



NORTH CENTRAL
Catchment Management Authority



North Central Dryland Region Management Plan

29 March 2007

DRAFT

Committed to Catchment Health

Version Control

Version	Date	Author	Amendments made	Purpose
1.0a	14 September 2006	Andrea Delaney		Initial drafting of background sections of document plus mapping of document contents – for steering committee consideration
1.0b	25 October 2006	Andrea Delaney	Major amendments to document form, following Steering Committee Meeting	Draft for further technical review - condensing of contexting information and focus on 'action' parts of document
1.0c	13 November 2006	Andrea Delaney	Amendments to document following technical review of draft	Draft for further steering committee consideration
2.0a	22 December 2006	Andrea Delaney	Re-drafting of whole document, following SC meeting	Draft for consideration by senior CMA and DPI staff, in preparation for SC
2.0b	12 January 2007	Andrea Delaney	Further additions to document & changes following targets logic meetings	Draft for SC consideration in preparation for Rapid Appraisal; Draft to guide finalisation of Plan.
2.0b	25 January 2007	Andrea Delaney	Final additions to document contents	Finalise document contents in preparation for final edit before rapid appraisal
	5 February 2007	Andrea Delaney & Jennifer Alexander	Coordinated input from Gavin Hanlon, Geoff Park, Anna Ridley, David Pannell, Daniel Mudford, Tony Watson	Finalise document contents in preparation for final edit before rapid appraisal
2.0c	9 February 2007	Andrea Delaney & Jennifer Alexander	Final minor edits on content and formatting	Final edits for draft to be circulated to Implementation Committees and Board
3.0a	22 February 2007	Andrea Delaney & Jennifer Alexander	Edits following IC comments and DSE rapid appraisal prior to Board meeting	Final edits to draft prior to Board meeting to release document for community consultation

Document name: [North Central Dryland Region Management Plan](#)

North Central Catchment Management Authority
 PO Box 18
 Huntly Vic 3551
 T: 03 5440 1800
 F: 03 5448 7148
 E: info@nccma.vic.gov.au
www.nccma.vic.gov.au

© North Central Catchment Management Authority, 2007

ISBN: [\[Click here to type ISBN\]](#)

A copy of the draft is also available on www.nccma.vic.gov.au

Front cover photo: [\[Click here to type Front Cover Photo\]](#)

The North Central Catchment Management Authority wishes to acknowledge the Victorian and Commonwealth governments for providing funding for this publication through the National Action Plan for Salinity and Water Quality.

This publication may be of assistance to you, but the North Central Catchment Management Authority and its employees do not guarantee that the publication is without flaw of any kind, or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on information in this publication.

Foreword

Foreword by – Board Chair

DRAFT

Plan Summary

The North Central Dryland Region Management Plan will replace the current salinity management plan for the North Central region of Victoria. It has been developed in close consultation with a Steering Committee comprising of both community and agency representatives. There has also been consultation with wider community and agency representation throughout its development.

The Plan is needed because:

- The current approach is not having the regional benefits anticipated (though is still producing local benefits);
- There is a need to protect key threatened assets before we lose them, to provide the best public benefit from expenditure of public money; and
- There is a need for a broader mix of investment responses for salinity to be considered in the region.

The Plan identifies high value assets (natural and built features) in the region that need to be protected from relevant threats. The Plan currently primarily addresses the threat of salinity. It will evolve to include the threats of pest plants and animals and soil health decline to these high value assets as well. It will also revalue new assets as they are identified.

Management actions for both high-value assets and dispersed assets have been identified in the Plan. SIF3 has identified management recommendations for the assets. A separate target setting process undertaken by community and agency representatives has identified other management actions to fill gaps that the Plan didn't address adequately from a community perspective.

Approximately 80 areas of high-value assets were identified by the community and regional experts. Of these areas, 44 were identified to be at threat from salinity, and of these, 20 areas were identified to have salinity intervention works that could be realistically applied or investigated. The specific high value local assets (wetlands, waterways, infrastructure and water resources) within these areas were identified and recommendations were developed for salinity intervention using the Salinity Investment Framework III (SIF3).

The recommendations made for dispersed assets recognised in the Plan (soil, remnant vegetation, indigenous cultural sites and floodplains) are diverse. Given the dispersed assets are of lesser value and of greater number, when considered from a regional public benefit perspective and the scope of the SIF3 methodology, it is not possible to protect them from salinity in this Plan.

The project activities identified in the Plan include extension, incentives, penalties, engineering, technology development, further research and development and informed no action. This is a greater suite of actions than has previously been considered in the region, providing a new direction for salinity management.

These project activities will contribute to various short, medium and long term targets to improve the condition of assets in the region. These targets are identified in the Plan. The project activities will be prioritised each year by the region and will be delivered by the CMA, delivery partners such as the Department of Primary Industries, Parks Victoria and local government, and by the community. Gaps in the Plan have been noted by community and agency representatives, and have had management actions identified. These gaps will need to be considered from a public benefit perspective, which will occur during each year's priority determination.

Annual adaptation of the Plan will occur to ensure that new information is incorporated into decision making and priorities each year and targets remain relevant and realistic. It is therefore likely that there will be ongoing change in terms of what work is done where, due to changes in understanding.

The Plan will undergo a full review after 5 years.

Implementation of the Plan will result in protection of high value assets (rivers, wetlands, infrastructure, etc) where it is determined the impact of threats (such as salinity) can be mitigated.

Contents

Foreword	ii
Plan Summary	iii
Contents	iv
<hr/>	
SECTION A – PROPOSED MANAGEMENT ACTIONS	1
1. Introduction	2
Objective of the Dryland Region Management Plan	2
Plan context	2
Review of previous salinity management in the region	4
The need for a new approach	5
The Salinity Investment Framework III (SIF3)	5
Major changes in approach	6
2. Assets in the Dryland Region	7
What are assets and why are they important?	7
High-value assets in the region	7
Dispersed assets in the region	8
3. Threats to assets within the Dryland Region	9
Salinity threat to the region	9
Assessing the urgency of salinity threat to assets	9
Other threats to assets in the region	10
4. Actions and targets for improving asset condition in the region	11
Target setting process	11
Basis of management responses to protect high-value assets	12
Basis for management actions and targets to protect dispersed assets	13
Management actions and targets for high-value assets	13
Waterways	14
Wetlands	16
Water Resources	18
Infrastructure assets	19
Management actions and targets for dispersed assets	21
Floodplains	21
Soils – management actions recommended from SIF3	22
Soils – management actions from a community participation perspective	23
Indigenous cultural heritage assets	25
Biodiversity	25
5. Works Plan	28
<hr/>	
SECTION B – PROJECT MANAGEMENT	29
6. How the management actions will be prioritised and implemented	30
Annual adaptive management framework	30
1. Newly identified and valued assets	31
2. Identifying and analysing threats to assets	31
3. Management actions recommended	31
4. Priorities set	31
5. Annual investment plan developed	32
6. Works undertaken	32
7. Monitoring, Evaluation, Reporting and Learning	33
7. Knowledge collected and collated	33
8. Evaluation and learning	33
Maintaining relevance of targets	35
8. Benefits and Costs of the DRMP	35

No-intervention scenario	35
Benefits and costs of the Plan	35
Benefits from intervention (salinity threat)	36
Costing of management responses to protect high-value assets	36
Cost sharing and accountability	36
<hr/>	
SECTION C – APPENDICES	38
Appendix A. Objectives and composition of the North Central Dryland Region Management Plan Steering Committee	39
Appendix B. Local asset areas descriptions and SIF3 recommendations for each local asset within the area	40
Avon-Richardson Catchment	41
Donald Township	41
Avon Plains Lakes area	41
Grays Bridge - Banyena	42
Avoca Catchment	43
Amphitheatre	43
Natte Yallock (smaller area identified than previous targeted area)	44
Gowar East Springs	44
Indigenous site – Avoca River reach 5	45
Lower Avoca Floodplain	46
Loddon Catchment	47
Bendigo urban growth area and peri-urban surrounds	47
Castlemaine Heritage	48
Merin Merin Swamp and Birches and Creswick Creeks	48
Cairn Curran	49
Tullaroop Reservoir	49
Bridgewater	50
Upper Loddon	51
Campaspe Catchment	51
Axe Creek	51
Tooborac Heathcote (east of Wild Duck)	52
Wild Duck Creek catchment including Lake Eppalock	53
Elmore	53
Appendix C Bibliography	55
Referenced in Text	55
Referred to in document creation	55

Section A – Proposed management actions

DRAFT

1. Introduction

The North Central Dryland region covers about 2.2 million hectares, from the upper to middle reaches of the Campaspe and Loddon River catchments and the Avoca and Avon-Richardson catchments (Figure 1). The Plan will replace the current salinity management plan in response to community interest in salinity management, increased knowledge regarding effective management of natural resources, the recognition of the need to protect the key features (or assets) and the recent dry conditions.

The Plan changes the way salinity funding is invested in the region however it is only part of the suite of funding sources available for natural resource management works in the region.

Objective of the Dryland Region Management Plan

The Dryland Region Management Plan is an Action Plan to enable the community, North Central Catchment Management Authority (CMA) and governments to successfully manage the threat of salinity on high-value natural (land, water, biodiversity) and built assets in dryland areas. Whilst salinity is the focus at present the Plan will be expanded to include multiple environmental threats. To assess the salinity threat and the management actions that need to occur, a rigorous approach called the Salinity Investment Framework (SIF3 www.sif3.org, Ridley and Pannell 2005) has been used along with community input and available science. The Plan will be refined and updated with community input and as relevant knowledge becomes available.

Implementation of this Plan will result in protection of high value assets (rivers, wetlands, infrastructure, etc) where it is determined the impact of threats (such as salinity) can be mitigated.

Only secondary (human induced) salinity has been considered in the Plan to date:

- Rising saline groundwater can make soils and land salty and can flow into water bodies;
- Saline waterways and wetlands, which can have impacts on local use of the water as well as downstream impacts as salt is exported from the region, and
- Salt wash from discharge areas, which impacts on a large range of assets at varying scales depending on the size of the discharge area.

Urban sources of salt (such as from detergents and from water treatment plants) will need to be assessed as part of the recommended rural towns program (refer to Chapter 4). Other ways salinity is generated in the landscape¹ are not currently covered in the Plan.

It is important to note that the impact of dryland salinity on the River Murray is not a primary objective of the Plan. Science has shown it's not possible to protect the River Murray from dryland salinity, due to the response times of regional groundwater flow systems.

Plan context

The North Central Dryland Region Management Plan is an Action Plan under the North Central Regional Catchment Strategy (RCS) (Refer to Figure 2). It is focussed on the dryland geographic regions of the North Central Region. It does not cover the dryland areas in the irrigation region (these are covered by the Loddon Campaspe Irrigation Region Land and Water Management Plan). The Plan recognises various state and federal plans and strategies. It was developed by the North Central CMA in collaboration with a Steering Committee comprised of community and government agency representatives and had strong input from the CMA Board and its community based Implementation Committees over an 18 month period (Refer to Appendix A for details on the role and composition of the Steering Committee).

¹ Bann and Field (2006) explain other sources of salinity within the landscape that do not relate to groundwater flow systems (for example: transient salinity and dry saline land)

Figure 1: Area covered (coloured green and yellow) by the North Central Dryland Region Management Plan – Avoca Avon-Richardson IC and Loddon Campaspe Dryland IC areas

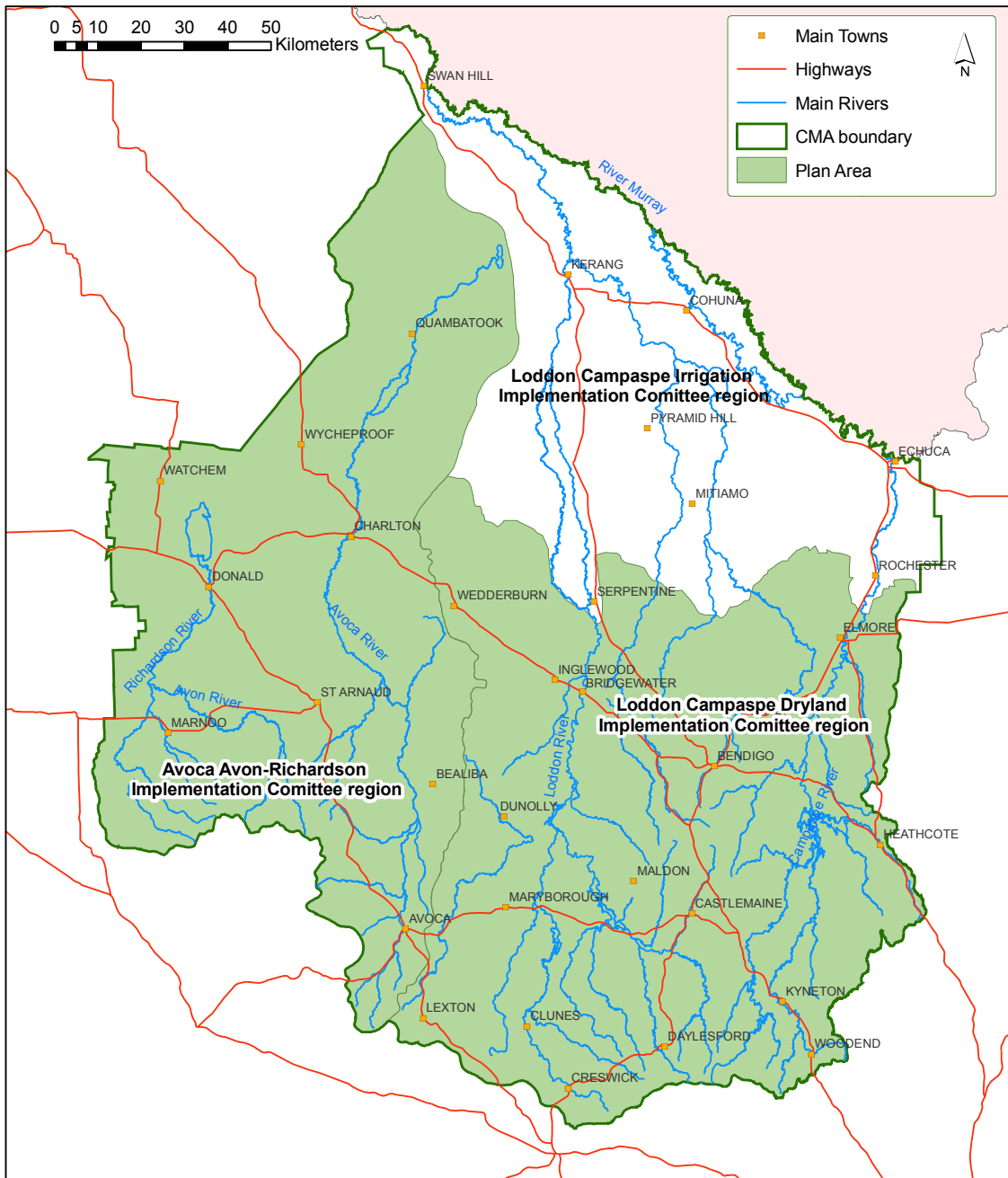
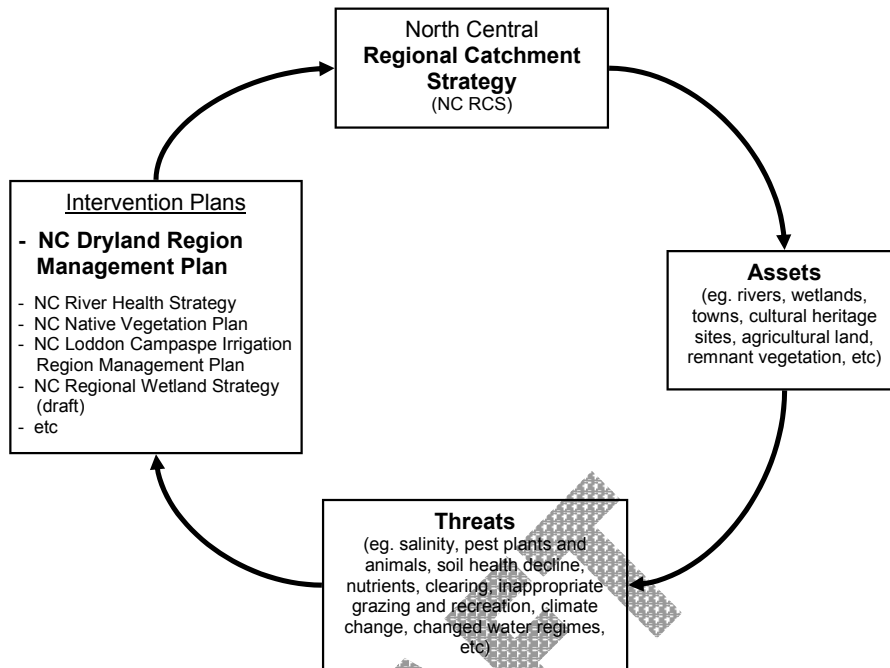


Figure 2: The Plan helps deliver the targets of the North Central Regional Catchment Strategy



Review of previous salinity management in the region

The region’s approaches to salinity decision making (both dryland and irrigated) have evolved over the last 25 years, initially from being relatively non-targeted, to salinity hazard-based (in the ‘target-area’ approach), and now to using an asset-based approach.

The first formal salinity plans were developed in 1992-3. Plans were prepared for each of the Avoca, Avon-Richardson, Campaspe and Loddon catchments. Community working groups with support from agencies were responsible for preparing plans. Plans, understandably, were based on optimistic assumptions about the effectiveness of management practices and limited appreciation of the time lags and complexity associated with community education, extension and on-ground works programs to deliver widespread changes in farming systems.

A new approach to salinity decision making was introduced in 2000, the first year of the National Action Plan for Salinity and Water Quality (NAP). The process used a decision making tool to identify areas of greatest salinity hazard. This led to the current ‘target area’ approach where 10 priority sub-catchments were eligible for funding incentives to plant perennial pastures, trees and protect native vegetation to reduce salinity impacts. This plan was externally reviewed in 2006 by specialists in hydrogeology, biodiversity, farming systems and economics.

Past approaches have had notable successes. Primarily they have built up community awareness and capacity for managing salinity more effectively, alerted many landholders to the need for change, and commenced the process of change. However, they have not gone close to achieving change on the scale required to manage salinity.

The need for a new approach

The main driver of the new Dryland Region Management Plan was a push from the North Central CMA Board to review salinity investment and intervention so as to improve its focus and achieve greater success. Other drivers included the direction from government to protect key high-value assets, the increase in knowledge in salinity management in recent years and the need to adapt given the last 10 years of dry conditions. We now understand the need to take a wider view of salinity and its impacts on all assets in the region, rather than mainly focusing on farmland impacts as in the past.

There are three reasons for a new approach to salinity management.

1. **The current approach is not working at a regional scale** (though local benefits have been achieved). In order to lower watertables, perennials are needed over large areas (50% or more) of sub-catchments, larger than that which can reasonably be achieved with current farming systems options. Both the economics of perennials and accompanying management changes required have often been under-estimated. The lag times between planting and response of groundwater levels are usually long (decades). We now also understand that some management interventions can have undesired effects on the rest of the catchment.
2. **Moving to protect key threatened assets is a logical response to limited funding and the need for greater public accountability.** The Plan needs to produce public benefits from the expenditure of public money. Public benefits are benefits that are provided to the broader community. Private benefits are benefits provided to private land managers. We need to invest public money to benefit the broader community, rather than individuals, though individuals may obtain some benefit as part of the works done.
3. **There is a need for a broader mix of investment responses to salinity.** In the past it has been assumed that the changes required are adoption of new land-uses on private land, and that these can be achieved using extension and accompanying small, temporary incentives. There is strong evidence that this is only true in a minority of cases. The appropriate response should be based on the amount of public and private benefits that are gained from an investment of public funding. The broader suite of investment responses needed to ensure greatest public benefit should include extension and incentives to promote land use change, as is currently the case. However it should also include engineering works where appropriate, informed no action, disincentives to prevent unwanted land uses and technology development (usually meaning the development of new, sustainable farming options that are attractive enough to landholders to be widely adopted). The suite of investment responses that should be considered when deciding how to manage salinity is outlined in Table 1.

The Salinity Investment Framework III (SIF3)

The Salinity Investment Framework III (SIF3) has been developed to address the need for a new approach for salinity management. SIF3 is an asset-based approach and the investment response is dependent upon the relative degree of public and private benefits (www.sif3.org). The public:private benefit framework embedded within SIF3 can also be used for accountable investment decision making for other natural resource management threats and is intended to be used when the Dryland Region Management Plan is broadened to cover other threats.

SIF3 provides the most rigorous and sophisticated approach to NRM planning and prioritisation that is currently available. It integrates the latest research knowledge from hydrogeology, biology, farming systems, resource economics, social science and policy mechanism design using the latest research from the major relevant research institutions in Australia and internationally, particularly the Cooperative Research Centre (CRC) for Plant-Based Management of Dryland Salinity, universities, State departments and CSIRO. By combining these elements with local information about community values, it allows us to identify the responses to dryland salinity that will have the greatest overall impact in any given circumstance.

Salinity impacts are considered on four asset groupings: 1) water resources; 2) high-value terrestrial assets such as built infrastructure and key biodiversity assets (both considered as high value assets in this Plan); 3) dispersed assets such as agricultural land and remnant vegetation; and 4) salt-affected land (both considered as dispersed assets in this Plan). The appropriate investment response (Table 1) for each of the 4 asset groupings is illustrated in 'decision trees' as part of SIF3, with the choice depending on the type of asset and on several other influential factors. These factors are different for each asset group. For further information regarding the implementation of SIF3 in this region, see Ridley, Pannell and Park (2006).

Major changes in approach

The major changes that are present in this Plan from previous natural resource management are:

- High value assets within the region have been identified for protection from threats – management is aimed at treating the causes of salinity at a local scale as regional groundwater systems take too long to respond to change;
- A rural towns program is recommended to manage salinity threats to town infrastructure from both secondary salinity and urban sources of salt; and
- Strong partnerships will need to be developed between government, the community and research bodies (in particular the Cooperative Research Centre for Future Farm Industries) to develop profitable new plant-based systems that can be utilised on-farm to manage salinity to dispersed assets, such as agricultural land.

Table 1: Management interventions considered in the Plan

Investment response	Description	Application (public private benefit motivation)
Extension	Technology transfer, education, communication, demonstrations, support for a community network. This is relevant to promotion of existing options where they are attractive to land managers to adopt.	Extension is used when private net benefit and public net benefit of the proposed management response are both positive. Private net benefit is sufficient that it will be 'adoptable' once the extension program ceases.
Incentives	Positive financial inducements to encourage a change in management. This is relevant to promotion of existing systems. Examples include subsidies, conservation auctions/tenders and cost-sharing. It can also include encouragement for land retirement where appropriate.	Incentives are used when public net benefits of the proposed management response are high but when private net benefits for landholders are not enough to get them to act without an additional financial incentive. If the private net benefits are highly negative, then incentives will not be taken up.
Penalties	Negative incentives to discourage a practice or land use. This is relevant when an existing system will cause harm to the catchment if implemented. Examples include the requirement to purchase water entitlements, regulations on land use or drainage, land use zoning or government acquisition of land.	Penalties may be used when there are public net costs, particularly if these outweigh private net benefits.
Engineering	This category represents direct investment in public engineering works. For example, salt interception through pumping saline water to avoid discharge into waterways, or to protect infrastructure.	Engineering is recommended where the asset value is very high (very high public net benefit of protection) and where engineering is the most cost-effective response. Due to the expense of engineering options they would usually be targeted to discrete, localised, high-value assets, rather than dispersed assets like farm land.
Technology development	Investment in development or improvement of technology options for management, such as development of profitable perennial or salt-tolerant plant-based systems, investment in market institutions and infrastructure, and participatory research with landholders.	Technology development is relevant when private net costs of existing sustainable land-use options outweigh their private net benefits, and where there are suitable prospects for better technologies to be developed. Technology development produces future land management options that are adoptable in the future over a large scale.
Other research and development	Research to provide information to support planning and decision making, such as to provide improved data on salt stores or groundwater depth, and research to measure the performance of existing management technologies.	This category of research and development is potentially relevant to all levels of public and private net benefits, where there is a sufficient data gap that needs to be filled to support planning and decision making.
Informed no action	No response is justified from a public investment perspective.	The intervention in question is not sufficiently high priority from the perspective of public investment or is too expensive to consider.
Source: Ridley and Pannell (2005); Pannell, D.J. (2006).		

2. Assets in the Dryland Region

What are assets and why are they important?

Assets are physical elements that are of value to people. They can be natural features (for example rivers, ecosystems) or man-made, such as buildings or sites of cultural significance. Assets can be valued for economic, environmental and/or social reasons. These values can be both tangible and intangible. An asset based approach to management aims to protect or maintain the biophysical features that are most highly valued by the community. There is increasing recognition that we are unlikely to be able to protect all assets, so resources must be allocated to produce the best outcome from public funding.

Assets are described in the Region at three levels:

- Primary assets at the landscape-level: land, water, biodiversity and atmosphere.
- Secondary assets are natural or built resources associated with the primary assets, such as rivers and river reaches, wetlands, groundwater, agricultural land, infrastructure, soil, native flora and fauna, public land and cultural heritage.
- Local assets are individual locally identified assets that can be part of a region's secondary asset, for example Lake Buloke (wetland), the Calder Highway (infrastructure), Quambatook township (infrastructure), the Avoca River (rivers and river reaches), Lake Eppalock (wetlands), a cultural site (cultural heritage), etc.

Primary and secondary assets are described in the North Central Regional Catchment Strategy (North Central Catchment Management Authority 2003). In implementing an asset-based approach in this Plan, we use priority local assets wherever possible because the categories of primary and secondary assets are too broad for effective intervention. Secondary assets have been used where there were gaps in knowledge of local assets.

Secondary assets have been grouped into high-value assets and dispersed assets for this Plan. This is as far as valuing assets in this Plan has extended for now (refer to Table 2). **Any high-value asset that has a salinity threat that is likely to be treatable is considered a priority in the Plan.** In the future it is likely that assets will be valued based on the services and values they provide to the community (Department of Sustainability and Environment 2005a, Department of Sustainability and Environment 2005b). Until a state-wide framework has been developed by DSE that is in sufficient detail to be implemented effectively, it is not considered possible to do this within the region. This asset valuation will occur in close collaboration with the community to ensure community values are reflected in the Plan's priorities.

High-value assets in the region

A set of high-value priority local assets for the dryland region has been identified through the development of this Plan. Asset **identification focussed on, geographically discrete, publicly important assets** such as waterways, wetlands, built infrastructure and key discrete biodiversity assets as opposed to more common assets dispersed over the landscape such as agricultural land and small patches of remnant vegetation.

A combination of scientific classifications (eg international, national, state and bioregional significance), regional priorities (for example priority river reaches in the River Health Strategy (North Central Catchment Management Authority, 2005b), expert opinion and local community knowledge was used to identify areas of high value assets. The local assets within these areas are the focus of this Plan (for more information refer to Ridley, Pannell and Park, 2006 and 2007). Expert opinion and local knowledge were critical as they provided necessary validation of data and the ability to tighten priority areas.

At this stage only assets with a high threat of salinity have had management actions developed. The whole asset set will be used as we broaden the focus from salinity to cover other threats. Local assets at threat of salinity and the management recommendations to protect them are outlined in Chapter 4 and the approximate location of these high-value assets are shown in Figure 2. Descriptions of these assets are provided in Appendix B as part of an asset area.

As a comprehensive process of prioritising local assets has not been done before, the list of assets will not be perfect. There is a need for an on-going process of refinement as more knowledge (both scientific and community knowledge) becomes available.

Dispersed assets in the region

In SIF3, agricultural landscapes and most small pieces of remnant native vegetation are treated as “dispersed assets”. Whilst dispersed assets are seen as high-value to the people who own them or live near them, from a public investment perspective they are generally of much lower value than waterways or ‘icon’ high-value terrestrial assets. If a small remnant is sufficiently valuable (e.g. it may contain an endangered species or has been deemed by science or the community to be high enough in value) then it could be considered within the “high-value assets” category, rather than as a “dispersed asset”.

The reason for treating dispersed assets as lower value than waterways or high-value terrestrial assets is simply that there are too many to be able to protect them adequately from a salinity threat. Spreading the majority of public funding across dispersed assets often results in very little or no effective protection of the threatened assets. The sad reality is that we can only protect a subset of the things we would like to protect. If we try to do more, we are likely to achieve less. This argument is specific to salinity, because of the need for large responses to protect even small areas. For other threatening processes, the situation may be different.

People who own dispersed assets often have strong motivation (economic, environmental, or social reasons) for investing in their improvement or protection. This is to be encouraged. This alone however does not mean that such assets are the best value to be protected from a broader community (public-good) perspective.

Through the ongoing process of priority setting and in considering other threats, these dispersed assets will continue to be considered and where possible, other high-value assets will be identified and the priority list refined.

It is also important to note that we recognise that indigenous sites have not been adequately identified so far in this process. Refer to the Indigenous cultural heritage assets part of Chapter 4 for recommendations relating to this information gap.

Table 2: Relationships between different descriptions of assets

Asset type	SIF3 Asset group	Secondary asset	Local asset (where identified)
High-value assets	Water resources & wetlands	Waterways	Axe Creek
			Campaspe River reach 4
			Loddon River reaches 7 and 10
			Avoca River reaches 5, 6, 7 and 8
			Richardson River reach 43
			Avon River reach 46
	Wetlands	Lake Eppalock	
		Cairn Curran Reservoir	
		Tullaroop Reservoir	
		York Plains wetlands	
Water Resources	Avon Plains wetlands		
	Avoca Marshes		
High value terrestrial assets	Infrastructure	Secondary asset considered only at this stage at a regional scale (expect where waterways and wetlands works may impact)	
		Bendigo	
		Donald	
Dispersed assets	Water resources & wetlands	Floodplains	Other specific towns identified if a state-wide rural towns program is successfully funded to manage salinity threat
			Lower Avoca Floodplain (specific local assets need to be refined further, as the whole area is too big for salinity management – these will then be elevated to high-value assets)
	Dispersed assets and salt affected land	Land/soil	Secondary asset considered only at this stage at a regional scale
		Biodiversity	Principles only set in the document for management of biodiversity assets at threat from salinity and considerations for works on other asset types
	Indigenous cultural heritage sites	Secondary asset considered only at this stage at a regional scale. Much more detailed identification of high value cultural sites and the threat of salinity to them is needed before recommendations on specific sites can be made	

3. Threats to assets within the Dryland Region

Salinity threat to the region

Dryland salinity is a major environmental threat to the community and environment in the North Central region. Approximately 32 000 ha of land (about 1% of the region) is mapped as affected by dryland salinity, almost half of which is in the Avon-Richardson catchment.

Whilst land affected by salinity is the most visible sign of the problem, it is only one of the key assets under threat. Waterways, wetlands, other terrestrial biodiversity, sites of cultural heritage (both indigenous and non-indigenous), towns and other infrastructure are also threatened. Some are already significantly degraded and others are under immediate threat of damage. The threat of salinity to some of these high-value assets is more significant from a public investment perspective than a dispersed loss of agricultural productivity.

Water quality in many waterways is already affected by salinity. Salt exports from large parts of the dryland region typically range between about 150 and 300 kg/ha, but may be 1000 kg/ha or more from some sub-catchments. Revegetation with trees would reduce salt exports but may also reduce water runoff yields. The trade-off issues between reducing salt exports and affecting fresh water flows to rivers is a major issue that needs to be tackled using best-available science and modelling.

Consecutive dry years have lessened the immediacy of the salinity threat across the region as a whole, however, key high-value assets remain under urgent threat of salinity. Water tables across much of the region have been falling over the last decade with significant declines recorded in some places. This, combined with the possibility that some groundwater flow systems (particularly local scale systems in hilly regions) have reached a new balance, means salinity threat will not increase in the short-term. With climate change the threat of salinity may actually decrease. Rather than causing complacency, this understanding provides us with an opportunity to be proactive and make sound decisions about protecting key high-value assets that remain under urgent threat of salinity, where treatment is both feasible and cost-effective. A return to a run of wetter than average years could see renewed impacts of salinity damage.

Assessing the urgency of salinity threat to assets

The information required to assess the threat of salinity includes land mapped as being affected, the height and trend (rising or falling) of the watertable and salinity concentration of the watertable. A reliable map of salinity concentration of watertables was not available.

Several sources of information were used to derive the threat of salinity. These included:

- Previous reports and work undertaken before the National Action Plan. These were used as a starting point and later for a 'reality check' against derived Geographic Information Systems (GIS) layers.
- Depth of watertables (3 data layers)
 - 1) North Central Salinity Audit (Peterson et al., 2002) depth to watertable data - watertables of less than 5 m depth were assessed as having a potentially urgent salinity threat (GIS layer D2000_EST_1);
 - 2) New [maps by](#) Sinclair Knight Merz (SKM) (Anon. 2006) integrating watertable height and trend data and saline discharge information (GIS layer SGS_5M_2004). Assets at risk were those estimated to have moderate and high probabilities of watertables at less than 5 metres depth in 2004; and
 - 3) The saline discharge layer, which used in combination with depth to watertable from the North Central Salinity Audit gave us additional confidence of salinity risk (DSE corporate library).
- Local expert opinion (hydrogeologists, extension staff and Implementation Committee members) was sourced through a workshop where they were shown the currently available layers of watertable information and asked to comment on accuracy.
- Hydrogeologist expert opinion was used to make sure we were not including areas affected only by waterlogging.

Other threats to assets in the region

Many threats occur in the region. Some of these are currently addressed through other regional plans (water quality through nutrient management plans, biodiversity through the Native Vegetation Plan) and others are not. To best invest in protecting and enhancing the assets in the region from other threats, this plan will need to consider relevant threats to all identified local assets.

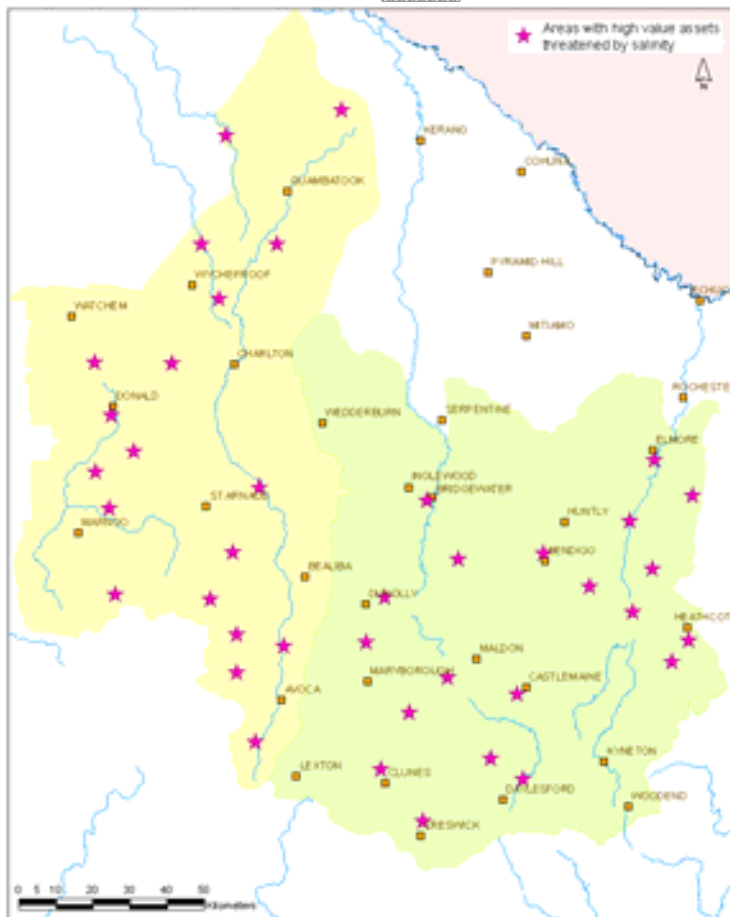
The Dryland Region Management Plan will ultimately address the threats to high value assets in the region of:

- salinity,
- pest plants and animals, and
- soil health decline

The management actions taken to address these three threats may ultimately help address other threats, such as land use change, altered water cycles, water quality, farm business viability, loss of knowledge and expertise, changes in rural communities, dry conditions/drought and inappropriate land management practices. The impact of climate change and actions to address this threat are beyond the influence of this plan. This threat will be addressed through the Regional Catchment Strategy when it is revised.

The Dryland Region Management Plan primarily includes management actions for addressing salinity threat. It also includes some actions aimed at understanding other threats and filling information gaps on some asset types at threat from salinity that have not yet been well identified to a local asset scale (for example groundwater and regionally significant areas of agricultural production). This is because the current knowledge base has not been well integrated to assess the public benefits from addressing other threats.

Figure 2: Local Assets at threat from salinity in the North Central Dryland Region



4. Actions and targets for improving asset condition in the region

The exercise of identifying discrete clusters of local assets (for example, river reaches, native vegetation and wetlands) to a manageable level was challenging, yet necessary. However, agreeing on a short list of high-value assets is important as the current salinity budgets will not permit adequate protection of all threatened assets so we need to know where to work first.

Once identified, the local assets at threat from salinity were analysed using SIF3 to determine the most appropriate management intervention. The resulting interventions represent the most feasible and cost-effective manner in which to protect the asset, considering how much of the salinity problem will be abated, by when and if there is sufficient benefit of public investment for asset protection.

Targets were then developed with the community for actions that would be undertaken to achieve the desired level of asset protection over specific time frames. Management actions and outputs were identified to meet these targets. These management actions and outputs address both the salinity threat to assets as guided by the recommendations of SIF3, as well as to advance understanding of gaps that the Plan has not yet addressed adequately, including threats other than salinity and assets that have not been defined well to local asset level.

It became apparent that the Plan would need to be flexible and adaptive as the target setting process is imperfect (gaps exist) and other threats to land based assets have yet to be considered. Also, the community values participation and support for protecting dispersed assets (such as agricultural land). We therefore felt it was important to also develop targets and actions for dispersed assets (particularly agricultural land) that were not seen as a priority for investment under SIF3.

At this stage, there is no guarantee there will be investment in all the management actions as sufficient public benefit has not been quantified and some actions will not be able to be afforded on the scale current funding permits. However they will act as a guide for a wide range of investment (public or private) in the region. The North Central CMA Board will be required to make strategic decisions regarding funding allocations each year. This will include consideration of the cost, overall benefit of the project and community support, along with the immediacy of the risk to be treated.

Target setting process

To define what the community wants to achieve in terms of improving the condition of assets in the region, targets have been set for the different asset levels, considering the varying timescales needed to achieve these changes. The Plan identifies short, medium and long-term targets to improve the condition of key assets in the region:

- 1-5 year management action targets (MATs) on local assets and regional-scale secondary assets (management action targets) to improve secondary asset condition. These actions are projects around 'foundational activities' which means working out if investment in the local asset is actually warranted (through feasibility studies) and then subsequent actions to protect assets.
- 10-20 year resource condition targets (RCTs) to improve regional secondary asset condition (resource condition targets), that contribute to the 30 year targets.
- 10-20 year targets to improve local asset condition (RCTs), where they could be identified, that contribute to improving the regional secondary asset condition.
- 30 year targets for achieving improvement of the condition the region's secondary assets (aspirational targets). We have used the RCS vision for the secondary asset for this target wherever possible.

Project activities that will contribute to management action targets have also been identified.

The link between project activities and targets resulting in improved asset condition is illustrated in Figure 4.

Figure 4: Link between project activities, outputs and targets in the Plan



The management action targets were identified by the community and technical experts, at a series of workshops. The targets that are relevant at a regional scale are provided below, grouped in terms of high-value assets and dispersed assets.

Where relevant, links to targets from other regional plans have been identified, to promote consistency and alignment between action plans under the Regional Catchment Strategy. New targets have been developed where existing targets were no longer relevant or did not exist.

The North Central RCS sets various RCTs and MATs relating to the management of dryland as an asset. Unfortunately, most of these targets specifically related to the previous 10 target areas of the *Second Generation Dryland Salinity Management Plan for the North Central region (Draft B)*. Because of the major shift away from the threat-based target area sub-catchment approach to the asset protection-based approach, this new Plan only contributes towards a few of the targets within the current RCS. When the North Central RCS is reviewed, it will need to consider the Plan in revising its targets

The targets of the North Central RCS that the Plan does address are noted here. The Plan will address these targets through the works described in the rest of this chapter. Below we list the relevant target numbers. For a description of these, refer to the Regional Catchment Strategy.

Resource condition targets:

RCT DL13

Management action targets:

DL2, DL4, DL12, DL13, DL14

Basis of management responses to protect high-value assets

The appropriate management response to salinity (Table 1) depends upon the type of asset threatened, the urgency of the problem and several other influential factors, some of which are different for different asset groupings, as outlined by Ridley, Pannell and Park (2006).

Recommendations exist for all of the 44 threatened asset areas, however only actions on the 20 areas where intervention is obviously possible are provided in this document. The full set of recommendations are in Ridley, Pannell and Park (2005), and should be referred to when work occurs in any area by other initiatives, to capitalise multiple benefits and integrated outcomes as much as possible. Recommendations focus on undertaking works in the catchment affecting the identified assets, so mainly include works on land surrounding the asset rather than works within the asset boundaries, though works within the asset would obviously complement salinity management in the surrounding catchment to improve asset condition further.

Basis for management actions and targets to protect dispersed assets

Targets and management actions have been identified for dispersed land assets, cultural heritage, floodplains and soil. Dispersed biodiversity assets are also considered as part of the Plan but do not have specific targets set, instead setting principles that need to be followed when undertaking salinity management works that will meet needs of the North Central Native Vegetation Plan and other biodiversity initiatives from government.

Protection of dispersed assets from a salinity threat: Recommendations for protection of dispersed assets from the perspective of public investment for protection from a salinity threat using SIF3 are for:

- Technology development (eg development of new plants and farming systems options) where there are not sufficiently economic or adoptable systems (this is the case in almost all areas, with the exception of lucerne and perennial grasses in a few particular localities)
- Extension (where land use options are sufficiently economic and adoptable)
- 'Informed no action' which means that investment is not justified from a public perspective.

Note that incentives for land use change are not recommended for dispersed assets, except for "land retirement" in limited situations.

Protection of dispersed assets from a community engagement perspective: The community strongly value participation and engagement through local Landcare and extension programs. There could be a case for protection of dispersed assets from the perspective of threats other than salinity (eg. pest plants and animals or soil health decline) but this has yet to be established. Due to the need for community participation we have included management actions for salinity based on extension programs at this point, but make the point that these will be re-assessed according to their merits from a public benefit perspective. It is acknowledged that supporting the rural community in establishing viable enterprises enables them to better participate in programs to protect high-value assets, however it is likely that some actions to protect dispersed assets will not be able to be afforded on the scale current funding permits.

Management actions and targets for high-value assets

Management actions were developed for the following high-value secondary assets:

- Waterways
- Wetlands
- Water resources
- Infrastructure

For each secondary asset type the following section outlines the current vision within the RCS, MATs developed through workshops as part of the preparation of this Plan and the management actions resulting from the SIF3 analysis for local assets, which will contribute to improving regional secondary asset condition. They also include management actions arising from any gap identification through the target setting process.

In the following sections, feasibility studies are given as an initial project activity on some assets. Feasibility studies should include the following (where relevant) and should promote a partnership approach wherever possible. The intention is to scope the project and develop a plan for implementation and should not be too onerous time wise (eg. 3-6 months only).

Project activities for feasibility studies
Partnerships developed with relevant agencies, land managers and delivery agencies/groups
Feasibility study considering these factors (where relevant): <ul style="list-style-type: none">• Confirmation of salinity risk and ease of treatment• Assess feasibility and cost-effectiveness of management intervention (considering SIF3 recommendation)• Assess community support for salinity intervention• Surface water-groundwater interactions• CAT modelling to determine impacts of potential management interventions (including salt and water yield trade-offs where relevant) - CAT is a computer model used to forecast salinity and water quality impacts from land management interventions• Benchmark of asset condition

- Establish the need for a monitoring program
 - Indigenous site identification and need for protection
 - Recommendations for works to protect the asset from salinity (detailing works for surrounding land (what and where), and where possible for the asset itself, to be delivered in partnership with other CMA programs). Must consider Native Vegetation Plan requirements
 - Cost/benefit analysis of recommended works
 - Potential benefits for high priority infrastructure assets
 - Potential cost share arrangements for management options
 - Set management action targets for the local asset
- If the feasibility study deems that salinity investment should not continue on the asset (project not feasible), then work should stop on the local asset at this stage. Investment may however still be needed into technology development to develop new profitable plant-based interventions.
 - If the feasibility study deems that works are viable, then:
 - Develop an action plan for the asset based on the recommendations of the feasibility study
 - Implement the action plan
 - Establish and implement a local asset monitoring program, where relevant

Waterways

Waterways of the region include natural rivers and creeks, but not constructed channels (these are classed as infrastructure assets). Priority river reaches of the North Central RHS that are at threat from salinity combined with community knowledge were used to identify the priorities within the Plan.

The vision for waterways as part of the RCS is:

Waterways will be managed to enhance their environmental function and, where appropriate, provide opportunities for economic, recreational and amenity use.

Salinity management actions on waterways will contribute significantly to targets from the River Health Strategy, particularly targets to improve physical form, riparian zone and water quality. It is inappropriate to set separate regional targets for waterways at this time, as the River Health Strategy targets have already been set. However, the River Health Strategy does not deal with salinity risks adequately, and identifying rivers at likely salinity risk offers opportunity for improvement in management actions and targets within both the River Health and Dryland Management Plans. The targets in this plan, set from a salinity perspective need to be used in conjunction with the current River Health targets in mind. Any works that occur on waterways needs to be coordinated with the River Health Program so that investment is capitalised and multiple benefits can both be achieved and monitored effectively.

To achieve the RCS vision, in 20 years the condition of waterways in the dryland region will need to reflect the surface water quality RCTs for water resources (refer to page 18) – DRMP WR 2, DRMP WR 3, DRMP WR4. (Water quality targets for Avon and Richardson Rivers are currently undefined.)

Progress towards these targets will be achieved through works on individual priority waterways. Relevant targets still need to be developed for these local assets.

The following project activity is relevant to regional waterways however, it will contribute towards the regional RCTs for water resources:

Project activities	Key assumptions
Review existing end of valley targets for the dryland component of the Campaspe, Loddon and Avoca Rivers	The end of valley targets may/will be achieved through a series of dry years, not through land management actions. With a move to an asset-based approach to investment there is a key need to re-assess EoV targets

Project activities that are identified for specific river reaches will generally result in outputs related to property management planning and River Health Strategy outputs. Ultimately the aim is to improve the riparian condition of each river reach by one measurement of the Index of Stream Condition, which is the target for all the river reaches identified as part of the River Health Strategy.

Project activities (from SIF3 recommendations) have been identified for the following specific priority river reaches under the DRMP.

Local asset project activity

Feasibility studies should occur on each of the priority river reaches below, and include the specified recommendations and other issues for consideration given below

For full SIF3 recommendations, refer to full SIF3 recommendations document. The community have currently identified the following waterways as the highest priority to protect from a salinity perspective.

Priority river reach	SIF3 recommendations and other issues for considerations
Axe Creek (asset area: Axe Creek)	Incentives for land retirement and development of low-cost land retirement strategies. <ul style="list-style-type: none"> Assess the priority for Axe creek as a priority area compared with other priority areas. This needs to be weighed up in terms of the importance of salt reduction downstream before funding is allocated. CAT modelling would be useful to assist with this.
Loddon River reach 10 (asset area: Upper Loddon)	Penalties or incentives depending upon the water yield/ salt trade-off issues <ul style="list-style-type: none"> Establish if there is a salinity risk Use CAT modelling and available data to see if penalties to prevent perennials or incentives for land retirement is most appropriate if there is salinity threat
Avoca River reach 8 (asset area: Amphitheatre)	Several possible recommendations including regulation, technology development or incentives for land retirement. <ul style="list-style-type: none"> Assess salinity threat to river and to Amphitheatre township Assess risk and responsiveness to treatment for river reach 8. Response will depend upon this assessment (may fall under Rural Towns Program, if so, stop and address as part of Rural Towns Program if it gets funded). Assess salt loads to Avoca reach 8 and Glenlogie creek Assemble technical experts and those with strong local knowledge to work out most likely scenario for successful intervention. Develop a project on CAT modelling in the Avoca to work out salt-water yield trade-offs.
Avon River reach 46 (asset area: Grays Bridge-Banyena)	Use extension if lucerne is profitable. If not, using perennials to protect the river and nearby wetlands would require long-term incentive payments, imposing some land use restrictions on those who participated. <ul style="list-style-type: none"> This project needs to link with any project occurring on the York Plains wetlands.

Some river reaches are associated closely with towns. Subject to funding allocations there river reaches will be considered under the Rural Towns Program, if it gets funded. Assessment is needed to verify if these river reaches warrant investment into salinity management in their own right, or if they need to be combined solely with a Rural Towns Program project.

Priority river reach	SIF3 recommendations and other issues for considerations
Loddon River reach 7 (asset area: Bridgewater)	SIF3 recommendation: Technology plus engineering if economic. Link to Rural Towns Program for Bridgewater. <ul style="list-style-type: none"> Establish risk of salinity using available knowledge and bore data Extension is recommended if lucerne is economic, but no incentives. If economics marginal, invest in technology development
Campaspe River reach 4 (asset area: Elmore)	SIF3 recommendation: Technology development plus engineering if economic and subject to urgent salinity threat. Link to Rural Towns Program for Elmore
Richardson River reach 43 (asset area: Donald township)	SIF3 recommendation: Engineering if economic (as part of Rural Towns Program for Donald)

Some river reaches had technology development as their only recommendation. These areas should be considered as priorities for any on-ground regional trial of profitable new perennial plant systems for farms to assist with salinity management, and should occur in partnership with the CMA, state government, land managers and research bodies (such as the CRC Future Farm Industries).

Priority river reach	SIF3 recommendations and other issues for considerations
Avoca River reach 7 (asset area: Natte Yallock)	SIF3 recommendation: Technology development
Avoca River reaches 5 & 6 (asset area: Gowar East Springs)	SIF3 recommendation: Technology development

Wetlands

Wetlands are defined as any water body, including natural and man-made water bodies, such as reservoirs and dams.

The vision for wetlands in the North Central Regional Catchment Strategy is:

Wetlands will be managed to enhance their environmental function and where appropriate provide opportunities for economic, recreational and amenity use.

To achieve this vision, in 20 years wetlands at a regional scale need to reflect targets within the North Central Regional Wetland Strategy (in development). Works within the DRMP that will contribute to the Regional Wetland Strategy and RCS will be reflected in the following targets:

DRMP WL	6 priority wetlands with a lower threat from salinity relative to 2006 levels by 2026 ²
DRMP WL	6 priority wetlands with an appropriate watertable regime (level in space, time, duration and frequency)
DRMP WL	6 priority wetlands with surface water quality appropriate to maintain the wetlands
DRMP WL	Improvement in condition and extent of native vegetation in 6 priority wetlands

Management action targets for wetlands are still not defined, but will consist of the aggregated outputs from works on individual wetlands. The targets will be identified in feasibility studies for individual wetlands and are likely to contain the following themes, as a minimum:

MAT undefined	60-80 % perenniality around 6 high priority wetlands threatened by salinity, in relevant catchment areas
MAT undefined	# ha of wetland/riparian vegetation protected around 6 high priority wetlands threatened by salinity
MAT undefined	70% minimum vegetation cover around 6 high priority wetlands threatened by salinity in relevant catchment areas
MAT undefined	Meet SEPP (Wov) water quality objectives for 6 high priority wetlands (target for relevant reservoirs and water quality parameters only)

The activities and outputs that will contribute to these targets will occur on individual wetlands, and are described further below, however there are also some activities that need to occur at a regional scale to provide vital information to help increase our knowledge across the region on wetlands. These activities will provide the benchmark data on condition and extent of wetlands at threat from salinity in the region, so that progress towards the RCTs can be measured. These will be delivered through the Regional Wetland program.

Regional project activities for wetlands

Benchmark wetland condition of all DRMP priority wetlands threatened by salinity by June 2008 (Test the Index of Wetland Condition on priority wetlands threatened by salinity)

Benchmark regional wetland extent by June 2008

If appropriate, design a monitoring program to meet state and national standards to monitor wetland extent and condition (if this is not achieved through the Index of Wetland Condition).

The priority wetlands for salinity investment have been identified through the SIF3 process as being of high value and with some urgency of salinity threat that has some possibility of viable salinity management action. The priority wetlands identified in the DRMP currently are:

- Lake Eppalock (within asset area: Wild Duck Creek and Lake Eppalock)
- Cairn Curran Reservoir (within asset area: Cairn Curran Reservoir)
- Tullaroop Reservoir (within asset area: Tullaroop Reservoir)
- York Plains wetlands (within asset area: Grays Bridge – Banyena)
- Avon Plains wetlands (within asset area: Avon Plains Lakes area)

² Target is based on the current list of priority wetlands under the DRMP. This target should be updated when needed if new information shows the need (eg. new priority wetlands or salinity threat determined to be unmanageable on an existing priority wetland).

- Avoca Marshes (within asset area: Lower Avoca Floodplain)

Other wetlands may be identified as part of the annual review of assets and asset valuation (refer to Chapter 5). These will be included in this list of priority wetlands and targets reviewed where relevant.

The feasibility study approach should be applied to each of the priority wetlands listed, with consideration given to the SIF3 recommendations and identified issues listed below.

The community have currently identified the following wetlands as the highest priority to protect from a salinity perspective. For full SIF3 recommendations, refer to full SIF3 recommendations document.

Wetland	SIF3 recommendations and issues for consideration
Lake Eppalock	<p>Need to establish if the salt exports from Wild Duck Creek are important enough to consider encouraging increased perennials. If salt exports are important enough, then land retirement is recommended.</p> <ul style="list-style-type: none"> • Need to complete the Special Area Plan for Lake Eppalock by (DATE) considering the whole catchment • Need to consider salt/water yield trade-offs • Careful consideration is needed if penalties to establish perennials or incentives for land retirement result, given the implications for the community • Any works need to link with the existing storage management plan • Partnership needs to include Goulburn-Murray Water
Cairn Curran Reservoir	<p>Engineering (if feasible) and/or incentives if there are perennial options to enable groundwater response. Technology development with landholders is an important part of any investment response with respect to this asset. Recommendations dependent upon an assessment of the salt/water yield trade-off issues. Could be penalties to increased perennials if water yield is important. Middle and Joyces creek sub-catchments to be targeted for recommendations subject to salinity threat being urgent enough.</p> <ul style="list-style-type: none"> • Any works need to link to existing storage management plan • Need to consider protection of water quality in reservoir, including impacts of Middle and Joyces Creeks. • Need to consider salt/water yield trade-offs • Partnership needs to include Goulburn-Murray Water
Tullaroop Reservoir	<p>Needs confirmation of salinity risk. Recommendations will be dependent on salt/water yield trade-off issues.</p> <ul style="list-style-type: none"> • Feasibility study will need to identify appropriate salinity intervention after salinity risk is confirmed and salt/water yield trade-offs are considered. • Any works need to link with the existing storage management plan • Partnership needs to include Goulburn-Murray Water
York Plains wetlands	<p>Use extension if lucerne is profitable. If not profitable, use perennials to protect wetlands. This would require long-term incentive payments imposing some land use restrictions.</p> <ul style="list-style-type: none"> • Need to consider the impact of Wimmera Mallee pipeline • Need to assess flood risk relationships from an increase in perennials in the upper catchment (CAT modelling would be useful) • Need to determine appropriate project area for this project, considering wetlands present and community support for works • Need to identify relevant wetlands and land managers
Avon Plains wetlands	<p>Use perennials to protect the wetlands. This would require long-term incentive payments imposing some land use restrictions. For Batyo Catyo need to assess whether value is in fact high enough for considering asset protection.</p> <ul style="list-style-type: none"> • Need to consider impact of Wimmera Mallee pipeline • Be aware of outcomes of floodplain management works in this area on these wetlands • Partnership needs to include Parks Victoria and other relevant land managers
Avoca Marshes	<ul style="list-style-type: none"> • The "Lower Avoca Wetlands Salinity and Water Management Plan" was completed in 2005. This serves the purpose of an Action Plan, so actions need to be implemented according to the Plan. (ie. do not need to undertake feasibility study component of the project, as an action plan for salinity management already exists for these wetlands). • Targets specific to this asset have not been identified at this stage. • Partnership needs to include Parks Victoria

A major assumption of the framework for wetland works is that improving land management, land cover and water quality will result in an appropriate watertable regime, surface water quality that is appropriate to maintain healthy wetlands that sustain their biodiversity value (ecosystem function) and an improvement in the condition and extent of native vegetation. This assumption needs to be tested.

Water Resources

Water resources are defined as the water that is available for use by the region for various purposes. It refers to both surface water and groundwater resources.

The vision for water resources in the North Central Regional Catchment Strategy is:

Water will be shared equitably between environmental and consumptive uses, water quality will match users' requirements and water will be used efficiently.

To achieve this vision, in 20 years water resources need to reflect the following targets from the Plan:

DRMP WR 1	Protect, improve or maintain the quality of water in groundwater aquifers for both consumptive uses and the environment (eg. base flows in rivers/wetlands)
DRMP WR 2	2096 EC by 2015 at Quambatook Avoca River gauging station ³
DRMP WR 3	412 EC by 2015 at Campaspe Weir ⁴
DRMP WR 4	711 EC by 2015 at Loddon River gauging station 4 km downstream from Laanecoorie Reservoir ⁵
RCT undefined	Balanced runoff potential (Need target wording and indicators)

No specific local priority assets were identified in relation to water resources (other than the river reaches and reservoirs outlined previously) during the development of the Plan, though the assumption can be made that groundwater management areas and water supply protection areas would be the priority assets. It should be noted that groundwater was not specifically discussed as an asset in the community meetings. There will also be benefits for water resources through actions to protect priority wetland and waterway assets.

At a regional scale, some project activities that contribute to the targets have been identified.

Management action targets have not fully been identified, as their development relies on the outcomes of some project activities. Targets are likely to relate to the following themes:

MAT undefined	Targeted reductions in the height of groundwater levels, relevant to priority assets where relevant
MAT undefined	Decrease in area affected by soil erosion, relevant to priority assets
MAT undefined	Public and private land will be managed appropriately to minimise salinisation of groundwater, optimise recharge to groundwater, protect groundwater dependent ecosystems and maintain base river flows in priority areas
MAT undefined	Appropriate management of recharge areas in priority areas
MAT undefined	Appropriate management of discharge areas in priority areas

Project activities for surface water assets

Assess if need to refine/expand groundwater monitoring program in the region for protection of specific assets. Expand program if deemed necessary

Program focused on priority assets:

- Targeted CAT modelling, groundwater flow system mapping and water yield considerations in all

³ End of Valley Targets may be reviewed – need to update the relevant RCTs if this occurs

⁴ End of Valley Targets may be reviewed – need to update the relevant RCTs if this occurs

⁵ End of Valley Targets may be reviewed – need to update the relevant RCTs if this occurs

<p>implementation planning to inform appropriate land management to protect assets</p> <ul style="list-style-type: none"> • Understand surface water/groundwater interactions, particularly in groundwater management areas • Understand impacts of land management on groundwater and stream flow (including water salinity)
<ul style="list-style-type: none"> • Identification and implementation of salinity management actions for priority assets, as part of foundational project activities on those assets. Actions are likely to include planting perennials and improving land cover in priority areas to improve water resource condition.
<p>Consider the salt and water yield trade-offs in much more detail than currently.</p>

The issue of water yield and salt reduction will become even more important in future than it is now. The broad issue of salt reduction to the Murray River is not well catered for in SIF3, and neither is it in the threat-based target area approach. Debate and discussion with DSE and the Murray Darling Basin Commission would be useful to assess how to best start to address this in a more meaningful way. CAT modelling would be an excellent start to better considering this issue.

Some activities were also identified as necessary to improve knowledge and management of groundwater assets, however it was deemed that they were really outside the influence of the DRMP, but if these activities were occurring under another venture, we should offer support where relevant. These are described here:

<p>Project activities to protect groundwater</p>
<p>Investigate groundwater dependant ecosystems within the region – location, function, importance, threats, risk, need for action and what we want to see a change in.</p>
<p>Collaborate with DSE, G-MW and community to identify new groundwater assets that may affect stream flow</p>
<p>Investigate groundwater resources in the region (outside groundwater management areas) and their interaction with surface water. Groundwater management areas and water supply areas identified fully for the region</p>
<p>Groundwater management plans will be developed for these areas</p>
<p>A bore monitoring program needs to be put into place around each of the key assets which are to be protected. The investment needs to be made on a case by case analysis considering whether new bores are required, the frequency of monitoring and specifications for plain-english interpretation of bore information.</p>
<p>Groundwater conceptualisation. Development of more detailed (1:100,000) maps of groundwater flow systems are essential as the current 1:250,000 layer is too coarse. Hydrogeologists agree that 1:100,000 scale is as fine as is worth investing in (Mark Reid, Phil Dyson, <i>personal communication</i>), with additional point scale bore data and local knowledge being used to refine recommendations around specific assets. Agreed groundwater conceptualisation of the whole of NC CMA at a scale that enables CAT analysis of interventions at the point scale is essential.</p>

An assumption is made in relation to the project activities above that key agencies will share knowledge and collaborate to increase groundwater understanding.

<p>Infrastructure assets</p>

Infrastructure assets are built or constructed components of our region that provide support to the community in some way. Roads, railways and townships were primarily considered as part of the analysis of salinity threat to the high value asset areas in the region.

Some recommendations have been made about specific road and railway assets in some asset areas, but these have not been included here, as they were not common in the Plan and generally need further assessment. Reference should be made to the detailed SIF3 recommendations document (Ridley, Pannell and Park 2007) for each of the 44 asset areas when work is undertaken, to see if there are relevant recommendations about salinity management for roads and railways. Where possible, consideration of roads and railways should be built into any actions that relate to towns.

Numerous towns have been identified as part of the asset areas and at threat from salinity.

The vision for infrastructure in the North Central Regional Catchment Strategy is:

<p>Infrastructure assets will be protected by land and water management practice from the impacts of natural resource degradation. Infrastructure development will be carried out in ways that minimise and offset adverse environmental impacts</p>
--

To achieve this vision, in 20 years the following target will need to be reflected in the region's towns:

DRMP INF 1	Salinity threat minimised on 2 priority towns by 2026 (relative to 2006) ⁶
------------	---

This will be achieved through work towards the following management action targets

MAT undefined	Specified salinity management actions (to be developed as part of the Rural Towns Program) implemented on # priority towns
---------------	--

It has been identified that a state-based Rural Towns Program is required to provide adequate expertise and funding to effectively manage the salinity threat to towns across the region. A Rural Towns Program already exists and is quite successful in Western Australia (http://www.agric.wa.gov.au/servlet/page?_pageid=449&_dad=portal30&_schema=PORTAL30&p_reference_path=798_IKMP_NAVIGATION_PORTLET_260&p_start_url=&p_home_url=&p_show_menu=&p_login_url=&p_topic_id=20039&p_topic_name=0LWE0&p_no_sumpage=N&p_appname_img=).

A Rural Towns Program is beyond the scope of the North Central CMA to fund. It is also more appropriate for it to be funded by the State as there is a need across a number of CMA regions and expertise could be centralised. If such a program were funded, within the North Central region, the Rural Towns Program would be implemented to achieve the regional targets for infrastructure.

The following project activities and outputs were identified to contribute to these targets, subject to the Rural Towns Program. In the absence of such, and without key partnerships of relevant local governments, the CMAs commitment to protecting towns from salinity would need to be re-visited. Salinity management works on Bendigo and Donald should continue, as they are already underway, however these actions would be greatly improved if a Rural Towns Program was initiated by the State.

Project activities
Investigate the feasibility of salt disposal options for the region as a pre-cursor to any engineering (groundwater pumping) feasibility studies for individual towns (considering flood and drought conditions). <ul style="list-style-type: none"> Consider partnerships with industry regarding salt disposal options. Need to investigate if groundwater is a viable option for town usage (considering quality and need to desalinate) when compared to carting/more storage (the current 'easy option) and the salinity implications for the usage of each.
Need to investigate if desalination is an option for the region.
Discuss with DSE funding a state-wide Rural Towns Program
DSE establish a Rural Towns Program – piloted in the North Central region (if DSE fund the program)
Identify priority towns from the list of identified salinity threatened towns:
<ul style="list-style-type: none"> Bendigo Donald Amphitheatre Natte Yallock Gowar Springs Castlemaine Chewton Bridgewater Heathcote Tooborac Elmore Guildford Vaughan Springs Creswick
Apply Rural Towns Program methodology to priority towns and identify Action Plan for salinity management.

Elements that are considered to be essential for the rural towns program, that would be applied to each priority town are:

Project activities
Partnerships with DSE, Shires, CMA and delivery partners to work out co-investment strategy. (Regional NRM role in these projects is to provide technical input on salinity and its management)
Feasibility study covering: <ul style="list-style-type: none"> Viability of engineering and other salinity management interventions Identification of salinity costs within the town Identification of land likely to be affected by salinity Identify appropriate monitoring program Develop sub-division standards and development controls Understand impacts of existing bore pumping (residential, industry (mining), intensive agriculture) Causes and impacts of salinity on existing infrastructure (extent and cost), including cultural sites
Develop action plan of recommendations from feasibility study for salinity management on the town that includes a toolkit for urban salinity management and an education program focusing on community

⁶ Target is based on the work currently possible under the Plan, without the presence of a Rural Towns Program. This target should be updated if a State-based Rural Towns Program is funded and more works can occur on salinity management for priority towns in the region.

knowledge, attitudes, skills and aspirations that need to change for successful salinity management within a town.

Specific considerations need to be given to existing salinity management already occurring within Bendigo and Donald. These works should continue, even if the Rural Towns Program is unsuccessful in receiving funding. The specific considerations relevant to Bendigo and Donald are:

Bendigo	<ul style="list-style-type: none"> Partnership with G-MW and other water authorities regarding bore licensing and application of water within town boundaries Continue the WaterSmart program through partnership with City of Greater Bendigo, DPI, Coliban Water Need to understand the current water use practices (in drought) within Bendigo and their implications for salinity (eg. use of pumped groundwater and transported water on gardens) Is desalination of pumped groundwater an option for the town and what implications would this have for groundwater levels (both from pumping and use of the water) Detailed SIF3 recommendations for the CMA and City of Greater Bendigo (refer to full SIF3 recommendations document (Ridley, Pannell and Park 2007))
Donald	<ul style="list-style-type: none"> Engage with Buloke Shire to work out co-investment strategy Utilise existing knowledge to determine feasibility of engineering for salinity protection of Donald Consider partnerships with industry when determining groundwater disposal options (eg. use to grow seaweed)

Management actions and targets for dispersed assets

Management actions were developed for the following dispersed assets:

- Floodplains
- Land/soil (management actions from both SIF3 and community participation priorities have been developed)
- Biodiversity
- Indigenous cultural heritage

Also consider the recommendations provided at the start of Chapter 4 relating to protection of dispersed assets.

Floodplains

Floodplains are areas of land that are inundated when there is too much water in a river to be contained within its banks. Wetlands can occur as part of the floodplain, but are considered as part of the wetland secondary asset. All other floodplain features are considered here.

The vision for floodplains as part of the Plan is:

Floodplains will be managed to enhance their environmental function, temporary floodplain storage and sustainable land use.

To achieve this vision, in 20 years floodplain condition needs to reflect these targets within the Plan:

DRMP FP 1	Maintain or improve the extent and connectivity across priority floodplains by 2026
RCT undefined	x m decrease in watertable in targeted areas
RCT undefined	x decrease in salt export (from groundwater/ surface water/ surrounding land?) to the Avoca River

To achieve these changes in condition of floodplains, management action targets will need to be reached. Most of these MATs are yet to be identified, and will relate to specific outputs that are identified for works on priority floodplains. The following target has been identified already as part of the Plan:

DRMP FP	Increase of 400 ha of floodplains receive appropriate volume and timing of water by 2026 relative to 2006 Need to identify – 5 year target and if this is what needs to be done as part
---------	---

A	of the DRMP, or just that we help deliver as part of floodplain works.
MATs undefined	Cumulative targets relating to local works on local floodplain assets

The Lower Avoca Floodplain has been identified as the only priority floodplain area at threat from salinity with some urgency and feasibility of treatment. Other areas of floodplain may be added as part of the annual review of assets. The area currently identified in this plan is too large for effective salinity management works. Further prioritisation of the assets and areas within the Lower Avoca Floodplain needs to occur before specific outputs and targets can be identified that will contribute to achieving the regional floodplain targets.

Given this and the condition we want to achieve for regional wetlands, the following project activities are proposed, showing their linkages to the regional floodplain targets.

Project activities	
Better identification and prioritisation of assets within the Lower Avoca Floodplain	
Partnership with relevant land managers and delivery agencies	
Feasibility study considering the generic feasibility study elements (where relevant) as well as:	
<ul style="list-style-type: none"> • SIF3 recommendation viability and identification of appropriate salinity management intervention <ul style="list-style-type: none"> ○ SIF3 recommendation is: due to size of the floodplains, if under salinity threat there are several possibilities. Extension for lucerne if profitable (with no incentives), floodplain regeneration with possible incentives to cover opportunity cost. Technology development in partnership with farmers, government and research bodies. • Likely affect of the Wimmera Mallee Pipeline (where relevant) • Possible links to the actions identified in the floodplain management strategy for the area that will provide salinity outcomes 	
<ul style="list-style-type: none"> • If the feasibility study deems that works should not continue on the identified assets (project not feasible), then there should not be a specific salinity investment, however there should still be investment in developing profitable perennial farming options (technology development in partnership with farmers, government and research bodies). Local trials of flood compatible economic farming systems should be part of this. (This assumes that developing new profitable perennial options that are flood compatible will help manage salinity on priority assets) • If the feasibility study deems that salinity intervention is viable for the identified assets, then an Action Plan should be developed to house the recommendations from the feasibility assessment and should be implemented for the relevant assets. 	
<ul style="list-style-type: none"> • Action Plan document • Specific outputs still to be identified as part of feasibility study and Action Plan development • This assumes that delivery of the outputs will lead to land managers understanding why salinity will benefit from floodplains receiving more water 	

Soils – management actions recommended from SIF3

For protection of agricultural land, both non-salt affected and salt-affected categories, development of new farming systems through participatory research and development was the major recommendation (broadly termed as technology development), because there are currently no perennial plant-based farming systems that are adoptable on a sufficiently large scale.

Below we include the management actions to protect land from a salinity threat, as well as some catchment wide recommendations.

Projects to be developed to address issues relevant to more than one river basin	
Protect agricultural land and dispersed remnant vegetation assets	Invest in development of profitable new plant-based technologies/systems to protect against further salinity impacts. This could be achieved through projects in partnership between the CMA, DPI (extension and research), the CRC Future Farm Industries and the community to make maximum use of Australian research into perennial farming systems options. The projects could be conducted anywhere in the catchment, but the Avon-Richardson, parts of the Avoca and Loddon are the highest priority areas, as noted in the SIF3 recommendations document (Ridley, Pannell and Park, 2006).

Saltland agronomy	Develop a participatory approach with farmers, extension and research staff to develop practical and profitable perennial based systems, based on the partnership approach outlined above. This program would be focussed on practical dryland agronomy options for salt-affected land. Economics and potential downstream impacts of saltland systems need to be built in. Whilst the projects could be conducted anywhere in the catchment, we suggest that the Avon-Richardson is a high priority area for development of a partnership with local farmer groups, (for example. a partnership with the Northern United Forestry Growers (Loddon) who have shown strong leadership in this area).
Catchment Modelling	Avon-Richardson: Use CAT modelling with local validation to assess scenarios of feasibility and practicality of protecting all key assets and for assisting to assess the impacts of groundwater pumping (mine and private bores being put in for de-salination). Avoca: CAT modelling will help assess risks to lower Avoca and to assess issues of salt-water yield trade-offs in upper Avoca. Loddon: CAT modelling will help assess risks and treatability of asset protection as well as to assess salt-water yield trade-offs in the Loddon, especially in the Upper Loddon, Bet Bet and Timor West areas. Campaspe: Especially useful to assess salt and water yield issues in Axe Creek and Wild Duck Creek.
Salinity risk assessment	The SIF3 analysis highlighted that the available watertable mapping data are unreliable. Water table height and trend data are not presented in a way that enables reliable assessment of salinity hazard. There appears to be no reliable layer of salinity concentration of watertables. Development of a more robust method to assess salinity risk is essential, preferably incorporating watertable salt concentration data.

Soils – management actions from a community participation perspective

The land asset was considered to be hinged on soils being used within their land capability (healthy balanced soils). This concept was defined as the Regional Catchment Strategy vision for dryland to produce the following vision for soils within the region:

Healthy balanced soils: the use and management of land (soil) for agriculture, rural living and other purposes will be consistent with its capability, will be undertaken in an ecologically sustainable manner and provide economic and social benefits

Resource condition targets and management action targets for soil cannot be defined until some project activities occur, however they are likely to reflect the following themes:

RCT undefined	Maintain/increase in soil condition (Index of Soil Condition (proposed by federal government) or other suitable indicator)
RCT undefined	# % land cover in region
RCT undefined	Soil used to within land capability and its productive capacity limits
RCT undefined	Increase the area with stable soils (decrease in area affected by wind and water erosion)

MAT undefined	# ha of non-degraded agricultural land planted to viable species
MAT undefined	# ha of degraded agricultural land planted to profitable species that stabilise soils (addressing acidification, structure decline, waterlogging, erosion, salinity and compaction)
MAT undefined	# ha of perennials and land cover at farm scale
MAT undefined	# % land managed within to its capability

These targets are difficult to make specific at this stage as the community's understanding of 'soil health' is currently highly varied. Project activities and desired outputs have been established to help address this

gap in the targets and our understanding and are focussed on a soil health extension program for community participation. Other project activities and desired outputs have been proposed based on our current best knowledge of how to manage salinity in soil and associated assets. These activities should occur to provide support to the general community to protect the regional soil asset. They will also help provide guidance to land management activities that will be focussed around priority assets to manage salinity threat. As noted earlier public benefits of investing in soil health will need to be considered.

Activities and outputs to increase knowledge of soil and its management in the region

Project activities
Establish an agreed meaning of the scope of 'soil health'. The community has highly varied views as to what soil health is. It can contain chemical, physical and biological elements of soil. Some aspects (soil loss) are more likely to be important from a public-good perspective than others. Some aspects of soil health are not well related to productivity or function at present.
Establish a soil monitoring program to monitor soil condition (acidity, organic carbon, soil salinity and erosion) that suits regional needs and aligns with national soil monitoring standards. Identify representative sites for this monitoring to occur across the region. The resulting data may then be used to generate a soil health model for the region to benchmark condition and inform property management planning.
Complete the 1:100 000 detailed soil mapping for the North Central region. Modelling the extent of soil erosion in the region. Define areas of land class (soil) and high value industry of regional importance as local assets across the region.
Undertake a risk assessment of management practices impact on soil degradation, utilising the above information.
Write a soil health plan for the region to help define an implementation program that refines the soil health targets and provides direction for property management planning. It is assumed that the soil health plan will identify priority soil and industry assets within the region, in terms of land class, soil type, industry or something similar.
Develop partnerships with industry to help with all the above activities where relevant to help design and implement land management change to improve salinity management on private property and protect soils at a regional scale.
Implement the actions from the soil health plan
Undertake an education and extension program on soil and salinity management options

Activities and outputs based on current knowledge to continue to improve soil health and management across the region

Project activities
Improve the property management planning process by June 2008 and develop an associated technical guide for delivery staff – consider incorporating: <ul style="list-style-type: none"> • Current best practice for soil management on farm and other related integrated delivery programs (eg. river health, biodiversity) • Land use capability assessments • Monitoring standards for soil at a farm scale • EMS (environmental best practice self assessment and action plans as a minimum) • Appropriate planting of perennials for salinity and soil management • Methods for delivering best outcomes (Identifying methods for delivering best outcomes will need evaluation of previous delivery methods (eg. Most Significant Change evaluation method)). • Integration with other CMA and DPI programs for delivery (Co-funding may be needed for components of this package, where integrated delivery benefits – for example River Health Strategy projects, regional wetlands program and Native Vegetation Plan initiatives)
Develop partnerships with industry to help with all the above activities where relevant to help design and implement land management change to improve salinity management on private property.
Undertake training for extension staff in delivery of the new extension program (based on technical guide) that will result from improving the property management planning process for the region.
Undertake research and development activities in conjunction with community to develop profitable new plant-based technologies to protect against further salinity impacts and to produce dryland agronomy options for agricultural land and salt-affected land
Develop integrated property management plans as part of the extension program
Undertake an extension and education program on soil and salinity management options

Indigenous cultural heritage assets

When the asset identification process was undertaken across the region for the DRMP, only a few indigenous sites were identified. These were identified when the individuals that were part of the asset setting process knew of a site local to them and do not necessarily reflect what the Indigenous community would consider their priority assets.

The identification of indigenous sites across the region in terms of priorities has not been done and our understanding of the impacts of salinity on them is limited. A program of cultural site identification and site prioritisation is urgently needed if this information is to be meaningfully incorporated into salinity investment.

Rather than try to cover this asset in terms of vision and targets, it is believed that we need to work with the local indigenous community to prioritise the cultural assets across the region and determine how salinity threats are impacting on them and how these threats should best be managed.

As a result, there are only foundational project activities listed for this secondary asset.

Project activities	Key assumptions
Develop partnerships with Indigenous communities to identify how they want salinity threats to cultural heritage assets addressed	The Indigenous community want salinity threats to priority cultural sites managed
Indigenous community to identify the high priority sites across the dryland region so salinity threats to these sites can be addressed	The Indigenous community will want to run this process themselves
Partner with the Indigenous community to identify appropriate salinity management actions to protect priority cultural heritage sites	Salinity is a threat to cultural heritage sites and can be viably managed
Work with the Indigenous community as part of the development of the new North Central Regional Catchment Strategy to identify appropriate targets for cultural heritage	
Identification and protection of cultural sites has been built into the feasibility studies for other asset types to help identify sites at threat from salinity. This is particularly relevant as cultural sites in this region are often associated with wetlands, waterways and floodplains.	

Relevant targets within the current Regional Catchment Strategy that these activities will contribute to are:

RCT6, RCT7, RCT8, MAT CH3, MAT CH4

Biodiversity

Native vegetation is important for the health of the land and water assets of the region. Native vegetation provides low cost or free ecosystem services such as provision of clean air and water, pest control and protection from land degradation, particularly salinity.

Numerous significant areas of native vegetation and threatened species were identified within the asset areas identified in the region. Most of the remnant vegetation identified is associated with another asset, such as a waterway or wetland. Some high and very high conservation significant areas of native vegetation were identified in the asset areas; however the management actions recommended to protect these from salinity mostly were to undertake technology development to provide better profitable plant-based solutions to salinity management.

Targets for improvement of native vegetation already exist within the North Central Native Vegetation Plan (North Central Catchment Management Authority 2005a). A decision was made that these targets were adequate and that the DRMP needed to set principles for salinity management actions in line with the needs of the Native Vegetation Plan, rather than setting separate targets for native vegetation.

As a result, the following principles (Table 2) will apply when salinity management activities involve native vegetation:

Table 2: Principles for salinity threatened native vegetation and for utilising native vegetation to manage salinity

Principle	Description
Protection of existing remnant vegetation	The highest priority of the North Central Native Vegetation Plan (NVP) is to protect existing remnant vegetation, particularly those vegetation communities that are highly depleted and subject to threatening processes. High and very high conservation significance vegetation has been identified through the asset identification process and recommendations made regarding managing salinity threat to these where relevant. Protecting existing remnants will also help achieve the land cover and perenniality targets that occur in other secondary assets in this chapter.
Management and enhancement of existing vegetation	Virtually all remnant vegetation in the North Central region is substantially degraded. Enhancement works range from re-introduction of missing species or habitat features to selective control of pest plants and animals. Though this principle may not necessarily apply directly to actions that would occur for salinity management, it should be considered and partnerships developed where relevant to achieve this principle when undertaking works around existing remnants for salinity control. This principle will also be increasingly relevant once the other threats of pest plants and animals and soil health decline are included into the DRMP.
Rebuilding the viability, connectivity and integrity of native vegetation	<p>Clearing of native vegetation disrupts ecosystems and creates remnant 'islands' that are more susceptible to threats. The viability of the region's vegetation communities (and many flora and fauna species) requires networks and interconnections that link larger blocks of remnant vegetation. Many recommendations are made in the DRMP to increase the perenniality surrounding a local asset (such as a wetland or river reach). Where native vegetation is used to increase this perenniality, this should be implemented in line with this principle, while also ensuring a salinity benefit to the local asset that is the focus of the action.</p> <p>The priorities for revegetation in the NVP are:</p> <ul style="list-style-type: none"> • Promoting regeneration, using indigenous species, to increase the size and quality of existing remnants; • Establishing vegetation links between existing remnants; • Revegetating high recharge areas and waterways, including some wetlands, to help reduce salinity and protect water quality; and • Developing and integrating productive tree (and other perennial vegetation) systems, including farm forestry, that provide significant benefits in carbon sequestration, run-off, watertable control and water quality. <p>These priorities are consistent with many of the management actions proposed under the DRMP, and partnerships to achieve these priorities should be developed wherever possible.</p>
Community education and awareness	Any community education and awareness raising activities around salinity management should promote the multiple benefits of native vegetation in reducing recharge to ground water systems, reducing soil loss and soil structure decline as well as improving hydrologic properties of soil (Brown 2004).
When native vegetation is planted as part of improving perenniality to protect an asset, this vegetation needs to be planted in line with the NVP	Re-establishment of deep rooted, perennial vegetation is needed to help address many environmental problems (including salinity). Utilising native vegetation can help to address this issue as well as restore habitat to support other species. This plan promotes revegetation for multiple benefits by using EVC specific best management practices. The current best practice guidelines for native vegetation in the North Central region can be found on the internet at http://dev.nccma.vic.gov.au/bmp/
Projects achieving multiple benefits that coordinate efforts between salinity and native vegetation investment should be encouraged	Where possible, all projects proposed in this Plan should be integrated with other relevant strategies, such as the NVP, River Health Strategy and Regional Wetlands Strategy. This will enable increased benefits from a single project through coordinated delivery of priorities and implementation works.
As part of feasibility studies (proposed later in this	Where applicable and appropriate the DRMP will seek to work in partnership with the Department of Sustainability and Environment's Biodiversity group to

chapter) relevant EVCs and threatened species will be ground-truthed so salinity intervention can benefit these wherever possible	maximize efforts to conserve threatened species and communities. In doing so, any proposed works would require liaising with relevant staff on current and planned works, as well as being aware of actions arising from the Actions for Biodiversity Conservation system.
---	--

Fauna is also an important part of biodiversity as an asset. The impact of salinity is hard to quantify for specific species in the landscape and other programs already exist to manage these species (eg. DSE Threatened Species Program). Other work in terms of the DRMP is inappropriate on specific species, though works on other priority assets is assumed to have associated benefits.

The interactions of flora, fauna and their environment is considered to be outside the scope of the DRMP, though the assumption is made that if improvements are made to an asset like water (which is linked to biodiversity) then the biodiversity assets will also improve (and may be measured as part of indicating an improvement in the associated asset's condition).

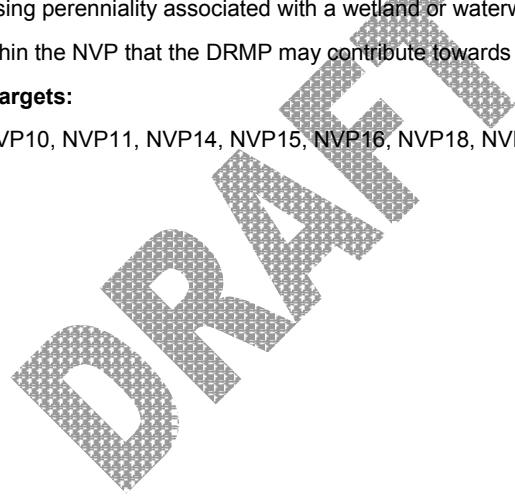
Many of the actions for vegetation management provide direct benefits for threatened flora and fauna species. Detailed information on the occurrence of threatened species in the region exists (Viridans Biological Databases 2006a & Viridans Biological Databases 2006b) and is contained within the regions Bioregional plans.

The responsibility for measuring biodiversity outputs lies outside the scope of the DRMP, though we may measure works that help contribute to biodiversity outcomes as part of salinity management works on other local assets (eg. increasing perennality associated with a wetland or waterway to manage salinity threat).

The relevant targets within the NVP that the DRMP may contribute towards are:

Management Action Targets:

NVP2, NVP6, NVP7, NVP10, NVP11, NVP14, NVP15, NVP16, NVP18, NVP19, NVP25, NVP26



5. Works Plan

DRAFT

Section B – Project Management

DRAFT

6. How the management actions will be prioritised and implemented

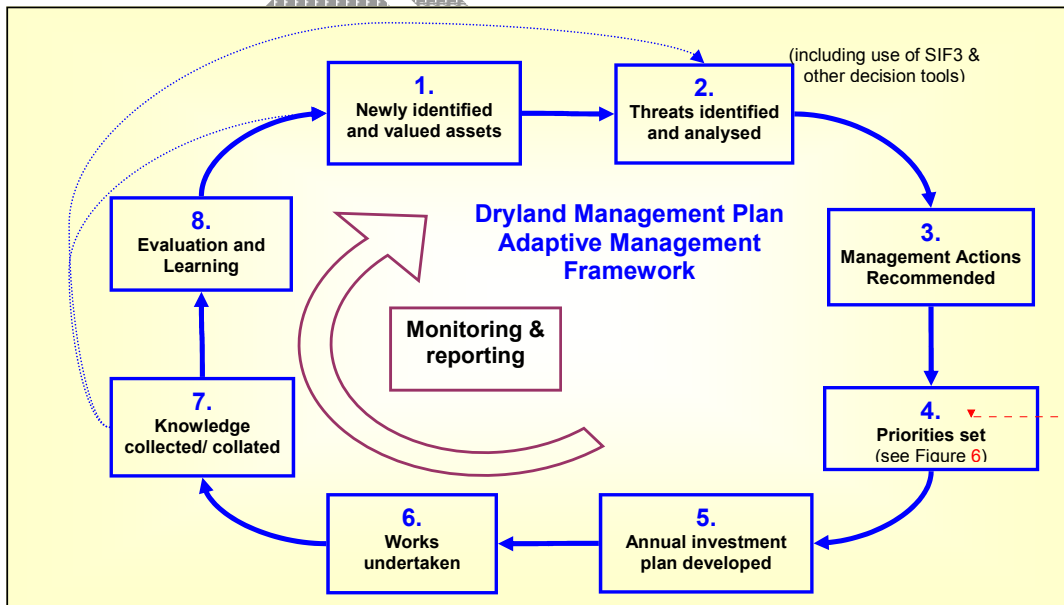
Annual adaptive management framework

The framework for future management of the dryland region is based on a cycle of activities from asset and threat assessment refinement through development of management actions, prioritisation, investment planning, works programs and review (Figure 5). The framework represents the annual process for the DRMP and enables the review of management actions and priorities in line with new information when it is available, rather than waiting for the 5 year review of the whole plan. The process described in this chapter will be followed each year, to update the assets, threats and management actions based on new information.

The framework incorporates the process from SIF3 in that it is part of the threat identification and analysis process of the project management framework. The annual review process will need to set clear boundaries to ensure the review occurs only of assets under question or those that have had relevant new information identified, to keep this review manageable and realistic. The level of review each year may vary at each step of the adaptive management framework. For example, intensive asset and threat confirmation will need to occur in the first year of implementation but will not need to be re-visited in such detail in subsequent years, unless necessary for an individual local asset because of new information available. The responsible agencies will gauge the need for review at each stage of the cycle each year, based on the information gathered through the cycle and on community views. Investments by the CMA should be based on whether there is a case for public benefit through investment.

The responsibility for implementing the adaptive management framework on an annual basis lies with the responsible agencies in the region and the community.

Figure 5: North Central Dryland Region Management Plan adaptive management Framework



1. Newly identified and valued assets

Assets have already been identified (See Chapter 2 above). This asset information will be refined when new information is available for specific assets or areas. Further identification and asset valuation will occur in each case management area as an initial action of implementing the Dryland Region Management Plan (2007/08). This is reliant upon DSE completing its methodology for asset valuation so it can be utilised in this activity.

It is also noted that further research will contribute to asset valuation techniques and provide a robust framework for asset valuation which incorporates scientific and community values.

2. Identifying and analysing threats to assets

The threat of salinity has already been identified to the currently identified assets (See Chapter 3 above). The threat of salinity to any refined asset information will need to be identified and analysed where relevant, as new information is made available. Salinity threat to assets in the region needs to be reliably identified across the whole region and in particular to high value assets. If improved salinity data is made available, this should also be applied to all existing asset information to ensure our salinity understanding is up to date for all assets.

The threats of soil health decline and pest plants and animals to specific assets will need to be identified once suitable tools are available for this to occur. Anna Ridley and David Pannell will be able to assist in this process through their work in the CRC Future Farm Industries which will expand SIF3 to consider multiple threats.

The North Central CMA will seek to develop, or support the development of suitable tools to assist in determining interventions for the threats of soil health decline and pest plants and animals on local assets, based on best-available peer-reviewed science.

3. Management actions recommended

Management actions for the current assets at threat from salinity have already been identified (See Chapter 4 above). If new asset and threat information requires new management actions to be identified for new and existing priority assets, then this should occur. The SIF3 process will continue be updated and we will need to use the most up to date version when relevant.

It will be important to empower catchment managers to be able to conduct their own SIF3 analysis and communicate with the community the reasons for a change in direction in dryland salinity management. Elements of this will include:

- A communications strategy: Undertake a process of community engagement in light of SIF3. Explain the need for change in the light of new knowledge, experience and more comprehensive analysis. This will be built into the community engagement around the release of the Plan.
- Training of catchment managers in SIF3: The SIF3 team to train catchment managers to be able to conduct their own analyses as new knowledge becomes available.
- 'Capacity needs' considerations: Based on the capacity needs identified in the SIF3 project (yet to be completed), develop a plan for securing the necessary skills within the CMA or key service providers.
- Liaise with extension service providers: Discuss the need for more strategic targeting of salinity extension, and refocussing of extension strategies in light of SIF3 recommendations.

4. Priorities set

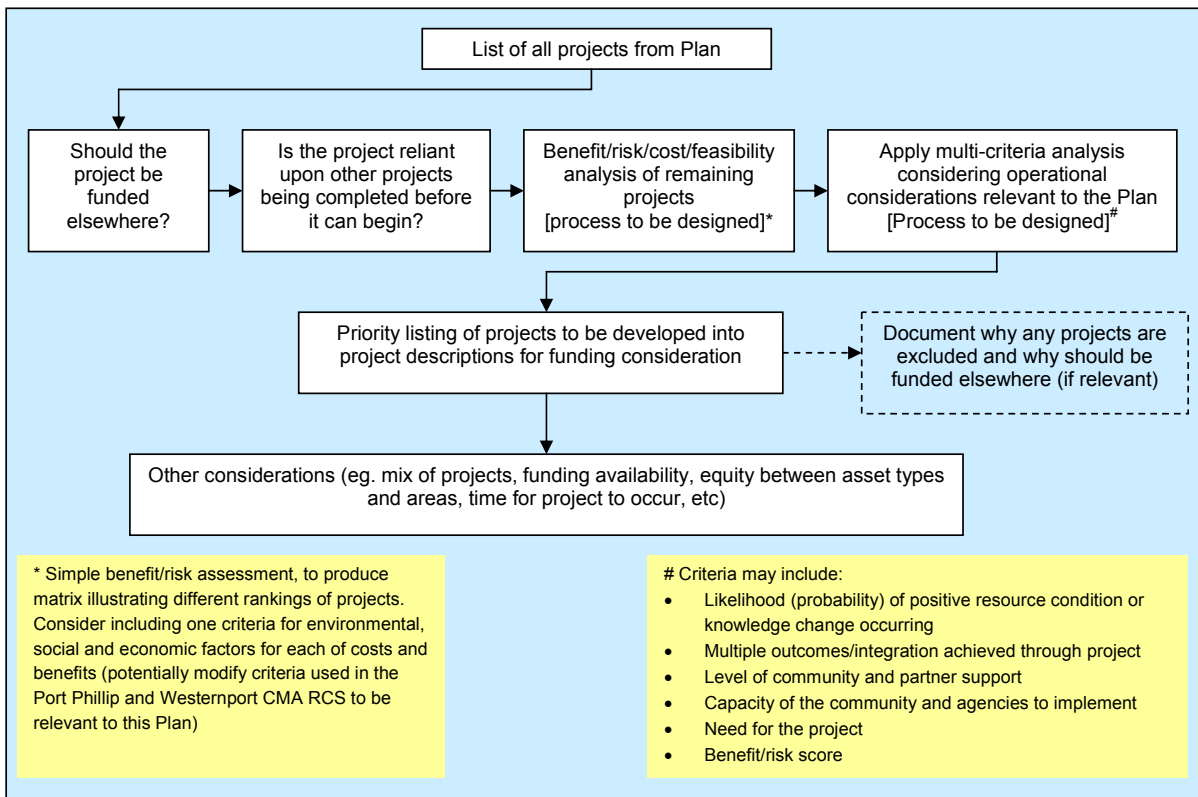
Given the large number of management recommendations that will result from the above steps, a process to prioritise between actions is needed. This is because it will not be possible to implement all actions at once, due to such things as funding constraints and knowledge gaps about processes or consequences of actions.

The CMA will commit to developing a transparent priority setting process. The basic principles will be to use the public:private benefits framework or the community participation objectives of the CMA to decide about funding priorities. The Board, Implementation Committees and senior staff will develop the process. Figure 6 shows an example of the proposed framework that will be developed in more detail. The priority setting process will have external input and use high-quality science as inputs, whilst recognising the importance of

local, community priorities and need for active participation. Learnings from previous year's process will also be used to adapt the priority setting process

This process should document all priorities for salinity investment, regardless of funding availability, to identify where some priorities may not be addressed by commonly used funding sources.

Figure 6: Proposed framework for investment prioritisation process for the Plan – Implementation Committees are responsible for this process, utilising relevant technical expertise



5. Annual investment plan developed

Each year the North Central CMA develops an investment plan that coordinates natural resource management activities of various agencies and community in the region – the Regional Catchment Investment Plan (RCIP). The RCIP enables the CMA and relevant delivery partners (such as DPI, Trust for Nature, Landcare, Parks Victoria, water authorities and shires) to identify priorities across the region and to apply for funding from various investors to implement the identified works.

The works for the dryland region will be identified through the above Framework, with the priorities set above used to determine the annual investment plan content. Priorities from other programs, such as river health and biodiversity, will be utilised to encourage co-investment where relevant. Soil health and pest plant and animal based projects will be incorporated into the framework once these threats are included into the Plan.

Opportunities for funding management actions through other funding sources/processes should also be investigated each year where possible, if priority actions cannot be funded through the RCIP.

6. Works undertaken

Management Actions are implemented in line with the RCIP. These works will be delivered by the North Central CMA and through its delivery partners.

Delivery of the works in the Plan is the responsibility of both the public and private sectors. Public delivery will occur through regional delivery mechanisms:

- Coordination, planning and strategic direction – North Central Catchment Management Authority
- Delivery of asset management actions – North Central Catchment Management Authority, delivery partners and, land managers of specific assets
- Delivery of regional management actions – various delivery and research agencies (both public and private)
- Collaboration with high quality research providers – Commonwealth Environment Research Facility, Cooperative Research Centres (CRC), DPI, universities
- Technology development – CRC's (partnership with CRC Future Farm Industries in particular, in which the North Central CMA is a partner), universities

Private investment should occur through landholders, industry and community. Private investment is a good indicator of the private benefit that a landholder gets from investing in an activity (monetary or non-monetary). If landholders are not investing in activities this indicates that there is insufficient private benefit. Public investment should only occur where there is sufficient public benefit in doing so, not simply because landholders are not investing. The public:private benefit framework (www.sif3.org) is very useful for helping verify the case for public investment into any natural resource management threat, not only that from salinity. Cost sharing will follow the arrangements of the North Central Incentives Matrix. This matrix will be updated where relevant to reflect any change in incentives and management interventions that may result after feasibility assessments are undertaken for local assets.

Participatory research and development and ongoing extension will be developed for the region to protect dispersed assets (refer to soils asset project activities).

To best enable extension officers to deliver the suite of management actions that will result from the Plan, a technical reference document should be created that includes all relevant information to assist in integrated program delivery (including delivery of programs other than the DRMP). This should include access to the full SIF3 recommendations document so extension officers are aware of the management interventions recommended for all 44 asset areas in terms of salinity, to maximise multiple outcomes wherever possible.

7. Monitoring, Evaluation, Reporting and Learning

7. Knowledge collected and collated

It is important to collect and collate all new information relevant to management of the region's assets to help with ongoing improvement in management. This new knowledge includes research and development works that have occurred within and external to the region.

It is essential to ensure that external peer review is built into any research projects. Furthermore projects will develop a short, plain-English version of the project outcomes so that projects are able to be evaluated and understood by CMA staff, Board and Implementation Committees and interested community members. All research projects should be subjected to rigorous peer-review as this is the accepted method for quality assurance in research. Building such expectations into work conducted will make much better use of information commissioned as well as give the CMA assurance that it is using work of good quality to underpin important public investment decisions.

8. Evaluation and learning

An important component of continually improving and adapting the management of the dryland region is the evaluation of project delivery each year, the works undertaken and the knowledge gained to improve delivery in the next year. Monitoring and reporting throughout the year can assist with this task. Reflection on the years successes and failures is also an important part of adaptive management and learning.

Monitoring and reporting will focus on measuring indicators that will show progress towards achieving project outputs, management action targets and resource condition targets. Given that not all these outputs and targets are clearly articulated yet, the indicators will need to be identified for them once the outputs and targets are developed.

Many project activities identified in Chapter 4 are necessary to help develop these outputs and targets, as well as provide critical information for the projects to progress towards outputs. Projects that provide this

critical information to enable projects to progress are obviously first priorities for implementation. As soon as these project activities occur, more meaningful and measurable targets can be set for the Plan.

A monitoring and evaluation strategy (M&E strategy) will be developed for the region that will cover this Plan, once the outputs and targets are identified. The Monitoring, Evaluation, Reporting and Improvement for NRM methodology (Dart, 2006) will be used to develop this (as this methodology is being continuously improved, the most up to date version will need to be used at the time of development of the strategy) and it will need to align with the National NRM Monitoring and Evaluation Framework and include the following key elements:

Element	Comment and if the Plan currently addresses this
Program logic	A program logic has been developed linking the proposed project activities to outputs that will lead to progress on the targets. This will be used to help develop the M&E strategy (using Dart 2006 or other relevant method). The M&E strategy will need to document the assumptions that the Plan makes and how these assumptions will be tested and the Plan revised accordingly where relevant.
Existing monitoring	There is already monitoring of surface and groundwater in the region. Feasibility studies planned in the project activities will help to further refine this monitoring if necessary. This existing monitoring will need to be documented in the M&E strategy where it can be used to monitor progress towards the Plan's targets
Performance Indicators	Performance indicators are yet to be identified. These will be developed once the targets of the Plan are finalised, following project activities that will help identify them. The M&E strategy will need to document what indicators will be used and the quality standards around monitoring these.
Baseline data	Many of the feasibility studies will be collecting baseline data on current condition of assets. This will need to be included in the M&E strategy where relevant.
Actions to address data gaps	Many of the existing project activities are aimed at addressing data gaps. When the M&E strategy is developed, these actions will need to be documented within it
Data management	The M&E strategy will need to document how data and information will be managed for the Plan. Before the M&E strategy is developed, the following should still be considered, and incorporated into the M&E strategy where relevant: <ul style="list-style-type: none"> • It is important to collect and collate all new knowledge relevant to management of the region's assets to help with ongoing improvement in management. This new knowledge includes research and development works that have occurred within and external to the region. The M&E strategy will allow for some of this to occur. It is also necessary to ensure that records of new knowledge are not lost. • Copies of reports resulting from research and development as part of implementing the Plan will be kept by both the North Central CMA and the Department of Primary Industries as a minimum. Other relevant stakeholders (including the community and asset managers) should be provided with such reports where deemed relevant and circulate copies to relevant stakeholders when they have been responsible for the reports • To ensure quality data and information is generated from the Plan, any studies and reports generated should be peer reviewed.
Evaluation	Will form part of the M&E strategy to review progress and methods for implementation, to promote continuous improvement in delivery of the Plan
Communication and reporting	The M&E strategy will need to document the reporting structures that will assist delivery partners and the CMA to account for progress on project activities, outcomes and targets. Current CMA RCIP reporting processes will be used in the interim, and will form part of the M&E strategy once it is developed
Roles and Responsibilities	Will need to be clearly documented in the M&E strategy in terms of data and information collection and storage, reporting, etc

Adequate resources	the M&E strategy will need to cost it's own implementation so adequate funding can be made available for it to be implemented effectively
--------------------	---

Even though a formal monitoring, evaluation, reporting and learning strategy is not yet in place, there will still be annual progress and achievement reports generated as part of the CMAs reporting cycle. This will report on progress and achievements of outputs and progress towards targets.

These reports, as well as new information generated each year as part of project implementation will be used to undertake the annual review of the plan, explained earlier.

When the monitoring and evaluation strategy is developed, it will need to show how the targets of this Plan contribute to the Matters for Target under the National Monitoring and Evaluation Framework (National Land and Water Resources Audit 2007).

Maintaining relevance of targets

It has become increasingly evident in the North Central region that targets need to be adaptable when new information becomes available. Otherwise targets that are set in an action plan may become irrelevant or inaccurate over time.

The Steering Committee saw it as important to enable revision of targets in the Dryland Region Management Plan over time, as relevant.

8. Benefits and Costs of the DRMP

No-intervention scenario

For salinity threats (using SIF3 analysis): In order to estimate the benefits of taking action, it is necessary to establish a baseline of what we expect would happen in the absence of action. In many parts of the North Central region, groundwater tables have stabilised or even fallen during the current series of years with below-average rainfall. However, our planning for dryland salinity needs to take a precautionary long-term view, and so is based on a return to average rainfall conditions in coming years.

For all of the assets that have been targeted for intervention for salinity management, it is expected that there will be a high impact from dryland salinity once average rainfall conditions return. For salinity, two data sets showing depth to watertables were used in the SIF3 framework to identify likely salinity impacts in coming years in the absence of intervention by the North Central CMA (as identified in Chapter 3 under the heading 'Assets at urgent threat from salinity'). In some sub-catchments, the two different data sets are highly consistent, while in others the predicted areas of high salinity risk were different. The disparities were partly addressed by drawing on local knowledge during a workshop with key local stakeholders during 2006, and they will be further addressed by more detailed technical assessments of those priority assets that have been identified for investment. This detailed technical assessment will occur prior to substantial investment in on-ground works.

To protect soil/land assets (community participation priority):

Current knowledge and data is not sufficient to establish a no intervention scenario, or to analyse the benefit of investment and the impact of soil health on high value local assets.

The fragile nature of Australia's soils, the application of European farming systems and increased economic pressure has generally resulted in a decline in soil health. This is despite a dramatic improvement in the awareness of soil fertility, acidity and biological activity (possible indicators of soil health) over the last 50 years. There is ongoing community concern about these issues and the impact of soil health on high value local assets.

Further work is required to quantify soil health and current trends. The likely interventions to arrest soil health decline will need to be fully understood and assessed.

Benefits and costs of the Plan

A full cost:benefit analysis has not been done of the Plan, given its adaptive nature and the need to undertake feasibility assessments on many proposed projects to determine if they will progress. A full cost:benefit analysis will be undertaken as part of works on specific local assets, as part of their feasibility studies.

Below is a discussion on the anticipated benefits and costs of implementing the Plan.

Benefits from intervention (salinity threat)

The interventions that make up this plan will result in economic, social and environmental benefits beyond those of the no-intervention baseline scenario for salinity.

Environmental benefits will be created by the reduction in salinity concentrations in targeted wetlands and river reaches, and through protection of native vegetation. These will particularly arise from the targeted interventions presented in Chapter 4.

Economic benefits will arise in several ways:

- reductions in the salinity concentrations in waterways that provide water resources to downstream users;
- reductions in the cost of maintaining and repairing roads in targeted areas;
- protection of agricultural production from salinity impacts in targeted areas (i.e. as a side benefit from targeting high-value assets);
- protection and enhancement of agricultural production through technology development;
- protection and enhancement of agricultural soils;
- support for making productive use of salt-affected land;
- reductions in the future cost of protecting threatened assets as a result of technology development.

Social benefits are expected through greater resilience of agricultural production as a result of technology development, through enhancement of the aesthetic values of protected assets, and through participation of many community members in projects that protect and enhance the highest-value environmental and natural resource management assets in the region, resulting in stronger community linkages and pride in the outcomes achieved.

Given the rigour and sophistication of the prioritisation process undertaken using SIF3, it is expected that this plan will lead to significantly greater benefits, and with greater certainty, compared to previous plans in this and other regions.

Costing of management responses to protect high-value assets

With the available knowledge, it has not been possible to cost priority interventions at this stage. For the targeted assets this will need to be completed during the first year of the Plan.

Full costing of effective interventions for salinity management for an asset is expected to be considerably higher than previously allocated to any one asset. This emphasises the need for stronger targeting of the investment than in previous plans. Although a similar analysis has not been conducted for other aspects (such as non-salinity aspects of river health and biodiversity) it is likely that a stronger focusing of effort will be required in these areas as well. As additional information about the costs and benefits of each intervention becomes available, there will be adaptive management through adjustment of the relative priority of the assets within this plan.

Given the strong case, based on detailed analysis, for protection of a selection of key high-value assets in this plan, we will negotiate with DSE and other investors in natural resource management to increase funding to protect assets of state and national significance.

Cost sharing and accountability

State government policy requires the case for public investment to be made on at least one of the following criteria: public benefits due to externalities, failure of competition and information asymmetry (Anon 2001). Public benefits due to externalities are central to the SIF3 framework, and as a result, protection of the target assets is judged to result in high net public benefits in each case. In addition, the framework considers the level of private net benefits resulting from the interventions. These provide the basis for rigorous decision making about cost sharing.

Given high public net benefits in each case, the cost sharing arrangement recommended in SIF3 depends on private net benefits as follows:

- If private net benefits are very positive, there is no need for intervention as landholders will adopt the changes voluntarily (i.e. landholders bear the full cost of implementation);

- If private net benefits are moderately positive, extension alone (without payment of incentives) is likely to be sufficient (i.e. landholders bear the full cost of implementation);
- If private net benefits are positive but very small, payment of a small up-front incentive to cover the cost of learning by the landholders is appropriate (i.e. landholders bear most of the cost of implementation);
- If private net benefits are slightly to moderately negative (i.e. landholders suffer a loss from implementing the changes), a grant to offset the loss suffered plus learning costs is appropriate, provided that public net benefits are large enough to warrant it (i.e. landholders bear the full cost of implementation other than an amount equal to their net private loss);
- If private net benefits are highly negative, the intervention is unlikely to be a high priority as the cost of providing financial support to landholders will probably make it less attractive than other interventions in the above categories.

These rules from SIF3 provide a much stronger and more theoretically defensible basis for cost-sharing than was previously available.

DRAFT

Section C – Appendices

DRAFT

Appendix A. Objectives and composition of the North Central Dryland Region Management Plan Steering Committee

The Steering Committee purpose was to recommend the draft Dryland Management Plan to the North Central CMA Board.

Specifically, the objectives of the group were to:

- (i) Oversee the content and direction of the DMP
- (ii) Ensure consistency with the North Central Regional Catchment Strategy, DSE's *Generic Guidelines for the Review and Renewal of Action Plans/ Sub-strategies to the Regional Catchment Strategy*
- (iii) Guide the process of community engagement and consultation and oversee incorporation of community feedback, as appropriate, in the final DMP
- (iv) Critically review draft and final reports and provide appropriate feedback concerning content and recommendations

The members of the Steering Committee and who they were representing were:

Name	Capacity	Representation
Jock Leishman	Chairperson	Chairperson, North Central CMA Board Member
Rob Loats	Member	Avoca/Avon-Richardson Implementation Committee (IC) ⁷
Doug Streefer	Member	Avoca/Avon-Richardson IC
Judy Crocker	Member	Loddon-Campaspe Dryland IC
Shane O'Loughlin	Member	Loddon-Campaspe Dryland IC
Andrea Delaney	Project Manager	North Central CMA
Daniel Mudford	Member	North Central CMA – Team Leader Land
Jennifer Alexander	Member	North Central CMA – NRM Manager
Geoff Park	Member	North Central CMA – Knowledge Broker
Tony Watson	Member	North Central CMA – Catchment Manager (LCD IC & AAR IC)
Peter Johnson	Member	Department of Sustainability and Environment – Regional Services
Greg Turner	Member	Department of Primary Industries – Sustainable Landscapes
Shayne Annett	Member	Department of Sustainability and Environment – Melbourne
Anna Ridley	Member (Corresponding)	Department of Primary Industries – DPI Research & CRC for Plant-based Management of Dryland Salinity

⁷ Implementation Committees (ICs) are subcommittees of the North Central CMA Board - their membership is community-based and as such they provide a community perspective to the programs and projects of the CMA

Appendix B. Local asset areas descriptions and SIF3 recommendations for each local asset within the area

Important local assets in the region were identified by the community and local experts by locating areas within the region where groups or clusters of different assets occur.

Approximately 80 areas were identified across the region and of these, 44 were at threat from salinity. These 44 areas were assessed using the SIF3 framework and 19 of the areas were seen to have feasible salinity management interventions possible for them.

Descriptions for these 19 areas are given in the rest of Appendix B, grouped according to river basin. Each asset area is colour coded according to river basin: Green = Avon-Richardson River basin; Blue = Avoca River basin; Red = Loddon River basin; Purple = Campaspe River basin.

These 19 asset areas are described in this chapter in terms of:

- a list of the local assets within each area
- a map of the area (no boundaries are put on the areas as these were not always well defined)
- a description of the current condition of the asset area
- an overview of the services the assets provide to the region
- a description of the threat posed by salinity to the asset.
- an overview of the recommendations that were made for the asset area in terms of salinity management,

The descriptions of condition have been written as a subjective judgement by experienced CMA staff. The scorings attributed to condition scores and Index of Wetland Condition scores are their best guess of condition, these areas have not officially been assessed. The condition description for towns relates to a subjective judgement about condition of infrastructure made by CMA staff and is in no way a judgement about the township's viability. The Index of Stream Condition scores are accurate.

The salinity threat and recommendations descriptions have been generated from the SIF3 recommendations and the workshops held as part of identifying targets and assets in developing the Plan. The information on salinity threat and management actions is included in more detail in the full SIF3 recommendations for the North Central Dryland region (REFERENCE). The recommendations in this section are coded:

	Priority for consideration in projects for investment. These have been built into the project activities in Chapter 4
	May be a priority for investment, or to be covered as part of technology development within the region
	Not a priority for investment

The asset descriptions included here relate only to the priority areas identified for salinity investment (19 asset areas). Descriptions of the other asset areas are not included because the identification and valuation of assets will be further refined in 2007-08. This process will provide much more detailed and accurate descriptions of all priority assets within the region once that asset review process has occurred.

Avon-Richardson Catchment

Donald Township

Local assets identified:

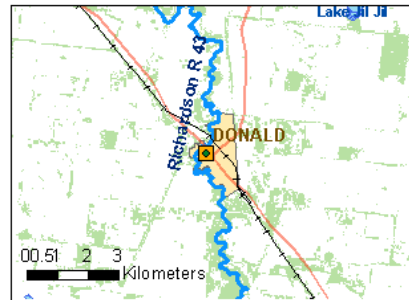
- Donald township
- Richardson River reach 43
- 4 wetlands (none regional priorities)
- Dispersed high value remnants

Current condition of assets:

Donald township - Declining condition

Richardson River reach 43 - Poor condition (ISC 2001)

Dispersed high value vegetation - High value remnants (endangered and vulnerable vegetation) vary from very low to high condition (>0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 habitat hectare range). Most are isolated remnants within an agricultural landscape.



Salinity threat description

The risk of salinity to the river, land, dispersed vegetation, wetlands and Donald township is high. The confidence relating to this risk is high.

The urgency of addressing the salinity threat to these assets is high.

Groundwater systems in the area are all regional, with ease of treatment considered low and asset protection will be very costly.

Recommendations for salinity investment

This area should be a priority for technology development or new perennial-based farming systems. The extent of salinity is large and ease of treatment is low. The community is active and willing.

Richardson River (reach 43)	This is a 'high priority' reach in the 'Top 20' but the problem of salt water intrusion to the river appears to make treating the salinity in the river difficult to do cost-effectively
Wetlands	Not a specific priority for investment, but may tie in with investment in management of salinity on other assets
Donald township	This is potentially a priority for salinity investment. Engage with Buloke Shire to work out a strategy for co-investment. Include in potential Rural Towns Program.
Dispersed native vegetation and land	Development of profitable new plant-based technologies/systems for salt affected and non-salt affected land for the Avon-Richardson catchment will benefit this asset area. Use a partnership approach between community, government and research bodies (eg. CRC Future Farm Industries).

Avon Plains Lakes area

Local assets identified:

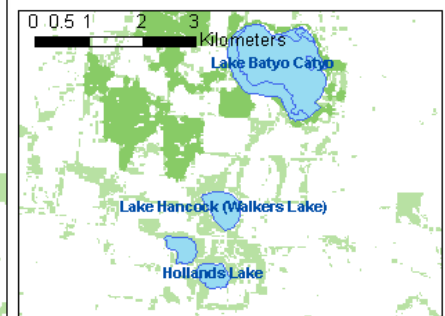
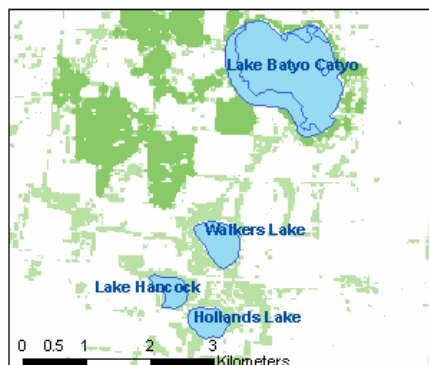
- Avon Plains Lakes (Hollands Lake, Walkers Lake, Hancocks Lake)
- Lake Batyo Catyo
- High value dispersed vegetation (high and very high conservation significance)

Current condition of assets:

Avon Plains Lakes - Moderately to slightly below reference (30-60, 60-90 IWC range)

Lake Batyo Catyo - Moderately to slightly below reference (30-60, 60-90 IWC range) (recreational purposes)

Dispersed high value vegetation (high conservation significance)



High value remnants (endangered and vulnerable vegetation) vary from very low to high condition (>0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 habitat hectare range). Most remnants (some large) are isolated within an agricultural landscape.

Salinity threat description

Risk of salinity is high, with shallow watertables present under the wetlands and high conservation significance vegetation.

The urgency of addressing the salinity threat to these assets is high.

Groundwater systems are both regional and local. Management actions will be focused on local groundwater flow systems to manage recharge.

Recommendations for salinity investment

Avon Plains Lakes and areas of high conservation significance vegetation	These should be a priority for salinity investment, due to the value of the assets, the salinity risk and the ability to manage it. Recommendation is to use perennials to protect the lakes, subject to a feasibility assessment using existing information. Develop a local area plan with landholders to use lucerne and revegetation to protect high value assets. Long term incentives would be tied to farm planning and land use caveats to ensure hydrologic control. Bore monitoring is recommended to monitor asset condition.
Lake Batyo Catyo	Determine if Batyo Catyo is high enough value to warrant protecting from salinity. It would need to be prioritised against other assets.
Other assets	Not a priority for direct investment in works or extension, but all the lower Avon Richardson is recommended for development of new profitable plant-based technologies/systems in salt and non-salt affected areas using a partnership approach between community, government and research bodies (eg. CRC Future Farm Industries).

Grays Bridge - Banyena

Local assets identified:

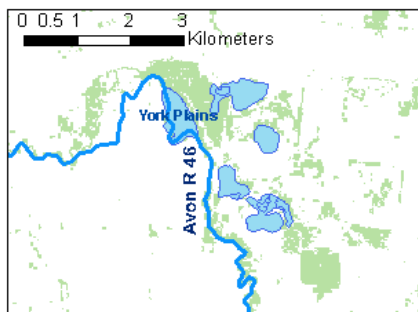
- York Plains wetlands (named and unnamed)
- Avon River Reach 46
- High conservation significance vegetation
- Creswick Swamp [not of regional significance]

Current condition of assets:

York Plains Wetlands - These have been highly rated in historical environmental assessment reports. Moderately to slightly below reference (30-60, 60-90 IWC range).

Avon River Reach 46 - Poor condition (ISC 2001)

Creswick Swamp - Moderately to slightly below reference (30-60, 60-90 IWC range)



Salinity threat description

Risk of salinity is high for rivers and wetlands if the North Central Salinity Audit data are used, and unknown if using the SKM watertable data. Environmental assessments in the early 1990s also suggested high risk.

The urgency of addressing the salinity threat to these assets could be high.

Groundwater systems are regional over most of the area, with a local system on the northern side of part of the York Plains. Feasibility of treatment seems to be low, except for the local groundwater flow system.

Recommendations for salinity investment

This area should be a priority for salinity investment, due to the large cluster of wetlands and the 'high' priority river reach present.

Waterways	This is possibly a priority for salinity investment, if the value of the river reach is high enough. Extension should be used if perennials are profitable. Otherwise technology
-----------	--

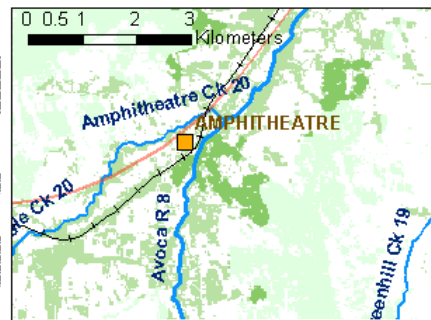
	development should occur (as for rest of catchment).
Wetlands	This is the highest priority for salinity investment on York Plains. The value of the other wetlands, particularly when considered as a cluster may also warrant investment, following investigation. The area is too large for engineering. Lucerne is currently the only practical perennial option and if used to protect wetlands from groundwater rise, may require the use of extension and long-term incentives. For York Plains wetlands, use perennials to protect lakes, subject to feasibility assessment using available information. Develop a local area plan with landholders to use lucerne and revegetation to protect high value assets. Long term incentives would be tied to farm planning and land use caveats to ensure hydrologic control. This would require imposing land use restrictions, which would need to be accepted by the community. Bore monitoring would be required to monitor asset condition.

Avoca Catchment

Amphitheatre

Local assets identified:

- Amphitheatre township
- Avoca River reach 8
- Very high and high conservation significance native vegetation
- Glenlogie creek (not a regional priority)
- Pyrennes Highway
- Railway line



Current condition of assets:

Amphitheatre township - Stable to declining condition

Avoca River Reach 8 - Moderate condition (ISC 2001)

Very high conservation significance native vegetation - Very high conservation significance remnants vary from medium to high condition (0.4-0.6, 0.6-0.8 habitat hectare range). Some remnants connect to or link larger reserves.

Pyrennes Highway – no condition provided

Railway line – no condition provided

Salinity threat description

Risk of salinity is high to the town, highway, railway, some high and very high value vegetation and the Avoca River. Groundwater may have reached an equilibrium, but is likely to respond to climatic conditions. Whether there is influence of the deep lead also needs to be assessed as this would make salinity treatment less viable.

The urgency of the salinity threat to these assets appears high.

Groundwater systems are both local and intermediate, suggesting some ease of treatment.

Recommendations for salinity investment

If confirmed to be at risk from salinity:

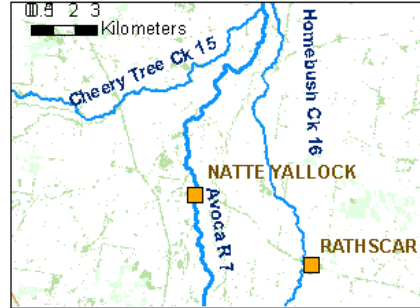
Waterways	This should be a priority for salinity investment into Avoca River reach 8. If groundwater is responsive, recommendations are for regulation, incentives for land retirement or plant-based research and development. Assessment of salt loads from both the Avoca River and Glenlogie Creek and potential appropriate intervention.
Roads	This is potentially a priority for salinity investment into the Pyrennes Highway
Towns	This is potentially a priority for Amphitheatre township. Evaluate feasibility using existing knowledge in partnership with Council. Consider as part of potential Rural Towns Program.
Native	Unlikely to be a priority for direct investment, but need to ascertain vegetation value

vegetation before determining priority for investment.

Natte Yallock (smaller area identified than previous targeted area)

Local assets identified:

- Natte Yallock township
- Avoca River reach 7
- Cherry Tree Creek and Homebush Creek (not regional priorities)
- Small amounts of high value native vegetation



Current condition of assets:

Natte Yallock township - Stable to declining condition

Avoca River reach 7 - Moderate condition (ISC 2001) also included in the 'top 20' reaches.

Significant native vegetation - (Creekline Grassy Woodland, Floodplain Riparian Woodland, Grassy Woodland, Grassy Woodland/Alluvial Terraces Herb-rich Woodland, Plains Woodland, Swampy Riparian Woodland, Wetland formation and Plains Grassy Woodland). Significant remnants (endangered and vulnerable vegetation) vary from very low to high condition (>0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 habitat hectare range). Remnants are isolated within an agricultural landscape.

Salinity threat description

Risk of salinity is deemed high due to shallow watertables, less than 5 m, and in some cases at 0-2 m. The presence of the deep lead with high pressure also adds to this risk.

The urgency of the salinity threat to these assets is high.

Groundwater systems are local and intermediate. On the plains area, treatability of the problem is rated as low. Large areas of perennials for the plains may be effective, but would have long response times.

Recommendations for salinity investment

Avoca River reach 7	This is a priority for salinity investment, due to the value of the asset; however information is needed on feasibility and cost-effectiveness of treatment. Technology development would be best for areas where economics are marginal. If lucerne can be grown profitably, extension without incentives is recommended.
Natte Yallock township	This is a priority for salinity investment, due to the value of the asset; however information is needed on feasibility and cost-effectiveness of treatment. Consider as part of potential Rural Towns Program. Technology development would be best for areas where economics are marginal. If lucerne can be grown profitably, extension without incentives is recommended.
Dispersed assets	Investing in a partnership approach with farmers and major agencies to develop and trial profitable plant-based perennial options or not a priority for salinity investment.

Gowar East Springs

Local assets identified:

- Avoca River reaches 5 and 6
- A small wetland (not a regional priority)
- Scattered high conservation significance vegetation
- Gowar Springs locality



Current condition of assets:

Avoca River reaches 5 and 6 - Moderate condition (ISC 2001) also included in the 'Top 20' reaches.

Scattered high conservation significance vegetation - Scattered high conservation significance remnants varies from very low to medium condition (>0.2, 0.2-0.4, 0.4-0.6 habitat hectare range). Remnants are isolated within an agricultural landscape.

Gowar Springs locality – no condition description provided

Salinity threat description

Risk of salinity appears is unclear, being high using the salinity audit data and low using the SKM model. The assumption is made that the salinity threat is present and, based on the audit data, high. The threat is particularly present on the Avoca River, wetlands, some infrastructure and some vegetation.

The urgency of the salinity threat to these assets is deemed to be high, particularly for the high value river reach.

Groundwater systems are predominantly local, which intersects other local and intermediate flow systems. It is anticipated that groundwater responsiveness to salinity management actions could be high, though this needs to be confirmed.

Recommendations for salinity investment

Avoca River reaches 5 and 6	This should be a priority for salinity investment, based on the high asset value. Technology development is recommended in partnership with community, government agencies and research bodies (eg. CRC Future Farm Industries). Incentives and/or land retirement are also possibilities.
Gowar Springs locality	Depends upon salinity threat being confirmed and how much infrastructure is threatened.

Indigenous site – Avoca River reach 5

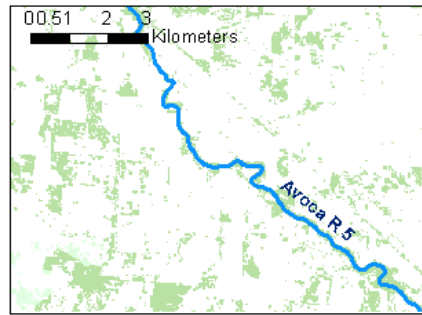
Local assets identified:

- Avoca River reach 5
- Indigenous site (refer to plan-wide recommendations regarding Indigenous sites).

Current condition of assets:
None provided

Salinity threat description

Risk of salinity is unclear, being less than 50% probability using the SKM model. The urgency of the salinity threat to these assets is also unclear.



Groundwater systems are predominantly local. Groundwater responsiveness to salinity management could be high, but this needs to be confirmed.

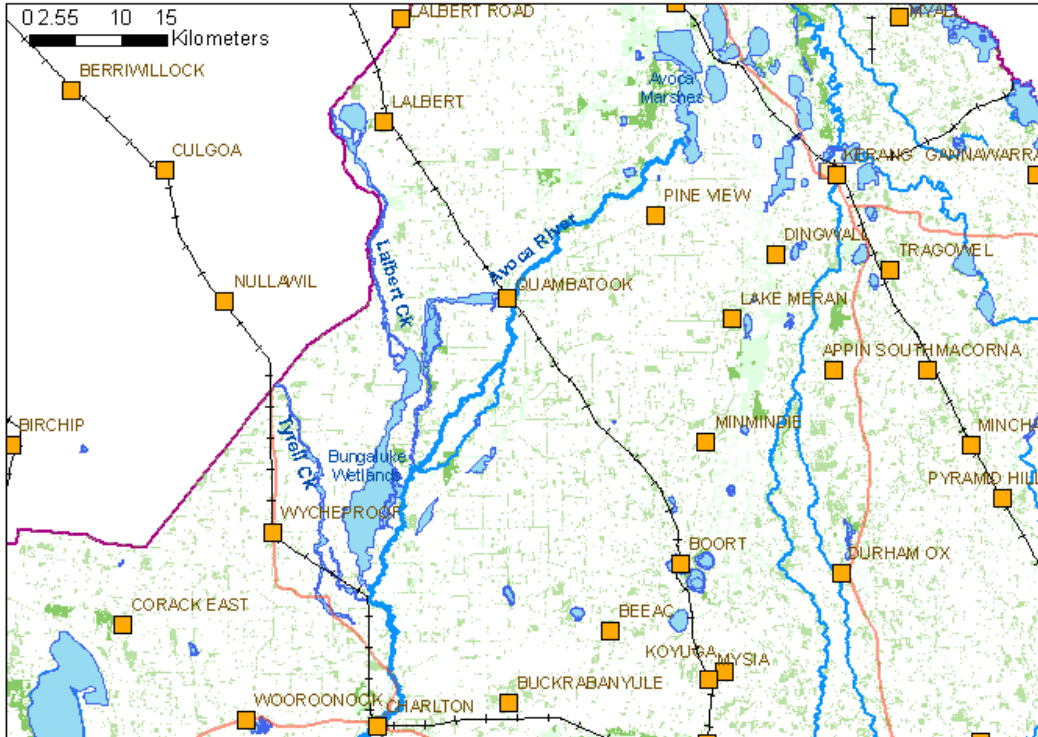
Recommendations for salinity investment

Avoca River reach 5	This could be a priority for salinity investment, based on the high asset value, but subject to threat confirmation. Technology development is recommended in partnership with community, government agencies and research bodies (eg. CRC Future Farm Industries). Incentives and/or land retirement are also possible
Indigenous site	Depends upon salinity threat being confirmed. This was the only cultural heritage site listed, and clearly a more systematic process needs to be undertaken to identify other important indigenous sites at threat from salinity. No specific salinity investment should occur on this specific asset until its relative value to other cultural sites in the region is assessed.

Lower Avoca Floodplain

Local assets identified:

- Avoca River reaches 1-4
- Lalbert Creek
- Lake Lalbert
- Bunguluke wetlands (The Gums)
- Avoca Marshes
- Yassom area
- Lake Marmal
- Mosquito Creek (not a regional priority)
- Sandhill Lake
- Back Creek (not a regional priority)
- Griffith Lagoon (not a regional priority?)
- Lalbert township
- Glenloth township
- Wycheproof township
- Quambatook township
- Charlton township
- Lake Gilmour
- Lake Lookout



Recommendations relate to Lake Lalbert/Tyrell Marshes region (the Tyrell Marshes are within the Mallee CMA, but are of high value for protection from salinity threat).

Current condition of assets:

Avoca River reaches 1-4 - Reach 1 is poor condition (ISC 2001). Reaches 2, 3, 4, are moderate condition (ISC 2001) and are also included in 'Top 20' reaches.

Others to be described better once asset identification is refined on this area

Salinity threat description

Risk of salinity is variable for different areas of this asset area – the area is very large. The salinity audit data indicates no salinity threat present to any assets, where the SKM model indicates salinity risk to some of the assets. The assumption is made that the threat is present, until confirmed more fully. Preliminary indications from hydrogeologists are that salinity is not an urgent threat in much of the area.

The urgency of salinity threat is also variable for different local assets in this asset area, assuming the salinity threat is present.

Groundwater systems are all regional, with groundwater responsiveness to treatment considered low. The strong groundwater gradient to the west may also be minimising the salinity threat to these assets.

Recommendations for salinity investment

The whole of the Lower Avoca floodplain contains high value wetlands and waterway assets, with Lake Lalbert and the Lalbert/Tyrell floodplains considered the highest value. Re-assessment and further prioritisation of this asset area is needed, as protection of the whole area would be difficult to fund.

If the salinity threat is present, extension is recommended is lucerne is profitable for most farmers. Investment responses would need to be considered on an asset-by-asset basis and could include engineering if economic, otherwise technology development would be recommended. Floodplain regeneration is also recommended, replacing commercial perennial plant development on the floodplain.

Loddon Catchment

Bendigo urban growth area and peri-urban surrounds

Local assets identified:

- Bendigo
- Bendigo Creek (reach 44)
- Specific wetlands (none of regional significance)
- Significant native vegetation
- Midland Highway
- Railway line



Current condition of assets:

Bendigo - Stable to increasing high condition

Bendigo Creek (reach 44) - Moderate condition (ISC 2001), however, sections within the identified zone are likely to be very poor condition (including some man made channels).

Significant native vegetation - (Alluvial Terraces Herb-rich Woodland/Creekline Grassy Woodland mosaic, Creekline Grassy Woodland, Grassy Woodland and Plains Woodland)

Endangered vegetation varies from very low to low condition (<0.2, 0.2 - 0.4 habitat hectare range).

Remnants are generally small in size and isolated within the urban landscape.

Vulnerable vegetation varies from very low to low condition (<0.2, 0.2 - 0.4 habitat hectare score). These areas are generally connected with larger reserves and/or provide significant links between reserves.

Midland Highway – no condition provided

Railway line – no condition provided

Salinity threat description

Risk of salinity is high, particularly within Bendigo.

Urgency of the problem is high, with salinity visibly affecting some buildings already.

Groundwater systems are both local and intermediate. Overall it is thought that responsiveness and ease of treatment is moderate to high, if engineering solutions are used. There would be limited response if surrounding farmland was revegetated. The effect of groundwater pumping in mining operations needs to be understood.

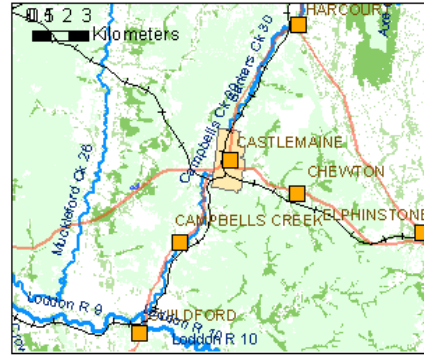
Recommendations for salinity investment

Bendigo and surrounds	This area should be a priority for salinity investment. Various recommendations are made in the full recommendations document, aimed towards the City of Greater Bendigo and the North Central CMA. Recommendations include lobbying State Government to fund a Rural Towns Program, similar to that which exists in Western Australia, committing resources to monitoring and knowledge generation, continuing community education programs and developing partnerships. Mt Alexander Shire needs to become more active in salinity and land use planning for peri-urban developments.
-----------------------	---

Castlemaine Heritage

Local assets identified:

- Castlemaine township
- Campbells Creek locality
- Chewton locality
- Campbells Creek (not a regional priority)
- Muckleford Creek (not a regional priority)
- A number of wetlands (not regional priorities)
- Small amount of very high conservation significance vegetation
- Midland Highway
- Pyrennes Highway
- Railway
- European heritage areas



Current condition of assets: (no description yet)

Castlemaine township
 Campbells Creek locality
 Chewton locality
 Midland Highway
 Pyrennes Highway
 Railway
 European heritage areas

Salinity threat description

Risk of salinity is considered high for Campbells Creek, the wetlands, roads, much of Castlemaine, Campbells Creek and Chewton townships, and some vegetation.

Urgency of salinity problem is considered high, with very high value infrastructure assets potentially at risk.

Groundwater systems are local and intermediate. They are likely to be relatively responsive to treatment.

Recommendations for salinity investment

Specific assets within this asset area warrant salinity investment, rather than the whole area. The main focus for investment should be around the town and infrastructure assets threatened by salinity.

Waterways	Are not a priority for salinity investment
Wetlands	Are not a priority for salinity investment
Roads	Are a priority for salinity investment, subject to confirmation of salinity risk and urgency
Towns	Area a priority for salinity investment, subject to confirmation of salinity risk and urgency. Engineering if economic plus incentives. Consider for inclusion in potential Rural Towns Program
Native vegetation	May be a priority, depending upon the value of vegetation and the ease of treatment
Agricultural land protection	Land retirement if cost of land use change is low, not a priority for investment if cost is high.

Merin Merin Swamp and Birches and Creswick Creeks

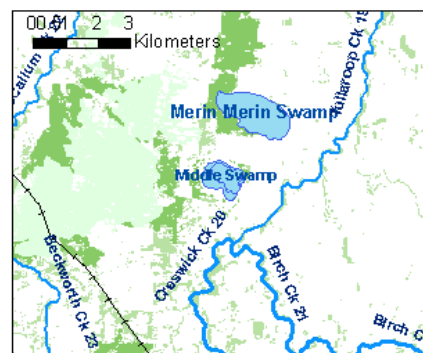
Local assets identified:

- Merin Merin Swamp
- Birch Creek (reach 21) – RHS priority only
- Creswick Creek (reach 20) – RHS priority only
- Tullaroop Creek (not a regional priority)
- Blocks of very high conservation significance vegetation

Current condition of assets:

Merin Merin Swamp - Moderately to slightly below reference (30-60, 60-90 IWC range)

Birch Creek (reach 21) - Moderate condition (ISC 2001)



Creswick Creek (reach 20) - Moderate condition (ISC 2001)

Salinity threat description

Risk of salinity was considered high (though local expert opinion has since disputed this). Needs to be confirmed.

Urgency of addressing the salinity threat is assumed to be high, but will need re-assessing once salinity threat is confirmed.

Groundwater systems are local and intermediate, with some feasibility of treatment, though this needs to be confirmed.

Recommendations for salinity investment

Merin Merin Swamp	This would be a priority for salinity investment assuming the scientific value of this wetland is confirmed. The salinity risk, urgency and treatment all need to be better understood before final recommendations are made on appropriate intervention. Further bore monitoring is needed. Technology development with landholders is important as part of any investment for this asset.
Birch Creek and Creswick Creek	These need further investigation into salinity threat and ease of treatment to determine their priority for salinity investment and appropriate intervention.

Cairn Curran

Local assets identified:

- Cairn Curran Reservoir

Current condition of assets: (no descriptions yet)

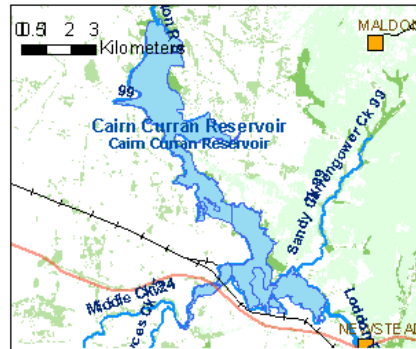
Cairn Curran Reservoir

Salinity threat description

Risk of salinity to Cairn Curran Reservoir needs to be confirmed. There is shallow groundwater but the salinity threat is unknown.

If there is a salinity threat, the urgency is likely to be high.

Groundwater systems are local and intermediate, so it is considered that actions for salinity management may be effective.



Recommendations for salinity investment

Cairn Curran Reservoir	If a serious salinity risk is confirmed using available knowledge and data, this would be a priority for salinity investment. Initial investigations to further analyse salinity threat and potential salinity management actions is needed. Additional bore monitoring is also needed. Technology development with landholders is an important part of any investment response with respect to this asset.
------------------------	---

Tullaroop Reservoir

Local assets identified:

- Tullaroop Reservoir

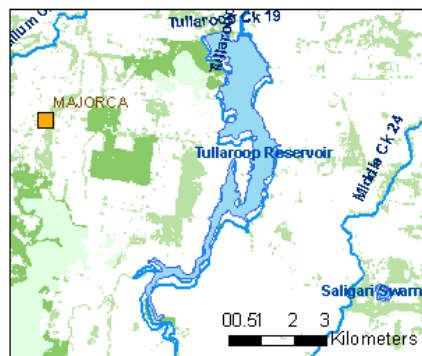
Current condition of assets:

None provided

Salinity threat description

Risk of salinity to Tullaroop Reservoir needs to be confirmed. There is shallow groundwater but the salinity threat is unknown.

If there is a salinity threat, the urgency is likely to be high.



Groundwater systems are local and intermediate, so it is considered that actions for salinity management may be effective.

Recommendations for salinity investment

Tullaroop Reservoir	If a serious salinity risk is confirmed using available knowledge and data, this would be a priority for salinity investment. Needs confirmation of salinity risk. Recommendations will be dependent on salt/water yield trade-off issues. Recommendations may include engineering or long-term incentives for perennials.
---------------------	--

Bridgewater

Local assets identified:

- Bridgewater township
- Loddon River reach 7
- Wetland (not a regional priority)
- Scattered high conservation significance vegetation
- Bulabul Creek (reach 12) (not a regional priority)

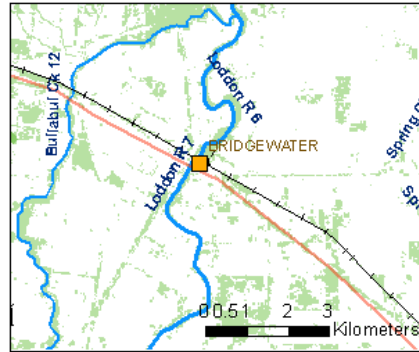
Current condition of assets:

Bridgewater township - Stable to declining condition

Loddon River reach 7 - Poor condition (ISC 2001). Included in the 'Top 20' reaches

Wetland within river - Moderately to slightly below reference (30-60, 60-90 IWC range)

Scattered high conservation significance vegetation - Condition varies from very low to medium condition (>0.2, 0.2 -0.4, 0.4-0.6 habitat hectares range) Remnants isolated within an agricultural landscape.



Salinity threat description

Risk of salinity is assumed to be high, though this needs to be confirmed due to discrepancies between different salinity data sets.

The salinity threat to these assets is considered urgent based on the high value of the assets and the above assumption about salinity risk.

Groundwater systems are regional, with ease and responsiveness of treatment low.

Recommendations for salinity investment

Waterways	May be a priority for salinity investment, if the salinity threat is urgent. Recommendation would be for technology development (in partnership) plus engineering if economic (thought to be unlikely).
Wetlands	Not a priority for salinity investment, as asset not of high enough value
Towns	May be a priority for salinity investment, if the salinity threat is urgent. Engineering would be recommended, if economic.
Dispersed native vegetation and agricultural land	Technology development or not a priority for salinity investment

Upper Loddon

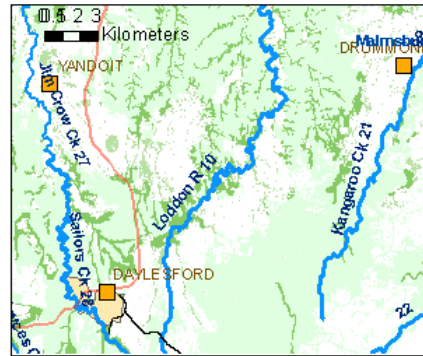
Local assets identified:

- Loddon River reach 10
- Medium to very high conservation significance vegetation
- Tributary catchments to the upper Loddon River

Current condition of assets:

Loddon River Reach 10 - Good condition (ISC 2001).

Medium, high and very high conservation significance vegetation - High and very high conservation significance vegetation varies from very low to medium condition (<0.2, 0.2-0.4, 0.4-0.6 habitat hectare range). Medium conservation significance vegetation varies from very low to high condition (<0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 habitat hectare range)



Tributary catchments to the upper Loddon River – no condition provided

Salinity threat description

Risk of salinity is considered to be low, despite groundwater being shallow, but this needs confirmation.

Urgency would be considered high if the salinity threat is confirmed as present, due to the high value of this asset in the Loddon catchment.

Groundwater systems are mainly local and assumed to be highly responsive to treatment, but this needs further assessment.

Recommendations for salinity investment

Waterways	This is a priority for salinity investment due to the extremely high value of this asset as a supplier of fresh water runoff. Investment should initially focus of assessment of salinity risk. If salinity risk is confirmed, recommendations may be for penalties to prevent perennial establishment, technology development or incentives for land retirement.
-----------	---

Campaspe Catchment

Axe Creek

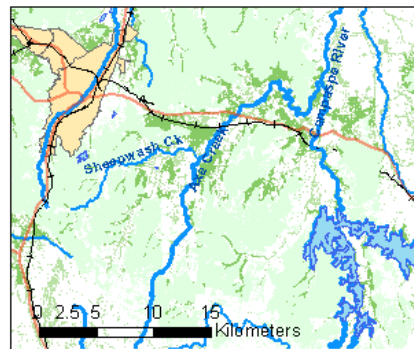
Local assets identified:

- Axe Creek (reach 12)
- Campaspe River (reach 5)
- Numerous small unnamed wetlands (not regional priorities)
- Medium and very high conservation significance vegetation
- Sheepwash Creek (not a regional priority)

Current condition of assets:

Axe Creek (reach 12) - Moderate condition (ISC 2001)

Campaspe River (reach 5) - Poor condition (ISC 2001)



Medium high and very high conservation significance vegetation - (Alluvial Terraces Herb-rich Woodland/Creekline Grassy Woodland mosaic, Floodplain Riparian Woodland, Grassy Woodland, Plains Woodland and Creekline Grassy Woodland). High and very high conservation significance vegetation varies from very low to medium condition (>0.2, 0.2-0.4, 0.4-0.6 habitat hectare range). Medium conservation significance vegetation varies from very low to high condition (>0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 habitat hectare range)

Salinity threat description

Shallow watertables present and salinity risk is well known to be high, though the risk of further expansion is considered low.

The urgency of the problem is considered high in the waterways due to the high value of the Axe Creek and Campaspe River and shallow watertables. The urgency is low on the higher relief areas.

Groundwater systems are local on the high relief areas and intermediate near the waterways. Ease of treatment of the salinity problem is known to be moderately low.

Recommendations for salinity investment

Waterways	This area may be a priority for salinity investment, but this needs further investigation. Assessment is needed into the importance of the downstream salt exports, including implications of dilution of water entering from Axe Creek, because fresher water comes into the Campaspe River from Lake Eppalock which is above where the Axe Creek joins the Campaspe River. The importance of the Axe Creek as a representative river also influences its priority for investment. It would help to know if there are higher salt stores in some parts of the catchment than others as this would help decisions about where investment could be targeted more strongly. Recommendations would be for incentives for land retirement (low cost natural regeneration) and technology development.
Wetlands	Not a priority for salinity investment
Dispersed native vegetation	Recommendation is for engineering if economic, which is unlikely, in which case recommendation is not a priority for salinity investment.

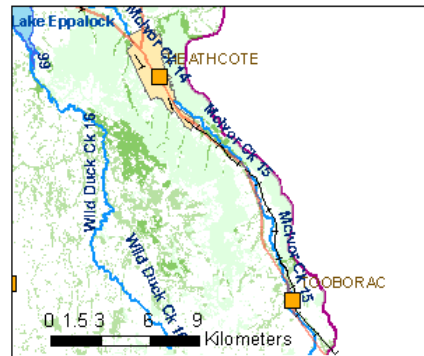
Tooborac Heathcote (east of Wild Duck)

Local assets identified:

- Heathcote township
- Tooborac locality
- Northern Highway
- Railway line
- High value dispersed vegetation
- Mclvor Creek (reaches 14 and 15) (not a regional priority)
- Two unnamed wetlands (not regional priorities)

Current condition of assets:

Heathcote township – none provided
 Tooborac locality – none provided
 Northern Highway – none provided
 Railway line – none provided



High value dispersed vegetation - High value remnants (endangered and vulnerable vegetation) vary from very low to high condition (>0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 habitat hectare range). Some remnants are isolated within an agricultural landscape while others are connected with larger reserves and/or provide links between reserves.

Salinity threat description

Risk of salinity is unclear, due to the discrepancies between the two salinity data sets.

Urgency is assumed to be high for the Mclvor Creek. Urgency is unclear due to unknown salinity risk.

Groundwater systems are local, suggesting that salinity treatment is viable.

Recommendations for salinity investment

Waterways	This is not a priority for salinity investment, due to relatively low value of waterway assets compared to the rest of the region
Towns, roads and rail	Priority for salinity investment needs further investigation, subject to salinity threat. Recommendation would be for engineering if economic and to be considered under the

	potential Rural Towns Program. Partnership with local council is needed if any investment is to occur.
Dispersed high-value native vegetation and land	Recommendation is incentives for land retirement if salinity threat is confirmed, otherwise not a priority for salinity investment.

Wild Duck Creek catchment including Lake Eppalock

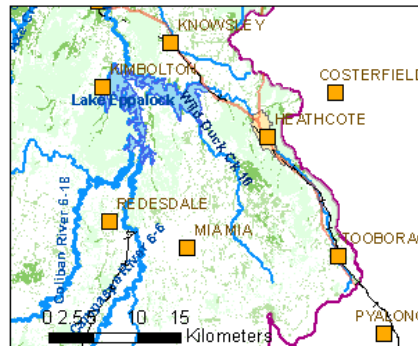
Local assets identified:

- Lake Eppalock
- Wild Duck Creek (reach 16) (not a regional priority)
- Some very high conservation significance native vegetation

Current condition of assets:

Lake Eppalock - none provided

High value dispersed vegetation - High value remnants (endangered and vulnerable vegetation) vary from very low to high condition (>0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 habitat hectare range). Some remnants are isolated within an agricultural landscape while others are connected with larger reserves and/or provide links between reserves.



Salinity threat description

Risk of salinity to these assets is considered high.

Urgency of a further salinity problem is considered low as the watertable would be at equilibrium.

Groundwater systems are local, with success of treatment variable in the area due to various groundwater conditions. Treatment seems viable on small pockets of agricultural land and salt input into Wild Duck Creek.

Recommendations for salinity investment

Lake Eppalock	Whether it is a priority for investment will depend upon the salt/water yield trade-off issues. CAT modelling combined with expert opinion is needed to assess this.
Waterways	Although Wild Duck Creek is not a river health priority reach it may be a priority for salinity investment, depending on importance of salt/water yield tradeoffs. This needs further investigation with CAT modelling and expert opinion

Elmore

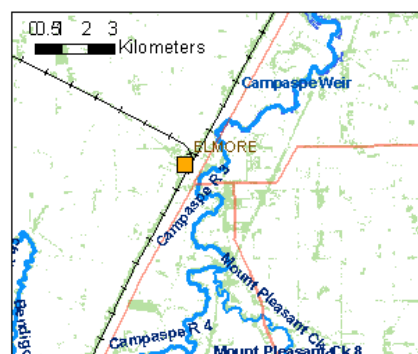
Local assets identified:

- Elmore township
- Campaspe River reaches 3 and 4
- Mt Pleasant Creek reach 8 (not a regional priority)
- Numerous wetlands (not regional priorities)
- Scattered high value native vegetation

Current condition of assets:

Elmore township - Stable to declining condition

Campaspe River reaches 3 and 4 - Reach 3 is poor condition (ISC 2001). Reach 4 is moderate condition (ISC 2001). Both included in 'Top 20' reaches.



Scattered high value native vegetation - High value remnants (endangered and vulnerable vegetation) vary from very low to high condition (>0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 habitat hectare range). Most are isolated remnants within an agricultural landscape. Some remnants provide links through this landscape.

Salinity threat description

Risk of salinity is considered unknown due to discrepancies in data, but is assumed to be high in the southern part of the area, if the SKM data is used.

Urgency is high for Campaspe River reach 4, if the above assumption is correct.

Groundwater systems are regional and responsiveness is low.

Recommendations for salinity investment

Elmore	Salinity threat needs further assessment. A Rural Towns Program is recommended to assess this threat
Waterways	Salinity threat needs further assessment. If threat is confirmed, recommendation is for technology development plus engineering if economic, for the Campaspe River reach 4 only. Reach 3 appears not to be under threat according to watertable information.
Wetlands	Not a priority for salinity investment

DRAFT

Appendix C Bibliography

Referenced in Text

- Anon. 2001, **Beneficiaries and funders of research and development in agriculture: Science, Technology and Innovation, and Naturally Victorian initiatives 2000/2001. Evaluation Report No. 4** Natural Resources and Environment, East Melbourne.
- Anon. 2006, **National Action Plan for Salinity and Water - Benchmarking regional water table and trends. Project report, draft 1, 23 March 2006.** Sinclair Knight Merz: Armadale, Vic
- Bann G and Field J 2006, **Dryland salinity in south east Australia: Which scenario makes more sense?** Australian Earth Sciences Conference 2006
<http://www.earth2006.org.au/papers/extendedposter/Bann%20Glenn.pdf> (retrieved 28 February 2007)
- Brown W 2004, **Opportunities to use Native Grasses in Viticulture: Presentation to native Seeds PTY Ltd Filed Day.** Echuca, unpublished
- Dart J 2006, **Monitoring, Evaluation, Reporting and Improvement for NRM: Course workbook 23rd to 25th October 2006 Melbourne Australia,** Clear Horizon, unpublished
- Department of Sustainability and Environment 2005a, **The Asset-Based Approach for Natural Resource Management in Victoria: Discussion Paper,** Department of Sustainability and Environment, Melbourne
- Department of Sustainability and Environment 2005b, **Interim guidelines for developing multiple outcome projects 2005 – Draft for comment 25 October 05,** Unpublished
- North Central Catchment Management Authority 2003, **North Central Regional Catchment Strategy 2003-2007,** North Central Catchment Management Authority, Huntly
- North Central Catchment Management Authority 2005a, **North Central Native Vegetation Plan 2006,** North Central Catchment Management Authority, Huntly
- North Central Catchment Management Authority 2005b, **North Central River Health Strategy 2005,** North Central Catchment Management Authority, Huntly
- Pannell D.J. 2006, **Public benefits, private benefits, and the choice of policy tool for land-use change,** <http://cylene.uwa.edu.au/~dpannell/dp0601.htm>, (Retrieved 8 September 2006)
- Peterson T, Clifton C, McGregor C, Chaplin H, Heislors D, Reid M and Smith N 2002, **North Central Salinity Audit: Current and future salinity risk areas,** unpublished
- Ridley A, Pannell D 2005 **SIF3 The role of plants and plant-based research and development in managing dryland salinity in Australia,** *Australian Journal of Experimental Agriculture* 45:1134-1355.
- Ridley A, Pannell D, and Park G 2006 **SIF3 Methods – North Central CMA region** Co-operative Research Centre for Management of Dryland Salinity, Rutherglen, Victoria, unpublished
- Ridley A, Pannell D, and Park, G 2007. **Community-identified priority assets for dryland salinity in the North Central Catchment Management Authority region. Recommendations** Co-operative Research Centre for Management of Dryland Salinity, Rutherglen, Victoria, unpublished
- Sinclair Knight Merz 2002 **Second Generation Dryland Salinity Management Plan for the North Central region – Draft B,** unpublished
- Viridans Biological Databases 2006a **Flora Information System** [Computer program]. Brighton East, Victoria: Viridans.
- Viridans Biological Databases 2006b **Atlas of Victorian Wildlife** [Computer program]. Brighton East, Victoria: Viridans.

Referred to in document creation

- Avoca Dryland Community Working Group 1993, **Avoca Catchment Draft Salinity Management Plan: A Land and Water Management Strategy,** Avoca Dryland Community Working Group with assistance from DCNR, RWC, DoA

- Avon-Richardson Land and Water Management Group 1992, **Avon-Richardson Draft Land and Water Management Plan: A draft for public discussion**, Avon-Richardson Land and Water Management Group with assistance from DCE, RWC, DFA
- Campaspe Community Working Group 1992, **Campaspe Catchment Salinity Management Plan, A Land and Water Management Strategy: A draft for public comment**, Campaspe Community Working Group with assistance from DCNR, RWC, DoA
- Department of Natural Resources and Environment 1997, **Victoria's Biodiversity: Directions in Management**, Department of Natural Resources and Environment, East Melbourne
- Department of Natural Resources and Environment 2000, **Victoria's Salinity Management Framework – Restoring our Catchments**, Department of Natural Resources and Environment, Melbourne
- Department of Natural Resources and Environment 2002, **Healthy Rivers Healthy Communities and Regional Growth: Victorian River Health Strategy**, Department of Natural Resources and Environment, Melbourne
- Department of Sustainability and Environment 2004, **Securing Our Water Future Together – Victoria's Action Plan for a Secure Water Future**, Department of Sustainability and Environment, Melbourne
- Department of Sustainability and Environment 2006, **Our Environment Our Future – Sustainability Action Statement 2006**, Department of Sustainability and Environment, East Melbourne
- Department of Sustainability and Environment 2006b, **Land Asset-Based Approach Framework Draft**, unpublished
- Dyson P undated (2005?), **Second Generation Dryland Salinity Management Plan for North Central Victoria Peer Review**, unpublished
- Loddon Community Working Group 1992, **Loddon River Catchment Dryland Salinity Management Plan: A draft for public comment**, Loddon Community Working Group with assistance from DCE, RWC and DFA
- Murray-Darling Basin Ministerial Council 2001, **Basin Salinity Management Strategy 2001-2015**, Murray-Darling Basin Ministerial Council, Canberra
- National Land and Water Resources Audit 2007, **National Monitoring and Evaluation Framework**, <http://www.nlwra.gov.au/about.asp?section=93> (retrieved 25 January 2007)
- National Water Commission 2006, **National Water Initiative**, <http://www.nwc.gov.au/NWI/index.cfm> (retrieved 15 September 2006)
- Ridley A 2005, **North Central Dryland Salinity Management Plan: 2003-2008; Peer review comments on farming systems/economic aspects of the plan**, unpublished
- Ridley A, Pannell D, Seymour E 2006 **Evolution of dryland salinity decision making in north-central Victoria** (Co-operative Research Centre for Management of Dryland Salinity, Rutherglen, Victoria).
- Saunders D 2005, **Biodiversity Peer Review of the Second Generation Dryland Salinity Management Plan for the North Central Region**, unpublished
- Sinclair Knight Mertz 2003 **Review of the North Central Dryland Salinity Management Plans**, unpublished