table provides the details for a selection of dryland monitoring programs within the Coorong District. Some of these programs are current, while others are no longer being undertaken. There are other monitoring programs, particularly along the coastline and around the Lower Lakes, which are not included here.

Program	Duration or start date	Frequency	Sites in the Coorong District	Comments	Agency
Soil Fertility and acidity analysis	1990-1999	Ad hoc, plans for this to be reported on every 3-5 years	Per council area or Hundred	Fertility data supplied as number of samples per council area. Acidity is supplied per Hundred.	DENR
Phytopthora Location Database	Unknown	Ad hoc soil testing, with quarterly newsletter	Unknown	Relies on staff and public reporting symptoms.	DENR
Electromagnetic Mapping of salt and clay within the soil profile	2004/05	Once only	Tintinara	High resolution data	DENR
Wind Erosion Transects	1999 to present	Four times per annum.	>100Km		DENR
Lower Murray Mallee Land use mapping	2000	Once only	Significant portion of the District	Needs to be updated	DENR
Dryland Salinity Data source	2000	Once only	Entire state, no scale given. Predictions for 2025 and 2050.	Estimated accuracy 70%.	PIRSA
Obswell – Unconfined	Varies from well to well	Twice per year	Level = 63 Salinity = 52		DW
Obswell - Confined	Varies from well to well.	Twice per year	Level = 41 Salinity = 15	All Obswell data is available on the internet.	DW
Drill Hole Enquiry system	Unknown	Ad hoc	Details all drill hole data collected by drillers.	Available on the PIRSA website.	PIRSA
Wetlands Data	2002	Updated as	Covers the		DENR

Program	Duration or start date	Frequency	Sites in the Coorong District	Comments	Agency
source		required.	spatial distribution of wetlands on the South East coastal plain area.		
Ambient Groundwater quality	Unknown	Annual - November		EPA monitoring currently on hold, subject to review	EPA
Frog Census	Since 1994	Annual - September	Meningie	Community program.	EPA
Water Use Reports	Various	Annually	One report per PWA.		DENR
Water Resource Condition Triggers	Since 2002	Ad hoc	Prescribed Wells Areas		NRM Boards
Waterwatch	Unknown	6 events per year	Several schools including Meningie and Tintinara.	Regional coordinators are in Murray Bridge and Mt Gambier.	DENR
Reserves Biological Information		Ad hoc	All reserves and other polygons which have biological records.		DENR
Biological survey of SA					DENR
SA Biodiversity Distribution and Information Application (VIRIDANS)	Since 1977	Ad hoc	All available biological records state wide.		Multi agency
Vegetation clearance applications and heritage agreements	1981 to present	Ad hoc	All clearance applications and heritage agreements		Native Vegetation Council
Roadside Vegetation (Floristic) Mapping		Once only.	1:40,000 scale. Unknown distribution.		Transport SA and Councils
Pre-European Settlement Vegetation		Once only.	Appropriate for use for 1:50K scale	Does not cover floristic types smaller than 1	DENR

Program	Duration or start date	Frequency	Sites in the Coorong District	Comments	Agency
Floristic Mapping			mapping.	Ha.	
Native Vegetation floristic mapping		Updated as required.	Area divided into two datasets – South East and Murray Mallee.	Resolution: Habitat types greater than 1 ha.	DEH
Pest 2000+	2000	Ad hoc, patchy uptake on ground	Not widely used in this area.	Officers regularly conduct their own monitoring programs, which may be available on request.	Animal and Plant Control Commission.
Native Vegetation Extent		Biannual	Whole area.	Low resolution	NVC
Bush condition monitoring	Ad hoc	Generally once only	Whole area	Is currently required by the SA MDB NRM Board for all funded biodiversity works.	LAP and other on ground biodiversity programs.

12 RISK ASSESSMENT

Risk analysis for each of the options can be undertaken and could involve drawing upon material from other elements of the study, for example information about the range of potential outcomes and the probability of each occurring. The key source of this information will be (ideally) empirical evidence eg.

- Observed outcomes for projects with similar characteristics
- Professional advice from study team engineers
- Statistical analysis, eg. Risks of specific events
- Time series data of values of key variables
- Historical evidence of cost and program delivery options

A risk register assigns probabilities and impact exposures to project risks, using the following table. The risk ratings provided here are based on the personal opinion of the author and the outcomes of the literature review. Opinions from committee members, landholders, staff or experts are welcomed, as this will increase our confidence in the assessment.

Probabilities were assigned based on their probability over the next 20 years, given no further action on behalf of the LAP. The probabilities are defined as;

- Rare events would happen in exceptional circumstances, they have often not happened before.
- Unlikely has <25% chance of occurring in the assessment period.
- Possible has a 25-50% chance of occurring.
- Likely processes will occur in most circumstances (50-75%).
- Almost certain processes can be expected to occur in most circumstances (>75%).

The consequences were based on the impacts to human usage of natural resources. These impacts are defined as;

- Negligible impact will render <5% of a natural resource unusable or decrease the usability of an entire resource by <5%.
- Moderate consequences use a similar method of assessment, but affect <20% of the resource.
- Critical is <50%, and
- catastrophic is >50%.

	Consequences				
Probability		Negligible	Moderate	Critical	Catastrophic
	Almost certain	High	High	Extreme	Extreme
	Likely	Moderate	High	High	Extreme
	Possible	Low	Moderate	High	Extreme
	Unlikely	Low	Low	Moderate	High
	Rare	Low	Low	Moderate	High

Risk	Consequences	Probability	Rating	Comments
Risk to useability of district natural resources				
Higher unconfined groundwater levels	Moderate	Possible	Moderate	Increased flooding, increased dryland salinity. Increased likelihood of leakage to confined aquifer.
Lower unconfined groundwater levels	Negligible	Likely	Moderate	Pumping difficulties. Effects on groundwater dependant ecosystems.
Increased groundwater salinity	Critical	Likely	High	Reduce the range of crops that can be grown. Impacts on soil health and groundwater dependant ecosystems. Salinisation of the river, due to groundwater base flows.
Decreased confined aquifer pressure	Negligible	Possible	Low	Reduced allocations. Adaption required to groundwater extraction systems. Increased likelihood of salinisation.
Increased annual rain	Moderate	Rare	Low	Could increase flooding or dryland salinity impacts. Could increase production
Decreased annual rain	Moderate	Almost certain	High	Could move the area from cropping to grazing systems
Increased summer rain	Moderate	Possible	Moderate	See above. Could increase dryland salinity risks. Increased opportunities for grazing and different crops.
Decreased winter rain	Moderate	Likely	High	
Decreased summer rain	Moderate	Likely	High	Increased wind erosion. Grazing impacts.
Decreased autumn rain	Critical	Almost certain	Extreme	Late autumn breaks increase the likelihood of wind erosion and could decrease the viability of cropping systems.
Decreased spring rain	Critical	Almost certain	Extreme	Reduced time to finish crops.
Increased atmospheric CO2	Negligible	Almost certain	High	Could increase plant growth and water use efficiency. Could cause acid rain. Could decrease grain protein content, animal respiration efficiency and increase pest management concerns.
Increased hot days	Moderate	Almost certain	High	Increased animal and plant stress. Decreased plant growth or animal weight gain. Decreased fecundancy.
Increased frosts	Negligible	Unlikely	Low	Increased fruit set. Increased damage to vines and pastures. Higher mortality for young animals.

Risk	Consequences	Probability	Rating	Comments
Decreased frosts	Negligible	Almost certain	High	Decreased fruit set. Increased lamb/calf survival.
Decreased biodiversity in existing areas of remnant vegetation	Moderate	Likely	High	Species dying out due to predation, climate change, increased fire disturbance, decreased fire disturbance, herbicide use, competition, and not being replaced.
Reduced areas of suitable habitat for known threatened species	Critical	Likely	High	Threatened species are often highly selective and thrive in areas of low disturbance. They often exist in isolated pockets. Faster or more extreme changes to climate or other resources are likely to stress these species to the point of localised extinction if some form of migration or habitat extension is not provided.
Extinction of individual species, such as the metallic sun-orchid.	Catastrophic	Possible	Extreme	
Decreased area of native vegetation	Negligible	Possible	Low	The Native Vegetation Act has ceased clearance of vegetation, without a significant biodiversity offset.
Increased coastal erosion (this needs to be confirmed by a technical specialist)	Moderate	Possible	Moderate	Damage to the integrity of barrier dunes along the Coorong. Reduced breeding areas for the Hooded Plover. Reduced feeding areas for migratory shorebirds.
Increased coastal flooding	Negligible	Possible	Low	Low areas around the Lower lakes (<3.6m AHD) may start to experience increased flooding. Groundwater levels may also increase due to high sea levels.
Economic, social or other human risks to implementation of LAP actions				
Increased population (urban residents, lifestyle landholders)	Moderate	Unlikely	Low	Higher number of new residents, unused to natural resource limitations of the area. Increased stormwater and sewerage. Increased infrastructure usage.
Decreased population	Moderate	Likely	High	Reduced social infrastructure. Reduced landholder health.
Increased water price or licences	Critical	Almost certain	Extreme	Landscape scale changes to land use. Economic challenges to communities
Decreased water availability (all sources)	Moderate	Likely	High	Water allocation restrictions, water use restrictions, water accessibility due to drops in water level etc.

Risk	Consequences	Probability	Rating	Comments
Income from carbon credits	Moderate	Likely	High	This could be a positive or negative risk, depending on how the systems are structured. Increased forestry plantings. Focus on high sequestration species. Potential to lower groundwater levels, improve water quality, increase biodiversity, introduce new pest or weed species. Likely to reduce food production.
Increased phosphate price or availability	Moderate	Likely	High	
Increased input prices due to carbon tax	Moderate	Likely	High	
Increased petrol price	Moderate	Almost certain	High	
Decreased commodity prices	Critical	Possible	High	Potentially due to exchange rates or other global economy influences. Many landholders are just making do. A decrease in the price of commodities would adversely impact on land management practices.
Increased commodity prices	Negligible	Possible	Low	This is mainly a positive risk, in that higher prices would allow more financial investment into land management. It does have some negatives if prices rise to the point that areas retired to revegetation become viable for crop production (unlikely).
Food security policy restrictions on land use	Moderate	Unlikely	Low	
Increased electricity costs	Negligible	Almost certain	High	
Higher demand on land resources for sustainable energy, fuel or water production.	Negligible	Likely	Moderate	

13 COORONG LAP AND NRM BOARD LINKAGES

SAMDBNRMB targets compared to Coorong LAP actions

				Current on-ground works program											Future on-ground actions			Trials and investigations			Knowledge and awareness				Partnerships	Monitoring	
Asset and Asset Goals	**RCTs**	**Strategies**	**MATs**	Perennial pastures	Fodder shrubs	Native vegetation establsihment	Windbreaks and alley farming	Farm forestry	Clay spreading, delving and mapping	Protecting remnant vegetation and wetlands	Enhancing hanitat for threatened flora and fauna	Productive use of saline lands	Reclaiming or retirement of wind or water eroded land	Controlling lakeshore erosion	Mains water leak detection incentives	Decommission abandoned, leaking confined aquifer bores	Expand existing weather station networks to cover dryland areas	Run or promote trials of climate change adaptation practices	Investigate and trial alternative water supplies, particularly stock water	Seek funding to provide alteranative water supply or water use efficiency incentives, where incentive programs do not already exist	Run workshops to increase community knowledge of new issues, for example carbon trading or water security	Raise awareness of existing alternative water supply or water use efficiency incentives	Distribute information on carbon sequestration and air pollution research	Assist NRM Boards engage with the community on animal and plant control issues	Work with schools, indigenous organisations, community groups and government agencies to increase NRM understanding and awareness within the Coorong District	Monitor the efficiency of all actions	Work with government agencies to maintain or resume past monitoring programs, which are needed to assess LAP program efficiency
PEOPLE (Communities living sustainably)	P1: 80% increase in the number of people managing natural resources sustainably by 2030	Increase community awareness of NRM	P1.1: 50% of the regional community is aware of NRM														♦				♦	♦		♦	♦	♦	♦
		Increase community knowledge, skills and participation in NRM	P1.2: 25% of the NRM community have the knowledge and skills to manage natural resources sustainably by 2014	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦			♦	♦	♦		♦	♦	♦	♦		♦	♦
		Increase participation of volunteers in NRM	P1.3: Increase the level of NRM volunteering in the SA MDB NRM Region above 1200 members			♦				♦	♦														♦	♦	♦
	P2: Increase protection and preservation of Aboriginal culture by 80% by 2030	Protect and restore cultural sites and assets	P2.3: By 2014, the management of cultural sites and assets has improved							♦	♦		♦													♦	♦
	P3: All landscape development and management to have a neutral or beneficial impact on natural resources by 2030	Natural resource managers respond effectively to natural disasters when they occur	P3.5 25% of priority NRM assets actively managed to enable effective response to natural disaster by 2014	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦			♦	♦	♦	♦					♦		♦	♦
WATER (Water resources that are healthy, valued and supporting of communities and thriving ecosystems)	W1: All water resources are managed sustainably by 2018 W2: Improve water quality to achieve the regionally endorsed environmental values by 2030	Minimise saline impacts of irrigation on all water assets	W1.4: Minimise impacts of irrigation induced saline groundwater flows to water or ecosystem assets			♦	♦	♦	♦	♦		♦				♦		♦	♦	♦						♦	♦
		Increase re-use of treated wastewater	W2.3: 70% of treated wastewater generated in the Region to be reused by 2014															♦	♦	♦	♦	♦			♦	♦	♦
		Manage the impacts of primary production on water quality	W2.5: 50% of land in the agricultural zone to have neutral or beneficial effects on water assets by 2014	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦	♦	♦			♦	♦	♦	♦				♦	♦
		Maximise sustainable fit-for-purpose water use	W2.7: By 2014, 70% of water used shall be taken from sources that are fit-for-purpose												♦	♦			♦	♦	♦	♦			♦	♦	♦
	W3: Water is available to enhance and maintain the ecological character of water-dependent ecosystems	Re-establishment of estuarine area in the northern lagoon of the Coorong	W3.4: Re-establish Coorong and Lower Lakes ecological communities present pre-drought (2002) by 2014			♦				♦				♦	♦										♦	♦	♦
BIODIVERSITY (A healthy and ecologically productive environment that sustains biodiversity and is valued by the community)	B1: Native ecosystem extent increased to 53% of the Region and native ecosystem condition improved across the Region by 10% by 2030	Protect and manage priority remnant native ecosystems	B1.1: Protect and manage an additional 10,000 ha of existing priority remnant native ecosystems by 2014							♦	♦			♦											♦	♦	♦
		Increase the extent of native ecosystems	B1.2: The extent of native ecosystems is increased by 15,000 ha by 2014			♦					♦		♦	♦											♦	♦	♦
		Improve the condition of existing native ecosystems	B1.3: A 10% improvement in the condition of 25% of native ecosystems in the Region by 2014							♦	♦			♦										♦	♦	♦	♦
		Improve community appreciation of native ecosystems and species	B1.4: Increase community appreciation of native ecosystems and species by 30% by 2014			♦				♦	♦										♦		♦	♦	♦	♦	♦

	B2: By 2030, water-dependent ecosystems in priority areas maintain ecological function, resilience and biodiversity	Coordinate the protection and enhancement of priority floodplains and wetlands	B2.1: 75% of priority floodplains and wetlands actively managed as per management plans by 2014			♦				♦	♦		♦	♦											♦	♦	♦
		Protect and restore watercourses and ephemeral waterways	B2.2: Adoption of sustainable grazing practices in water-dependent ecosystems by 2014							♦			♦	♦												♦	♦
		Improve the connectivity between and within aquatic and terrestrial ecosystems of the Lower Lakes, Coorong and marine environments	B2.3: A 20% increase in connectivity between/within aquatic and terrestrial ecosystems of the Lower Lakes, Coorong and marine environments by 2014			♦	♦	♦	♦	♦				♦							♦		♦	♦	♦	♦	♦
	B3: No species or ecosystem moves to a higher risk category and 50% of species move to a lower risk category by 2030	Manage critical threats to threatened species	B3.1: Reduce the impact of critical threats to priority threatened species by 2014			♦				♦	♦			♦												♦	♦
		Manage critical threats to threatened ecosystems	B3.2: Reduce the impact of critical threats on EPBC-listed threatened ecosystems by 2014			♦				♦	♦			♦												♦	♦
LAND (Sustainable, productive landscapes)	L1: A 10% improvement in soil and land condition from 2008/2009 levels by 2030	Improve soil conditions to increase productivity	L1.1: Dryland water use efficiency (WUE) is maintained at 80% by 2014	♦	♦	♦	♦	♦	♦	♦		♦	♦		♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦
		Manage pastures within carrying capacity of stock	L1.2: 90% of landholders are managing pastures sustainably by 2014	♦	♦				♦			♦	♦	♦				♦			♦	♦	♦	♦		♦	♦
		Detection and early management of new pest incursions	L1.3: 50% increase in participation in early warning system for new pest incursions (communication network)																					♦	♦	♦	♦
	L2: The area of land affected by land degradation processes is reduced by 2030	Protect agricultural cropping land from erosion	L2.1: By 2014 achieve a 6% improvement in wind erosion protection for agricultural cropping land						♦				♦					♦			♦		♦		♦	♦	♦
		Protect grazing lands from erosion	L2.2: By 2014, a 3% increase in the area of grazing land with adequate soil surface cover (based on 2009 levels)	♦	♦		♦		♦			♦	♦	♦				♦			♦		♦	♦		♦	♦
		Reduce the spread and impacts of dryland salinity	L2.3: 7,500 hectares of appropriate perennial vegetation established in priority areas by 2014 for the management of dryland salinity	♦	♦	♦	♦	♦				♦	♦													♦	♦
ATMOSPHERE (A clean and healthy atmosphere with effective adaptation to climate change)	A1: Reduce greenhouse gas emissions in the SA Murray-Darling Basin by 60% by 2050	Encourage natural resource dependent industries to respond to climate change challenges	A1.2: Natural resource affecting industries adopting climate change sector agreements by 2014	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦
		Promote the offset of emissions by carbon sinks with NRM benefits (biodiversity and salinity)	A1.4: Revegetation for future carbon (CO_2e) sequestration of 126,000 tonnes by 2014			♦						♦	♦					♦			♦		♦			♦	♦
	A2: 100% of natural resource managers incorporating climate change adaptation into their forward planning or management by 2030	Natural resource managers anticipate and respond to climate variability and climate change	A2.1: 25% of natural resource managers incorporating climate change adaptation into their forward planning or management by 2014															♦			♦		♦			♦	♦

SENRMB targets compared to Coorong LAP actions

Asset and Asset Goals	MATs	Current on-ground works program											Future on-ground actions			Trials and investigations			Knowledge and awareness				Partnerships	Monitoring	
		Perennial pastures	Fodder shrubs	Native vegetation establsihment	Windbreaks and alley farming	Farm forestry	Clay spreading, delving and mapping	Protecting remnant vegetation and wetlands	Enhancing hanitat for threatened flora and fauna	Productive use of saline lands	Reclaiming or retirement of wind or water eroded land	Controlling lakeshore erosion	Mains water leak detection incentives	Decommission abandoned, leaking confined aquifer bores	Expand existing weather station networks to cover dryland areas	Run or promote trials of climate change adaptation practices	Investigate and trial alternative water supplies, particularly stock water	Seek funding to provide alteranative water supply or water use efficiency incentives, where incentive programs do not already exist	Run workshops to increase community knowledge of new issues, for example carbon trading or water security	Raise awareness of existing alternative water supply or water use efficiency incentives	Distribute information on carbon sequestration and air pollution research	Assist NRM Boards engage with the community on animal and plant control issues	Work with schools, indigenous organisations, community groups and government agencies to increase NRM understanding and awareness within the Coorong District	Monitor the efficiency of all actions	Work with government agencies to maintain or resume past monitoring programs, which are needed to assess LAP program efficiency
Healthy landscapes supporting high value ecological systems	A.1 Improving native vegetation			♦	♦	♦		♦	♦		♦												♦	♦
	A.4 Managing Ramsar wetlands			♦				♦	♦		♦	♦											♦	♦
	A.5 Managing priority habitats			♦				♦	♦		♦	♦											♦	♦
	A.6 Improving water quality	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦					♦	♦			♦	♦
	A.7 Retaining water in the landscape	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦					♦	♦	♦		♦				♦	♦
	A.9 Managing threatened species			♦				♦	♦							♦						♦	♦	♦	♦
	A.10 Improving habitat connectivity			♦	♦	♦			♦		♦	♦												♦	♦
	A.11 Protecting Aboriginal Sites							♦			♦	♦											♦	♦	♦
	A.14 Adapting to climate change																							♦	♦
	A.15 Building resilience in a changing climate	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦
Regional communities active in NRM	B.1 Involving primary producers	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦		♦	♦		♦	♦	♦	♦	♦	♦	♦
	B.2 Supporting community groups and volunteers			♦				♦	♦						♦			♦			♦	♦	♦	♦	♦
	B.3 Engaging schools			♦				♦	♦						♦								♦	♦	♦
	B.4 Increasing community awareness														♦	♦			♦	♦	♦	♦	♦	♦	♦
	B.6 Respecting Aboriginal issues			♦				♦			♦												♦	♦	♦
Resilient industries taking responsibility for sustainable use and management of natural resources	C.2 Reducing key invasive species																					♦	♦	♦	♦
	C.3 Understanding land use change														♦	♦	♦	♦					♦	♦	♦
	C.5 Reusing waste water												♦			♦	♦	♦	♦	♦				♦	♦
	C.6 Improving salt-affected landscapes	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦											♦	♦
	C.8 Managing pests															♦						♦		♦	♦
	C.9 Improving soil condition				♦		♦			♦	♦	♦				♦			♦		♦			♦	♦
	C.10 Improving water use through soils	♦			♦		♦			♦	♦	♦				♦			♦		♦			♦	♦
	C.11 Increasing efficiency of industrial water												♦	♦			♦	♦	♦	♦				♦	♦
	C.12 Increasing perennial plant systems	♦	♦		♦	♦										♦			♦		♦			♦	♦
	C.16 Adopting synergistic practices																							♦	♦
	C.17 Protecting land from erosion	♦	♦	♦	♦	♦	♦	♦		♦	♦	♦			♦	♦			♦		♦			♦	♦
Leadership, adaptability and partnerships for effective NRM	D.1 Responding to new pests																					♦	♦	♦	♦
	D.2 Adapting water management												♦	♦	♦	♦	♦	♦	♦	♦			♦	♦	♦
	D.6 Supporting biodiversity on private land			♦	♦	♦		♦	♦			♦												♦	♦
	D.9 Protecting habitats through formal arrangements			♦				♦	♦			♦												♦	♦
	D.11 Involving Aboriginal People			♦				♦	♦			♦											♦	♦	♦
	D.12 Planning for climate change														♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦

14 GLOSSARY

Annual plant	A plant which completes its life cycle within one year or less.
Aquifer	An underground soil or rock layer which contains sufficient open spaces (pores) to store and transmit large quantities of water.
Artesian aquifer	An artesian aquifer is a confined aquifer that is under so much pressure that water flows up and out of the wells.
Beneficial use	A beneficial use is the use of a resource for productive or environmental purposes, e.g. the use of groundwater to water stock. These uses are often placed into categories depending on their water quality or quantity requirements.
Biodiversity	The variety of life forms; the different plants, animals and micro-organisms, the genes they contain, and the ecosystems they form.
Biophysical	Biological structures and process in terms of physics.
Bore	A hole of uniform diameter (usually 150 to 160 mm) drilled vertically into the ground to tap an aquifer. It contains a pipe through which groundwater can be pumped or can flow to the surface by artesian pressure.
Calcrete	Hardened crust of limestone rock. Created by the precipitation of calcium by evaporation of seawater or saline groundwater. It can form within the soil profile or on the soil surface.
Catchment	A water catchment is the area, eg. a valley, which directs water to a water body, eg. a creek, lake or aquifer.
Climate change	A long-term change in annual climate locally or at a global scale (> 50 years).
Climate variation	Short-term changes in weather between individual years or decades.
Conductivity	The ease with which an electrical current is passed through water or other matter. It is often used to identify the approximate salinity of water. It is expressed in a range of standard units, including $\mu S/cm^2$, mS/cm^2 or dS/m^2.
Confined aquifer	A pressurised body of water deep in the soil profile, constrained by layers of clay or rock.
Conservation	All the processes and actions of looking after a place so as to retain its natural significance and always includes protection, maintenance and monitoring.
Corridor	A patch, belt or strip of native vegetation through which or along which birds and other animals are thought to move between larger patches of remnant vegetation, in orger to find new areas for feeding or in which to live, find mates and successfully reproduce.

Cost Sharing Framework	The approach adopted to improve the basis for negotiation for funding by providing a principled and objective approach to determining the public and private benefits of on-ground works.
Degradation	Any decline in the quality of natural resources or the viability of ecosystems, caused directly or indirectly by human activities.
Discharge area	Low-lying areas where groundwater reaches the surface
Ecological services	Ecological services are benefits provided to ecosystem health via an action or object. Ecological services provided by isolated trees include nesting sites and roosts, homes for insects, feed for insect eating birds and so on.
Ecosystem	The dynamic interaction between the complex of organisms that make up a community with their nonliving environment and each other.
Endangered	Endangered is a state or national conservation significance rating. These species are facing a very high risk of extinction in the wild.
Erosion	The wearing away of the land by rain, running water and wind.
Groundwater	All free-moving water found below the surface of the soil.
Habitat	The structural environments where an organism lives for all or part of its life.
Habitat 141°	A joint effort between government agencies and not-for-profit organisations. The vision of Habitat 141° is to work with communities to conserve, restore and connect habitats for plants and wildlife on a landscape scale from the ocean to the outback.
Heritage agreement	Voluntary agreement under the Native Vegetation Act to protect native vegetation on a property in perpetuity by covenant on the title.
Indigenous	Originating in a particular region
Land capability	The capacity of the land to support a particular use and sustain that use in the long term.
Monitoring	Ongoing review, evaluation and assessment to detect changes in condition of the natural integrity of a place, with reference to a baseline condition.
Native vegetation	Plants which are native to Australia.
Natural community	Plants and animals (an ecosystem) which naturally occurred in an area.
Naturelinks	The Naturelinks project is run by DENR. The aim is to have five well-established biodiversity corridors aimed at maximising ecological outcomes particularly in the face of climate change. The River Murray to South East corridor runs through the Coorong District.
Non-wetting or water repellent sand	Soil in which the soil particles are coated in waxes that prevent water from penetrating or wetting the soil when it is dry.

Observation bore	A bore where monitoring regularly takes place.
Obswells	A long term state government groundwater monitoring program. The data is available from https://obswell.pir.sa.gov.au/new/obsWell/MainMenu/menu.
Organism	A plant, animal, bacteria and fungi
Overhead irrigation	Irrigation where the water is distributed from above the crop canopy.
Parkland cleared	An area of land that has been cleared of all native understory, leaving scattered to moderate density paddock trees over pastoral grasses.
Perennial plant	A plant with a life cycle which extends for more than two years.
Piezometer	A shallow bore (<10m) which is used to measure water level.
Pressurised irrigation	Irrigation where water is distributed via pressurised pipe work and sprinklers or drippers
Property Management Planning (PMP)	A series of workshops run by PIRSA that integrate personal goals with enterprise production, economics, marketing and natural resource management. Similar programs are still run in other areas by other agencies.
Provenance	Plants from a specific location. Implies that they have the same genetic composition, which enables that plant to tolerate the rainfall, soils, temperature, frosts, droughts and other environmental conditions of that locality.
Puccinellia	A genus of salt tolerant grasses. There is one native Australian species and several introduced species.
Ramsar	The Ramsar Convention, an International agreement signed in Ramsar, Iran in 1971 under the sponsorship of the International Union for the Conservation of Nature (IUCN) to protect wetlands of international importance as habitat for waterfowl.
Rare	Rare is a state or regional conservation significance rating. A rare species has a population in decline or has a naturally limited presence.
Recharge area	The area in which surface water (from rainfall, irrigation or streams) infiltrates into the soil and is added to the groundwater
Regional groundwater system	An aquifer occurring extensively over a large area.
Rehabilitate	Restore to former condition.
Remnant vegetation	The remaining natural vegetation left after clearance. It is not limited to trees but can consist of heathland, saltbush, wetlands or grasslands. It can also include scattered paddock trees, however the LAP does not currently offer incentives for fencing this type of remnant vegetation.

Revegetation	A program which replaces the plants in an area which have previously been cleared or degraded.
Salinity	The quantity of salts dissolved in water (expressed as mg/L or %) or contained in the soil profile (expressed as g/kg or $mg/L_{(1:5)}$)
Saltbush	Plants of the *Atriplex* genus. They have a grey, goosefoot shaped leaf and are highly tolerant of salinity or dryness.
Surface water	Water flowing across or stationary on the soil surface, for example runoff, lakes and rivers.
Socio-economics	Pertaining to both social and economic considerations.
Standing Water Level	The depth you have to dig below the soil surface to hit water (the watertable).
Sub-surface irrigation	Irrigation systems that distribute water via under-ground pipes, hoses or drippers.
Surface irrigation	Non-pressurised irrigation systems that distribute water by running it across the soil surface, often using check banks, channels and gates.
Sustainable Agriculture	is the use of farming practices and systems which maintain or enhance: · the economic viability of agricultural production · the natural resource base · the environment which is influenced by agricultural activities.
Threatened	Native plant or animal species that have a conservation significance rating.
Unconfined aquifer	The aquifer closest to the surface, which is recharged by local rainfall, and is not pressurised.
Vulnerable	Vulnerable is a state or national conservation significance rating. The species is facing a high risk of extinction in the wild.
Watertable	The upper limit of the zone of soil saturated by unconfined groundwater.
Wetlands	Areas of either permanent or temporary (ephemeral) shallow flooding; they include swamps, billabongs, and bogs, and may be of fresh, brackish or salty water; wetlands are important habitats for fish, invertebrates, plants and birds; they are complex and delicate ecosystems that contain great diversity of life.

ABBREVIATIONS

µS	Microsiemens
ABS	Australian Bureau of Statistics
CARE	Community Action for a Rural Environment
CLLMM	Coorong, Lower Lakes and Murray Mouth.
cm	Centimetres
CO_2e	Carbon dioxide equivalent (in greenhouse impact terms)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DENR	Department for Environment and Natural Resources
dS	Decisiemens
DW	Department for Water.
DWLBC	Department for Water Land and Biodiversity Conservation (past)
EC	Electrical conductivity
EPA	Environment Protection Agency
EPBC	Environmental Protection and Biodiversity Conservation
g/L	Grams per Litre
GL	10^9 litres
JAMBA / CAMBA	Japan – Australia Migratory Bird Agreement / Canada – Australia Migratory Bird Agreement.
LAP	Local Action Plan
LWMP	Land and Water Management Plan
m	Meters
MERI	Monitoring, Evaluation, Review and Improvement
mg/L	Milligrams per Litre
ML	Megalitre
mS	Millisiemens
NHT	National Heritage Trust
NP&WS	National Parks and Wildlife Service
NRM	Natural Resources Management, often followed by a B for Board or preceded by SAMDB (South Australian Murray Darling Basin) and SE (South East)

NWI	National Water Initiative
NWS	National Weed Strategy
P	Phosphorus
pH	A measure of acidity or alkalinity on a logarithmic scale, where 7 is neutral, lower values are more acid and higher values are more alkaline.
PIRSA	Primary Industries of South Australia
PMP	Property Management Plan
ppm	Parts per million
SARDI	South Australian Research and Development Institute
SECWMB	South East Catchment Water Management Board (past)