Shepparton Irrigation Region Catchment Implementation Strategy

Review 2005-2006 and
Implementation Plan 2006-2007 to 2010-2011

Background Report

GOULBURN BROKEN
CATCHMENT MANAGEMENT AUTHORITY

For further information contact:

Carl Walters
Shepparton Irrigation Region Implementation Committee
Goulburn Broken Catchment Management Authority
C/o Department of Primary Industries
255 Ferguson Road
Tatura
Victoria 3616

Phone: (03) 5833 5360
Fax: (03) 5833 5299
Email: carlw@gbcma.vic.gov.au

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Find more information about the Goulburn Broken Catchment Management Authority on the web at:
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Acknowledgement

The Goulburn Broken Catchment Management Authority, Shepparton Irrigation Region Implementation Committee acknowledge the efforts of the following individuals in the preparation of the SIRCIS 2005-2006 Review incorporating the 2005-2006 to 2010-2011 Implementation Plan.

Goulburn Broken Catchment Management Authority

Peter Gibson (Chair) and members of the Shepparton Irrigation Region Implementation Committee

The late Ken Sampson (1950-2009)

> *Ken was a key player in the initiation, development and management of the SIRCIS, as Executive Officer, from its inception until his passing on October 8 after a short illness. Ken had been the Executive Officer of SIR IC and the Co-ordinator of the Land and Water Salinity Management Plan. He had successfully linked local government, various agencies and community through a common aim. His quiet ability to bring together complex networks for the benefit of the community and his humility in his service will always be remembered.*

Andrea Smith
Carl Walters
Menon Parameswaran
Pam Collins
Peter Howard
Rachael Spokes
Wayne Tennant

Department of Primary Industries
Bruce Gill
Chris Nicholson
GIS Group at Tatura
Jen Pagon
Lyndall Ash
Olive Montecillo
Raechel Ballinger
Rebecca Pike
Terry Batey

Department of Sustainability and Environment
Kylie Pfeiffer

Goulburn-Murray Water
Greg Smith
James Burkitt
Sam Green
Terry Hunter

This document was prepared by:
Andrea Smith
Menon Parameswaran
Olive Montecillo

Foreword

It is a challenging but ultimately rewarding time to be involved in catchment management. As we struggle with meeting the challenges of drought, competition for water, climate change and our old foes of salinity and biodiversity loss, we face a rapidly changing policy environment. Finding a way forward requires us to embrace these challenges and seek innovative solutions that protect the environmental future of the region, and provide pathways for a prosperous community.

This update of the original 1989 Shepparton Irrigation Region Land and Water Salinity Management Plan seeks to build on the experience of the past, continue to address salinity and the biodiversity issues while finding approaches to deal with the future challenges.

The strategic approaches of the past have served us well and we continue on this path. The Strategy adopted the principles of the triple bottom line and using an asset based approach long before they became fashionable. For example, the original Plan was focussed on four major objectives:

- The Environmental objective: the Plan is to address current and future environmental problems resulting from high water tables and salinity in the region. On balance, salinity control activities are to maintain and where possible, enhance existing ecological processes.
- The Social objective: wherever possible, the Plan is to provide the community with equal access to decision-making and financial resources required to implement salinity control works. The plan will reduce inequities resulting from uncontrolled salinity impacting differently on individuals.
- The Economic objective: where works are undertaken to protect the region from high water tables and salinity, the value of benefits, both measurable and non measurable should exceed the costs.
- The Financial objective: the Plan is to be both equitable and affordable to the individual, the regional community and the nation, now and in the future.

The Goulburn Broken Irrigation Futures project has been influential in shaping our thinking about the challenges ahead. The project has allowed us to consider what the future might bring and how these different futures might require us to act. As a general principle the project has emphasised the need to maintain a flexible approach to our programs and to maintain our review process.

We have achieved much in the first 15 years of implementing the Strategy and are determined to continue our success in the final 15 years.

The Shepparton Irrigation Region Implementation Committee looks forward to working with our partners from the irrigation community, government, agencies, and the broader community, to ensure a vibrant, sustainable, and prosperous future.

Peter Gibson
Chair
Shepparton Irrigation Region Implementation Committee

Glossary of Terms

Biodiversity (biological diversity) – This is the natural diversity of life: the sum of all our native species of flora and fauna, the genetic variation within them, their habitats and the ecosystems of which they are an integral part (Victoria's Biodiversity Strategy 1997).

Conservation covenant - This is an agreement between a landowner and the Trust for Nature, which protects and enhances the natural, cultural and/or scientific values of the land. The covenant is registered on the property title and binds all future owners.

Land of high conservation significance is covered by a covenant with Trust for Nature. Such land may have threatened plants or animals, or be one of the last remaining patches of bush in the area. The farm property may form part of an important wildlife corridor, or act as a buffer to protect a neighbouring National or State Park. In our region it usually means an area of high quality remnant vegetation which is fenced by the property owner and has a management regime to protect it. This usually means no grazing or grazing only at strategic times of the year, and so represents an income loss to the landholder.

Earthwork planning controls - These controls were introduced across the whole SIR in 1994 through Local Government Planning Controls and make it necessary to obtain planning approval for earthworks on rural land. As laser grading to improve water use efficiency became more common, and as the Surface Water Management Strategy was developed and began to be implemented, it became clear that planning controls over earthworks were needed for two main reasons:

- to ensure that works by landowners were compatible with the regional drainage network
- to prevent damage and loss to others by landowners constructing inappropriate earthworks.

Local Government provides a 50 per cent subsidy of the Planning Permit Fee to landowners who obtain Planning Approval through certifying a Whole Farm Plan (WFP). This encourages landowners to consider water management on their property in an holistic way rather than in a piecemeal approach. Whole Farm Planning is being adapted to further incorporate environmental issues such as native vegetation. While native vegetation may be identified on a WFP, separate application is required for any removal. Local Government benefits from this arrangement by receiving only one application for works rather than a number for any given property. This subsidy also demonstrates to the community that Local Government is strongly committed to the SIRCIS and its implementation.

Benefit-Cost Ratio (BCR) – This is the ratio of the present value of project benefits to the present value of project costs (DCE 1992 and Makeham, J.P. and Malcolm, L.R. 1993). The higher the BCR, the more economically viable is the project because it is earning more than the required rate of return. A BCR of 1.04 means that for every dollar spent on the project, the benefits generated were valued at $1.04.

Employment – This measures the number of people employed (SPPAC 1989, page21).

Income – This measures payments to householders for labour input, including an imputed wage for self employed persons (SPPAC 1989, page21).

Internal Rate of Return (IRR) – This is the break-even discount rate. It is the discount rate at which the present value of the benefits from a project equals the present value of the costs of the project. The higher the IRR, the more economically attractive is the project (DCE 1992 and Makeham, J.P. and Malcolm, L.R. 1993).

Market-priced benefits or costs - A commodity has a market price if it can easily be traded. For example, milk is a 'market' priced commodity with a farm gate price usually as either cents per litre or $ per kg butterfat.

Net Present Value (NPV) – This is the difference between the discounted values at a required discount rate of the future benefits and costs associated with the project (DCE 1992 and Makeham, J.P. and Malcolm, L.R. 1993). The higher the NPV the more economically viable the project because the project is earning at that rate plus some more. If the NPV is negative, the project is not economically viable.

Output (gross value of production) – This measures business turn-over at each stage and therefore includes double counting eg the value of milk produced is a dairy farm output but it is also included in the value of output of processed dairy products (SPPAC 1989, page 21).

Real discount rate – This is the rate that has been adjusted to eliminate the effect of expected inflation.

Index of Stream Condition (ISC) –This is a measure of a stream's change from natural or ideal conditions. The ISC has been applied to about 2,500 km (25 per cent) of the GB catchment's streams on a representative reach basis. The ISC provides an indication of the extent of change in respect of five key, "stream health" indices:

- hydrology (change in volume and seasonal flow)
- physical form (stability, degradation, influence of artificial barriers and abundance/absence of in-stream debris)
- streamside zone (plant species - native / exotic, spatial extent, width, continuity and links)
- water quality (assessment of total phosphorus, turbidity, conductivity and pH)
- aquatic life (abundance and type of macro invertebrates) (Goulburn Broken Regional Catchment Strategy, November 2003).

Irrigation Development Guidelines (IDG) – This is a guide for irrigation developers on the process that needs to be followed to obtain a Water Use Licence.

Local Area Planning – This is a process of the local community developing ownership of the SIRCIS. Procedures are used to identify the issues that have the most impact within their local area. Key community people and staff then have the opportunity to contribute to the development and implementation of the SIRCIS within that particular local area. It is a plan to establish a sustainable sound environment by identifying and overcoming land management and social problems through community action. Local Area Plans help ensure the accelerated implementation of existing natural resource programs (GB CMA 2007a, page 68).

Management Action Target (MAT) – This is a shorter term measure of the targeted quantity or quality of works or measures that will directly or indirectly impact on the quality of the resource or asset and usually aimed at achieving a particular Resource/Asset Condition outcome.

Resource Condition Target (RCT) – This is the targeted long term quality of a resource or asset and is usually expressed in terms of the quality of the resource/asset in question.

Triple Bottom Line (TBL) – This is an assessment which comprises a social, environmental and economic assessment of a particular action or program of actions to determine the benefits of undertaking an action.

Water Use Licences (WUL) – This is a licence to authorise the licensee to use water for irrigation on a property in accordance with the Water-Use Objectives and Standard Conditions. A WUL is granted by the Water Authority, on behalf of the Minister for Water.

Abbreviations

AAV	Aboriginal Affairs Victoria
BMP	Best Management Practice
CDLWSPA	Campaspe Deep Lead Water Supply Protection Area
CMA	Catchment Management Authority
COAG	Council of Australian Government
CSIRO	Commonwealth Scientific Industry Research Organisation
DCE	Department of Conservation and Environment (now DSE)
DCD	Drainage Course Declarations
DNRE	Department of Natural Resources and Environment (now DPI and DSE)
DEP	Drought Employment Program
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment
EMS	Environmental Management System
EPA	Environment Protection Authority
EPBCA	Environmental Protective Biodiversity Conservation Act
EVC	Ecological Vegetation Classes
GBWQWG	Goulburn Broken Water Quality Working Group
GBWQS	Goulburn Broken Water Quality Strategy
GB CMA	Goulburn Broken Catchment Management Authority
GBIF	Goulburn Broken Irrigation Futures
GBRRHS	Goulburn Broken Regional River Health Strategy
GGAP	Greenhouse Gas Abatement Program
GMA	Groundwater Management Area
GMP	Groundwater Management Plan
G-MW	Goulburn-Murray Water
HVEF	High Value Environmental Features
IDG	Irrigation Development Guidelines
ISO	International Organization for Standardization
IDMOU	Irrigation and Drainage Memorandum of Understanding
KWSPA	Katunga Water Supply Protection Area
LAP	Local Area Plans/Planning
LWMP	Land and Water Management Plan
LWRRDC	Land and Water Rural Research and Development Corporation (now Land and Water Australia)
MDBC	Murray Darling Basin Commission (now Murray Darling Basin Authority)
NAP	National Action Plan for Salinity and Water Quality
NHT	National Heritage Trust
NRSWS	Northern Region Sustainable Water Strategy
O and M	Operations and Maintenance
PCV	Permissible Consumptive Volume
PPA	Pest Plants and Animals
R and D	Research and Development
R and I	Research and Investigation

RCIP	Regional Catchment Investment Plan
RCS	Regional Catchment Strategy
RCT	Resource Condition Target
SDA	Salt Disposal Allocation
SIR	Shepparton Irrigation Region
SIR AP	SIR Action Plan
SIRCIS	SIR Catchment Implementation Strategy
SIR IC	SIR Implementation Committee
SIRTEC	SIR Technical Committee
SIRLWMP	SIR Land and Water Management Program 1995
SIRLWSMP	SIR Land and Water Salinity Management Program 1989
SPAC	Salinity Program Advisory Committee
SPPAC	Salinity Pilot Program Advisory Council
SSDP	Sub-surface Drainage Program
SWMP	Surface Water Management Program
TBL	Triple Bottom Line
TWE	Transferable Water Entitlement
UDV	United Dairy Farmers of Victoria
VFF	Victorian Farmers Federation
WFP	Whole Farm Plan
WFPIS	Whole Farm Plan Incentive Scheme
WSPA	Water Supply Protection Area
WUE	Water Use Efficiency
WUL	Water Use Licence

Units of Measure

EC	Electrical conductivity
GL	gigalitre
ha	hectare
km	kilometre
m	meter
ML	megalitre
no.	number
t	tonne
%	Per cent

1. Introduction

1.1. Salinity in the Shepparton Irrigation Region

The Shepparton Irrigation Region (SIR) is located in northern Victoria and is part of the Goulburn Broken Catchment (Figure 1). The local governments within the SIR are the City of Greater Shepparton, Campaspe and Moira Shires. The major towns in the region are Shepparton, Echuca and Cobram.

Prior to agricultural development and irrigation, the region's groundwater levels are thought to have been around 15 to 30 metres (m) below surface. Irrigation and tree clearing has altered the water balance and significantly increased the volume of water infiltrating the soil profile, resulting in rising groundwater levels, causing both waterlogging and salinity.

Salinity and high watertables first became a major concern around the Tatura and Bamawm area in the 1930s. Successive wet years in the early 1970s have caused severe salinity problems that affected 50 per cent of the pear trees across the SIR. By the mid 1980s approximately 30 per cent of the SIR was underlain by shallow watertables (less than two metres deep) (SPPAC 1989, pages 10-14).

The extrapolation done to predict salinity impacts if "nothing is done" showed the areas with high watertable will increase from 159,000 hectares (ha) in 1987 to 218,000 ha in 2000 and 274,000 ha in 2020, about 55 per cent of the SIR (SPPAC 1989, page 40). Economic modelling done by the Salinity Pilot Program Advisory Council (SPPAC) showed the economic losses from salinity in the SIR would rise from $47 million per year in 2000 to $120 million annually by the year 2025 (SPPAC 1989, page 53)[1]. The actual watertable levels across the SIR were consistent with the predicted level up to the mid 1990s. Since then, the implementation of works and the drought have seen continual decline in the areas at high risk (G Smith, pers comm, 2010).

The environment (SPPAC 1989, page 44) will also be adversely affected if nothing is done to address the problems of high watertable and salinisation. Effects such as:

- destabilisation of river banks due to saline seepage from the high watertable
- loss of riparian vegetation and precipitation of bank erosion and bed widening in streams
- replacement of the natural species in the wetlands firstly by a dense mass of floating couch grass, then cumbungi and finally, by salt-tolerant aquatic plants, (some wetlands will be replaced by lignum and saltbush)
- continued decline in remnant vegetation along streams and depressions and on the plains due to waterlogging, salinity, old age and insect attack.

The Salinity Pilot Program Advisory Council (SPPAC) responded to the salinity and waterlogging challenges by developing the Shepparton Irrigation Region Land and Water Salinity Management Plan (SIRLWSMP) in 1989 and the implementation started a year later.

The title of the Plan was changed a few times to reflect an holistic approach to the management of natural resources in the SIR. The Plan is now known as the Shepparton Irrigation Region Catchment Implementation Strategy (SIRCIS). The SIRCIS is essentially a land and water management plan but now includes biodiversity, river health and climate change issues. The Shepparton Irrigation Region Implementation Committee (SIR IC) oversees the implementation of SIRCIS. SIR IC is part of the corporate and business management structure of the Goulburn Broken Catchment Management Authority (GB CMA). SIR IC also oversees projects in a part of the North Central Catchment on behalf of the North Central Catchment Management Authority (NCCMA).

[1] In 2006 prices, the economic losses are about $78 million in 2000 rising to about $200 million in 2025.

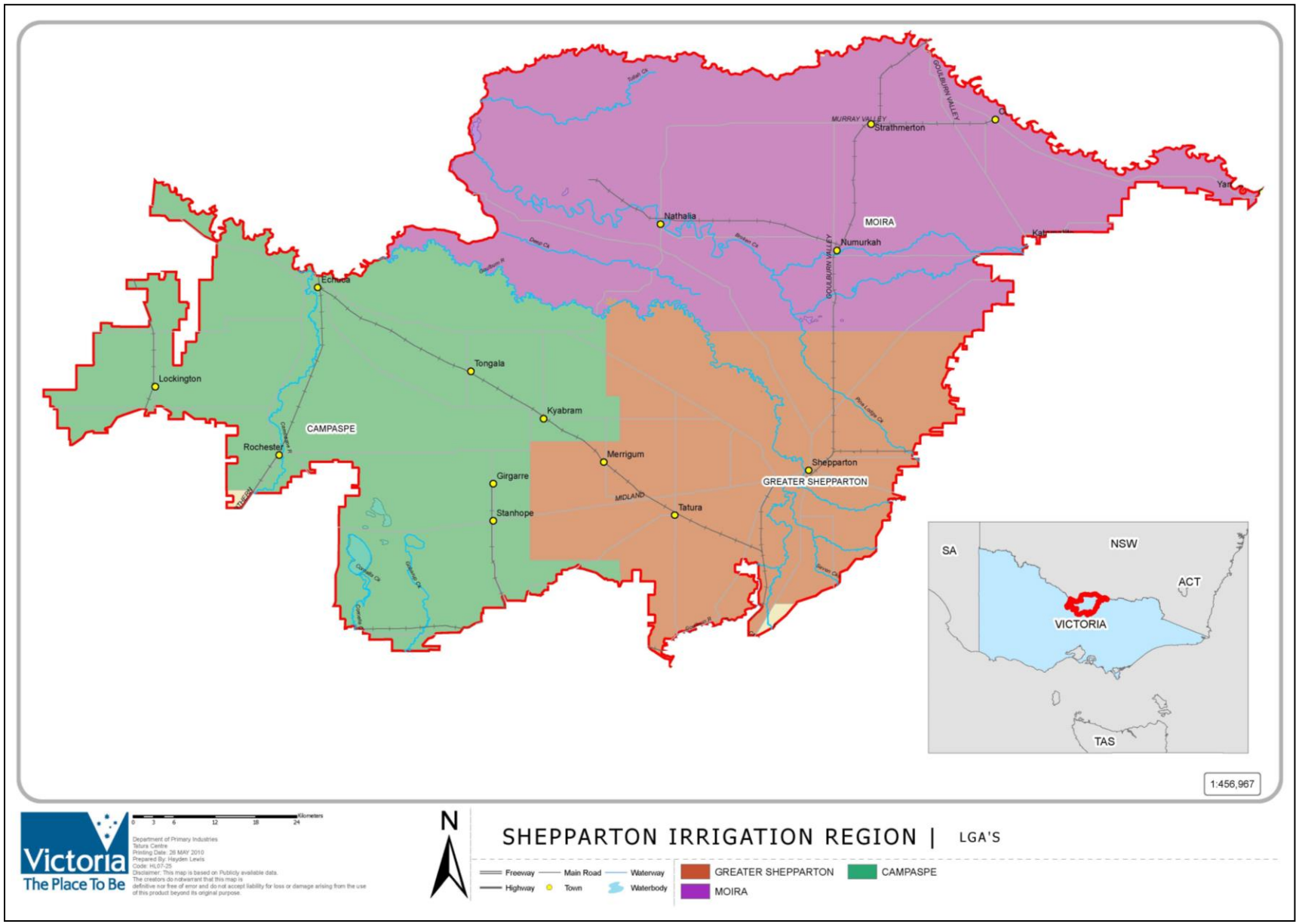


Figure 1 **SIR with municipal boundaries**

1.2. Structure of the document

This background report presents an overview of the SIRCIS and the result of the program reviews conducted between 2006 and 2007. It contains a list of the assets, identifies the threats to these assets and the barriers to and drivers for change. It also presents the recommended targets and actions to address the opportunities and manage the threats.

The SIRCIS is made up of five key implementation programs:

- Environment Program
- Farm Program
- Sub-surface Drainage Program (SSDP)
- Surface Water Management Program (SWMP)
- Waterways Program.

This document is a part of a series of documents (Figure 2 and Table 1).

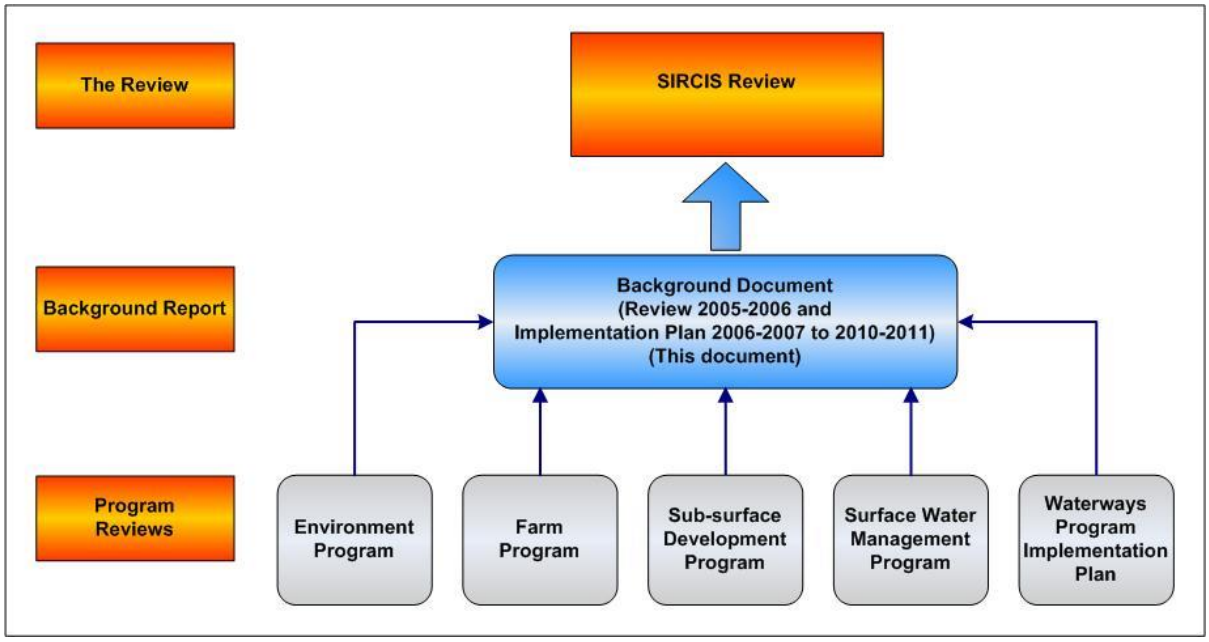


Figure 2 Structure of the document

Table 1 Sections of the documents

Documents	Contents
SIRCIS Review 2005-2006 and Implementation Plan 2006-2007 to 2010-2011 (The Review)	This document is a summary, setting out the justification for the Strategy, what has been achieved, what needs to be achieved and the benefits of Strategy implementation.
SIRCIS Review 2005-2006 and Implementation Plan 2006-2007 to 2010-2011 (Background Report)	This document provides detailed information of the Review.
Program Reviews: • Environment • Farm • Surface Water Management • Sub surface Drainage • Waterways.	These documents contain the result of the five-year review of each Program. Information from these reviews has been incorporated into the SIRCIS Review 2005-2006.

1.2.1. Changes to plan implementation since 1990

There had been a lot of changes relevant to the Plan implementation since 1990 and also after the 2006-2007 review. These are:

a. The SIRLWSMP was introduced in 1989 and broadened over time. It is now referred to as the SIRCIS. From a largely salinity-focussed plan, the SIRCIS now also covers issues of biodiversity, river health and climate change.

b. The Surface Drainage Program has been changed to the Surface Water Management Program (SWMP) in 1999 and this document uses the new name.

c. The Sub-surface Drainage Program (SSDP) has been changed to the Groundwater and Salt Management Program (GSMP) in 2009 and this document uses the old name.

d. The Drainage Nutrient Reduction Incentive Scheme (DNRIS) was introduced in 1998 as part of the Farm Program but was moved to the SWMP in 2003.

e. Murray Darling Basin Commission (MDBC) has been changed to Murray Darling Basin Authority in 2009 and this document uses the old name.

f. *"Our Water Our Future"* is one of the drivers for change and has been implemented since 2004.

g. Northern Victoria Irrigation Renewal Project (NVIRP) /FoodBowl Modernisation Project has been implemented since 2008.

h. Northern Region Sustainable Water Strategy (NRSWS) was formally released in December 2009 after 18 months of consultation.

i. Lake Mokoan was decommissioned in 2009.

j. Exemptions from the 4 per cent cap on water trading were granted in 2009.

k. The 'Securing our Natural Future' White Paper was released in 2009.

1.2.2. Limitations of this report

One limitation in the program reviews is inconsistency in the investment horizon and period covered:

- The reviews of the Environment, Farm and Surface Water Management Programs in 2007 covered the investment period from 2001-2002 to 2005-2006.
- The review of the SSDP in 2006 covered the investment period from 1990 to 2030.
- The Cost-Benefit Analysis of the DNRIS in 2007 covered the investment period from 1998 to 2006. The Scheme was not included in the review of either the Farm Program or the Surface Water Management Program.
- Review of the Waterways Program in 2007 covered the period 2000-2001 to 2005-2006. The review was not as comprehensive as the other four programs (eg no "triple bottom line analysis").

A more robust economic analysis will be conducted in 2011 when the Strategy will be reviewed after 20 years of implementation. It will address the limitation stated above and the assumptions to be used will be consistent across all Programs. The Drainage Evaluation Spreadsheet Model (DESM) used in the review of the Surface Water Management and Sub-surface Drainage Programs has the capability to run the analysis of the whole Strategy.

This document has focussed separately on each program except for the 'triple bottom line' analysis (Section 7), cost-sharing arrangement (Section 11.3) and funding requirements (Section 11.4). The Farm and Environment Programs are combined at the strategic level but remained separate programs at the operational level.

Some areas in the Shires of Campaspe and Moira are not within the SIR. As such the statistics from the Australian Bureau of Statistics (ABS) and the Department of Sustainability and Environment (DSE) presented in this document cover areas outside of the SIR.

2. The Shepparton Irrigation Region Catchment Implementation Strategy

This section briefly describes the SIRCIS and its history. It details the vision for the future as well as outlining some of the SIRCIS mechanics and the review process.

The SIRCIS is a 30-year land and water management plan designed to protect and enhance the natural assets of the SIR in order that the Region has a healthy and prosperous future with a vibrant community.

This 2005-2006 update of the SIRCIS celebrates the successes of catchment management in the SIR to date and identifies key challenges to achieving the SIR and broader Goulburn Broken Regional Catchment Strategy (GBRCS) visions. In doing this, the SIRCIS provides the mechanism to leverage government investment in natural resource management in the SIR.

The five Programs of the SIRCIS provide the detail on the relevant regional issues and what actions when, how and where.

Table 2 is a summary of the issues that each Program addresses.

Table 2 Program summary, SIRCIS, 2006

Programs	Issue	Action
Farm	Salinity	Preventing groundwater recharge by: • developing and implementing a whole farm plan (WFP) • installing reuse systems • installing automatic irrigation systems.
	Water quality decline	Preventing loss of nutrient rich water from farms through irrigation management and layout improvements.
Environment	Biodiversity loss	Incentives for remnant protection and biodiversity plantings.
Surface Water Management	Salinity	Preventing groundwater recharge by providing a drainage network to remove irrigation induced rainfall runoff from a 1 in 2 year rainfall event within 5 days.
Sub-surface Drainage	Salinity	Providing for strategic use of pumped groundwater to prevent rising groundwater levels.
Waterways	Biodiversity loss	Providing for revegetation of waterways, construction of fish passage to allow fish movement up stream and control of weeds.
	Water quality decline	Providing for activities such as removal of stock watering in rivers.

The Environment Program supports the implementation of the Farm, SSDP, SWMP and Waterways Programs. In recent years it has focussed on strategic planning including Biodiversity Action Planning (BAP) and high value environmental features for SSDP and SWMP. The Environment Program has been instrumental in mapping environmental features in the SIR and assessing their habitat/biodiversity values towards establishing their priority for action.

2.1. Establishing the vision

The SIR is one of the few non-coastal areas in Australia that is thriving; however land use patterns are changing.

The world demand for food will continue to increase, driving an expansion of the SIR's agriculture sector. The SIR's population is growing and the cultural and demographic mix is changing. A diverse community requires a diverse approach to engagement. SIR IC has a strong history of working with multicultural groups.

The region's population has a comprehensive understanding of the value of natural assets and the

contribution to the region's productive capacity that the assets make. Natural and agricultural assets are interconnected and degradation of any natural asset may have an adverse impact on the other assets. Biodiversity assets, in particular, are under threat from salinity and intensification of agriculture.

Water is becoming increasingly scarce with strong competition among environmental, agricultural, urban, industrial and recreational demands. Water markets and water reform programs will continue to be major drivers of land use change. The water market is driving the increase in water productivity (money generated per megalitre of water used). Development of the mechanism that enables water entitlements to be transferred has presented the opportunity to better match water and land use to land capability.

Irrigated agriculture is undergoing a time of dramatic change with pressures occurring on many fronts. Of pressing concern is how the SIRCIS responds to water scarcity, plans for connecting Melbourne to the SIR water supply, updating aging irrigation infrastructure, climate change and environmental requirements.

The prolonged drought is resulting in rapid structural adjustment of agricultural industries, especially dairying. Adjustment that would have taken 10 years is likely to take less than two. It is too early to predict how a dairy farm will look in a decade, although it is likely farm entities will get larger as some farmers leave the industry.

Further options for managing salt in the irrigation area will need to be developed. Drainage diversion remains an important part of managing salt exports but, as drainage flows decrease (because of improved water use efficiency and climate change), the salinity concentration will increase, which will reduce the water quality for diverters and other downstream users. This will require more effort in identifying other salt management options within irrigation areas.

2.1.1. Implications for the future of the region

Agricultural industries are becoming more efficient, with production levels doubling every 10 years (GB CMA 2003, page 10) and land used for agriculture decreasing. The choice to use land for rural living rather than agriculture is becoming common.

The SIR community's understanding of the importance of its biodiversity assets has grown significantly. There is an increased community expectation that these assets should be protected and rehabilitated from the effects of clearing, salinity, nutrients, and pest plants and pest animals.

The shift in land use likely to occur over the next 50 years may result in a mosaic that comprises:

- an intensive agricultural zone with a smaller ecological footprint - 'double the production from half the land'
- an increased conservation zone where the land previously used for traditional agriculture is managed for nature conservation
- a change in rural living areas where land, particularly near urban centres, is converted to lifestyle farms and smaller farms where the main household income is from activities other than agriculture and which may offer additional conservation benefits.

2.1.2. The region's goals and the 'triple bottom line'

The SIRCIS must demonstrate how the government (public) and landholder (private) investments in natural resource management will maximise the 'triple bottom line'. That is, how the economic, social and environmental outcomes from investment will be maximised and how potential trade-offs among these outcomes will be identified and considered.

Actions that are promoted by the SIRCIS and its programs often generate environmental, economic and social benefits. In some cases, the actions might generate an economic or social benefit, but an environmental cost. It is important these costs and benefits are made explicit, so that investors and decision-makers can carefully consider the multiple benefits that can arise from investing in particular actions and the trade-offs that might be required.

2.1.3. The importance of long-term programs

In one sense, the challenges facing the SIR remain largely unchanged since the SIRLWSMP was developed. This reinforces the need to develop and implement long-term plans and programs. The SIRCIS is part way through its 30-year implementation. Progress to date represents significant investment by governments and landholders. It is essential that investment in these programs continues in order to capture the benefits of the investment made to date.

2.2. Vision

SIR IC has adopted the following vision for the SIR:

The natural resources of the SIR are being managed sustainably for current and future generations with:

- abundant and well maintained environmental assets delivering a range of ecosystem services
- local and international recognition for its high quality produce
- a progressive and enthusiastic community that is actively engaged in care of its natural resources.

The Irrigation Futures Project (see Section 8.2 for more information) developed aspirations for 2035 which have also been adopted by SIR IC.

2.3. Goals

SIR IC has adopted the following program goals:

Environment Program Goal

To protect and enhance natural assets and their ecosystem processes and functions in a way that provides benefits for native biodiversity, social and economic aspects (GB CMA 2007d, page 14).

Farm Program Goal

To improve land management practices on private land within the SIR to protect and enhance the environment, to improve economic viability, and to help rural communities make informed decisions (GB CMA 2007a, page 9*).*

Sub-surface Drainage Program Goal

To work with community to provide innovative groundwater and salt management services which support sustainable agricultural practices and protect environmental assets across targeted areas of the SIR (GB CMA 2007c, page 3*).*

Surface Water Management Program Goal

By 2020, improve the health of natural resources and improve the productivity in the SIR by providing an appropriate Surface Water Management service in areas where the total economic, social and environmental benefits, exceed the cost (GB CMA 2007b, page 49*).*

Waterways Program Goal

To protect and enhance the natural riverine features in the region, improve water quality, and the social, economic and cultural values they provide" (GB CMA 2007g, page ii).

2.4. Strategy history

2.4.1. Strategy scope

The SIRCIS sets the framework for natural resource management within the SIR. Details of the threats and programs relating to the region's natural resource management are found in the supporting programs, action plans and technical papers. The Program reports are stand alone documents about the threats, such as salinity and pest plants and/or the asset that we want to protect, such as rivers and biodiversity.

The programs attempt to isolate issues to help us to understand and communicate them. The strong linkages between issues in natural resource management make the task of isolating issues very challenging. The programs set out a long-term program of works and describe the options and trade-offs for addressing particular issues.

Although strongly focussed on salinity management, the SIRCIS integrates components of other Goulburn Broken Catchment-wide plans. This ensures that benefits of actions are maximised and the SIRCIS reflects the implementation framework that has evolved. Figure 3 describes the relationships between the national and local strategies and plans.

2.4.2. How did we get here?

Salinity first became a major concern around the Bamawm area in the 1930s. The successive wet years in the early 1970s caused severe salinity problems that affected 50 per cent of the pear trees across the SIR. By the mid 1980s approximately 30 per cent of the SIR was underlain by shallow watertables (less than two metres deep) (SPPAC, 1989).

By the late 1980s it became clear the SIR needed to respond to the salinity threat. In response to the Victorian Government's *"Salt Action - Joint Action"* initiative the community developed the SIRLWSMP 1989.

The SIRLWSMP was salinity focused but has evolved overtime to encompass a broad range of environmental and sustainability issues. The Plan has been regularly reviewed and is now known as the SIRCIS. The SIRCIS integrates a broad range of issues (

Table 3), reflecting changing community expectations and government policy.

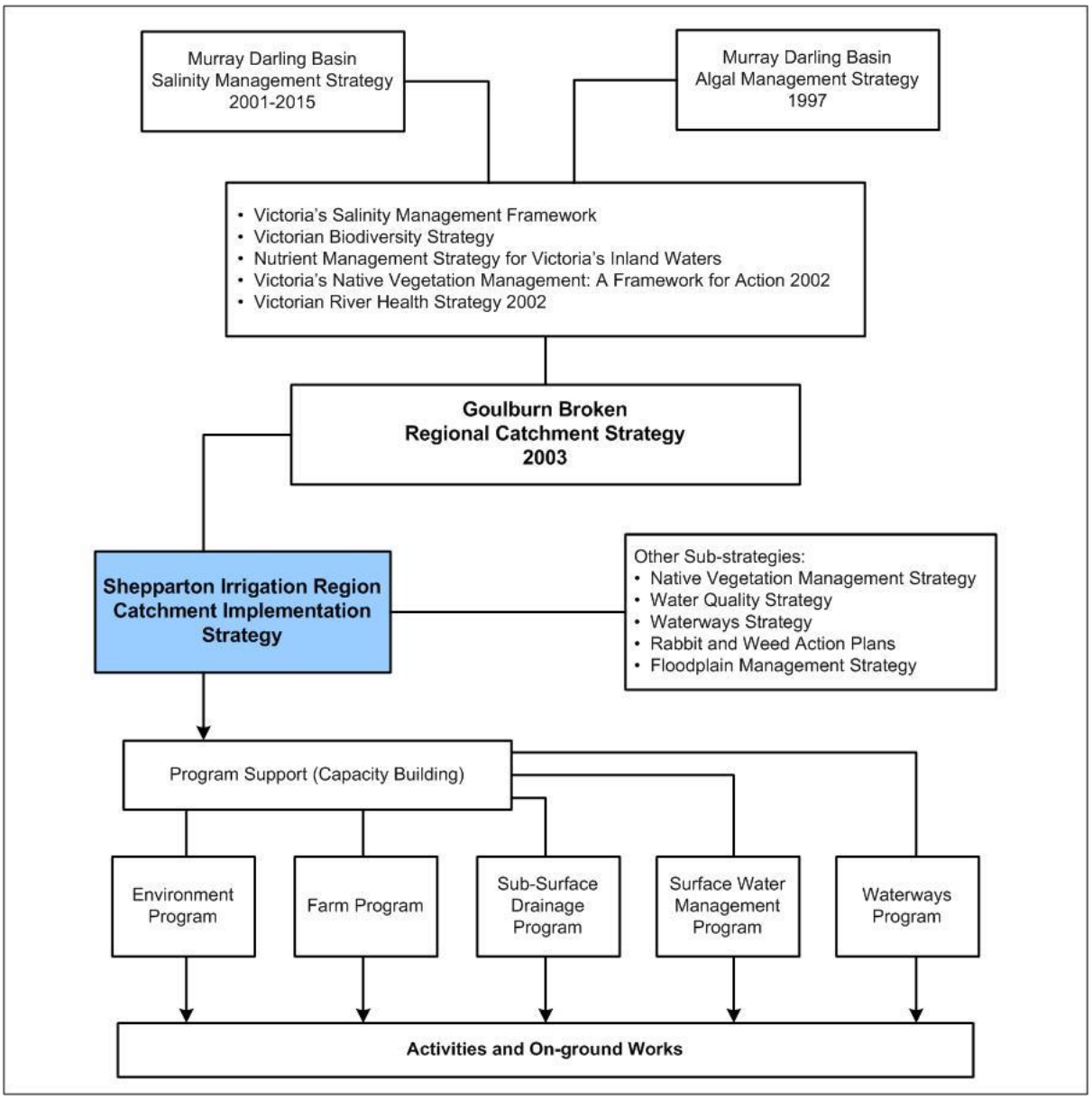


Figure 3 **Strategies and plans relevant to the SIRCIS**

Table 3 Evolution of natural resource management strategies in the SIR

Periods	Strategic documents	Natural resource management features	Institutional features
1987-1990	SIR Land and Water Salinity Management Plan 1990	Description: • salinity focused • 'environment' is acknowledged as important, but what this means or how it will be included is not known.	Overview: • empowering community leaders • decentralised decisions • multi-stakeholder participation • implementation programs established • local government, state agriculture and conservation agencies come closer together.
1996	SIR Land and Water Management Plan 1996	Changes: • SIRLWSMP is re-badged (salinity dropped) to reflect an holistic approach to land and water management • water quality is included as a major issue.	Implementation programs are reviewed
1999	SIR Water Supply Protection Area (WSPA) Management Plan	The focus is on the management of shallow aquifers (depth of less than 25 m from ground surface) for the control of groundwater levels and prevention of salinisation.	Goulburn-Murray Water (G-MW) administers and enforces the management plan.
2001-2002	Implementation program reviews: • Environment 2001 • Farm 2001 • Sub-surface Drainage 2002 • Surface Water Management 2002.	Pest plants and animals are included in the Farm Program.	Changes: • Environment Program becomes totally integrated into other programs • River Health becomes Waterways Program in the Goulburn Broken Regional River Health Strategy (GBRRHS).
2003	SIR Catchment Strategy (SIRCS) 2003	Focus: • floodplain management • climate change • soil health.	Activities: • the focus on natural assets is formalised • first attempt to standardise resource condition and management action targets in line with national approach • self-assessment of “standard practice checklist” approach to catchment management.
	Campaspe Deep Lead WSPA Management Plan	The focus is on the management of the deep aquifer (below a depth of 25 m from the ground surface) in the protection area.	G-MW administers and enforces the management plan.
2004	Irrigation Drainage Memorandum of Understanding (IDMOU)	Continuous improvement through adaptive management processes is a focus.	Focus on: • regular performance reviews • audits • enhanced monitoring programs.
2005-2006	Reviews of implementation programs: • Environment • Farm • Sub-surface Drainage • Surface Water Management.	The SIRCIS is starting to grapple with climate change.	The following changes occur: • Farm and Environment Programs are combined at the strategic level under one Working Group but remain separate at the operational level • SIRCS is renamed SIRCIS • 2005 the River Health - Waterways Program is formally recognised as a SIRCIS Program.
	Katunga WSPA Management Plan	The focus is on the management of the deep aquifer (below a depth of 25 m from the ground surface) in the protection area.	G-MW administers and enforces the management plan.
2007	Review of the Waterways Implementation Plan	The focus is on in-stream and riparian habitat and water quality.	Critical institutional issues: • G-MW Reconfiguration • NVIRP/FoodBowl Modernisation Projects.

The SIRCIS still has a major emphasis on combating the causes of salinity, reflecting the significance of this threat to natural assets and the prosperity derived from them. Living with salt and managing it will be a fact of life for many decades as a strong and prosperous SIR community depends on the security of the irrigation industry, which in turn relies on healthy rivers and land, and a secure water supply.

"Our Water Our Future" - the Next Stage of the Government's Plan (2007) sets out initiatives for water conservation in Victoria. Understanding water entitlements and the introduction of water use licences are two major water reforms introduced to improve the management and use of water supplies.

The SIRCIS projects and programs are underpinned by these reforms. In addition to these programs, annual regional management plans contain even more detail about the work programs.

2.4.3. Why have a strategy?

Rising watertables and increases in salinity have been identified as major threats to farm production and the economy in the SIR. It also affects the environmental assets.

The study conducted by Kelly (1994) found that 50 per cent of the few remaining areas of native vegetation is threatened by high watertables (<3m). Only 3.7 per cent of the Region has native vegetation cover. Shallow seasonal wetlands (>1 ha) within the SIR have been reduced by 48 per cent with the majority of the remainder being highly degraded, (Kelly, 1994a). The SIR is also home to approximately 15 highly threatened fauna species that need protection. Local flora communities identified as being highly threatened by salinity include White Cypress or Murray Pine, Buloke, Yellow Box and Grey Box (Kelly, 1994).

The regional economy and the long term viability of the SIR are thought to be dependent on a successful response to the salinity issue.

2.4.4. Shepparton Irrigation Region Land and Water Salinity Management Plan 1990 Preferred Plan

Several management options were analysed in the founding SIRLSWMP:

- "Do nothing" or "No Plan"
- Farm Program Only (implementing only the Plan activities on farms, without connecting surface water management systems and groundwater pumps)
- Full Watertable Control (an integrated package of Farm, and Regional surface and sub-surface drainage)
- Economic Guidelines (only those activities meeting strict economic criteria)
- Preferred (a balance between protecting the land and water resources within an economic framework).

The Preferred Plan represented a balanced option and was a package that included all of the farming community hence making implementation easier. This option also was most likely to have the support of local governments and other partner agencies. The Preferred Plan provided good coverage of surface water management systems for all but 40,000 ha of the region, and was in areas where the most active and involved farm salinity groups were located.

The SIRLWSMP focused on four major objectives:

- Environmental objective
  The Plan is to address current and future environmental problems resulting from high watertables and salinity in the region. On balance, salinity control activities are to maintain and where possible, enhance existing ecological processes.
- Social objective
  Wherever possible, the Plan is to provide the community with equal access to decision-making and financial resources required to implement salinity control works. The Plan will reduce inequities resulting from uncontrolled salinity impacting differently on individuals.

- Economic objective
  Where works are undertaken to protect the region from high watertables and salinity, the value of benefits, both measurable and non measurable, should exceed the costs.
- Financial objective
  The Plan is to be both equitable and affordable to the individual, the regional community and the nation, now and in the future.

The SIRLSWMP had four programs:

- Farm Program
- Surface Drainage Program
- Sub-surface Drainage Program
- Environmental Program.

The Plan was extensively reviewed in 1995 and 2003. This is the third review of the Plan and will provide direction from 2006-2011.

2.4.5. Changing targets and adaptive management

Over the life of the Strategy things have not stood still. New issues have emerged, science has progressed, communities and external factors (drought, terms of trade, etc), and State and Federal priorities and policies have changed. The Strategy has evolved to deal with such challenges through continuous improvement and policy development and through the regular five yearly reviews. When new information has informed the programs, the targets and programs have been modified.

2.5. The context

2.5.1. Philosophy (eg assets-based approach, capacity building)

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) developed an asset-based approach to catchment management for the Goulburn Broken Catchment (Figure 4). The catchment's social assets, consisting of its people (individually and as communities of interest) and its economic assets (physical and financial) depend upon ecosystem services provided by its natural assets. These assets are detailed in Section 4.

Threats to natural assets are threats to the catchment's social and economic assets. Major threats include salinity, water quality decline arising from nutrients and sedimentation; pest plants and animals; climate change; soil health decline; and the loss of biodiversity.

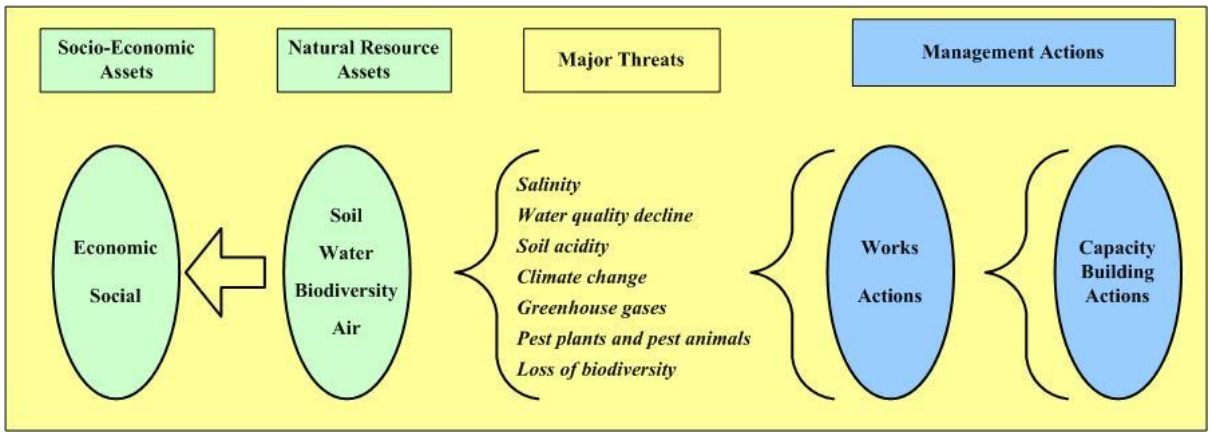


Figure 4 Assets, threats and actions framework

Source: CSIRO 2001, page 5 cited in GB CMA 2003, page 27

Investment decisions centre on determining the appropriate mix of management actions that can provide the best overall outcome for the region. Management actions are either works actions or capacity building actions.

Works actions are direct physical changes or structures such as removal of weeds, tree planting or construction of a fence. Targets can be set for these works actions on a short-term (one to five years) or long-term basis.

Capacity building actions are programs that increase the capacity of the community and its agencies to implement a particular works action. A capacity building action can influence more than one works action. Examples of capacity building actions include planning, extension and/or research and development.

The challenge is to select the most efficient, and economically feasible, mix of management actions that will lead to overall improvement in the quantity and quality of the assets.

2.5.2. Understanding ecosystem services

Natural assets such as soil, water, air and biodiversity are the foundations of the ecosystem. These assets are valued in their own right as important resources we strive to protect so they are available for future generations. We are now beginning to appreciate the inter-connectedness of these assets and how protecting one provides benefits for other natural assets.

The term "ecosystem services" is used to describe the benefits that natural assets provide (Figure 5). For example natural assets provide clean water, recreation and lifestyle opportunities, replenishment of soil following a cropping cycle and maintaining habitat for wildlife (CSIRO, 2001).

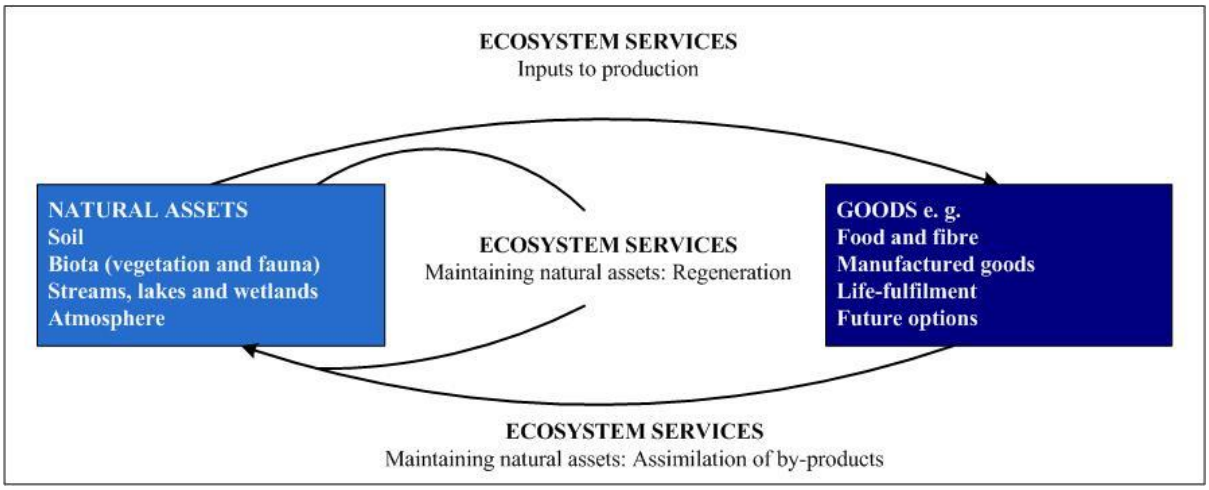


Figure 5 Ecosystem services conceptual framework

Source: CSIRO cited in GB CMA 2003, page 28

2.5.3. Program logic

Program logic is the term used to explain the links between Strategy outcomes, program outputs (management actions), assumptions and annual investment planning (these are also known as Regional Management Plans). The links between these elements are shown in Figure 6 and illustrate the importance of assumptions for measuring outcomes.

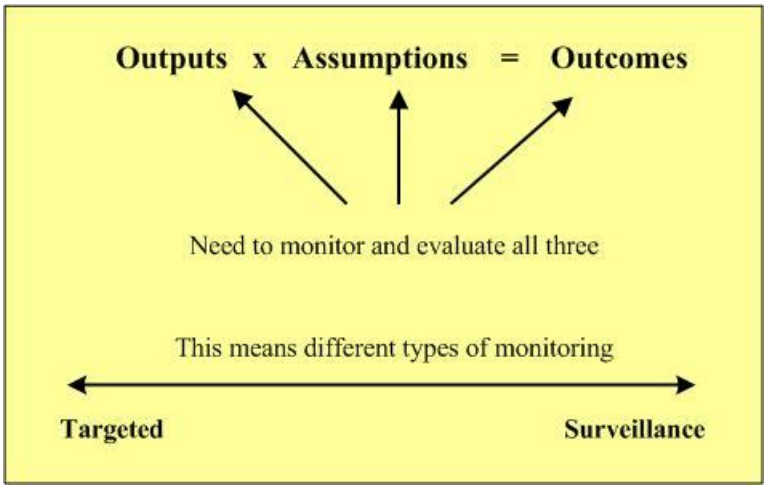


Figure 6 Relationship between outputs, assumptions and outcomes

Source: GB CMA 2003, page 29

In deciding on the appropriate mix of management actions, assumptions are made about the relationship between the management action and the impact of that action in terms of addressing the threat or enhancing the asset. In some cases the assumptions have been well tested and we can move forward with confidence. In other cases we are less sure, but are confident the actions generally produce positive natural resource management benefits. The latter group of actions is the subject of on-going research and development.

The assumptions we make are an important part of the Strategy. We are addressing threats and processes with many years, and sometimes decades, between the cause and effect. For example, the causes of the salinity problems began 150 years ago as we cleared the landscape, but the impact was not readily apparent until the 1970s. The management actions can take just as long before they have a significant impact on the threat.

This presents challenges for reporting to the community and government on progress towards achieving outcomes.

A second area of complexity in measuring outcomes is attaching a "value" to the natural asset. As discussed in the previous section the region's work with CSIRO on Ecosystem Services will assist with valuing natural resource assets. Where the asset generates goods such as agricultural produce, the direct economic benefit can be readily measured in dollars. Many ecosystem services result in benefits that are measured in different "currencies", such as improved recreation and habitat values. The different currencies create a challenge when comparing values and communicating the "triple bottom line" of environmental, social and economic outcomes of a project.

2.5.4. The monitoring, evaluation and reporting framework

The uncertainty around investment decisions requires the region to have a strong monitoring, evaluation and reporting framework. The GB CMA has developed a Monitoring, Evaluation and Reporting Framework (MER). SIR IC follows this framework and the information generated from it enables the review of progress and adaptation of programs in the light of better information. Figure 7 shows the generalised process for conducting MER in the GB CMA.

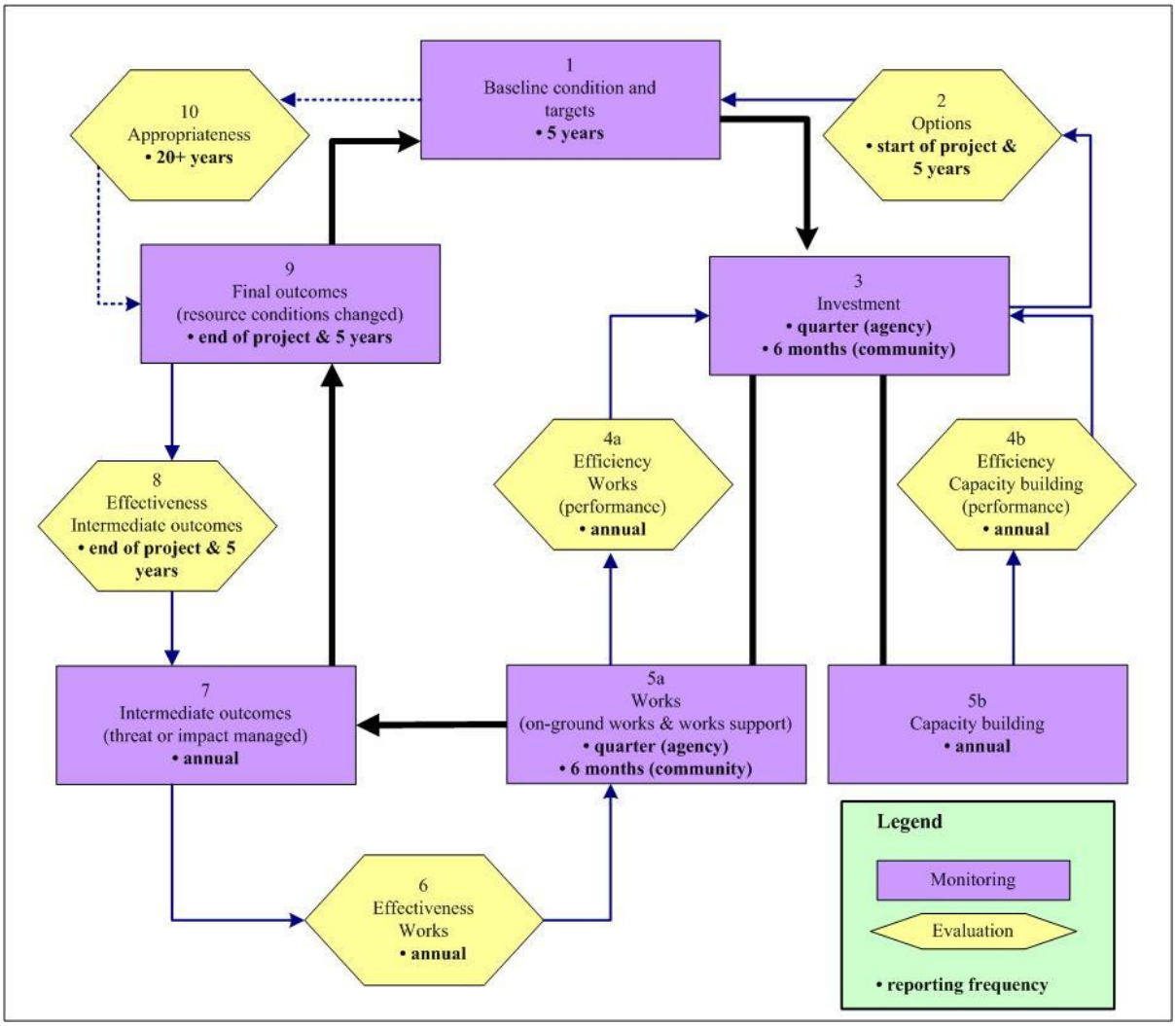


Figure 7 **Monitoring, evaluation and reporting cycle**

Source: Garrett B and McLennan JR 2004, page 6

2.5.4.1. Monitoring

Monitoring programs have been in operation for many years to detect threats and trends, determine priorities and assess progress towards achieving catchment strategy targets for salinity, nutrient and other environmental issues. The information collected is used to determine the priority of SIRCIS works, indicate the threat to the region's natural resources, provide information on the effectiveness of SIRCIS works and refine management plans.

Groundwater levels are monitored at nearly 1800 locations across the region, with the monitoring frequency varying from monthly to annually. It is now over 20 years since the first watertable maps were produced and widely distributed.

Monitoring of surface drainage water commenced in the late 1980's under the SIRLWSMP and expanded over the following decades. Of the area of the SIR served by primary SWMS, 93 per cent are continuously monitored for flow; 90 per cent are continuously monitored for salinity; and 87 per cent are monitored for nutrients, pH, turbidity and suspended solids (fortnightly).

The monitoring of flow and salt levels in SWMS and streams across the region covers a total of 32 sites. This enables determination of salt loads exported to the River Murray, to meet requirements under the Murray Darling Basin and Victorian salinity strategies/plans, and allows assessment of salinity strategy implementation progress. A recent review of 10 years of data concluded that the current monitoring program was meeting all requirements.

Monitoring of nutrient levels in surface drainage water commenced in 1990 at four sites and has since expanded to 14 sites. Results are used to assess progress against the nutrient load reduction target set in the water quality strategy, which primarily aims to reduce the risk of eutrophication and blue-green algal blooms.

The Waterwatch community monitoring program for drainage water was re-named Drainwatch. Dry conditions since 2002 resulted in low drain flows that restricted sampling opportunities.

Monitoring is also being undertaken to determine the long term impacts of high watertables and salinity on natural features. Groundwater depths and salinity levels, vegetation transects and photographs were recorded for three wetland and four terrestrial sites. The water quality parameters were also measured in wetlands with water.

2.5.4.2. Evaluation

The Programs under SIRCIS are evaluated every five years to assess their economic, environmental and social efficiency, effectiveness and appropriateness. The evaluation can be qualitative, quantitative or both. Economic evaluation of projects [ex-ante (before) and ex-poste (after)] are also undertaken to determine their economic feasibility.

2.5.4.3. Reporting

The results of the monitoring and evaluation activities are reported to the stakeholders in the form of written reports and presentations to appropriate forum. SIR IC produces annual reports covering SIRCIS activities, achievements, budget and final expenditure.

2.5.5. Precautionary principle

The philosophy has been that lack of knowledge should not dictate inaction. SIR IC acts where it has “good enough” information and the MER strategy is implemented to ensure programs are updated as monitoring occurs and new understanding is reached.

2.5.6. Policy, planning and legislative framework

The GB CMA was established in 1997 under the State's Catchment and Land Protection Act 1994 to manage land and water resources in the Goulburn Broken Catchment.

The GB CMA is a statutory Authority under the Water Act 1989 and the Catchment and Land Protection Act 1994, and operates according to specified protocols. The GB CMA has regular reporting requirements including an Annual Report which is audited by the Auditor General and tabled in Parliament. The SIR IC is a committee of the GB CMA and reports to the GB CMA Board.

The SIRCIS is governed by, and responds to, a variety of legislation and policy initiatives. The most important are detailed below. A detailed list of Commonwealth and State legislation and policy documents that influence natural resource management in the SIR is provided in Appendix 9.

The Water Act 1989 is the most significant state legislation for the SIR. This Act:

- provides for the integrated management of all elements of the water cycle
- ensures water resources are conserved and properly managed for sustainable use and for the benefit of present and future Victorians
- maximises community involvement in the making and implementation of arrangements relating to the use, conservation or management of water resources
- provides formal means for protecting and enhancing environmental qualities of waterways and their in-stream uses
- provides for the protection of catchment conditions.

The Commonwealth's Environmental Protection and Biodiversity Conservation Act 1999 is also significant for the SIRCIS. Actions occurring after July 2000 that is likely to have significant impact on matters of national environmental significance are subject to a rigorous assessment and approval process. An action includes a project development, undertaking of an activity or series of activities. Matters of national environmental significance identified in the Act are:

1. World Heritage properties
2. Ramsar listed wetlands
3. nationally threatened species and ecological communities
4. migratory species
5. Commonwealth marine areas
6. nuclear actions.

The second, third and fourth matters of national environmental significance may impact on the SIR.

Victoria's reform agenda is detailed in the 2004 White Paper 'Our Water Our Future'. Naturally, this agenda is having and will continue to have a large impact on the SIR. The introduction of Water Use Objectives and Water Use Licences is probably the key reform in terms of the SIRCIS. More information can be found in Section 8.1.1.

2.5.7. Implementation and engagement structure

The SIRCIS is delivered primarily through a Catchment Partnership as detailed in the SIR IC Communication Strategy January-June 2007. Its success depends on the actions and cooperation of a number of partners. In particular this includes:

- landholders
- Goulburn-Murray Water (G-MW)
- Department of Sustainability and Environment (DSE)
- Department of Primary Industries (DPI)
- Environment Protection Agency (EPA)
- Goulburn Valley Water (GVW)
- local Government
- landcare groups
- Local Area Plan groups
- Water Services Committees.

SIR IC reports to the GB CMA Board and has an extensive community engagement network. Each of the SIRCIS programs has a Working Group which provides advice to SIR IC on policy and funding decisions. These Working Groups contain representation from local landowners, irrigators, environmentalists as well as agency staff. The Working Groups provide a valuable link between SIR IC and people who relate directly to the environmental, social and economic needs of the community. An over-arching technical working group known as the Shepparton Irrigation Region Technical Committee (SIRTEC) with key partner organisation representatives provides comment to SIR IC on the broad impact of natural resource management issues and Regional Catchment Strategy implementation issues. Figure 8 outlines the relationships between the committees and partners.

Additional to representation on committees and working groups, agency staff work with landowners and local media to promote the SIRCIS programs. This is done through incentive schemes, field days and media promotion. The role of each SIRCIS partner is described in Appendix 8.

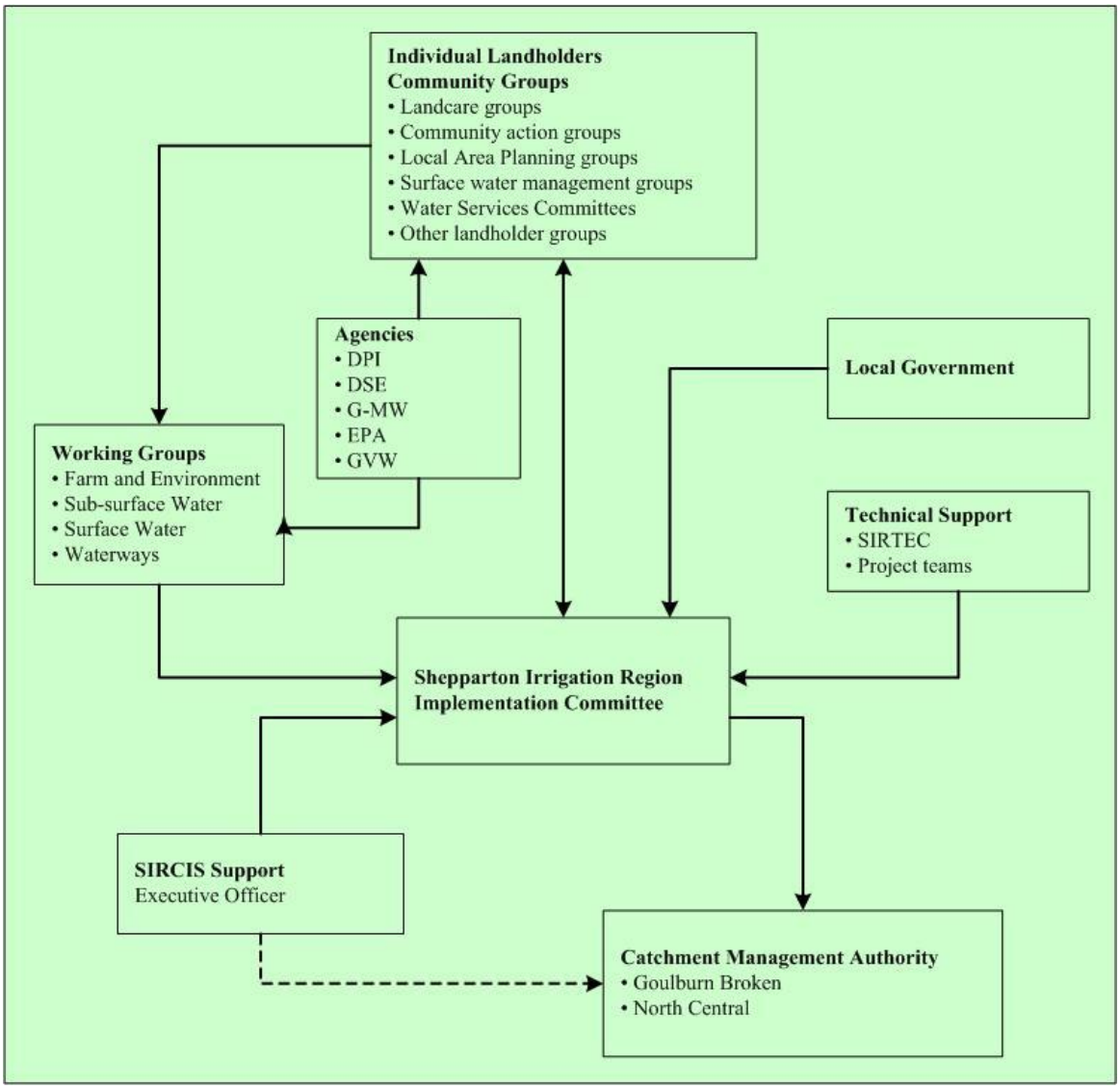


Figure 8 **Community engagement, SIRCIS**

2.5.8. Communication strategy

SIR IC has a Communication Strategy, which is updated every six months. The purpose of the Communication Strategy is to:

> *provide SIR IC with the means of demonstrating to stakeholders and partners that it is connecting appropriately with all stakeholders. These include the major political, economic, market, competitive and social influences which can impact on the successful implementation of the Regional Catchment Strategy" (GB CMA 2007e, page ii).*

The Communication Strategy details key messages, audiences and partners as well as key external factors which affect the SIRCIS such as the "Our Water Our Future" White Paper implications. It also details information about the partner organisation relationships.

2.6. The review of the SIRCIS Programs

The Environment, Farm, Sub-surface Drainage and Surface Water Management Programs have undergone a rigorous five-year review in 2005 and 2006. The SIR Waterways Implementation Plan (under the GBRRHS) was reviewed in 2007. These reviews form the overall SIRCIS Review.

The Programs were reviewed according to a process developed by the Review Coordinating Committee. This ensured the Programs followed a similar process. This included:

- focussing on three key areas for evaluation: effectiveness, efficiency and appropriateness, and key evaluation questions
- conducting a facilitated workshop to explore key historical influences on the Programs
- collaborating with the Goulburn Broken Irrigation Futures (GBIF) team to identify key challenges and opportunities (please see Section 8.2 for more information on the GBIF)
- developing a five-year implementation plan containing targets for the next five years and to the end of the SIRCIS in 2020[2].

The following key evaluation questions were common to all reviews.

Effectiveness:

- How is the Program having an impact?
- Are the Program objectives still relevant?
- Are we meeting the strategic and operational Program objectives and targets?
- How do we demonstrate to our clients and investors we are meeting our objectives and targets (quantitative and qualitative measurement)?
- Have we identified why we have been successful and, where we haven't, why not?
- What is the future outlook of the Program? What are the opportunities and constraints? What are the improvements needed in the Program to meet future issues?

Efficiency:

- How can the Program improve its core processes?
- How is the Program delivered? Is it working? Can we improve it and how?

Appropriateness:

- How do we demonstrate alignment between the Program and government policy?
- Is the Program fulfilling client requirements?
- How does the Program demonstrate its responsiveness?
- Has government policy improved Program objectives?

Details can be found in Sections 10 and 11 and in the Program reviews in the Appendices.

The SIRCIS is the Strategy that links the Programs together, sets the underlying principles, provides a mechanism for deciding which action to take, and responds to the GB RCS and other government strategies.

[2] The Sub-surface Drainage Program has targets up to 2030.

3. Socio-Economic Profile of the Shepparton Irrigation Region

This section details the Socio-Economic Profile of the SIR. It demonstrates the importance of maintaining and, where possible, improving the natural resource base, in order to ensure the future of the people and the existing investment in the SIR.

The SIR statistics presented in this section include small areas outside of the region. The statistics from Australian Bureau of Statistics (ABS) covered the Statistical Local Areas of Greater Shepparton, Campaspe and Moira and the DSE statistics covered the local government areas of City of Greater Shepparton, Campaspe and Moira.

Despite the drought being experienced since 2002, the SIR is one of the few non-coastal areas in Australia that is growing. The Region supports a range of economic assets that rely on the natural resource base. These include farm production, irrigation and drainage infrastructure, food processing, transport, retail, services, education, tourism and recreation assets. The human and intellectual capital - the skills, knowledge and experience of the regional community - drives the efficient production of output from these assets and leads to the development of new capacity and the creation of new economic assets.

3.1. Regional economy

One of the compelling reasons for developing the SIRCIS is to protect the economic base of the region.

Since 1986 the agriculture and food processing (dairy and horticulture) sectors have maintained their importance in the regional economy. About 40 per cent of the total output, almost a third of the income and about 30 per cent of employment came from these sectors.

In 1986, the region's total output (gross value of production) reached $4,766 million and increased to $8,709 million in 2001.

Table 4 shows the contribution of the three sectors to output. Income increased by three and four percentage points, respectively from 1986 to 2001. Their contributions to regional employment, however, decreased from 32 per cent in 1986 to 27 per cent in 2001. Although the number employed in these sectors increased (from 12,700 to 21,500), employment in other sectors of the regional economy grew faster in 2001.

Table 4 Contribution of agriculture and food processing (dairy and horticulture) to the regional economy, SIR, 1986 and 2001 (in per cent)

	1986			2001		
Sectors	**Outputs**	**Income**	**Employment**	**Output**	**Income**	**Employment**
Agriculture	17.5	17.5	24.8	15.7	23.7	14.2
Dairy processing	13.8	5.4	3.3	18.4	6.5	8.5
Horticulture processing	8.1	6.6	3.8	8.4	2.9	4.1
Total	39.4	29.5	31.9	42.5	33.1	26.7

Note:

- The 1986 output and income were adjusted using the Consumer Price Index (CPI) for Melbourne published by the ABS (www.abs.gov.au accessed in August 2009).

Source: SPPAC 1989 p21 and spreadsheet used in Abel 2003, page 101

3.2. Agriculture

The SIR is intensively irrigated with approximately 317,000 of its 500,000 ha irrigated annually (G-MW, 1998). The region uses around 1.5 million megalitres (ML) of water for irrigation per year, depending on seasonal allocations. These figures will need to be revised once the current drought ends. The major agricultural industries are dairying and perennial horticulture, which support a large food processing industry. Orchards abound mostly in areas around the towns of Shepparton, Cobram, Kyabram and small pockets in Tatura, Ardmona and Invergordon whilst dairy and mixed farms are scattered in the region (Figure 9).

Gravity supplied surface water is the dominant source of irrigation water supply in the SIR and groundwater is also a major resource that is utilised. Shallow groundwater is extracted from the Upper Shepparton Formation, with deeper groundwater being pumped from the Calivil Formation and Renmark Group groundwater systems (known as the deep lead).

Almost 90 per cent of the land in the SIR is privately owned (Figure 10).

Regional horticulture and dairy production (ABS 2008b) accounts for:

- 48 per cent of national stone fruit production
- 57 per cent of Victoria's apple production
- 95 per cent of the national pear production for processing and 86 per cent of the fresh market
- 37 per cent of the national tomato production
- 59 per cent of the national kiwi fruit production
- 48 per cent of the national olive production
- 26 per cent of Victoria's gross value of milk production and 17 per cent of Australia's gross value of milk production.

Cereal crops and pasture account for almost 87 per cent of the total agricultural area in the region (Figure 11).

The SIR is referred to as the "Food Bowl" of Victoria.

In 2005-2006 the region had an estimated gross value of agricultural production of $1.38 billion. It represents almost 16 per cent of Victoria's total gross value of agricultural production from 9 per cent of the State's agricultural land.

Table 5 and Figure 12 show the gross value of agricultural production by different categories and their per cent contribution.

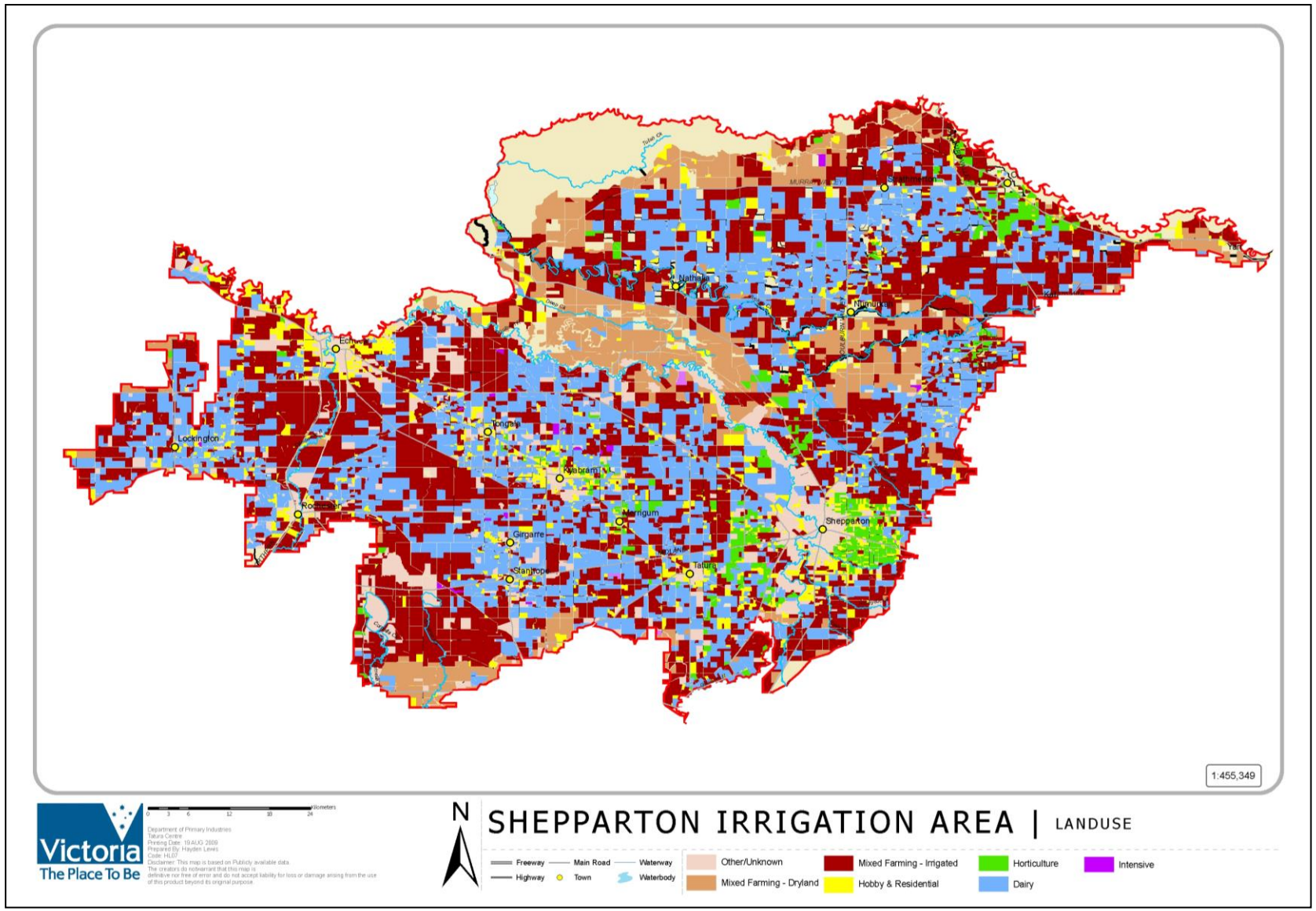


Figure 9 **Land use, SIR, 2005-2006**

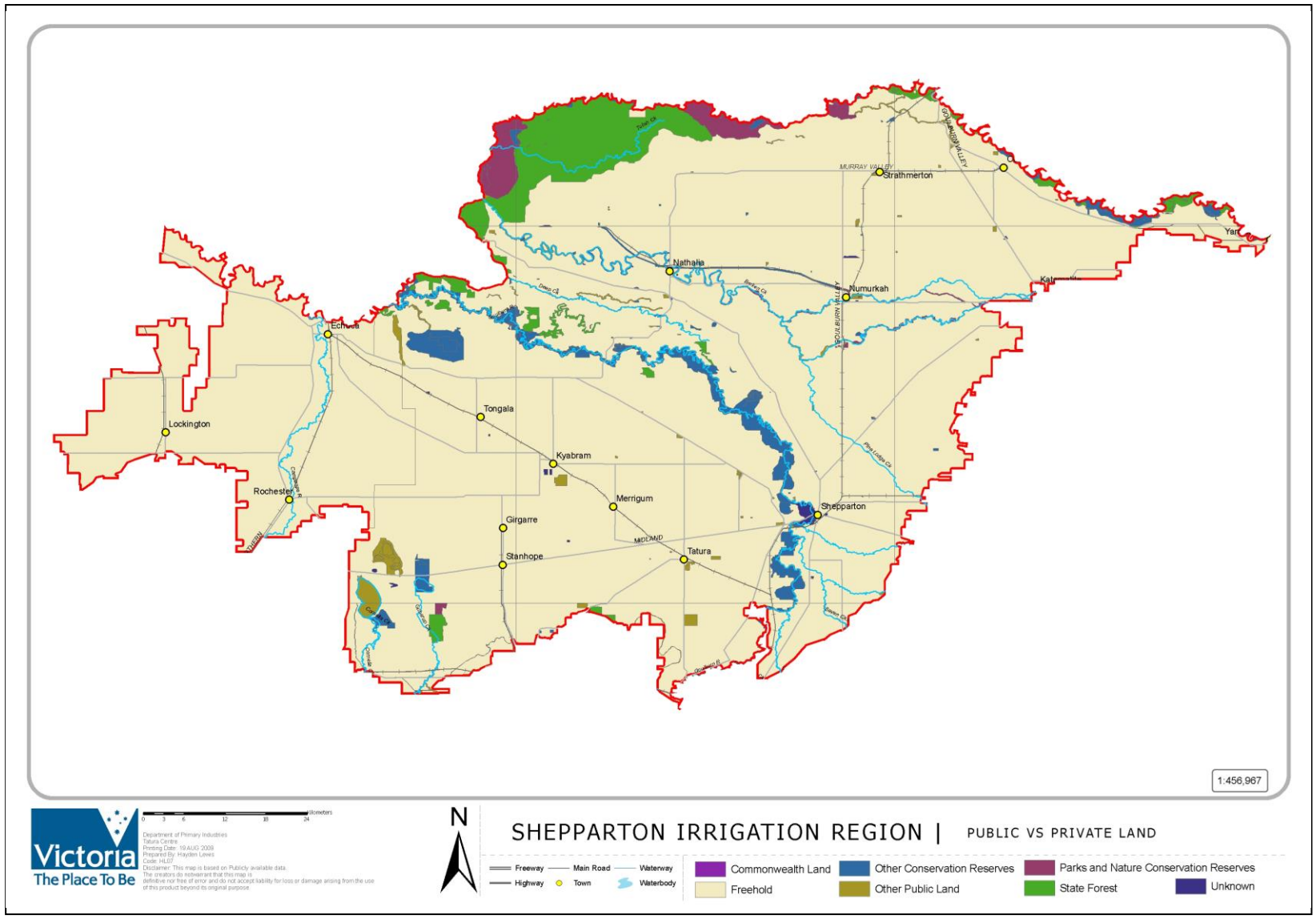


Figure 10 **Location of public and private land, SIR, 2005-2006**

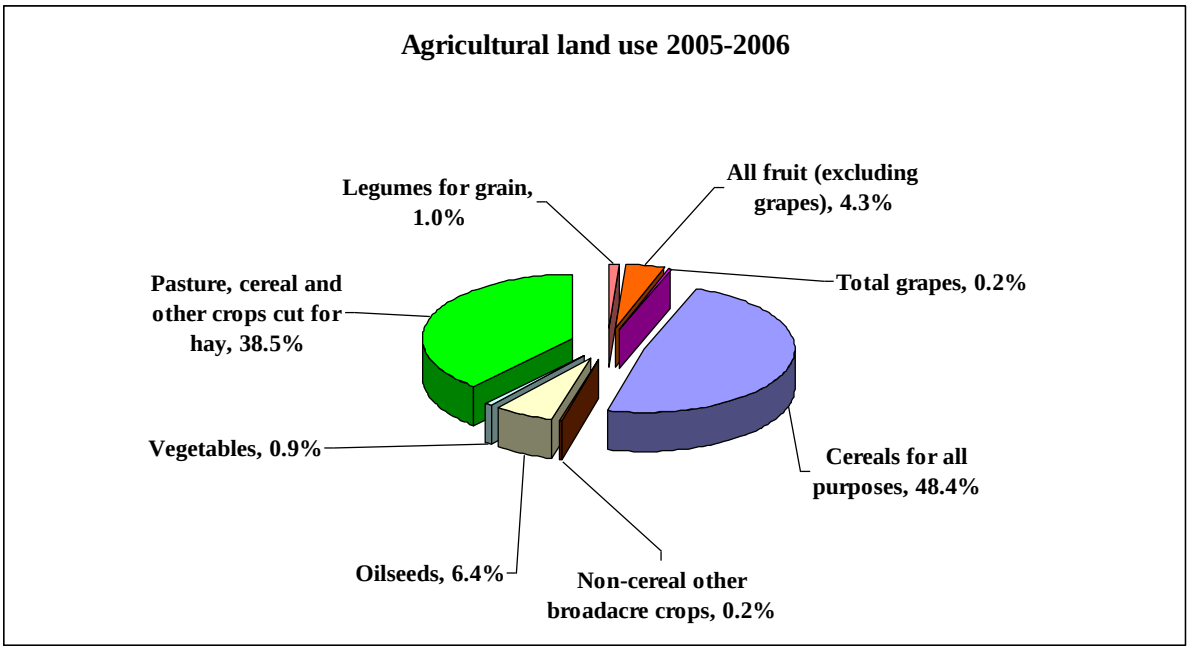


Figure 11 **Agricultural land use, SIR, 2005-2006**

Table 5 **Gross value of agricultural production, SIR, 2005-2006**

Categories	Gross value ($M)
Milk	$552.7
Fruit	$299.1
Vegetables	$63.5
Cereals, pasture, legumes, oilseeds and other crops	$203.3
Other crops	$23.5
Livestock slaughterings	$217.2
Wool and eggs	$16.5
Total - Shepparton Irrigation Region	**$1,375.8**

Source: ABS 2008b

Dairying accounted for 40 per cent of the total gross value of agricultural production. Horticulture contributes 26 per cent from 5.4 per cent of agricultural land and uses 5 per cent of irrigation water.

Table 6 shows the changes that have occurred over recent years in land use in the SIR. These changes are the result of a variety of pressures such as drought, water trading and terms of trade. The most dramatic change in enterprise has been the reduction in grazing, followed by the reduction in horticulture.

A new category, that of lifestyle farming, (farms which are generally not financially viable in their own right with the owner having a supplementary off-farm income), now exists. While this category currently represents only 5 per cent of rural land use, it is expected to grow over the coming years and will have some impact on resource management in the region.

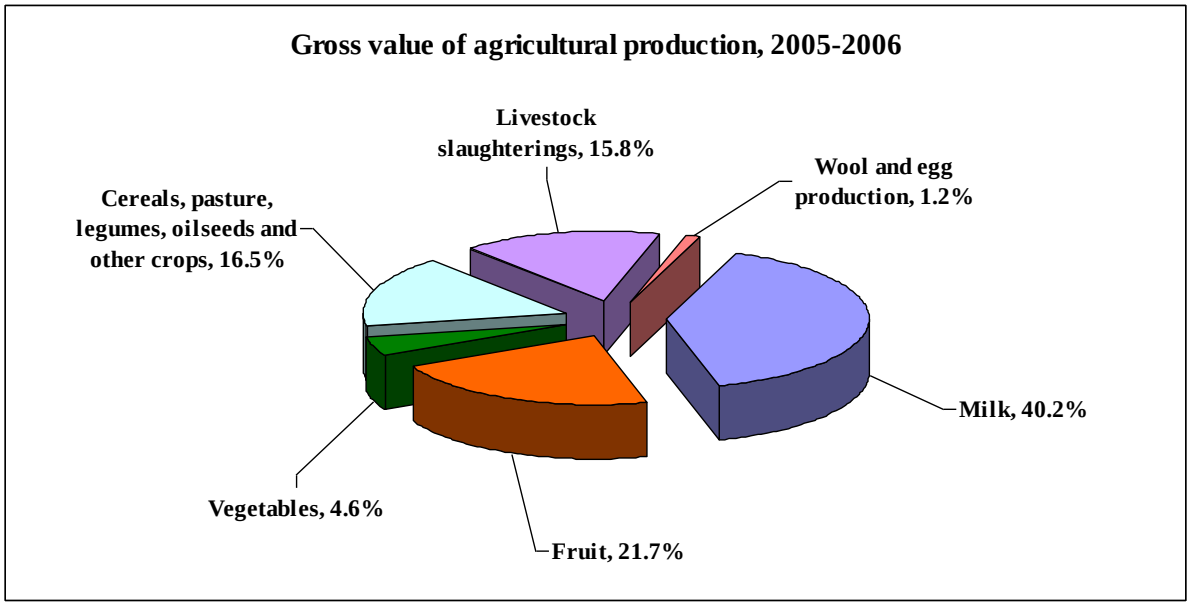


Figure 12 **Per cent share of the gross value of agricultural production, SIR, 2005-2006**

Table 6 **Change in enterprise area, SIR, 1996-1997 and 2003-2004**

Enterprises	Area (ha)		Change
	1996-1997	2003-2004	
Dairy production	198,817	189,866	5% reduction
Grazing	100,741	60,793	40% reduction
Horticulture	20,127	15,464	23% reduction
Mixed farming	89,547	121,448	36% increase
Lifestyle	not available	22,255	not available
Total area	**409,232**	**409,826**	-

Note:

- Data extracted from G-MW 2006c.

Source: A McAllister, pers comm, 2009

Regarding water use in the SIR, the vast bulk is used by the dairy industry (Table 7). The average irrigated dairy farm in Australia uses 386ML of irrigation water each year (Dairy Australia, 2006).

Table 7 **Water use, SIR, 2004-2005**

Enterprises	1998-1999		2001-2002		2004-2005	
	ML	%	ML	%	ML	%
Dairy production	725,372	63	786,384	46	668,311	64
Grazing	108,858	9	121,146	7	92,449	9
Horticulture	56,228	5	57,594	3	51,739	5
Mixed farming	198,424	17	210,563	12	177,954	17
Intensive	2,162	<1	2,366	0	1,646	<1
Lifestyle	66,368	6	66,132	4	50,300	5
Other	2,943	<1	449,267	27	2,429	<1
Total	**1,160,355**	**100**	**1,693,452**	**100**	**1,044,828**	**100**

Source: A McAllister, pers comm, 2009

With the advent of water trading, temporary water trading has increased to around 15 per cent of entitlement per year, with permanent trading occurring at around 2 per cent (T Hunter, pers comm, 2010).

Declining terms of trade

For decades now, Australian agriculture has been under pressure due to declining terms of trade. This means while the price received for a product has been declining in real terms the costs of production have at best remained steady or, more often, increased.

Large farms are in general more profitable than small farms. This is demonstrated by research showing the largest 10 per cent of farms (large in terms of gross income) produce more than 50 per cent of the Australian value of agricultural production. Conversely, the smallest 50 per cent only produce 10 per cent (Barr, 2005).

> *"The Australian Bureau of Agriculture and Resource Economics concluded that generally only farms in the top third of the farm size distribution (as measured by gross value of production) achieved productivity increases greater than the compression of the terms of trade"* (Barr 2005, page 5).

In order to counteract terms of trade pressures and remain viable, Australian producers in general seek efficiency gains and produce more from less, while farms become larger and the number of farmers decreases.

It is expected that productivity improvements will continue in both farming and processing sectors. In farming this will come from new technologies that increase yields or reduce inputs, including water. Consequently, further farm amalgamation might continue.

Dairy

An example of the decline in the terms of trade is shown in the dairy industry. In 1960 dairy farmers received $0.55/L, this was down to $0.30/L by 2005 (in nominal terms). In response, the industry now produces around 5,000 litres of milk per cow per year compared with less than 2,000 litres in 1960 (DPI 2007, page 24). Over the same period, farm numbers decreased while herd sizes increased, generating economies of scale.

Perennial horticulture

Research and development in the horticulture sector is helping fruit growers to improve farm productivity and profitability. High density trellising systems are becoming a norm in the SIR. Free standing systems have about 300 trees per hectare and systems on trellises can have up to 1,000 trees per hectare. With improved canopy management, trees can start bearing marketable yield from the third year of planting. The trellis system can also improve labour productivity as it minimises ladder use during harvest.

Advances in irrigation management such as partial rootzone drying and regulated deficit irrigation improve productivity and product quality while increasing water use efficiency by around 50 per cent (DNRE October 2002, page 6). Changing the irrigation system from flood irrigation to micro-irrigation systems (drip and trickle irrigation systems) can reduce run-off and ensure water is applied to the root system.

3.3. Manufacturing

The SIR has a strong manufacturing sector. The major industry is food processing, primarily milk and fruit. Companies include:

- Kraft Foods
- Fonterra Cooperative Group
- Snow Brand Australia
- Cedenco
- Simplot Australia
- Nestlé Australia
- Unifoods
- Tatura Milk Industries
- Murray-Goulburn Cooperative
- Coca-Cola Amatil (SPC Ardmona)
- Campbells Soups Australia
- Girgarre Country Foods
- Unilever

There is increasing pressure on the dairy processing sector and consequently to dairy farming due to the re-introduction of the European Union dairy subsidy and the strengthening of the Australian dollar against major currencies.

3.4. Employment

Agriculture and food and beverage manufacturing play a large role in providing employment within the SIR.

Approximately 6,900 people are directly involved in agricultural production and 4,400 are involved directly in food manufacturing processing (Table 8 and Figure 13). They represent 23.3 per cent of total employment in the region. One of the industries providing services to agriculture and the food manufacturing sectors is the transport sector and accounts for 3.8 per cent of employment in the region.

Table 8 Employment, SIR, 2005-2006

Industry	Persons employed
Agriculture, forestry and fishing	6,879
Agriculture, forestry and fishing support services	232
Total: agriculture, forestry and fishing	**7,111**
Food product manufacturing	4,419
Other manufacturing	2,809
Total manufacturing	**7,228**
Accommodation and food services	2,465
Administrative and support services	1,030
Arts and recreation services	346
Construction	2,902
Education and training	3,574
Electricity, gas, water and waste services	791
Financial and insurance services	1,070
Health care and social assistance	5,846
Information media and telecommunications	509
Mining	40
Professional, scientific and technical services	1,651
Public administration and safety	1,823
Rental, hiring and real estate services	547
Transport, postal and warehousing	1,874
Wholesale and retail trade	8,539
Other services	1,811
Inadequately described	297
Industry of employment not stated	44
Total employment Shepparton Irrigation Region	**49,498**

Note:

- Working Population Profiles for the Greater Shepparton City Part A and North Goulburn Statistical Sub-divisions.

Source: ABS 2007a, Table W09

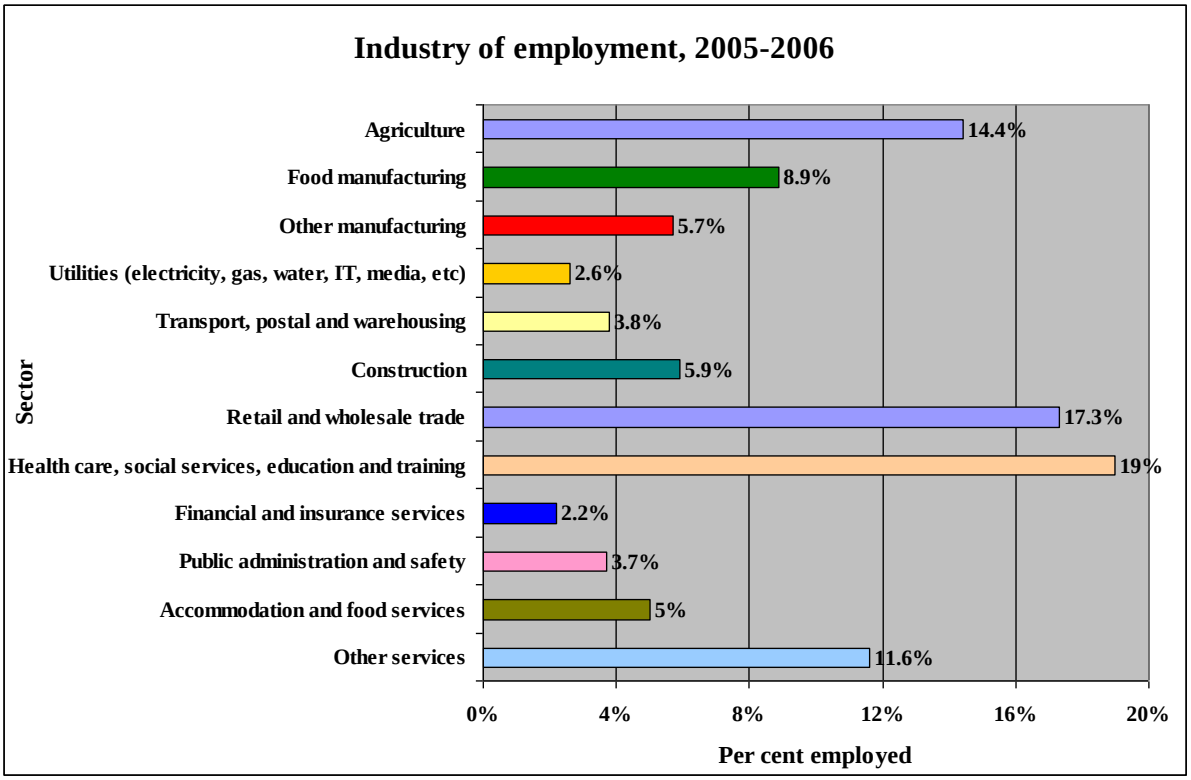


Figure 13 Industry of employment, SIR, 2005-2006

Note:

- Working Population Profiles for the Greater Shepparton City Part A and North Goulburn Statistical Sub-divisions.

Source: ABS 2007a, Table W09

As a regional centre, Shepparton has employment from a wide range of sectors, for example universities, a major teaching hospital and retailing.

Tourism is increasingly important, as the River Murray remains a strong tourist attraction. Main tourism activities include wineries, camping, water-skiing, four-wheel driving and fishing.

3.5. Social

The major rural towns and cities in the SIR include Shepparton, Mooroopna, Kyabram, Cobram, Echuca, Rochester, Yarrawonga, Numurkah, and Nathalia. The region is split into three local government municipalities, the City of Greater Shepparton, the Shire of Campaspe and the Shire of Moira.

The SIR's population is growing, and the cultural and demographic mix is changing. The population grew by 9.5 per cent in 10 years, from 109,935 in 1996 (ABS 2000) to 120,383 in 2006 (ABS 2009) with a more diverse cultural mix.

By 2026, the population is expected to be 147,200. Rapid population growth is occurring in some parts. The population of the City of Greater Shepparton is predicted to grow at an average of 1 per cent per year from 2006 until 2026, while the Goulburn Statistical Division will grow by 1.3 per cent per year and the State by 1.5 per cent per year over the same period (

Table 9).

The population swells considerably during the fruit harvest season from December to March, when approximately 10,000 itinerant workers from throughout Australia and overseas converge on the SIR.

Table 9 Population census and projection, SIR, 2006 to 2026

Municipalities	2006	2011	2016	2021	2026	Annual change (%)
City of Greater Shepparton	59,280	63,208	66,368	69,139	71,606	1.0
Campaspe Shire	37,486	39,051	40,305	41,490	42,648	0.7
Moira Shire	27,983	29,516	30,728	31,859	32,964	0.9
Total Shepparton Irrigation Region	**124,749** (Note a)	**131,775**	**137,401**	**142,488**	**147,218**	**0.9**
Goulburn Statistical Division	202,098	215,765	228,581	241,861	255,595	1.3
Regional Victoria (million)	1.38	1.47	1.55	1.63	1.71	1.2
Total Victoria (million)	5.13	5.55	5.94	6.33	6.71	1.5

Note:

(a) This is the 2006 DSE projection. The 2006 Census of Population conducted by the ABS shows the total population is 120,384.

Source: DSE 2008a

The social assets of the SIR are the abilities, knowledge and skills of each individual resident as well as the capacity of communities that make up the region. Community and physical assets include:

- a diverse multicultural community. The region is a popular destination for migrants and this has resulted in a diversity of cultures. The region is now home to people of Italian, Greek, Turkish, middle-eastern and Indian descent. Increasingly, people from Africa are making Shepparton their home
- the strong regional centre of Shepparton
- a close network of social organisations such as sporting clubs, community arts groups, environmental groups, welfare groups and family support groups
- strong community representation through a wide range of organisations such as councils, businesses, government agencies and social clubs
- a good cross-section of educational facilities including primary and secondary schools, colleges and universities. La Trobe University has a strong presence through its campus at Shepparton
- good public transport services
- accessible resource centres such as libraries and internet access centres
- active community group networks such as Landcare Groups, Local Area Plan Groups, Field Naturalist Groups and Field and Game Branches
- relatively reliable hospitals, emergency services and religious organisations
- good recreational fishing and tourism opportunities.

The SIR is a culturally diverse regional area. Based on the 2006 Census of Population, 85 per cent of the usual residents of the region were born in Australia (

Table 10). About 90 per cent of the usual residents in the region stated both their parents were born in Australia. The Region followed the trend across Australia with 95 per cent of the usual residents speaking only English at home.

The City of Greater Shepparton in particular has 3 per cent of the population identifying themselves as Indigenous while in Victoria the figure is less than 1 per cent.

Table 10 Population and cultural features, SIR 2006

Locations	% identifying as indigenous Note (a)	% born in Australia Note (b)	% with both parents born in Australia Note (c)	% speaking only English at home Note (d)
City of Greater Shepparton	3.3	82.9	89.4	95.2
Campaspe Shire	1.9	88.9	91.4	96.5
Moira Shire	1.2	85.8	90.6	96.0
Shepparton Irrigation Region	**2.4**	**85.4**	**90.3**	**95.7**
Goulburn Statistical Division	1.9	84.7	88.9	95.5
Melbourne	0.4	64.2	77.8	94.4
Victoria	0.6	69.6	81.5	94.8
Australia	2.4	70.9	79.5	94.3

Notes:

(a) Excludes "Not Stated" responses; Source: ABS CDATA.
(b) ABS 2006 Census of Population QuickStats (www.abs.gov.au).
(c) Excludes "Not Stated" responses; Source: ABS Ancestry by country of birth of parents (Cat. No. 2068.0 - 2006 Census Tables).
(d) Excludes "Not Stated" responses; Source: ABS Language spoken at home by sex for time series (Cat. No. 2068.0 - 2006 Census Tables).

From 1996 to 2006, the number of residents born overseas increased by 8 per cent, from 8,300 to almost 9,000 (Table 11). The details of the country of birth are in Appendix 2. Migration from Africa and the Middle East increased considerably in 2006.

Table 11 Population by birthplace (continent), SIR, 1996, 2001 and 2006

Continents/regions	1996	2001	2006	% change 1996 to 2006
Oceania (excl Australia)	764	1,058	1,236	62
Eastern Europe	77	65	53	-31
North West Europe	3,624	3,480	3,403	-6
South Eastern Europe	622	557	512	-18
Southern Europe	2,087	1,882	1,653	-21
Middle East	332	748	833	151
North America	135	130	178	32
North-East Asia	135	115	138	2
South-East Asia	300	382	466	55
Southern Asia	177	249	348	97
North Africa	29	27	24	-17
Southern and East Africa	27	73	133	393
Sub-total overseas born	**8,309**	**8,766**	**8,977**	**8**
Australia	97,431	99,248	100,620	3
Born elsewhere	641	948	1,444	-
Not stated	3,380	6,077	6,833	-
Overseas visitors	181	262	234	-
Total population	**109,942**	**115,301**	**118,108**	**7.4**
Population excluding those born elsewhere, not stated and overseas visitors	105,740	108,014	109,597	3.6

Sources: ABS 2007 and ABS 2008a

If “born elsewhere” “not stated” and “overseas visitors” responses are not included in the population count, 8.2 per cent of the region’s population in 2006 were born overseas, an increase from 7.9 per cent in 1996.

Table 12 and Figure 14 show the changes in the proportion of residents born overseas. Europe-born residents still hold the majority although their share of the total migrant population decreased in the last 10 years from 77 per cent in 1996 to 63 per cent in 2006. The proportion of residents born in the Middle East more than doubled during the same period, from 4 per cent in 1996 to 9.3 per cent in 2006.

Table 12 Changes in the proportion of migrant population in the SIR, 1996, 2001 and 2006

Continents/regions	1996 %	2001 %	2006 %
Asia	7.37	8.51	10.60
Africa	0.67	1.14	1.75
Europe	77.15	68.26	62.62
Middle East	4.00	8.53	9.28
North America	1.62	1.48	1.98
Oceania	9.19	12.07	13.77

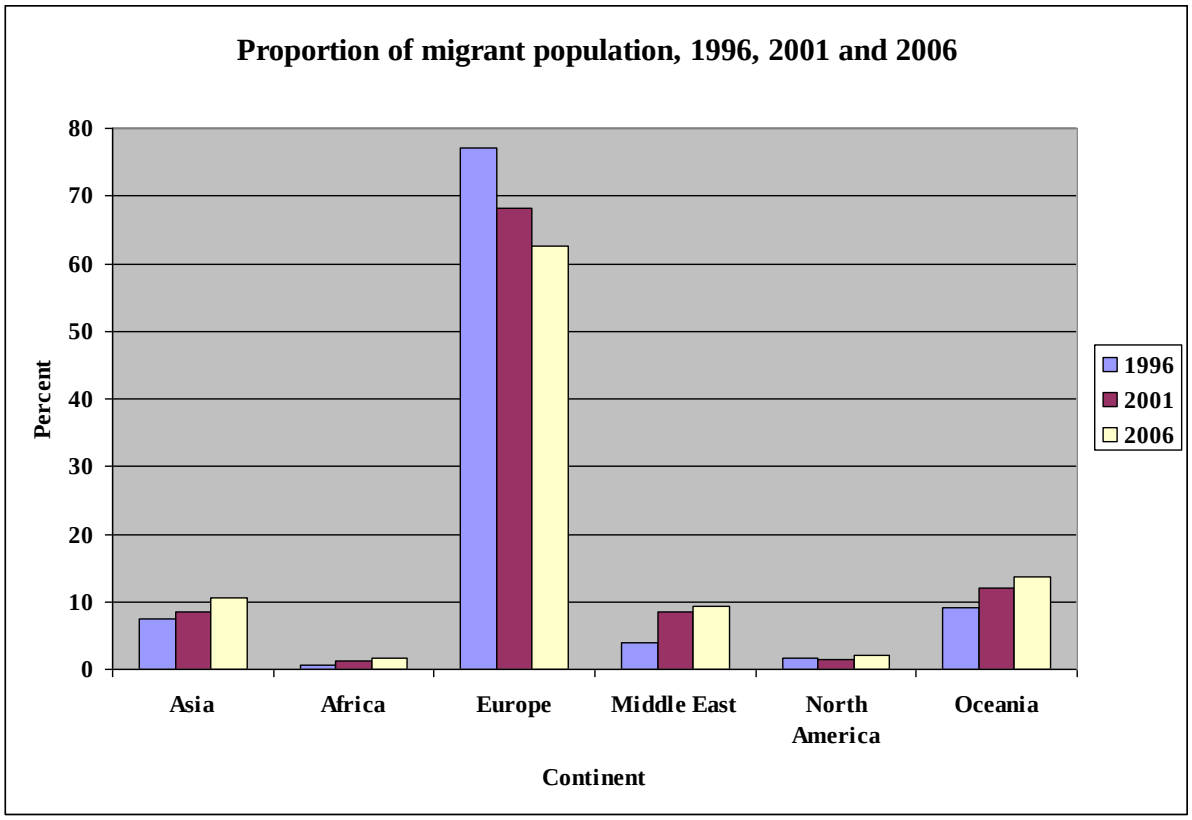


Figure 14 Changes in the proportion of migrant population in the SIR, 1996, 2001 and 2006

4. Assets

This section presents an overview of the natural and infrastructure assets of the SIR. These are the assets that the SIRCIS is striving to protect.

4.1. Natural assets

The natural assets in the SIR are the soils, water, biodiversity and air. These assets are interconnected and collectively support the region's social and economic assets. This interconnectedness means that for example, a decline in the health of the soil asset, can contribute to a decline in the biodiversity and water assets.

4.1.1. Soils

The health of soil in the SIR is critical to the region's continued prosperity. Soils within the irrigation area were comprehensively mapped during the 1940s to 1960s. Figure 15 shows the distribution of soil types across the SIR.

Suitability of the soil types for growing various crops has been described in the soil technical bulletins (Skene 1963, Skene and Harford 1964, Skene and Poutsma 1962, CSIRO 1952). While agronomic and cultural practices have changed significantly since these bulletins were produced, they still provide an excellent base for identifying the most suitable soils for growing high value crops.

Some crops may be successfully grown in specific soil types in Group IV or even V under the right management, but generally this is not the case. Conversely, some crops may not be suitable to particular soils in Group I, II or III due to inherent characteristics.

General descriptions of the Group I, II and III classifications are given in Skene and Poutsma (1962) and are reproduced below. Although not mentioned below, these soils are also well suited to viticulture, olives and other irrigated crops that were not considered during the original soil mapping project.

Group I

"Very good soils, if given careful irrigation, for all horticultural crops, vegetables, tomatoes… Summer fodder crops, cereals, lucerne, and perennial and annual pastures also can be grown successfully".

Group II

"Good soils for all horticultural crops (except citrus), pumpkins, peas, tomatoes, summer fodder crops, cereals, lucerne, and perennial and annual pastures".

Group III

"Good soils for apricots, apples, pears, plums, summer fodder crops, cereals, and perennial and annual pastures; fair soils for peaches, tomatoes, pumpkins, peas, beans and lucerne".

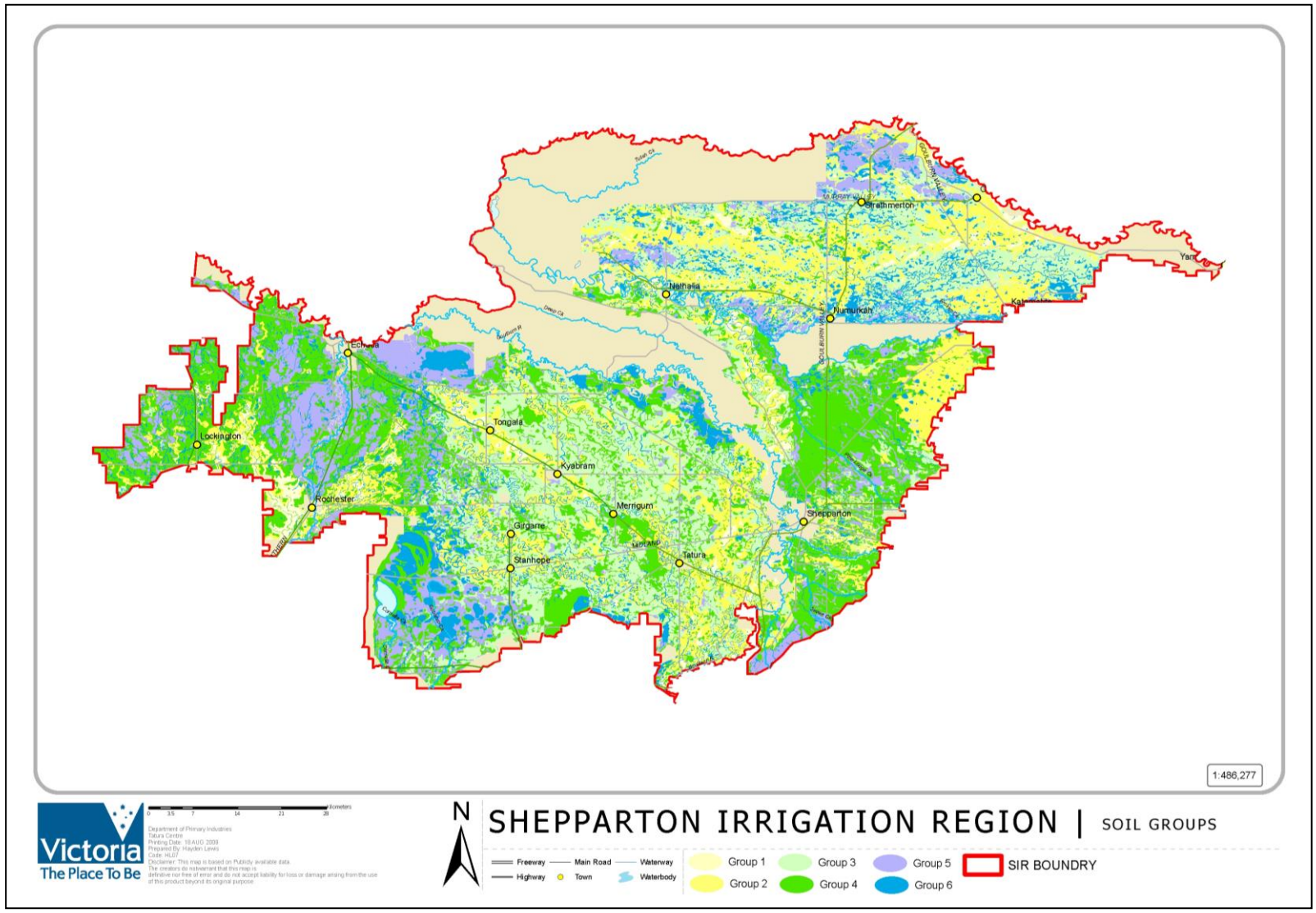


Figure 15 **Different soil groups, SIR**

4.1.2. Water

4.1.2.1. Surface water quantity

The SIR produces a considerable amount of the Murray Darling Basin stream flow from less than 2 per cent of the land area. It also imports water from the River Murray and exports water to the adjacent Campaspe, Loddon, Avoca and Mallee Catchments for irrigation, urban and stock and domestic supply. The SIR comprises about 22 per cent of the total 2.34 million hectares of the Goulburn Broken Catchment.

The SIR has an average monthly temperature range of 7.5°C to 22°C. It receives an annual average rainfall of 380mm to 500mm with annual variation of ± 180mm and runoff of up to 180mm during wet years. In recent times run-off has varied from 0 to 30mm and averaged around 13mm per year (G Smith, pers comm, 2009). The average surface water availability under the historical climate is 3,233GL a year. Of this, at the current level of development, 1,606GL/year (or more than 50 per cent) of this is diverted for use. The average annual rainfall and runoff over the 10-year period 1997 to 2006 are, respectively, 15 per cent and 41 per cent lower than the long term (1895-2006) average values (CSIRO, 2008).

The SIR is one of Australia's major irrigated agriculture regions and uses between 40 and 45 per cent of all the water used in Victoria for irrigation. The bulk of the water used in the region is supplied via the Goulburn River from Lake Eildon and from the River Murray via the Hume Dam. The SIR uses around 14 per cent of the surface water and 5.4 per cent of the groundwater diverted for irrigation in the Murray Darling Basin (CSIRO, 2008).

The Goulburn River Basin (Figure 16) is Victoria's largest, covering over 1.6 million hectares or 7.1 per cent of the state's total area. The Goulburn River is 570 km long, flowing from upstream of Woods Point to Echuca. The river has a mean annual water discharge of 3,040GL (1.8ML/ha), representing 13.7 per cent of the total state discharge. Stream flow along the Goulburn River has been modified by two major features, Eildon Reservoir and the Goulburn Weir (GB CMA, 2005 page 5).

Lake Eildon has a capacity of 3,390GL and supplies more than half of the water used in the SIR. The operation of Eildon Reservoir has reduced winter/spring flows passing Eildon and increased summer/ autumn flows so the flow regime is reversed from the natural regime. The Goulburn Weir near Nagambie and associated diversion channels to the east and west, have reduced the average annual downstream flow to 1,340GL, less than half the pre-regulated flow.

The area of the Broken River Basin is 772,386 ha and represents 3.4 per cent of Victoria's total area. The Broken River is a tributary of the Goulburn River and joins the Goulburn River at Shepparton. The basin also includes the catchment of the Broken Creek that diverges from the Broken River west of Lake Mokoan and then flows north-west to the River Murray. Stream flow is extremely variable between seasons and between years. The three months July to September generally account for over half the annual stream flow. The catchment has a mean annual flow of 325GL (0.42ML/ha), however annual flow has varied from a minimum of 5,000ML in the drought year of 1943, to maxima of more than 1,000GL in the flood years of 1917 and 1956 (GB CMA, 2005).

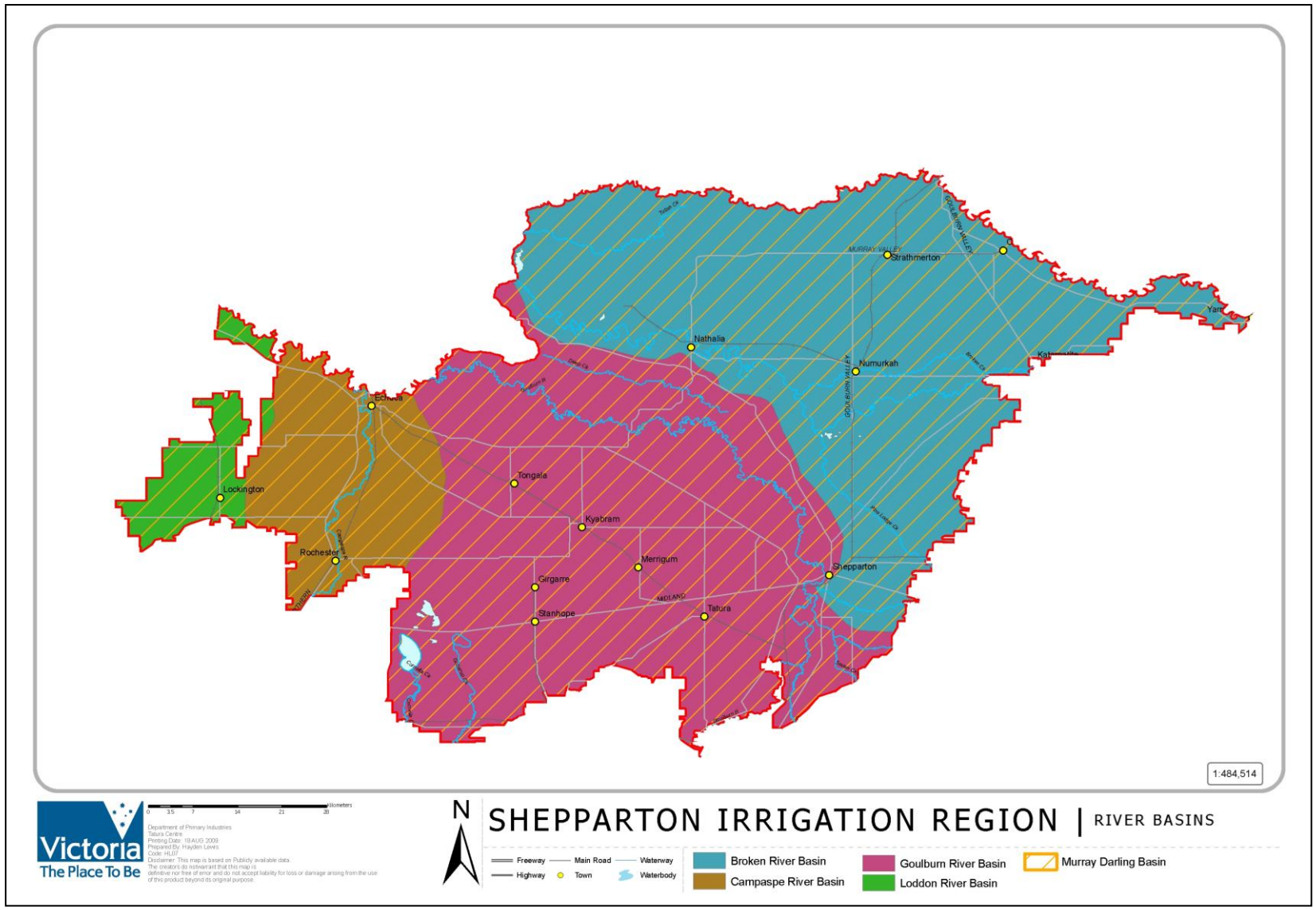


Figure 16 **River basins of the SIR**

4.1.2.2. Surface water quality

Surface water quality in the SIR, while still adequate for irrigation and domestic purposes, has suffered from increased nutrient loads, salinity levels and turbidity. The GB CMA is implementing a Goulburn Broken Water Quality Strategy (GBWQS) to improve water quality for environmental use and human consumption. The GBWQS includes maintaining riparian vegetation, encouraging irrigation best management practices, improving sewerage treatment, managing salinity, reducing nutrient loads leaving irrigation drains and enhancing environmental flow across the Goulburn Broken catchment.

4.1.2.3. Groundwater quantity and use

The SIR contains the Murray and Goulburn Groundwater Basins. Groundwater is extracted from shallow (upper Shepparton Formation) and deep (Calivil Formation and Renmark Group Deep Leads) groundwater systems (T Hunter, pers comm, 2009).

In natural (undisturbed/pre-development) conditions regional groundwater levels are thought to have been 15m to 30m below surface and the upper Shepparton Formation was generally not saturated. Infiltration to groundwater from rain and flooding would have been in balance with regional groundwater flows "down basin"[3].

Irrigation and tree clearing has altered the water balance. With irrigation development infiltration of water past the root zone increased and groundwater levels rose (an example of groundwater/surface water interaction). From the 1930s onwards, rising groundwater levels induced waterlogging and salinity problems for agriculture and the natural environment.

The SIR Water Supply Protection Area (SIRWSPA) Groundwater Management Plan was established in 1999 to support SIRCIS objectives. The objective of the Plan is principally to mitigate salinity problems caused by high groundwater levels by promoting groundwater extraction from the upper Shepparton Formation. The SIRWSPA Groundwater Management Plan controls the use of extracted groundwater by limiting applied irrigation salinities. However, the SIRWSPA Groundwater Management Plan is of limited value for groundwater resource management because it does not have a Permissible Consumptive Volume (PCV) or mechanisms to control water usage on a seasonal basis (i.e. usage is not capped). Also the variability of the Upper Shepparton Formation and lack of contiguous aquifers means it is not feasible to manage groundwater as a transferable and tradable resource in most areas of the SIR.

Groundwater in the upper Shepparton Formation is principally irrigation drainage water. As a result of groundwater extraction and drought conditions, groundwater levels have fallen significantly across the SIR in recent years. Catchment managers and groundwater resource managers are working together to develop strategies to deal with this changing environment. Engagement with key stakeholders has already started. The following conceptual approach has been developed:

- review the SIR total water balance in light of changing climatic conditions and improving irrigation efficiency
- reassess local, regional and basin salt management requirements
- assess SIR groundwater resource availability and management options
- develop salinity and resource management strategies in consultation with key stakeholders
- implement agreed management strategies with appropriate monitoring and adaptive management.

As at 30 June 2006 licensed entitlement in the SIRWSPA was 201,131ML with 200,144ML per year being irrigation entitlement (G-MW 2006, page 6). The groundwater usage by 789 metered bores in 2005-2006 was 62,752ML. The licensed entitlement of these bores is 156,984ML per year (G-MW 2006, page 7).

Groundwater from the Campaspe Deep Lead Water Supply Protection Area (CDLWSPA) and the Katunga Water Supply Protection Area (KWSPA) is also used in the SIR. The CDLWSPA partly underlies the SIR and the

[3] Down basin means the flow is similar to that of surface water.

KWSPA fully underlies the SIR. Both these Water Supply Protection Areas have PCVs and mechanisms to control water usage on a seasonal basis.

The Groundwater Management Plans (GMP) for the CDLWSPA and KWSPA were approved by Victoria's Minister for Water in 2003 and 2006, respectively. These Plans, aim to *"use annual allocations to manage groundwater extractions to prevent groundwater levels from falling below what many groundwater users consider to be an acceptable level based on equity, accessibility and cost"* (G-MW 2006b, page 1).

In 2006, about 45,000ML of groundwater was used in the Campaspe and Katunga WSPAs (Table 13).

Table 13 Groundwater use in the Campaspe and Katunga WSPA 2006

Items	Campaspe	Katunga
Number of licences	109	183 (Note c)
Total entitlement volume (ML/year)	46,251 (Note a)	59,778 (Note d)
Total annual allocation (ML/year)	46,069	42,487
Number of metered bores	105	121
Metered volume used (ML)	23,112	21,614
Number of licences with estimated volumes	1	0
Total estimated volume used (ML)	344	0 (Note e)
Total use (ML)	23,456	21,614
Use (% of total allocation)	51%	51%
Number of licences with use greater than licensed allocation	0 (Note b)	0
Total volume used above licensed allocation (ML)	0	0

Notes:

(a) Total annual allocation not the same as previous season due to a change in allocation.
(b) There was 1 unlicensed bore that pumped approximately 90 ML.
(c) Sole private rights licensed D&S use bores are not included in this number.
(d) Total entitlement volume has decreased due to the 20 per cent claw back of entitlement that occurred through a permanent trade.
(e) No of licences with estimated volumes, refers to bores that weren't metered and an estimate on volume extracted had to be made. Refer to Section 3.3

Sources: G-MW 2006b, page 6 and G-MW 2007, page 5

The volume of groundwater used in the Campaspe and Katunga WSPAs as presented in Table 13 are different from the data published by DSE in 2007 (

Table 14).

Table 14 Compliance with licensed groundwater volumes, Murray and Goulburn basins 2005-2006

Water supply protection area/Groundwater management area (Note a)	Depth limits (Note b) m	Allocation limit (Note c) ML/year	Licensed entitlement allocated (Note d) ML/year	Metered use ML	Estimated use in unmetered bores ML	Total licensed groundwater use 2005-2006 ML
Murray Basin						
Katunga WSPA (81%)	>25	59,770	42,487	21,610	0	21,610
Shepparton WSPA (32%)	≤25	244,226	224,226	62,750	0	62,750
Goulburn Basin						
Campaspe Deep Lead WSPA (10%)	>25	46,069	46,251	23,110	344	23,454
Katunga WSPA (10%)	>25	59,770	42,487	21,610	0	21,610
Shepparton WSPA (53%)	≤25	244,226	224,226	62,750	0	62,750

Notes:

(a) The percentage of the Groundwater Management Area (GMA)/WSPA by surface area within the river basin is given in the parentheses. Those GMAs/WSPAs with <5% surface area within the basin have not been included.

(b) This column indicates the aquifer depth limits for which the GMA/WSPA applies.

(c) The allocation limit represents the sum of licensed entitlements for WSPAs and the permissible consumptive volume (PCV) for GMAs.

(d) Allocated volume includes domestic and stock usage in those cases where it is part of a licensed allocation.

Source: DSE (2007b), pages 58 and 97

4.1.2.4. Groundwater quality

The sands of the Upper Shepparton Formation Aquifer System are variable and complex within a matrix of silt and clay. This heterogeneous nature of the formation results in varying flow rates and residence times of groundwater, which influences the groundwater salinity. More saline water generally occurs in the silty clay and clay aquitards and fresher water in the coarse grained aquifers. Fresher water is also likely to be found near areas of local recharge.

The best practice rule in the SIR is to blend shallow groundwater with surface water supply to achieve an applied irrigation salinity of 800EC or less for pastures. This minimises the impact that the use of shallow groundwater has on the productivity of the farm enterprise.

All bores that currently receive incentives under the SIRCIS are licensed to meet this best practice. Bores that have not received SIRCIS incentives can be licensed to achieve an applied irrigation salinity of up to 1,700EC for pastures (this represents minimum standards).

4.1.3. Biodiversity

Our understanding of the importance of biodiversity has grown significantly and there is an increased community expectation that biodiversity should be protected and rehabilitated from the effects of clearing, salinity, nutrients, pest plants and pest animals.

The SIR was once entirely covered in native vegetation, with red gum forests along the river corridors and open woodlands on the plains. Vegetation clearing has been extensive on the plains. Approximately 98 per cent of native vegetation within the SIR has been cleared since European settlement (GB CMA, 2000).

Our biodiversity has evolved over millions of years generating a diversity of species and complexity of interactions which underpin processes that provide a range of ecosystem services. Science cannot predict the impact of losing species of the delivery of ecosystem services to minimise risks and losses.

Bioregions depict the patterns of ecological characteristics in the landscape and provide a meaningful framework to address, and report on, biodiversity conservation. The SIR includes large areas of the Victorian Riverina and Murray Fans bioregions (Figure 17).

Biodiversity Action Planning

Biodiversity Action Planning (BAP) is a relatively new approach to identify priorities and map significant areas of native biodiversity (Figure 18). It is intended to inform conservation planning at a series of scales – catchment, bioregional, landscape and local.

There are three main developmental stages of BAP including:

- Strategic Bioregional Overviews (Victorian Riverina and Murray Fans)
- Landscape Plans (SIR North Zones and SIR South Zones)
- Landscape Zone Conservation Plans (Barmah, Yarrawonga, Central Creek, Southern Goulburn, Western Goulburn and Timmering).

The Environment Program is currently undertaking stage three of BAP - the development of a Landscape Zone Conservation Plan for four of the six landscape zones (Barmah, Yarrawonga, Western Goulburn and Timmering). This involves mapping significant sites within the Landscape Zones, developing a database of biodiversity data for each site and developing a Conservation Plan outlining biodiversity assets in the Zone. The Conservation Plans will be a valuable resource to assist with identifying priority biodiversity assets and the methods of action for their protection, enhancement or restoration.

A communication plan has been developed for BAP in the SIR. Community development advice and plan review is an important component of BAP and will continue to be undertaken during development and implementation. It is vital the overview plans are translated to the local landscape in partnership with the community in order to protect biodiversity assets that are “vulnerable”, “threatened” or at risk of becoming “endangered”.

Targeting of incentives toward biodiversity sites has commenced in the Central Creek Landscape Zone area. This has involved utilising the focal species approach (e.g. Bush-stone Curlews) to target sites and provide advice to landholders regarding protection of Curlews and other native flora and fauna in their area.

The following section lists some of the key components of our biodiversity. The accompanying 'Soils' and 'Water' sections (pages 34 to 36) also list some components of the ecosystem that are critical for biodiversity.

The number of nationally and state listed threatened species and critical habitat is very large and it is not appropriate to include all of them in the SIRCIS. Details can be found in McLennan, Bell and Howell (2004).

4.1.3.1. Native vegetation

Extent

- less than 3 per cent of native vegetation cover remains
- most remaining native vegetation is on public land in the Barmah Forest and along the Goulburn River corridor, and to a lesser extent, the Broken Creek corridor
- the two SIR bioregions (Victorian Riverina and Murray Fans), have been extensively cleared for intensive agriculture
- there are Threatened Ecological Communities listed under the *Environment Protection and Biodiversity Conservation Act*
- vegetation includes Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions, and Grassy White Box Woodlands
- many of the vascular and non-vascular plants are listed as threatened in Victoria

- "endangered" (less than 10 per cent of original cover) and "vulnerable" Ecological Vegetation Classes (EVC) with less than 15 per cent cover are found right across the SIR (see Figure 19)
- most threatened species of flora are understorey (grasses, herbs and low shrubs)
- there are cryptogams (include lichens, bryophytes, algae and fungi) – many species, many unknown, conservation status unknown.

Condition

- a vast amount of the remaining vegetation on private land is of poor quality (limited diversity, lack of understorey, lack of ground litter, etc)
- the number of hollow bearing trees (fauna habitat) has been reduced in parallel with general native vegetation decline in extent
- box-ironbark forests have especially suffered loss of hollows which are important habitat for native fauna
- vegetation cover remaining is polarised into two categories, larger blocks and corridors greater than 1,000 ha (Barmah Forest and the Goulburn River corridor) and very small fragments less than 1 ha
- of the remaining patches of vegetation in the Goulburn Broken Catchment 98 per cent are less than 1 ha. The figure is expected to be similar for the SIR
- threatened Ecological Vegetation Classes (EVCs) are mostly highly fragmented.

Trends

- conservation status of many species is still declining due to populations being below threshold levels
- declines in extent have largely stabilised with small incremental losses still occurring (anecdotal evidence). The extent is expected to increase in the next few years due to accelerated action over the past decade (replanting, direct seeding and grazing control programs)
- isolated trees and small remnants on farmland continue to decline due to removal and dieback (often called incremental loss)
- dead trees with hollows are still being removed on private land
- hollows in current tree plantings won't form until at least 2100, which may be too late for many fauna species that need them
- understorey plantings and pest plant and pest animal control programs are increasing
- connectivity is improving after massive impact since European settlement, with revegetation efforts focussing on connectivity over the past decade
- climate change is likely to impact on species which exist at the limit of their range.

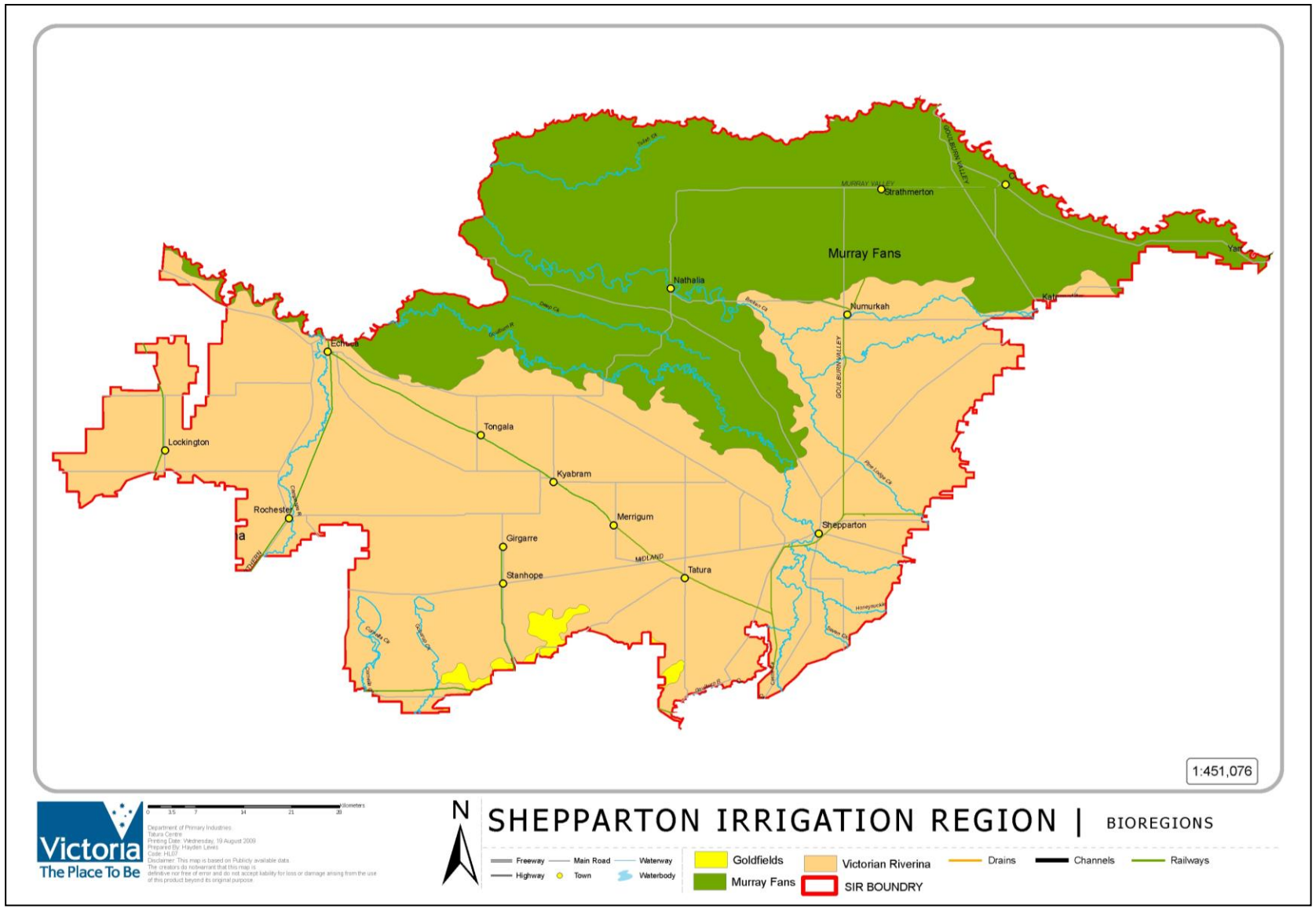


Figure 17 **Bioregions within the SIR**

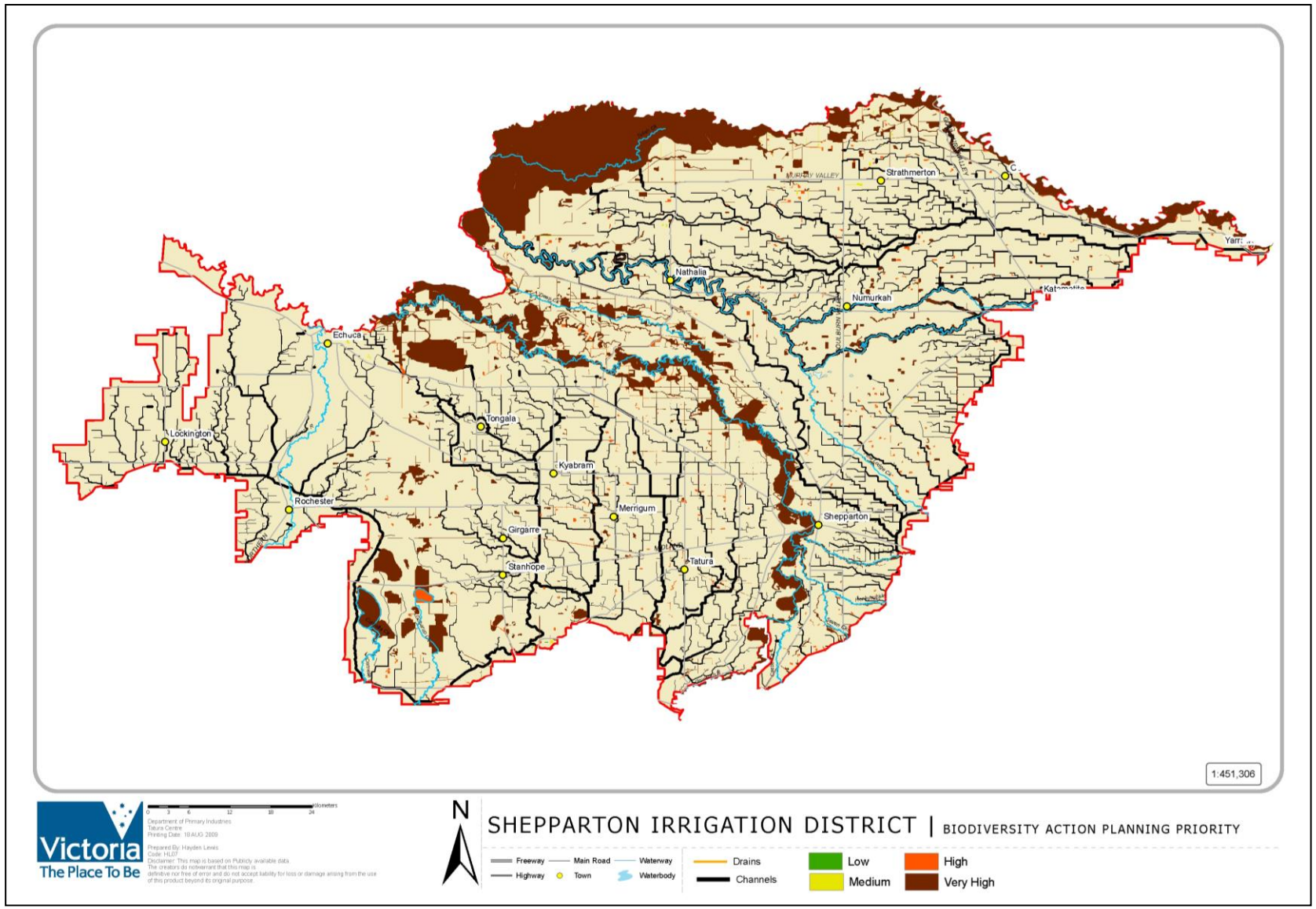


Figure 18 **Biodiversity Action Planning sites, SIR**

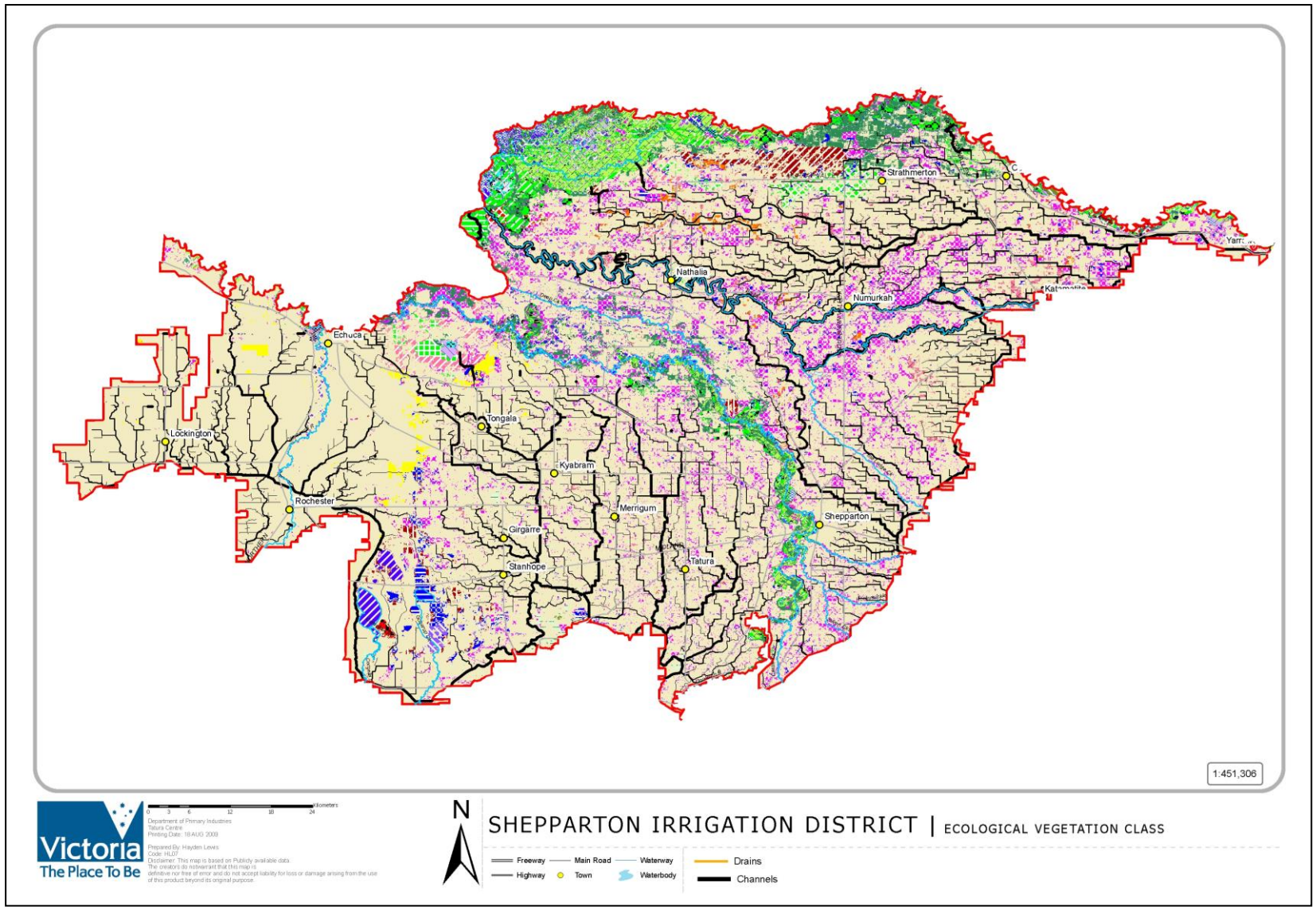
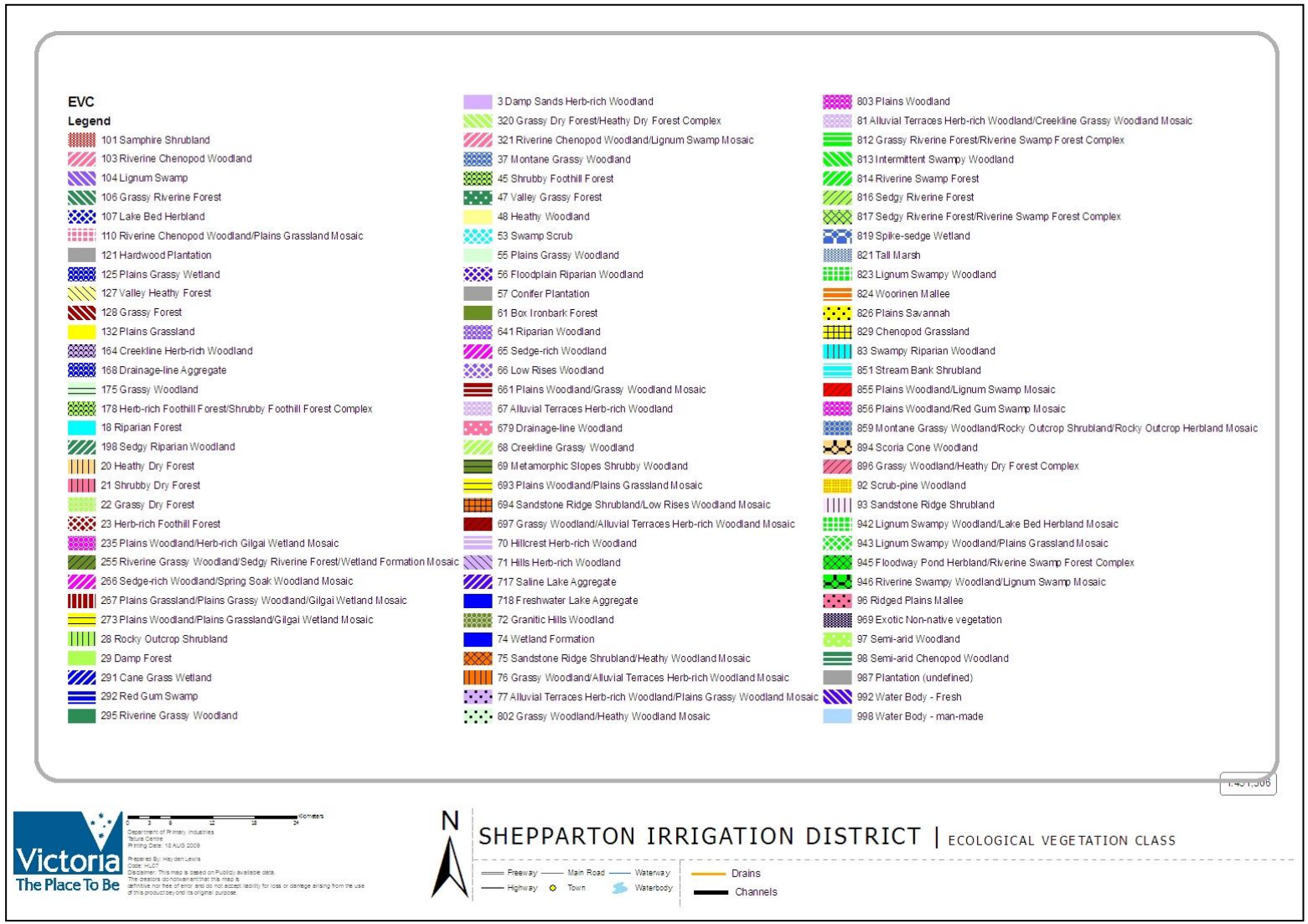


Figure 19 **Ecological Vegetation Classes, SIR**


EVC
Legend
101 Samphire Shrubland
103 Riverine Chenopod Woodland
104 Lignum Swamp
106 Grassy Riverine Forest
107 Lake Bed Herbland
110 Riverine Chenopod Woodland/Plains Grassland Mosaic
121 Hardwood Plantation
125 Plains Grassy Wetland
127 Valley Heathy Forest
128 Grassy Forest
132 Plains Grassland
164 Creekline Herb-rich Woodland
168 Drainage-line Aggregate
175 Grassy Woodland
178 Herb-rich Foothill Forest/Shrubby Foothill Forest Complex
18 Riparian Forest
198 Sedgy Riparian Woodland
20 Heathy Dry Forest
21 Shrubby Dry Forest
22 Grassy Dry Forest
23 Herb-rich Foothill Forest
235 Plains Woodland/Herb-rich Gilgai Wetland Mosaic
255 Riverine Grassy Woodland/Sedgy Riverine Forest/Wetland Formation Mosaic
266 Sedge-rich Woodland/Spring Soak Woodland Mosaic
267 Plains Grassland/Plains Grassy Woodland/Gilgai Wetland Mosaic
273 Plains Woodland/Plains Grassland/Gilgai Wetland Mosaic
28 Rocky Outcrop Shrubland
29 Damp Forest
291 Cane Grass Wetland
292 Red Gum Swamp
295 Riverine Grassy Woodland
3 Damp Sands Herb-rich Woodland
320 Grassy Dry Forest/Heathy Dry Forest Complex
321 Riverine Chenopod Woodland/Lignum Swamp Mosaic
37 Montane Grassy Woodland
45 Shrubby Foothill Forest
47 Valley Grassy Forest
48 Heathy Woodland
53 Swamp Scrub
55 Plains Grassy Woodland
56 Floodplain Riparian Woodland
57 Conifer Plantation
61 Box Ironbark Forest
641 Riparian Woodland
65 Sedge-rich Woodland
66 Low Rises Woodland
661 Plains Woodland/Grassy Woodland Mosaic
67 Alluvial Terraces Herb-rich Woodland
679 Drainage-line Woodland
68 Creekline Grassy Woodland
69 Metamorphic Slopes Shrubby Woodland
693 Plains Woodland/Plains Grassland Mosaic
694 Sandstone Ridge Shrubland/Low Rises Woodland Mosaic
697 Grassy Woodland/Alluvial Terraces Herb-rich Woodland Mosaic
70 Hillcrest Herb-rich Woodland
71 Hills Herb-rich Woodland
717 Saline Lake Aggregate
718 Freshwater Lake Aggregate
72 Granitic Hills Woodland
74 Wetland Formation
75 Sandstone Ridge Shrubland/Heathy Woodland Mosaic
76 Grassy Woodland/Alluvial Terraces Herb-rich Woodland Mosaic
77 Alluvial Terraces Herb-rich Woodland/Plains Grassy Woodland Mosaic
802 Grassy Woodland/Heathy Woodland Mosaic
803 Plains Woodland
81 Alluvial Terraces Herb-rich Woodland/Creekline Grassy Woodland Mosaic
812 Grassy Riverine Forest/Riverine Swamp Forest Complex
813 Intermittent Swampy Woodland
814 Riverine Swamp Forest
816 Sedgy Riverine Forest
817 Sedgy Riverine Forest/Riverine Swamp Forest Complex
819 Spike-sedge Wetland
821 Tall Marsh
823 Lignum Swampy Woodland
824 Woorinen Mallee
826 Plains Savannah
829 Chenopod Grassland
83 Swampy Riparian Woodland
851 Stream Bank Shrubland
855 Plains Woodland/Lignum Swamp Mosaic
856 Plains Woodland/Red Gum Swamp Mosaic
859 Montane Grassy Woodland/Rocky Outcrop Shrubland/Rocky Outcrop Herbland Mosaic
894 Scoria Cone Woodland
896 Grassy Woodland/Heathy Dry Forest Complex
92 Scrub-pine Woodland
93 Sandstone Ridge Shrubland
942 Lignum Swampy Woodland/Lake Bed Herbland Mosaic
943 Lignum Swampy Woodland/Plains Grassland Mosaic
945 Floodway Pond Herbland/Riverine Swamp Forest Complex
946 Riverine Swampy Woodland/Lignum Swamp Mosaic
96 Ridged Plains Mallee
969 Exotic Non-native vegetation
97 Semi-arid Woodland
98 Semi-arid Chenopod Woodland
987 Plantation (undefined)
992 Water Body - Fresh
998 Water Body - man-made
Victoria
The Place To Be
Kilometers
Department of Primary Industries
Tatura Centre
Printing Date: 18 AUG 2009
Prepared By: Hayden Lewis
Code: HL07
Disclaimer: This map is based on Publicly available data.
The creators do not warrant that this map is
definitive nor free of error and do not accept liability for loss or damage arising from the use
of this product beyond its original purpose.
N
SHEPPARTON IRRIGATION DISTRICT | ECOLOGICAL VEGETATION CLASS
Freeway
Main Road
Waterway
Highway
Town
Waterbody
Drains
Channels

4.1.3.2. Wetlands

There are numerous wetlands of varying status and sizes across the Goulburn Broken Catchment (GBC):

- SIR - one wetland of international significance (Barmah, Ramsar listed)
- SIR - seven wetlands of national significance
- SIR - 61 wetlands of bioregional significance
- GBC - 946 wetlands (greater than 1 ha each) cover an area of approximately 50,000 ha, including natural and constructed wetlands (Table 15).

There are many other high value wetlands along the floodplains of the middle reaches of the Goulburn River and its tributaries (Figure 20):

- 35 per cent are naturally small in size (1-5 ha)
- 40 per cent of wetlands are greater than 100 ha in size.

At least 17 per cent of wetlands occur on public land with 60 per cent on private land. The remaining 23 per cent occurs on both public and private land. These include natural wetland ecosystems, constructed lakes and dams.

Table 15 Listed significant wetlands, SIR

List	Wetland
International Ramsar Convention on Wetlands	Barmah -Millewa Forest (Barmah Forest component - Millewa is in NSW).
Directory of Important Wetlands in Australia (1995-2000)	Broken Creek, Kanyapella Basin, Lower Broken River, Lower Goulburn River Floodplain, Muckatah Depression, and Wallenjoe Wetlands.
JAMBA and CAMBA	Habitat for listed species: Barmah-Millewa Forest, Broken Creek, Kanyapella Basin, Lower Goulburn River Floodplain, Muckatah Depression and Wallenjoe Wetlands.

Groundwater level and groundwater quality play an important role in the health of the wetlands across the SIR. There are recharge and discharge interactions between groundwater and wetlands as well as the potential for groundwater to support wetland vegetation during dry conditions. However, if the groundwater is saline this can have detrimental affects on the health of wetland species.

Impact from European settlement to 2002

- There has been an overall increase in the area of wetlands since European settlement. This is primarily as a result of the large increase in impoundments for water storage.
- Increased nutrient loads affect many wetlands and fringing vegetation, causing substantial declines in bird and fish populations.
- Many wetlands on the floodplains are no longer ‘connected’ as part of wetland systems due to infrastructure development.
- Controlled flows have substantially reduced wetting of floodplain wetlands.

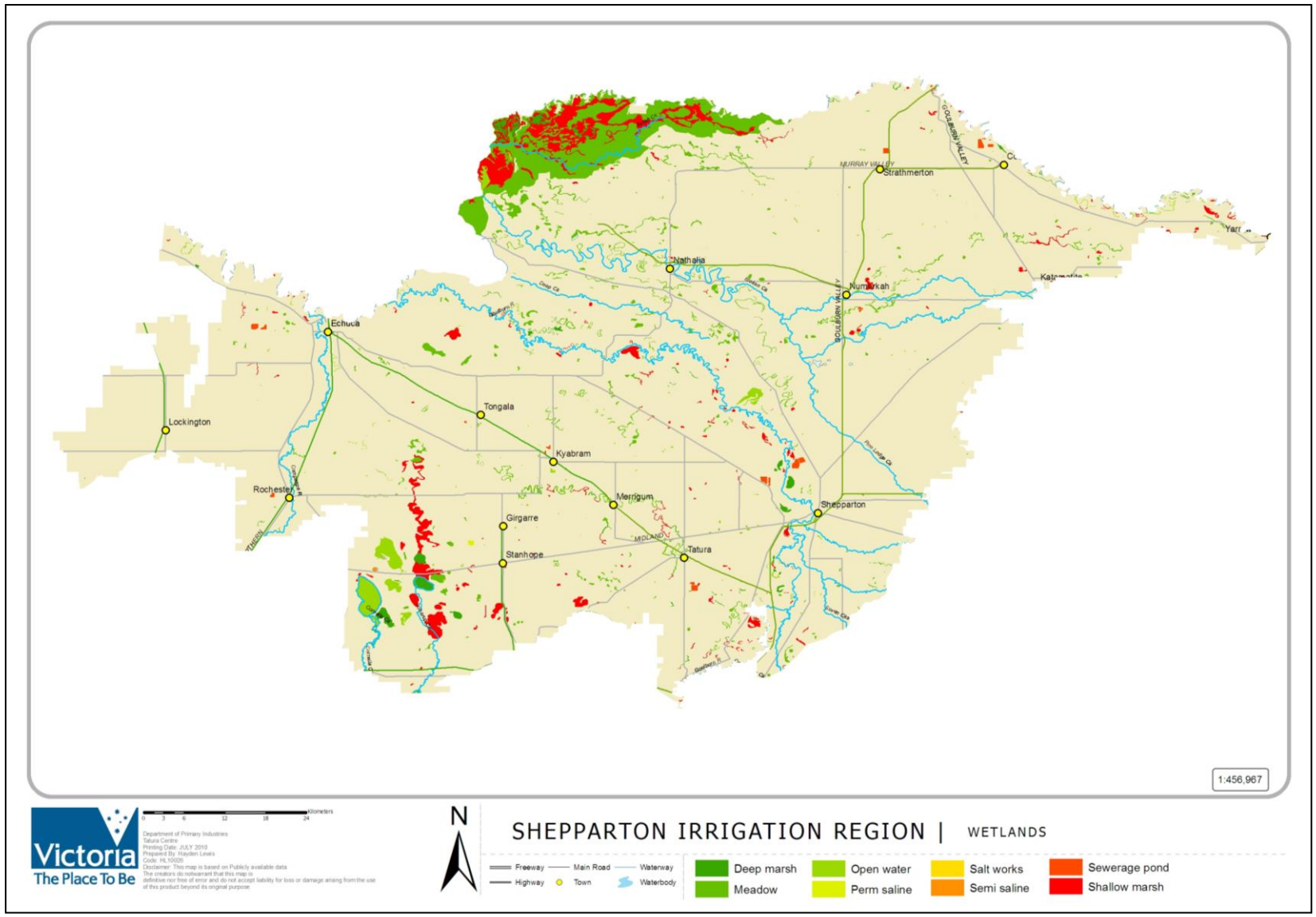


Figure 20 **Wetlands in the SIR**

4.1.3.3. Rivers and streams

Rivers and streams are the lifeblood upon which most of the region's other assets depend. The SIR has about 850 km of streams within the region, with approximately 580 km in the Goulburn River Basin and approximately 270 km in the Broken River Basin.

The Goulburn River below Eildon is one of only 18 declared Heritage Rivers in Victoria due to their very high nature conservation, recreational, social or cultural value. The Broken River and Broken Creek are considered to be of High Community Value. Therefore, these are priority assets to protect.

The Index of Stream Condition (ISC) has identified that 38 per cent of SIR streams are in moderate condition, 59 per cent are in poor condition and 3 per cent are in very poor condition. The ISC is a measure of a stream's change from natural or ideal conditions. The ISC considers streams on a representative reach basis and presents an indication of the extent of change in respect to five key 'stream health' indices:

- hydrology (change in volume and seasonal flow)
- physical form (stability, degradation/aggradation, influence of artificial barriers and abundance/absence of in-stream debris)
- streamside zone (plant species – native/exotic, spatial extent, width, continuity and links)
- water quality (assessment of total phosphorus, turbidity, dissolved oxygen, conductivity and pH)
- aquatic life (abundance and type of macro invertebrates).

The SIR has no streams that are regarded as 'ecologically healthy'. Criteria used to measure how 'ecologically healthy' a stream is, include:

- riparian vegetation (structural intactness)
- cover of exotic vegetation
- in-stream physical habitat
- barriers
- longitudinal continuity
- bed condition.

The Seven Creeks supports one of only two viable populations of Trout Cod species (*Maccullochella macquariensis*).

Trends

- The condition of riparian zones and the condition of channel form has improved in priority areas.
- Vegetation quality condition has improved in frontage zones subjected to action.
- Access for recreational pursuits has improved in a range of river reaches.

More information and context can be found in the GBRRHS 2005.

4.1.3.4. Floodplains

Flooding is a natural phenomenon and floodplains represent important biodiversity values. Floods replenish wetlands, transport food supplies and trigger stages in the life cycles of many plants and animals.

Floodplains provide natural overland flow paths and storage areas where floodwaters remain for slow release as stream heights recede, thereby reducing the potential for channel erosion from high energy flows. Nutrients, debris and sediment settle out during this process, protecting waterways from high sediment and nutrient loads and contributing to floodplain productivity.

Construction of levees for flood protection and conversion of floodplains to agricultural land has led to a decline in ecosystem services provided by floodplains within the SIR.

4.1.3.5. Native fauna

The SIR has many species of native vertebrate fauna (birds, mammals, reptiles, amphibians and fish) and an unknown, very large number of invertebrates. Invertebrates are often forgotten but play an extremely important role in the health of the region.

Many EVCs, and therefore species of fauna, exist beneath minimum threshold habitat level. Many are below the 15 per cent recommended by JANIS (1997) and there is a risk of further species decline if nothing is done.

With the extensive clearing of native vegetation and fragmentation of habitat, populations of fauna (and flora) are often isolated, limiting gene flow. The ability of species to adapt to new conditions, such as changing climate, is severely reduced if the gene pool is limited.

Fish and other aquatic species have been prevented from migrating because of structures on rivers and streams (such as weirs), which have dramatically affected fish populations. The removal of several barriers in recent years is expected to have a very positive effect on fish populations.

Some species, such as the Brolga and Bush Stone-curlew, are at particular risk from predators. Several SIR fauna species are 'Nationally Listed Species' under the *Environment Protection and Biodiversity Conservation Act 1999:*

- Spotted Tree Frog
- Barred Galaxias
- Trout Cod
- Swift Parrot
- Superb Parrot
- Striped Legless Lizard
- Warty Bell Frog.

Several terrestrial species are covered by migratory provisions and other species are covered by the marine provisions of the *Environment Protection and Biodiversity Conservation Act 1999*.

The SIR has many significant environmental sites which the SIRCIS trying to protect (Figure 21).

4.1.3.6. Soil biodiversity

The below-ground flora and fauna represent one of the most species rich components of terrestrial ecosystems but is often ignored because it is not well known or understood.

Recent research is also showing there is a strong link between above-ground and below-ground biodiversity. Healthy remnants and soil biodiversity go hand in hand. This is likely to influence how we undertake revegetation across the SIR.

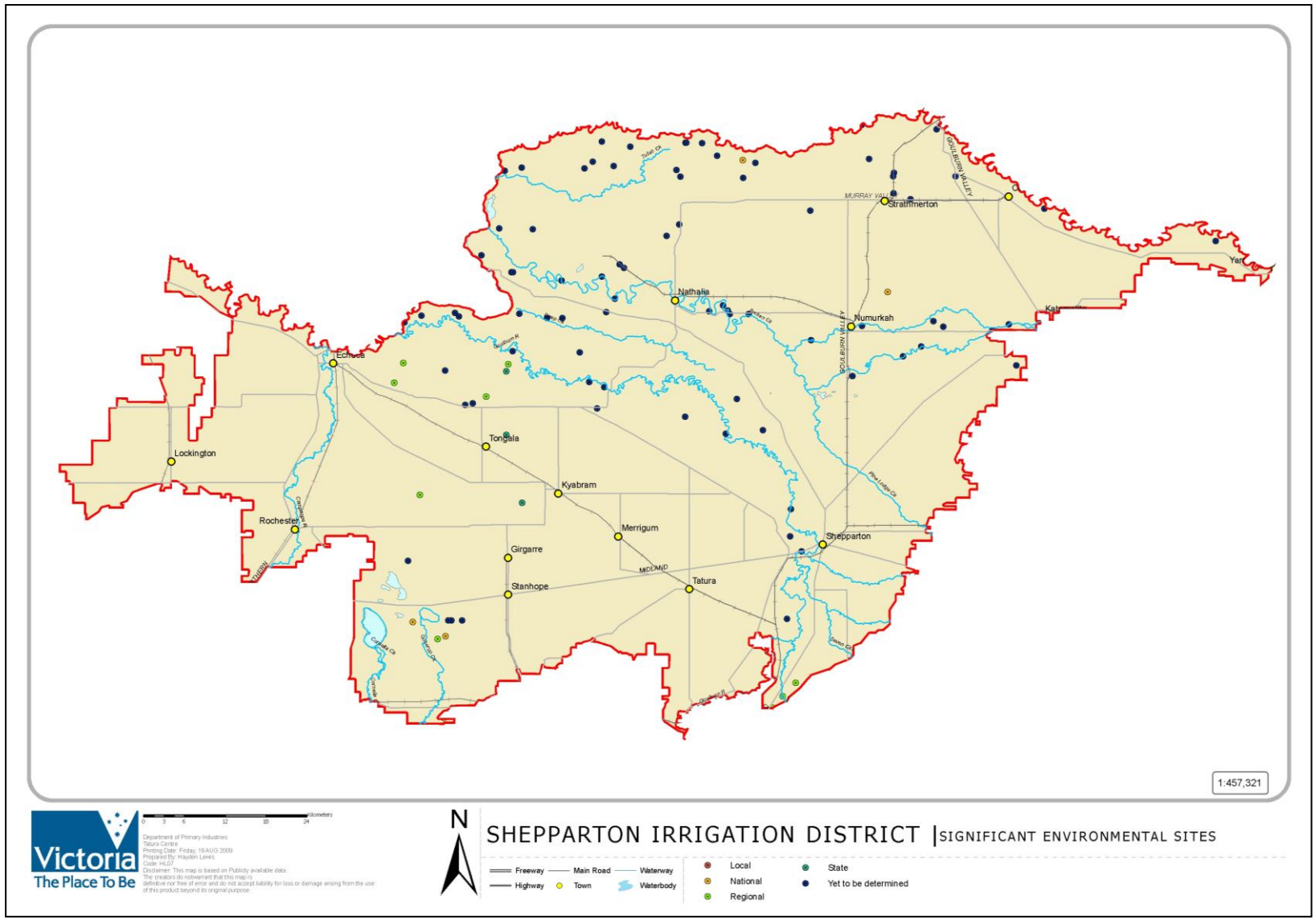


Figure 21 **Significant environmental sites, SIR**

4.1.4. Climate

The SIR enjoys a Mediterranean climate of hot summers and cool temperatures in winter months. The winter average temperature hovers around 12 to 14°C. Sufficient cold days occur to provide the chilling required for bud initiation of fruit trees. Winter frosts are common and occasional spring frosts can cause significant damage to some varieties of horticultural and vegetable crops. More than half of the rain falls between May and October (www.bom.gov.au/weather/vic).

In common with many other areas, the SIR community is only beginning to grapple with the question of how its industries and other land uses affect the composition and function of the atmosphere. The SIR has a lot at stake in relation to climate change and stability. The agriculture sector (horticulture, dairy, grazing and cropping) in the SIR would suffer negative impacts from climate change. The region is both a positive and negative contributor to climate stability. Contributions to greenhouse gas emissions are made through intensive dairy, cattle and sheep farming, while carbon sinks are provided in the catchment through existing vegetation and revegetation efforts.

Climate change is discussed in more detail in Section 5 (Threats).

4.2. Infrastructure Assets

4.2.1. Irrigation systems

Goulburn-Murray Water (G-MW) supplies irrigation water in the SIR, Pyramid-Boort Irrigation Area and the Torrumbarry Irrigation Area (Figure 22). Across the SIR, G-MW has infrastructure assets worth $2.2 billion (T Hunter pers comm, 2009). There is an extensive network of channels and drains within the SIR. Figure 23 shows the channel system.

Farm irrigation systems vary according to a number of factors: enterprise type, soil type and age of enterprise.

The main types of systems are:

- border check (also known as flood), almost exclusively used on pastures and crop,
- furrow
- moveable sprinklers
- self propelled irrigators (travelling irrigators, centre pivots)
- fixed sprinklers
- micro-irrigation (drip or small sprinklers used at the base of a horticultural crop)
- drip or trickle (sub-surface).

G-MW, the GB CMA and the NC CMA together with DPI conducted a survey in 2004-2005 of landowners within the irrigation areas of Central Goulburn, Pyramid-Boort and Rochester to determine the “irrigation culture” of the areas.

Central Goulburn is primarily a dairy area using a perennial pasture base while Rochester is a mixed farming and dairy area. Pyramid-Boort is not discussed here as it is outside the SIR.

Table 16 shows the characteristics of a typical farm in the area.

Table 16 Overview of the average farm in Central Goulburn and Rochester

Characteristics of farms - Central Goulburn (dairy)	Characteristics of farms - Rochester /Campaspe (dairy and mixed)
Most farms have twice as much perennial pasture as annual pasture.	The average property has nearly equal areas of annual and perennial pasture.
The average irrigated area is 70.5 ha, and is flood irrigated.	The average irrigated area is 65 ha with 57 ha flood irrigated, 2 ha each of self-propelled sprinklers and drip/trickle and 1ha furrow.
There is a 50% chance there is a WFP (but has very likely carried out laser grading regardless).	There is a 45% chance there is a WFP (but has very likely carried out laser grading regardless).
91% of farms have a drainage reuse system that is used 80% of the time to capture run off from nearly all of the farm's irrigated pasture.	60% of farms have a drainage reuse dam that is used 30% of the time to capture run off from nearly all of the farm's irrigated pasture.
11% of properties reported having Automatic irrigation. The average area irrigated automatically was 25 ha.	11% of farms reported having Automatic irrigation. Average area irrigated automatically was 62 ha.
Remnant vegetation fencing occurred on 11% of farms.	Remnant vegetation fencing occurred on 11% of farms (1.5 ha average area).
257 native plants were planted on average per farm per year over the last five years. On average 0.1 ha of wetland was fenced out.	The farmers planted nearly 100 trees per year during the last five years (436 average) and fenced out 1.2 ha of wetland.
Fencing out streams or saline areas is not a big concern (less than 0.1%).	Fencing out streams was important on 8% of properties with an average of 124m of fencing carried out. Fencing out saline areas is not a big concern (less than 2%).
The top three things planned to do during 2005-2006 were "laser grading" (35%), "improve irrigation efficiency" (22%), and "irrigation scheduling" (21%).	The top three things planned to do during 2005-2006 were: "laser grading" (24%), "improve irrigation efficiency" (20%), and "irrigation scheduling" (13%).
9% planned to put in a drainage reuse system, and 8% planned to undertake a WFP during 2005-2006.	11% "planned to improve drainage system", 10% planned to put in a drainage reuse system, and 3% planned to undertake a WFP in 2005-2006.

Source: Ash, L. 2006 page 3

The majority of water (more than 60 per cent) is used by the dairy industry, with livestock and fodder also using large volumes and finally horticulture (DPI 2007, page 16). Consequently, when seeking to improve water use efficiency the SIRCIS has a focus on dairy and mixed farming.

4.2.2. Transport systems

The SIR is very well serviced by both road, rail and light aircraft transport (Figure 24). In particular the current Mooroopna freight hub handles 14,000 containers a year and a new regional freight centre (worth $210 million) is currently under construction which will handle up to 550,000 tonnes of freight per year. Transport, postal and warehousing services provide almost 4 per cent of the SIR employment (ABS 2007a). An efficient transport sector is vital to allow agriculture and other industries to remain globally competitive.

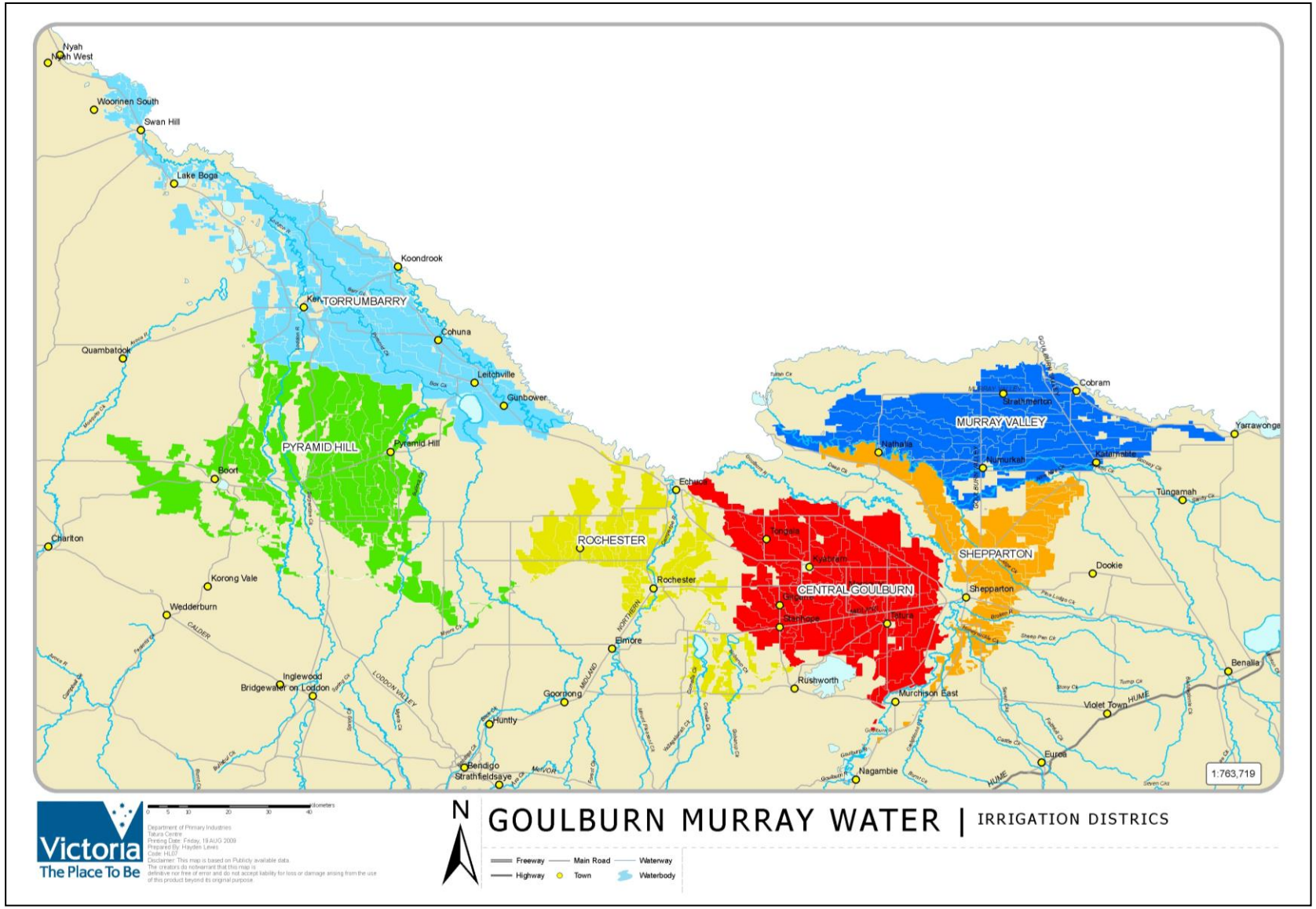


Figure 22 **Goulburn-Murray Water irrigation districts 2005-2006**

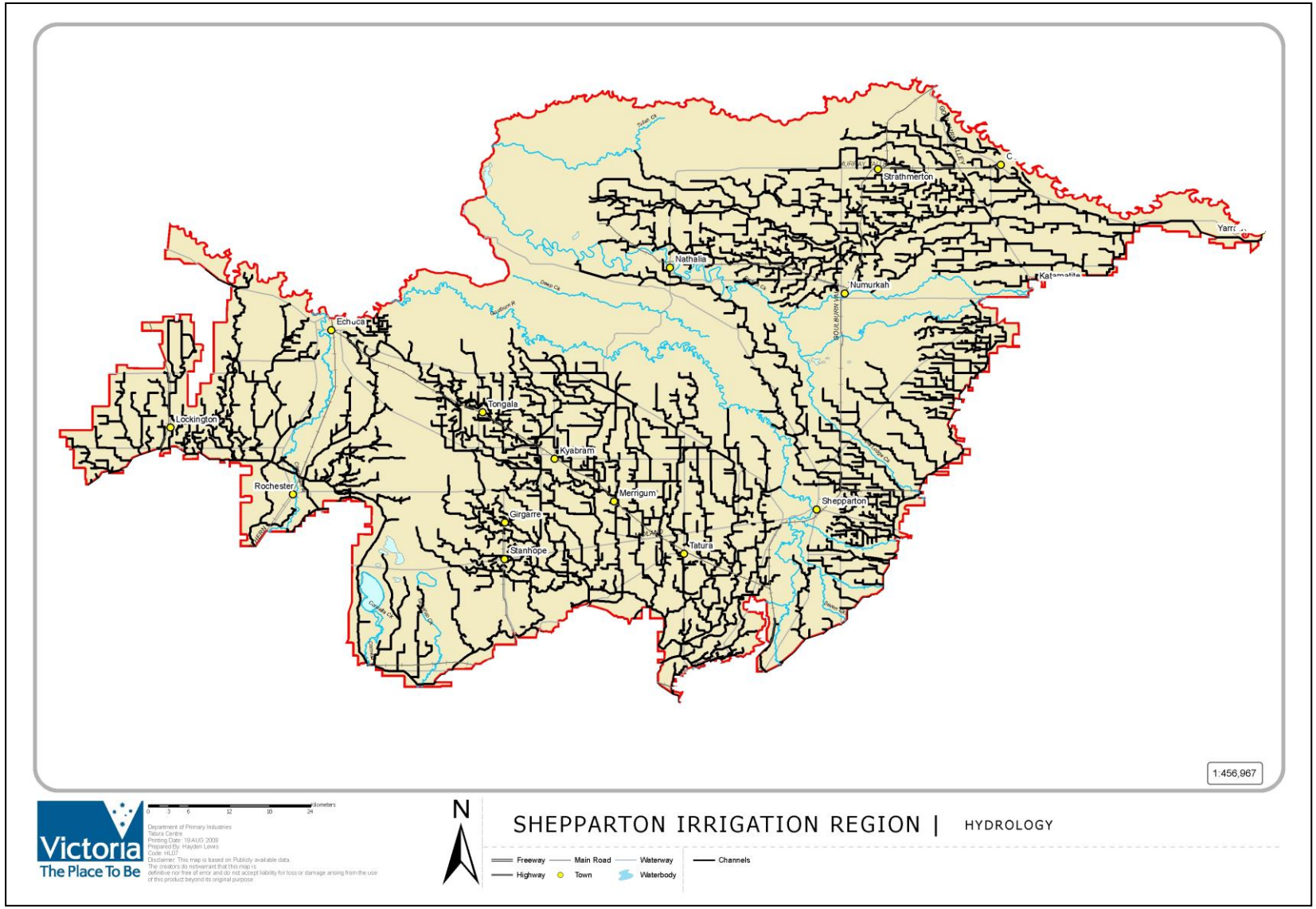


Figure 23 **Irrigation channel system within SIR, 2005-2006**

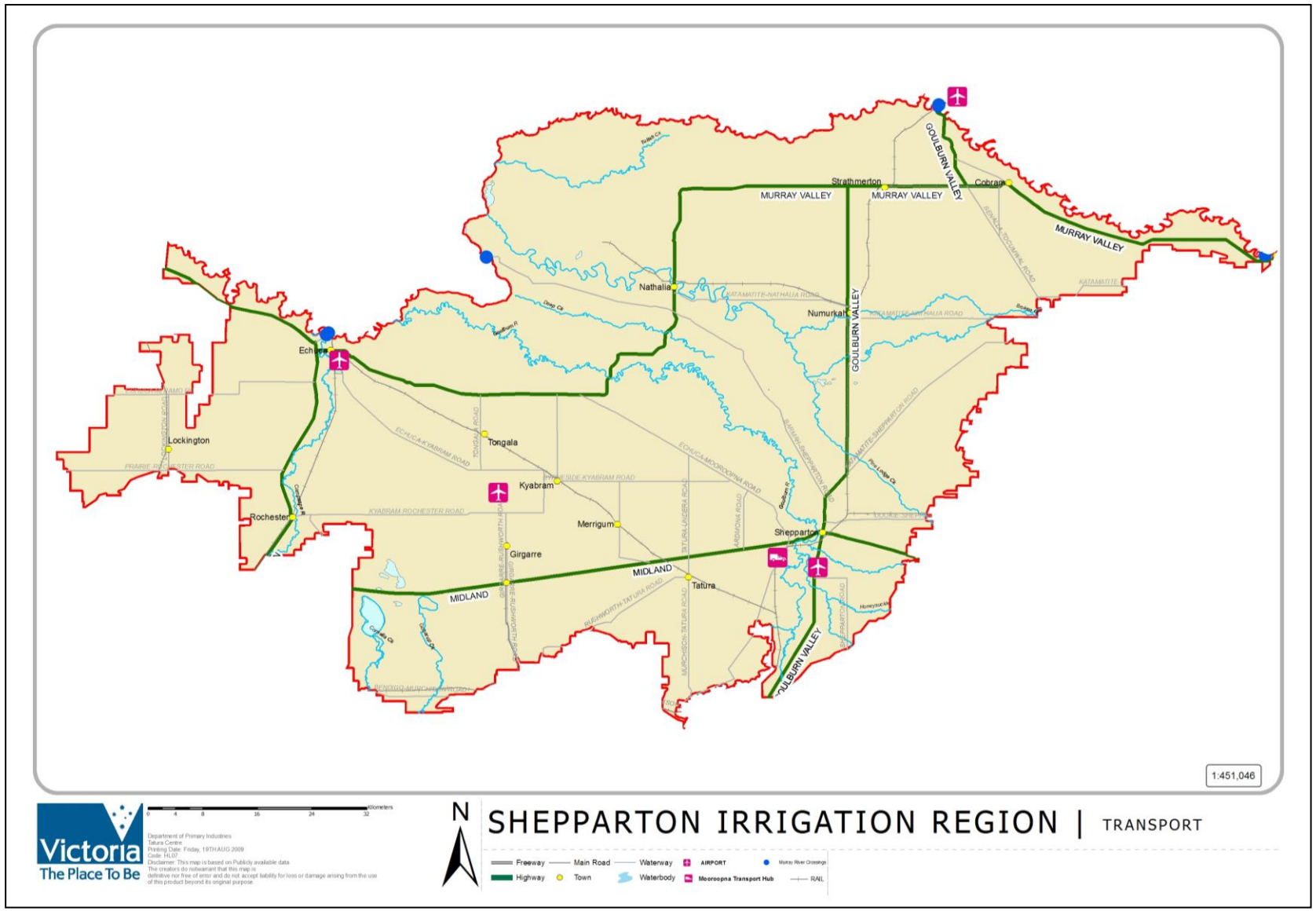


Figure 24 **Transport network within SIR, 2005-2006**

4.2.3. Flood protection measures

There are two strategic rural flood protection assets, namely: the River Murray levees (formally known as the Public Works Department Levees), and the lower Goulburn Levees. The level of protection offered by these two levee systems cannot be guaranteed as the levees are not maintained. Management of these levees is currently not resolved.

The replacement values of these levees would run in the tens of millions of dollars. During the last flood in 1993, the damage bill associated with the lower Goulburn was some $20 million (at 1993 prices). Other important assets within the SIR are the town levees at Cobram (construction cost of about $3.8 million at 2000 prices) and upgrade of Nathalia town levees.

Importantly flood warning upgrades in recent years include the Shepparton, Mooroopna and Loch Garry Flood Protection Districts. This will be expanded along the Broken Creek in the near future.

4.3. Social assets

4.3.1. Cultural heritage

The ownership, oral history and traditions of the First Nation in our area is that of the Yorta Yorta Nation which has been here for thousands of years with their cherished and deeply respected ways of communicating complex information about culture, politics and environment of their society and region.

Our knowledge of the Indigenous Australian people has been scarce and corrupted. This has mainly occurred because of a poor understanding of aboriginal society as passed on by those early recorders into the history books of Australia.

In more recent years the Yorta Yorta people, for example have begun to tell their story and pass on their knowledge of their people to the wider community. This is forging greater understanding and has brought social and economic benefits to both the wider community and the Indigenous Australian community. Existing relationships are being built on via formal agreements with the State Government such as the cooperative management agreement – Yorta Yorta Joint Body and The Registered Aboriginal Party Status - Cultural Heritage Act. Relationships with key stake holders such as GB CMA, DSE, Parks Victoria, DPI and G-MW will forge greater partnerships for the future and avoid repeating the mistakes of the past.

The Yorta Yorta Nation area radiates out from the River Murray to the Goulburn, Edwards, Campaspe, and Lower Ovens Rivers. The Yorta Yorta people find themselves today in a unique situation in relation to the state border of New South Wales and Victoria as the Yorta Yorta traditional boundaries encompass both sides of the River Murray.

This situation should be viewed as an opportunity for both states to develop a unified Natural Resource Management (NRM) plan for water and crown land areas of the River Murray and allow the traditional values and relationships of Indigenous Australian culture with scientific research to better understand these iconic public assets.

Throughout the catchment other Traditional Owner Nation groups exist and these groups have views and aspirations and are endeavouring to work jointly with the natural resource management agencies to form partnerships and assert their interests into development and works within their areas.

The 2006 Census states that 2,789 people living in the municipalities of Greater Shepparton, Moira and Campaspe identify as being Aboriginal and/or Torres Strait Islander (ABS 2007c).

Dr Alford (2002) reported that within the Shepparton/Mooroopna region in 2002, the total labour force, unemployed and employed, was 10,593. The total Indigenous labour force was 1,018. Within the broader community, unemployment was 7.5 per cent. Within the Indigenous community, excluding those on the Community Development Employment Program (CDEP), the unemployment rate for Indigenous people was 77.6 per cent.

4.3.2. Organisational partnerships

The organisations implementing the SIRCIS have very positive working relationships which have developed over the long history of the Program. The relationship structure is described in Section 2.5.7 and the role of each organisation is fully described in Appendix 8.

4.3.3. Community

The community has long been the driving force behind the SIRCIS and its success. Community leaders were heavily involved in drafting the original plan and have been an integral part of its implementation through committees and working groups. This involvement is described in Section 2.5.7. The achievements of the SIRCIS would not have been possible without individuals in our community implementing works on their own properties.

5. Threats

This section details the threats impacting on the assets described in Section 4. These threats can be physical processes such as salinity, they can be activities such as irrigation, or they can be barriers to change such as lack of financial resources.

5.1. Processes

5.1.1. Salinity

Salinisation of the land and water assets in the SIR remains the greatest threat to future prosperity and a major threat to the biodiversity in the SIR. The hydrological cycle in the SIR has undergone massive change since European settlement due to clearing of native vegetation and the introduction of irrigation. The result has been watertable rise and salt mobilisation.

In the late 1980s high watertables (less than two metres from surface) affected 30 per cent of the region. The rise in watertables in the region was very rapid and a peak of 47 per cent of the area surveyed had watertables within two metres was registered in 1995. A summary graph of depth of watertables in the SIR from 1982 to 2008 is shown in Figure 25.

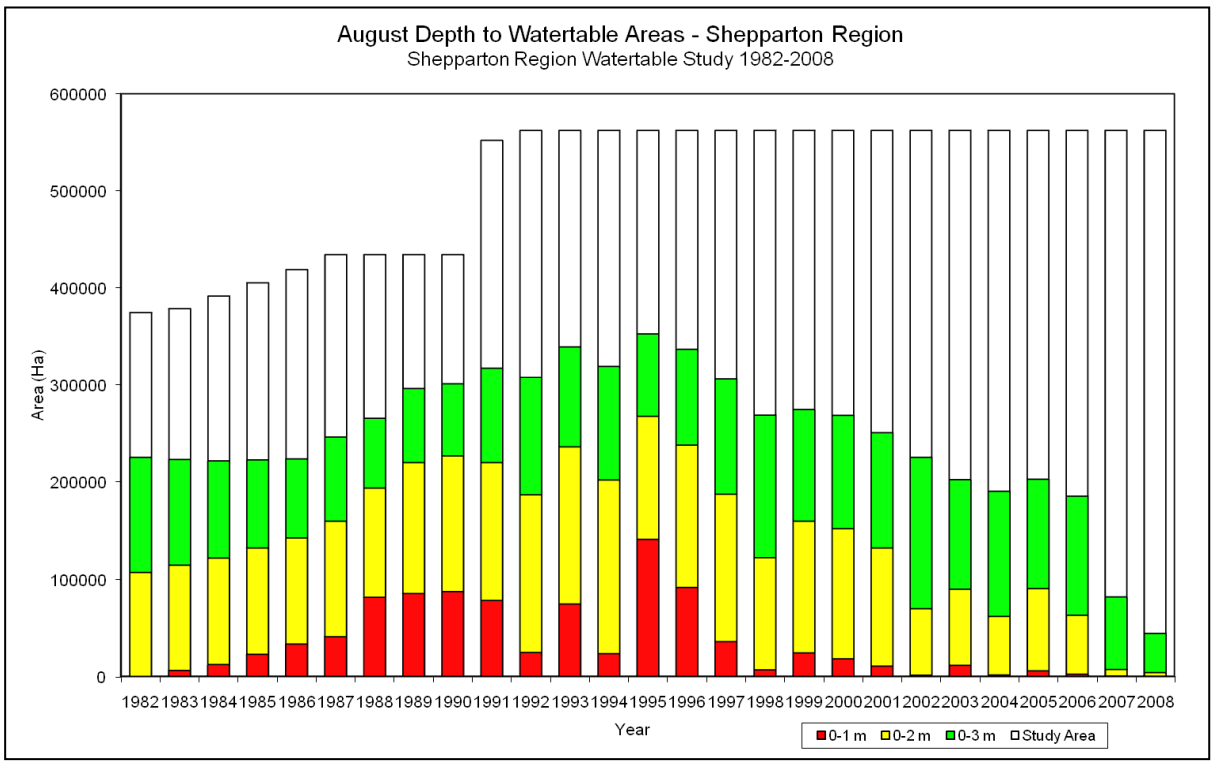


Figure 25 August depth to watertable areas, SIR, 1982 to 2008

A combination of dry seasons and progress with salinity works have led to a significant reduction in watertable levels since 1995. In 2006 only 16 per cent of the area studied is within the two-metre contours. It has been difficult to apportion the changes caused by reduced water availability, seasonal change and salinity mitigation works. It is expected, however, that a return to wetter conditions will see a rise in the watertable levels. The Sub-surface Drainage Program (SSDP) employs both private and public groundwater pumping and tile drainage to manage groundwater levels for salinity control and salt disposal within the region.

Habitats in the lowest parts of the landscape are under most immediate threat (streams and wetlands). Trees are at substantially increased risk when watertables are within two metres of the surface (Kelly, 1994). Salt loads in rivers and streams also contribute to a decline in water quality.

Salinity control works are defined as 'accountable actions' under the Murray Darling Basin Salinity Management Strategy due to the downstream impacts of additional salt entering the River Murray from works implemented under SIRCIS. The mix of these salinity mitigation works will change due to the changes in water use patterns. For instance, drainage diversion remains an important part of managing salt exports, but as drainage flows decrease (because of increased water use efficiency), the salinity concentration will increase, which will reduce the water quality for diverters. This will require some effort in identifying other salt disposal options. The use of evaporation basins is not considered a long term option.

5.1.2. Water quality and quantity

5.1.2.1. Nutrient-rich and turbid surface water

In addition to salt, the SIR generated 242 tonnes of phosphorus and 935 tonnes of nitrogen in 1993-1994 and exported some 236 tonnes of phosphorus and 887 tonnes of nitrogen from the region. This was set as the benchmark year and used to develop the Goulburn Broken Water Quality Strategy (GBWQS). Based on irrigation drain monitoring, the current phosphorous export for the five-year average of 2002-2003 to 2006-2007 was 15 per cent of the 1993-1994 levels. This was substantially better than the SIRCIS target of a 50 per cent reduction. Nutrient levels are still being watched closely as a series of dry years may significantly change these figures. We do not expect a return to 1993-1994 water quality levels as a result of the actions taken to improve irrigation efficiency and drain management.

High nutrient loads increase the risk of algal blooms which could occur in and downstream of the SIR. Major sources of nutrients included irrigation drainage, sewage treatment plants, sediment mobilisation, urban stormwater and intensive animal industries. The Goulburn Broken Catchment does contain fish farms which can be a source of high nutrient loads however none are located in the SIR.

According to the Goulburn Broken Water Quality Working Group (GBWQWG), the Goulburn Broken Catchment contributes only 37 per cent of the River Murray water flow above the Murrumbidgee, but contributed 58 per cent of the sediment (GBWQWG 1996, page 23). The volume of suspended solid loads has fallen dramatically and is at about 10 per cent of the 1996-1997 load (monitoring of suspended solids began in 1996-1997).

Generally farm chemicals are not a significant problem. However, commonly used pesticides in intensive horticulture within the SIR have been found in surface drainage water following application to soils. Studies of shallow well sites in the Tongala-Kyabram area have indicated contamination of groundwater with herbicides (Stork, P., 1999).

In 2006, G-MW commissioned the consulting firm URS *"to prepare a detailed report that aims to identify potentially harmful natural and anthropogenic substances occurring in groundwater in the SIR that may pose a risk to agriculture and human health"* (URS 2006 page 1-1). *These substances may include petroleum hydrocarbons, leachate and pesticides. Pesticides are generally a non point-source contaminant as they are applied by farmers to crops such as insecticides, herbicides and fungicides* (URS 2006 page 1-2). *The presence of naturally occurring salt and biological contaminants in groundwater will not be considered in this project as these substances are considered in ongoing programs within the SIR*.

The research project sets out to:

- Identify the substances carried in shallow groundwater that could potentially impact on the productivity and/or sustainability of irrigated land or on animal or human health.
- Identify areas where anthropogenic substances may be entering the shallow groundwater or are being used for irrigation, stock or domestic purposes and where the substances present the greatest risk to groundwater (groundwater risk hotspots)
- Present any real data for natural or anthropogenic substances.

The results of this research will be incorporated into SIRCIS when it becomes available.

5.1.2.2. Groundwater quality

While rising groundwater levels are the major cause of salinisation of land and streams, groundwater within the Goulburn Broken is a significant water resource for irrigation and for industry and urban supply. In such circumstances, a balance is necessary between pumping to provide salinity control while protecting the groundwater resource and the rights of groundwater resource users.

Increasing demand for groundwater has been apparent in recent years because of a series of dry seasons and the cap on surface water diversions within the Murray Darling Basin. In some areas, increased demand is threatening the sustainability of the groundwater resource.

A drier climate and improved irrigation efficiency is likely to lead to further reductions in groundwater levels. While this is good news from a salinity management perspective, it poses significant new groundwater management issues. Catchment managers and groundwater resource managers are working together to develop strategies to deal with this changing environment. The implementation of the Groundwater Management Plans (SIRWSPA, CDLWSPA and KWSPA) ensures groundwater use is managed sustainably.

The 2005-2006 monitoring done in the SIRWSPA shows that groundwater salinity is highly variable due to the complex nature of the shoe-string sands that make up the Upper Shepparton Formation aquifer (Figure 26).

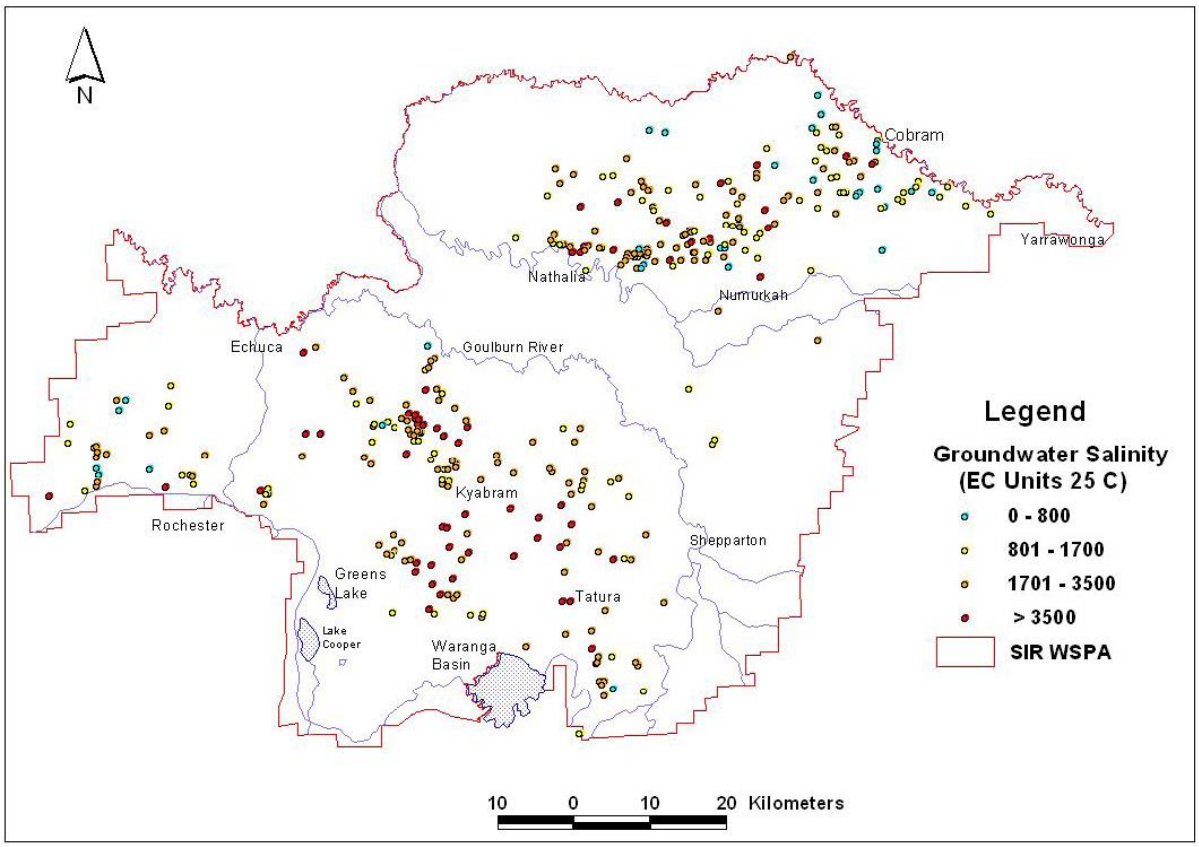


Figure 26 **Distribution of groundwater salinity samples received for SIRWSPA irrigation bores, 2005-2006**

Source: G-MW 2006a, page 13

The groundwater salinity within the deep lead aquifer tends to increase from south to north with salinity also being higher on the lateral boundaries in the Campaspe WSPA (G-MW 2006b, page 4). No analysis was conducted on temporal trends in salinity up to 2005-2006 as there is insufficient data to justify such an analysis on an annual basis. (Figure 27)

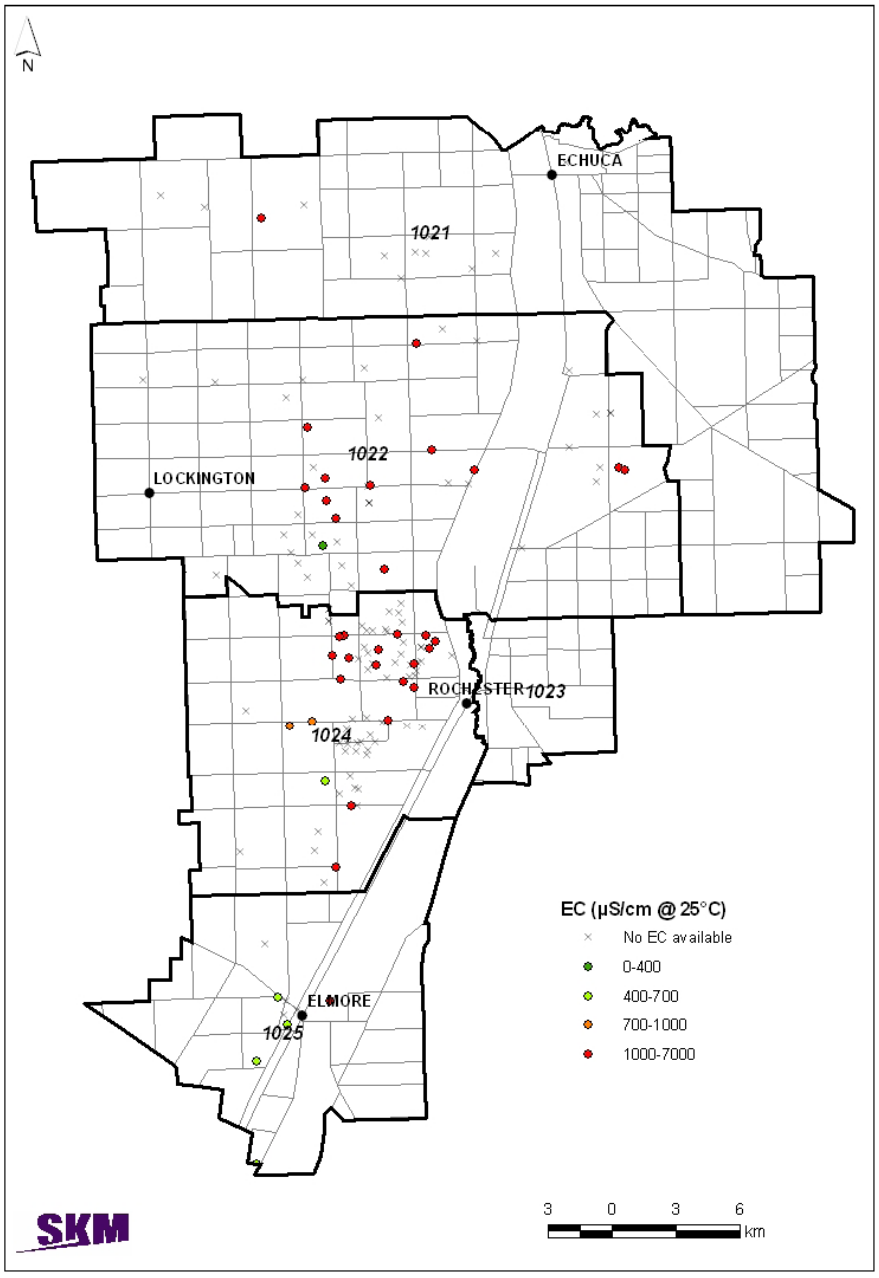


Figure 27 **Campaspe Deep Lead WSPA salinity sampling compliance, 2005-2006**

Source: G-MW 2006b, page 5

5.1.3. Changed flow patterns and water availability

We are using significantly less water, yet water is becoming increasingly scarce, with strong competition among environmental, agricultural, urban, industrial and recreational demands.

Harvesting, storing and delivering water for urban and agricultural use has dramatically altered the flow patterns and quantity of water in our rivers and creeks, often reversing the seasons when high and low flows would naturally occur. This has had a direct impact on the aquatic biodiversity in the SIR through changed watering patterns and quality of water. CSIRO (2008, page 4) stated that:

> *"Water resources development has increased more than four-fold the average period between large (1,000GL/month) beneficial floods to the lower Goulburn River floodplain. Additionally, undesirably low flows that diminish deep water pools and degrade native fish habitat are now more prevalent. They occur about twice a year on average rather than once every seven to eight years under 'without-development' conditions".*

The need to achieve water savings presents many unique challenges for the SIR community. Water savings will come from major infrastructure projects such as converting to open channels to pipes and modernising of irrigation supply systems, or from better use of storages. Water savings will also come from a more environmentally sensitive and productive use of available water resources both in irrigation and rain-fed production systems. To mitigate the environmental impacts of inefficient use of water requires a better understanding of where particular land uses should best be located in the catchment, and the development of appropriate practices to better manage water in both irrigated and dryland contexts. In particular, recharge rates under particular land uses and irrigation practices need to be quantified.

At the farm scale, irrigation can cause wetlands and remnant vegetation to undergo changed hydrological cycles that significantly degrade them. Algal blooms in some wetlands are increasing as a result of increased nutrient levels. Landforming can also directly affect these features.

The Victorian Government is responding to these challenges by the implementation of the Northern Region Sustainable Water Strategy (NRSWS).

5.1.4. Climate change

We are expecting a future where our climate is much more variable with less rainfall. CSIRO is beginning to define managing climate risk as a defining characteristic of farming excellence (CSIRO, 2008a). Table 17 summarises the scenarios which have been adopted for planning purposes in the SIR.

Table 17 Climate change scenarios for 2030 and 2070 for Northeast Region

Seasons	2030	2070
Spring	Warmer by 0.3 to 1.6°C Rainfall decrease likely (+3 to – 15%)	Warmer by 0.8 to 5.0°C Rainfall decreases likely (+10 to -40%)
Summer	Warmer by 0.3 to 2.0 °C Rainfall change uncertain (±15%)	Warmer by 0.8 to 6.0°C Rainfall change uncertain (±40%)
Autumn	Warmer by 0.3 to 1.6°C Rainfall change uncertain (±10%)	Warmer by 0.8 to 5.0°C Rainfall change uncertain (±25%)
Winter	Warmer by 0.2 to 1.4°C Rainfall decrease likely (3 to -10%)	Warmer by 0.7 to 4.3°C Rainfall decrease likely (+10 to -25%)

CSIRO projections for north eastern Victoria (

Table 18) were based on the results of 12 climate models that had good simulations of observed average patterns of temperature, rainfall and atmospheric pressure over south eastern Australia. Warmer and drier conditions are likely, with more heatwaves, fires, droughts and rain storms, fewer frosts and less snow.

Table 18 Climate changes likely for north eastern Victoria

Variables	Changes
Temperature	Annual warming of 0.3 to 1.6°C by 2030 and 0.8 to 5.0°C by 2070
	Daytime maximum temperatures and night time minimum temperatures are likely to rise at a similar rate
	Warming is likely to be greater in spring and summer
	10-60% increase in the number of hot summer days (greater than 35°C) by 2030 and a 20-300% increase by 2070 on the plains. Rate of increase will be greater in the mountains
	0-50% reduction in the number of frost days by 2030 and a 50-100% decrease by 2070
Rainfall	Annual rainfall decrease is likely (changes of +3% to -10% by 2030 and +10 to -25% by 2070)
	Extreme daily rainfall events are likely to become more intense
Snow	Area with at least one day snow cover per year likely to be reduced by 10-40% by 2030 with a 22-85% reduction by 2050
	Area with at least 60 days snow cover shrinks 18-60% by 2020 and 38-96% by 2050
	Peak snow depth at Mt Hotham declines 10-50% by 2020 and 25-95% by 2050
Drought	Droughts are likely to become longer and more frequent, particularly in winter-spring
	Rainfall deficiencies that currently occur once every 5 winter springs may occur once every 3-5 years by 2030 and once every 2-3 years by 2070
	Due to hotter conditions droughts are also more likely to become more intense
Fire	10-40% increase in the frequency of days with extreme fire-weather risk by 2020, and 20-120% increase by 2050
	4-25% increase in the frequency of days with very hot and extreme fire-weather risk by 2020, and 15-70% increase by 2050

Source: Feehan Consulting, 2007

This is expected to mean:

- lower groundwater levels and therefore lower salinity impacts
- lower water allocations and therefore improved water use efficiency.

However, it may also have some negative impacts for the program. For example, continued dry conditions may mean that surface water management systems are a low priority for landowners (GB CMA, 2007b).

> *"Warmer and drier conditions are likely to see a continued lowering of the watertable, decreasing the risk of land salinisation. It is anticipated that demand for water will increase and farmers will further rely on groundwater as a key source of supply. In the interim, this will lead to greater local distribution and storage of salt in the upper soil profile. The increase in water and soil salinity will increase the level of accessions to the watertable which may lead to further rises in watertables.*
>
> *A better understanding of these relationships for the different sub-catchments is required and will be addressed by the SSDP through its Research and Investigation Program over the next five years" (*GB CMA 2007c, page 81*).*

CSIRO is undertaking a Sustainable Yields Project to provide governments with "a robust, (Murray Darling) basin-wide estimate of water availability on an individual catchment and aquifer basis, taking into account climate change and other risks" (CSIRO 2008, page i).

The report for the Goulburn Broken is complete and found that:

- average surface water availability under the historical climate is 3,233GL/year
- under current development 1,606GL is diverted for use (this is an extremely high level of diversion)
- if the recent (1997 to 2006) climate were to continue, average surface water availability would be reduced by 41 per cent and the volume of water diverted for use within the region would be reduced by 25 per cent
- the best estimate [or median] climate change scenario by 2030 would reduce average

surface water availability by 14 per cent and volume of water diverted for use within the region would be reduced by 6 per cent.

The impacts on farming in the SIR are difficult to predict but some have already been determined. These impacts include (DSE 2008, pages 9 and10):

- *increased heat stress on dairy cattle, (reducing milk production unless management measures such as shade sheds and sprinklers are adopted)*
- *inadequate winter chilling for some fruit trees,(which may reduce fruit yield and quality, however, higher temperatures are likely to reduce the risk of damaging winter frosts for other crops)*
- *heavy rains and winds from storm events and other climate change impacts contributing to crop damage and soil erosion.*
- *indirect impacts due to changes in weeds, pests and international markets (placing farms under stress).*

"The impacts for biodiversity are similarly difficult to predict. However, we can say that species already at extinction risk and those suffering from reduced habitat are the species most likely to be at greater risk. "Climate change is likely to amplify existing threats such as habitat loss and invasive species, making their impacts considerably worse".

Our response to climate change will have to be a combination of adaptation and reducing production of greenhouse gas emissions. Responding to climate change will require sustained effort over a long time frame.

5.1.5. Dryland salinity

Dryland salinity is not the main focus of the SIRCIS as the SIR has limited dryland areas and the issue is outweighed by irrigation salinity. Dryland salinity in the upper catchment of the Goulburn Broken Catchment has a large and growing impact on the SIR in terms of water salinity levels, both river and groundwater. SIR IC supports the work of the upper catchment in its endeavours to manage the issue.

5.1.6. Soil health

The Draft Goulburn Broken Soil Health Strategy Action Plan states that:

There has been increasing concern that soil health in the Goulburn Broken Catchment has been declining. While this can be a natural process, farming practices and human impact have accelerated erosion, salinity, sodicity, acidity, soil structural decline, reduced soil biodiversity and lowered soil resilience. Declining soil health will affect agricultural production, and will also influence the success of revegetation efforts and erosion control (GB CMA, 2006, page 5).

5.1.7. Pest plants and pest animals

The successful management of pest plants and animals underpins the outcomes of other sub-strategies. Weeds and rabbits, for example, can both have a major impact on the quality of remnant vegetation, which in turn is critical for biodiversity, river health and salinity management outcomes. Co-ordinated control programs can significantly reduce the impact of foxes on native fauna while having economic benefits for graziers.

The Broken Boosey Conservation Management Network Coordinated Fox Control Program is a perfect example of the integration of biodiversity and pest animal control activities on private and public land.

A recent change in direction for the SIR pest plant program is for control efforts to be focused more on the management of new or emerging weeds in the first instance, rather than weeds that are well established across the region. The development of a "Weed Risk Assessment Model" has enabled the identification of weeds that pose a high level of threat to environmental and agricultural assets of the region. If these weeds are either not yet present or not established in the region, they are considered to be high priorities and prevention or eradication strategies will be developed and implemented.

New and emerging weeds that are currently targeted include ivy-leaf sida and camel thorn (state prohibited species), cape tulip, artichoke thistle and wild garlic (regionally prohibited species). None of these species are well established in the SIR and the aim of the program is eradication within a few years.

Where community groups can demonstrate a high level of coordination, more established high threat weeds will still be the target of extension and compliance programs. The ongoing blackberry program in the SIR is a good example. This program has been put on hold during the drought, but will recommence once seasonal conditions improve.

Weeds on linear reserves will be given a higher priority in the SIR in coming years, as it has been recognised that linear reserves provide major pathways for weed spread into the region. Serrated tussock for example, while not currently present in the SIR, is a significant threat to the region. Over the past couple of seasons, infestations have been located along the Goulburn Valley Highway and if these are not managed, this highly undesirable species will continue to move northward.

5.2. Activities

5.2.1. Stock grazing

Dairying and mixed farming (cropping including sheep and beef cattle grazing) are major agricultural pursuits and large areas of public land along streams are also licensed for grazing or are being illicitly grazed. Grazing is causing active degradation of biodiversity values on-site and downstream over vast areas.

5.2.2. Irrigation

Poor irrigation practices can threaten the health of our soils. Soils can become waterlogged, develop saline watertables, become less fertile and produce the greenhouse gas, nitrous oxide, in large quantities when drainage is inadequate. Poorly designed irrigation farms can also cause significant quantities of nutrients to flow into the river. Algal blooms in some wetlands are increasing as a result of increased nutrient levels. Landforming can also directly impact on these features.

With the development of tradeable water entitlements, new areas of land are being developed for irrigation. These are areas of “good” soils which often have remnants of the most endangered native vegetation. If the development of new areas is not well managed this can place pressure on these last remaining areas through clearing and insensitive irrigation management. Irrigation Development Guidelines and associated processes are in place to avoid or minimise this risk.

5.2.3. Culverts, regulators and in-stream water storage management, levee banks and flood protection

This threat is closely linked with the induced threat of changed river flow patterns. Barriers within streams can prevent the migration of native fish species. SIRCIS programs in recent years have removed many of these barriers, although several small barriers remain, with priority zones for action being the upper Broken, Boosey and Seven Creeks systems. Removal of flood protection measures and levees to improve water quantity and quality remains a contentious issue.

Floodplains were converted to agricultural land in the early days of European settlement. Many important ecosystem services provided by these floodplains have been lost, and much of the agricultural land cannot be economically protected from flood damage.

The ecological functioning of many of our river systems has been changed by development and use of the land adjacent to streams, recreational activities, use of the natural river systems for transporting stored water to downstream developments and flood mitigation works on the floodplains. These changes have led to in-stream instability, bank erosion, loss of in-stream and riparian habitat values, and isolation of wetlands and billabongs from the stream.

Raised structures such as levees, channels, raised roads and railways, spoil banks and bridges have had a significant impact on flood behaviour, affecting flow distributions, flow velocities and depths. While they can have significant benefits in reducing flood damage, they can have a number of 'dis-benefits', including:

- a reduction in riverine and floodplain habitats, leading to an isolation of wetlands and general fragmentation, leading to habitat decline, altered nutrient processes and further loss
- an increase in flow concentration and stream power, leading to increased flow rates and flood levels, and stream and bank erosion
- a reduction in the frequency of deposition of fertile material across the floodplains
- intensification of land use in the protected areas of the floodplain, with a resultant increase in social disruption and flood damage when the levee fails
- a reduction in soil moisture
- the creation of a false expectation of being protected from floods that are greater than the levees are designed to cope with.

5.2.4. Cultivating, cropping and pasture management

Cultivation to prepare soils for cropping and pastures and to create mineral earth firebreaks (especially along roadsides) can damage existing native vegetation, prevent natural regeneration of remnant vegetation and encourage pest plants. This activity usually occurs on the best soils for agriculture – which equates to the most threatened EVCs. Land managers are becoming increasingly sensitive to biodiversity needs as awareness grows but the risk is still substantial.

5.3. Barriers to change

During the Irrigation Farm Survey in 2004-2005, respondents were asked about barriers to improving irrigation management practices. The results are presented in Table 19. Clearly financial resources and uncertainty regarding water resource allocation are the major barriers. While the SIRCIS cannot directly affect these threats, it needs to address them and design programs which take them into account. Insufficient financial resources were cited as a major barrier. This emphasises the importance of government contribution to appropriate cost-share in order to ensure that the Strategy is implemented in a timely manner.

Table 19 Barriers to change, SIR, 2004-2005

Reasons for inability to undertake water use efficiency works	Response rate %
Financial resources	50.2
Allocation uncertainty	47.1
Lack of time	20.0
Inadequate water resources	19.3
Age and health	12.9
Doubt success	12.1
Insufficient information	3.6
Poor water quality	2.3
Other	8.6

Note:

- This question generated multiple responses thus the response rates were not added together.

Source: L. Ash 2006, page 7

6. Achievements

6.1. What has the Shepparton Irrigation Region Catchment Implementation Strategy achieved?

Since 1990, the SIRCIS has achieved much of its planned activities, with most of them at least on target if not ahead of target. Figure 28 shows a selection of achievements in terms of outputs. The colours of the bars in the graph represent an assessment of progress. Five out of 15 activities exceeded targets and three have scored satisfactory.

Any works that increase the salt load leaving the catchment that were implemented after 1 January 1988 are classed as an accountable action. Any such accountable action by a catchment (e.g. the SIR) requires a Salt Disposal Entitlement (SDE) allocated by the Victorian Government. Under the 1988 MDBC Salinity and Drainage Strategy, agreement was reached on how to manage catchment activities which increase the amount of salt discharging to the River Murray. The salt disposal impact is expressed as the average increase in salinity in the River Murray at Morgan in EC units. Table 20 shows the current uptake of entitlements and future requirements of SDE for the completion of work programs to 2030. The existing groundwater pumping activities account for 81 per cent of the uptake of the entitlement to 2006. See Section 8.1.7 for additional information.

The Strategy will require 11.1EC for works to be completed between 2006 and 2030. Groundwater pumping and other SSD activities will take up all the 12.2EC whilst the SWMS will reduce downstream impact. The MDBA Basin Salinity Management Systems - 5 year Review of the Shepparton Strategy assumes a credit of -0.0022EC/km for PSWMS and a credit of - 0.00089 EC/km for the CSWMS (SKM 2007). Therefore any further works will be a negative value and if no further SWMS are constructed the maximum is estimated to be -1.076EC. Future groundwater pumping activities and other SSD activities will take up the balance of the allocated SDEs under the Strategy.

Table 20 Uptake of and future requirements for Salt Disposal Entitlements, SIR

SIRCIS activities	Uptake of Salt Disposal Entitlements EC			Future SDE requirement EC	
	Pre 1991	Total to 2005-2006	% of total	2006 to 2030	% of total
Primary surface water management systems	0.055	0.444	12	-0.682	-6
Community surface water management systems	0.008	0.098	3	-0.394	-4
Public groundwater pumps	0	1.522	42	8.900	80
Private groundwater pumps	0	1.421	39	3.144	28
Horticultural sub-surface drainage works	0.030	0.156	4	0.156	1
Total	**0.093**	**3.641**	**100**	**11.124**	**100**

Note:

- The 'Total to 2005-2006' uptake of Salt Disposal Entitlements includes pre-1991 impacts.

Sources:

- J Burkitt, G-Murray Water (SSDP), pers. comm, 2010
- SIRCIS SSDP 2006/2007, Five Year Review, Vol.2 Compendium, Section D
- SIRCIS SSDP 2006/2007, Five Year Review, Vol.1, Final Report
- Goulburn Broken Salt Register for MDBA Salinity Management Strategy, version 2010.

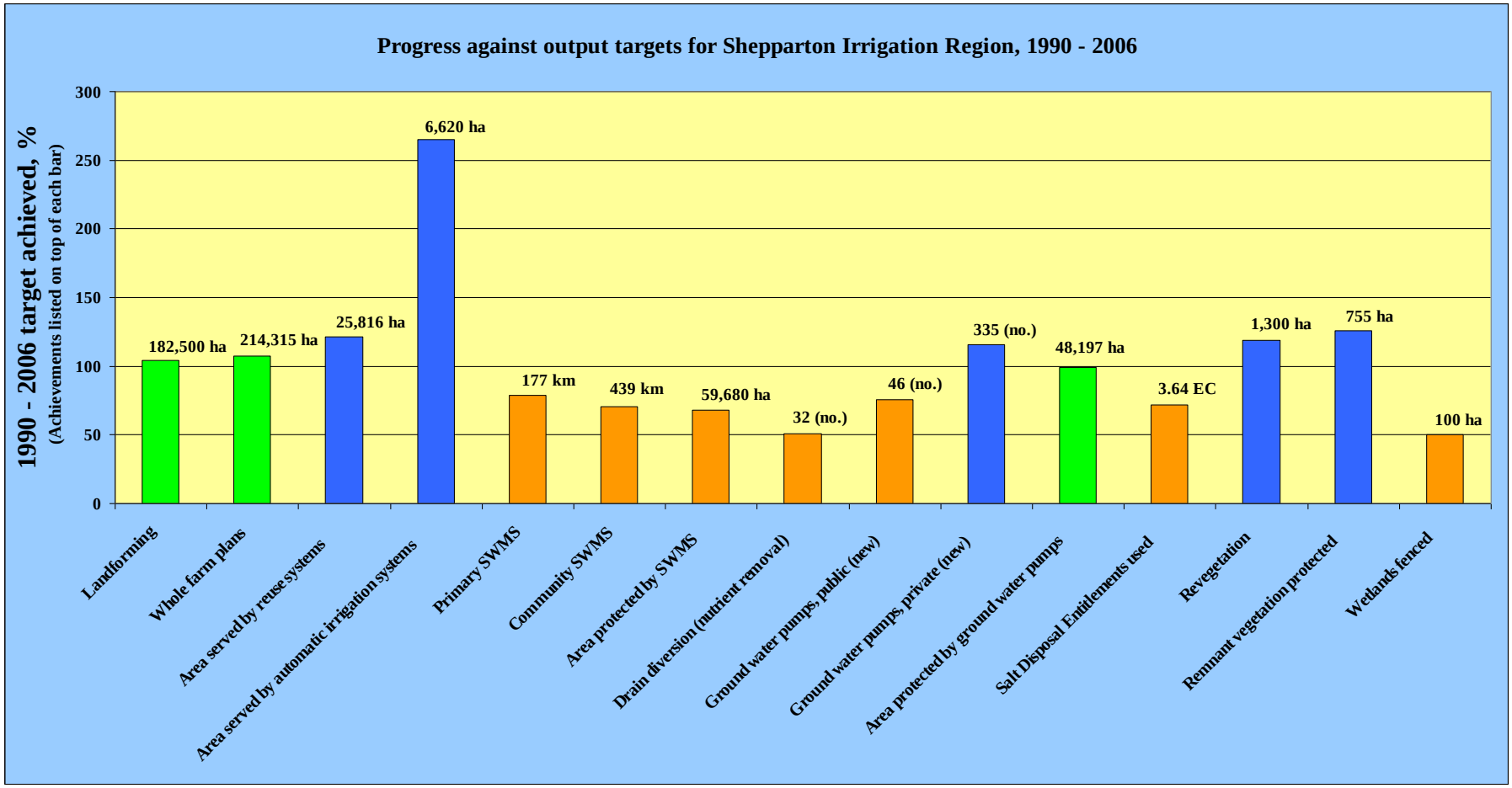


Figure 28 **Progress against output targets, SIRCIS, 1990-2006**

Legend:

Well below (<50%)	Below (50-79%)	Satisfactory (80-109%)	Exceed (110%+)

Note:

- The incentive schemes for reuse and automatic irrigation systems started in 2001-2002.

Since 1990, a total of almost $250 million was spent by the federal and state governments to address natural management issues in the SIR (Table 21).

Table 21 Summary of investment, SIRCIS (at 2006 prices)

Years	SIRCIS expenditure $M	Cumulative SIRCIS expenditure $M
1990-2001	$153.74	$153.74
2001-2002	$20.10	$173.85
2002-2003	$18.06	$191.91
2003-2004	$18.56	$210.46
2004-2005	$17.51	$227.97
2005-2006	$18.29	$246.27

Table 22 shows the performance of SIRCIS programs against targets. For the 2006-2007 targets, three programs were rated "satisfactory" and two programs were "below target". In terms of progress against long-term targets, the rating for two programs is "satisfactory" and program one program each for "exceed", "below target" and "well below target".

Table 22 Performance against targets, SIRCIS, 2006

Investment areas	Strategy life	Performance against targets 2006- 2007	Progress against target (long term outputs as determined by Strategy)
Environment Program	1990-2020	Below target	Below target
Farm Program	1990-2020	Satisfactory	Exceed
Sub-surface Drainage Program	1990-2030	Satisfactory	Satisfactory
Surface Water Management Program	1990-2020	Below target	Satisfactory
Waterways Program	2005-2015	Satisfactory	Well below

Legend

Well below (<50%)	Below (50-79%)	Satisfactory (80-109%)	Exceed (110%+)

Sources (pers comm, 2010):

- J Pagon (Environment Program)
- C Nicholson (Farm Program)
- J Burkitt (SSDP)
- S Green (SWMP)
- W Tennant and P Feehan (Waterways Program).

Much work is being done in the catchment to report against resource condition change outcomes (the difference made on the ground) rather than outputs (how many pumps, for example). Generally, the resource condition in the SIR has "improved" or "maintained" (

Table 23). Due to severe drought conditions since 2002, the water supply is “much worse” as water storages are experiencing low levels.

Table 23 Resource condition outcomes, SIRCIS, 2006

Investment areas	Resource condition change from all factors	Certainty of measuring	Comments/Sources of information
SIR salinity, watertables and River Murray salinity	**Improved**	High	Farm Program (Chris Nicholson, DPI)
SIR salinity and watertables	**Improved**	High	SSDP - Reduction in area at risk of salinity from high watertables. A combination of program implementation and drought. (James Burkitt, G-MW)
River Murray salinity	**Maintained**	Low	SSDP - A lot of uncertainty on SIR impact on River Murray salinity. MDBA modelling suggests large impact of reduced tail water fraction (less dilution flows from drainage), but actual salt entering river is significantly reduced. (James Burkitt, G-MW)
Water supply (on-farm)	**Improved**	High	Farm Program has a strong emphasis on improving on-farm water use efficiency and identifies options for farmers to make provision for water supply in winter. (David Lawler DPI)
Water supply	**Much worse**	High	Water storages are currently experiencing low levels; low inflows have been due to drought conditions experienced since 2002. (Wayne Tennant, GB CMA)
Environmental flows	**Improved**	High	Environmental flow has been delivered to key wetlands in the region with benefits to native flora and fauna. (Wayne Tennant, GB CMA)
Riparian and in-stream habitat and channel form	**Maintained**	Medium	There has been some improvement to many streams following the implementation of frontage initiatives (through the DEP and landowner projects). The drought has had an impact in some areas. (Wayne Tennant, GB CMA)
Water quality (nutrients) in rivers and streams	**Improved**	High	Nutrient loads are measured. Load targets have been greatly exceeded (Pat Feehan, Feehan Consulting)
Floodplain management (flood protection)	**Improved**	Low	Most improvement has occurred in emergency arrangements and flood warning (new technology telemetry to the Bureau of Meteorology); upgraded levees for the towns of Cobram and Nathalia, and in Planning Scheme information (flood mapping etc). Floodplain management is about:: • managing legacy flood problems, largely through flood warning and emergency management arrangements • managing the future problem through land use planning and controls which has been successful in Campaspe, Moira and Greater Shepparton Councils (Guy Tierney, GB CMA).
Biodiversity	**Maintained**	Low	While clearing has reduced and incentive programs are in place to increase native vegetation condition, long-term threats such as active and passive mismanagement of habitat and climate change persist. This is unlikely to change in the medium term given the scale of landscape modification since European settlement (Carla Miles, GB CMA and Jen Pagon DPI)
Pest plants and pest animals (waterways)	Improved	Medium	There has been some improvement to many streams following the implementation of frontage initiatives (through the DEP and landowner projects). (Wayne Tennant, GB CMA)

Legend

Much worse (<50%)	Worse (51-79%)	Maintained (80-109%)	Improved (>109%)

6.2. Achievement performance stories

6.2.1. Environment Program: Biodiversity Celebration Day, September 2006

The Biodiversity celebration day held at Drumanure, on the Nine Mile Creek, Broken Boosey State Park on Thursday 14th September 2006 was very successful. The day, titled 'Biodiversity - Working Together', was a showcase of community and agency people sharing information on a range of biodiversity projects. The day attracted more than 80 people interested in biodiversity management and included presentations (including the launch of the Yarrawonga and Central Creek Biodiversity Action Plans), lunch, guided walks, children's activities and displays, with input from over 10 agencies/organisations, numerous community groups and landholders. An evaluation indicated the day was a useful and positive experience and more opportunities will be identified to build on this experience. As part of this day, eight posters, one television interview, approximately seven newspaper/media releases, a formal invitation, displays and a DPI news article were produced.

6.2.2. Farm Program: Whole farm planning

Whole Farm Planning (WFP) is a tool used by landowners to consider the assets (natural and infrastructure) on their property and their plans for the future of their business, to design a property layout which will prevent groundwater accessions, and deliver efficient irrigation into the future. As Whole Farm Planning has evolved, issues such as native vegetation management and protecting water quality have been included. Figure 29 shows the areas with WFPs.

The Whole Farm Planning activity was reviewed in 1990, 1995, 2000 and 2005. The key evaluation questions were:

- "What changes in practices have occurred as a result of the Program?"
- "Did participants of the Program increase awareness, understanding as targeted? In what way?"

The information presented below is based on reports entitled "A Survey of Landowners Involved in the Whole Farm Plan Incentive Scheme (WFPIS) 1995- 2000" (Heard and Maskey, 2001) and "Whole farm planning in the SIR: a comparative analysis of reviews 1990, 1995, 2000, 2005" (Lawler and Maskey, 2006).

The significant findings from the two reports are:

- **Satisfaction:** There has been a significant improvement in the landowners' level of satisfaction from 59 per cent in 1990 to 91 per cent in 1995 and 96 per cent in 2000. This indicates the maturity of the program with time.
- When asked about the negative aspects experienced with development works, landowners mentioned high cost, loss of production, heavy cut areas and poor management as the main negative aspects.
- The majority (57 per cent) of landowners found the preparation of a WFP was useful for their farm development works. They said it allowed them to set priorities for their development works and they were able to stage works knowing it would fit together.
- The landowners used WFPs as a motivational tool. The plan provided landowners with better insight and an understanding of design that improved the efficient management of their properties. They also indicated they would encourage others to prepare a WFP.
- **Salinity benefit**: Landowners mentioned salinity control as the foremost benefit from implementing the WFP followed by ease of management, increased production and water use efficiency.
- **Incentive a key factor:** The majority also indicated they would not prepare a WFP if the incentive was not available. Landowners were positive about the scheme and indicated the scheme should continue in future.

- The 2000 and 2005 reviews showed landowners expected to fully implement their WFP within an average of six years after the preparation of WFPs with a range of one to 20 years (Lawler and Maskey 2006, page14).
- Almost all respondents said the WFP Program should continue into the future. Some recommended a few changes to the present WFP Program such as: increase the percentage of incentive; introduce incentives for drainage reuse systems; and that more information be made available about other incentive schemes.
- Overall, the results reflected a very positive reaction from the landowners about the scheme indicating the process undertaken to implement the scheme is working well.

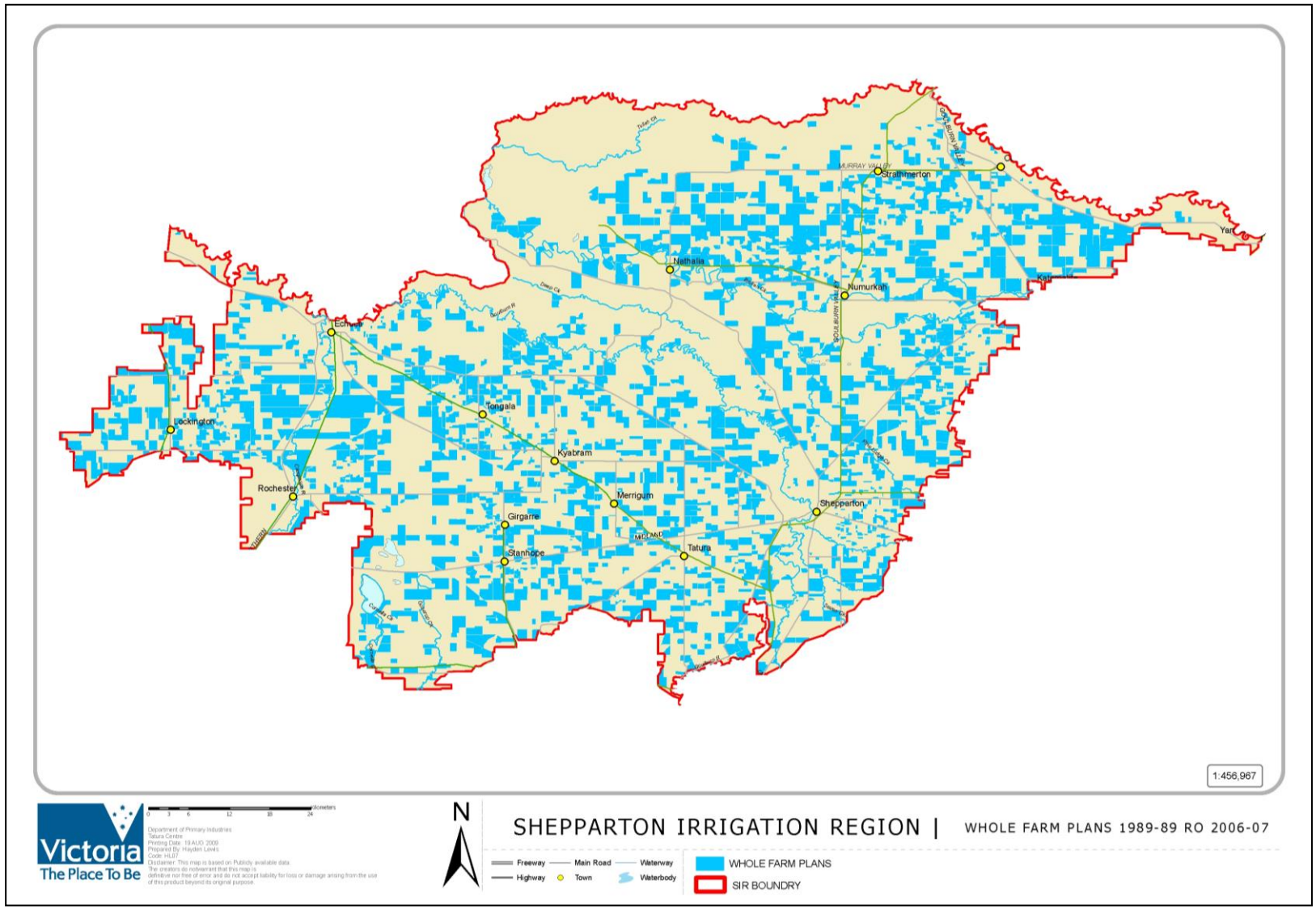


Figure 29 **Areas with whole farm plans in the SIR to June 2006**

6.2.3. Sub-surface Drainage Program: low volume groundwater pumping trial

Public and private pumps are being used in the region to protect the areas at risk due to rising watertable levels (Figure 30).

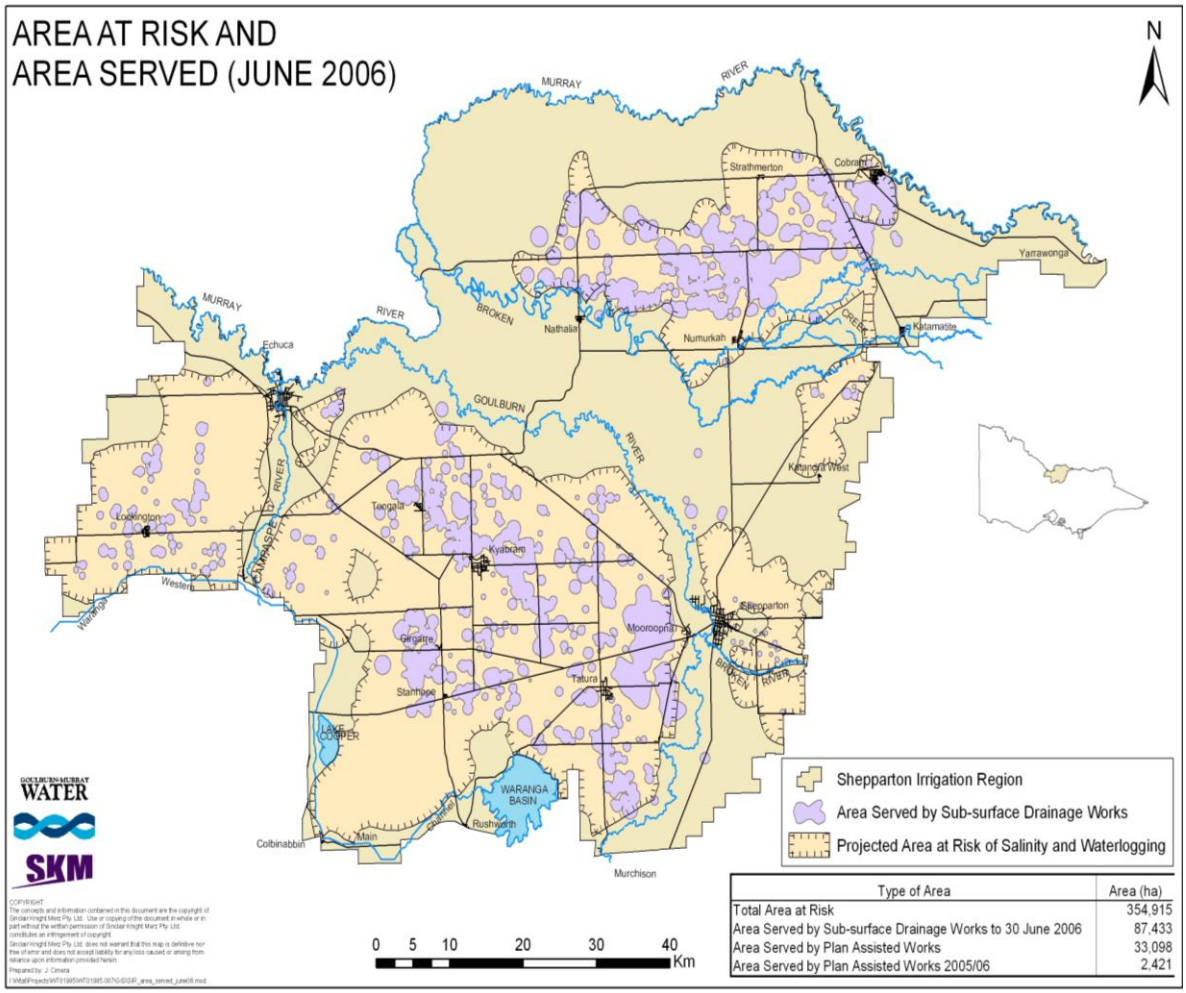


Figure 30 Areas served by public and private pumps

In the past the Wyuna community has been involved in extensive groundwater investigations to determine potential for salinity control in the area via the Farm Exploratory Drilling and the Public Salinity Control Pump Schemes provided by the SIRCIS.

The Wyuna Local Area Plan Group worked closely with the SIRCIS and G-MW to look at low volume groundwater pumping as a strategy for salinity control in areas where access to the groundwater is limited. A trial project (Figure 31) was set up in the area for a solar powered pump to pump groundwater at a rate up to 35,000L/day, with the aim of assessing the:

- effects of low volume shallow groundwater pumping for salinity control
- suitability of using a solar powered pump to achieve sufficient watertable lowering for salinity control.

The solar power trial indicated there is potential for low volume groundwater pumping to lower the watertable and provide salinity protection to pasture areas not suitable for conventional groundwater pumping systems. Besides being environmentally friendly, the benefits of using solar power in groundwater pumping include minimal maintenance requirements, no running costs, and systems can be located at sites where the supply of electricity is not viable.

Figure 31 **Solar powered low volume pump near Wyuna**

6.2.4. Surface Water Management Program: Kinnairds Wetland

Kinnairds Wetland (Figure 32) is a freshwater marsh that covers 93 ha and is located in both public and private lands. The Muckatah Depression drains into the northern end of Kinnairds, before outfalling into the Broken Creek. The wetland supports a number of waterbirds and wading birds listed under the migratory agreements Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA). The wetland vegetation is dominated by common spike sedge (*Eleocharis acuta*) and water milfoil (*Myriophyllum* spp) with sparse mature River Red Gums (DPI 2007a, page 11).

Works carried out during the construction of the Muckatah Main Surface Water Management System were designed to enhance environmental values throughout the catchment. This was achieved by constructing some 156 overflow sills that have been set at levels to ensure the reinstatement of appropriate wetting and drying cycles. A silt trap and drainage diversion sump upstream of Kinnairds Wetland collects sediment prior to water entering the retardation basin system (DPI 2007a, page 30).

Downstream flows enter Kinnairds Wetland via a series of low confining banks along the eastern boundary. The shallow wetland profile ensures the maximum removal of sediment, with the low sediment water delivered into the Broken Creek (DPI 2007a, page 30). A complementary monitoring program is carried out on a fortnightly basis for a range of physical and chemical parameters upstream and downstream of Kinnairds Wetland and suggests water quality is improved. This monitoring will continue and includes continuous turbidity monitoring for the first time in a SWMS (Smith, G, G-MW, cited in DPI 2007a, page 30).

The improvements have been achieved through a number of initiatives including sills of varying levels to enable the appropriate wetting and drying cycles to occur, silt traps, vegetation buffers and constructed wetlands.

Kinnairds Wetland design was the recipient of a Banksia Environmental Award in 2000.

Figure 32 **Kinnairds Wetland**

6.2.5. Waterways Program: bringing back the Broken

Underpinned by the Victorian River Health Strategy, the *"Our Water Our Future"* initiative and the Goulburn Broken Regional River Health Strategy, this multi-partner project is a strategic and integrated approach to river restoration works.

The $2.8 million program has achieved improved flows, erosion control, re-snagging and the revegetation of the Broken River corridor and the installation of a fishway at Casey's Weir (Figure 33 and Figure 34). Research shows the fishway is assisting native fish species, such as Murray Cod and Golden Perch to move upstream to feed and breed.

The river improvement program began with extensive research to identify the major threats to its wellbeing such as erosion, stock access, un-natural flow regimes, loss of habitat, artificial obstructions and weeds. Priorities for the works program were based on the levels of threat. A number of GB CMA programs offer incentives for landholders to carry out work along the river frontage, including alternative stock-watering,

fencing, irrigation reuse and revegetation. About 80 per cent of landowners have expressed interest in helping improve the condition of the river.

Local government has also been heavily involved in the program, particularly by improving the quality of urban stormwater entering the river. The City of Greater Shepparton and the Rural City of Benalla have installed several gross pollutant traps which prevent tonnes of litter reaching the river each month.

A number of community groups are also involved, particularly in monitoring, revegetation and weed control. An extensive monitoring program, which checks the river for salinity, nutrients, turbidity, temperature and a range of other environmental indicators, confirms the water quality and biodiversity are responding well to the Broken River work.

Success of this project has been enabled through support from project partners, G-MW, DSE, DPI and the local community.

Figure 33 Fish ladder on Broken River, at Casey's Weir

Figure 34 **Broken River**

6.3. Highlights of non bio-physical achievements

The major works undertaken include the construction of surface water management systems, re-use systems, whole farm planning(WFP) and installation of private pumps (horticultural and non-horticulture areas). The SIRCIS is a partnership between the community, agencies and all levels of government. It has a range of formal and informal processes in place to ensure that the catchment community remains actively involved in its implementation.

The non bio-physical achievements are:

- inclusion of the catchment community at all levels of decision making
- integration of all SIRCIS Programs (particularly the Environment and Waterways Programs) to achieve multiple benefits and to ensure efficiencies in investment in natural resource management, in particular the linkage of wetland water regimes to the surface water management network
- flexible and adaptable programs to respond to seasonal and funding cycles
- strong involvement from all partners in the catchment, especially local government and water authorities
- establishment of a cost-share arrangement with local government
- national and international recognition of the SIRCIS as an innovative and successful strategy that achieves long term and significant environmental, social and economic outcomes
- inclusion of cultural heritage issues within each of the programs, especially the SWMP
- development and implementation of the SIR Groundwater Management Plan
- design and development of a Catchment Partnership Memorandum of Understanding (MoU) articulating the key areas of a successful partnership and how we can continually build on our partnership strengths
- finalisation of the Irrigation Drainage MoU with the NCCMA, DSE, G-MW and the Environment Protection Authority (EPA)
- development and implementation of a prioritisation process for the Sub Surface Research and Development (R and D) Program
- completion of the Irrigation Futures Project
- integration with NVIRP.

A large amount of information on strategies and achievements is on the GB CMA web site - http://www.gbcma.vic.gov.au. The GB CMA's annual reporting was favourably received by the Australian National Audit Office when conducting the recent study on the Regional Model for the National Heritage Trust (NHT) and the National Action Plan for Salinity and Water Quality (NAP).

7. Triple Bottom Line Analysis

This section presents an overview of the economic, environmental and social impact analysis of the SIRCIS programs.

The program reviews provide detail on the triple bottom line analysis (GB CMA 2007a, GB CMA 2007b, GB CMA 2007c and GB CMA 2007d).

7.1. Economic impact

A cost-benefit analysis was conducted using "with" and "without" the Program scenarios. In accordance with the Victorian Government's guideline, a 4 per cent real discount rate was used (Government of Victoria, 1988). It covered the 'market' priced benefits and costs of the programs.

The investment horizon is 30 years for the Farm, Surface Water Management and Environment Programs. The investment horizon for the SSDP review is up to 45 years. The main economic indicators are Net Present Value (NPV), Benefit-Cost Ratio (BCR) and Internal Rate of Return (IRR). The SSDP review only provided NPV and BCR.

A project is considered economic if the NPV is positive at a nominated discount rate.
Other assumptions common to the reviews are:

- operating and maintenance costs are incurred for 30 years (Farm and Surface Water Management Programs); 40 years for the SSDP due to its longer investment period.
- one year lag before benefits accrue (Farm, Surface Water Management and Environment Programs) and operating and maintenance costs are incurred (Farm and Surface Water Management Programs)
- costs and benefits of Farm, Surface Water Management and Environment Programs were expressed in 2006 prices. The costs and benefits SSDP are expressed in 2005 prices.

7.1.1. Farm and Environment Programs

The economic benefits of the Farm Program included in the analysis are water and labour savings and benefits of reduced waterlogging, salinity and flooding. The Environment Program has no quantifiable economic benefits.

The cost components included in the analysis of the Farm Program are the capital and program support incurred between 2001 and 2006. The Present Value of the incremental economic benefit is $143.16 million and the incremental economic cost is $80.7 million. Economic benefit analyses are listed here:

- NPV is $62.46 million.
- BCR is 1.77:1 which means that for every dollar invested, $1.77 worth of benefits is generated after 30 years.
- IRR is 10.4 per cent.
- More than half the benefits are labour savings (54 per cent), 30 per cent salinity, waterlogging and flooding benefits, and 16 per cent are water savings.
- From the point of view of farmers using real discount rate[4] of 8 per cent over 30 years, the investment in on-farm development (to address natural resource management issues) valued at $59.89 million can generate $76.07 million worth of benefits. The NPV is $16.18 million, BCR is 1.27:1 and the IRR is 11.1 per cent.

[4] The landholders have a higher real discount rate to account for the risk associated with their investment.

The results show the Farm Program is financially profitable from the landowners' perspective and also economically viable from the viewpoint of society as a whole. The results presented above also show the Government and the community have played a significant role in working together to bring about increased irrigation efficiency in the area. This also indicates that the investment by the Government in Farm Program activities has led to major improvements in water use efficiency and has leveraged a huge investment in improved water management by landowners (GB CMA 2007a, p 59).

The two activities of the Environmental Program that support the Farm Program are:

- tree growing incentives - for fencing, revegetation or direct seeding
- environmental incentives - for the protection and enhancement of existing bio-diversity on private land.

The Present Value of cost of implementing these activities is $2.8 million[5], of which 59 per cent was spent on environmental incentives and tree growing activities; the balance was spent on program support. The value of the benefits of the Program is discussed in Section 7.2 "Indicative value of environmental benefits".

Combined, the Farm and Environment Programs have a NPV of $59.66; a 9.9 per cent IRR and a BCR of 1.71:1.

7.1.2. Sub-surface Drainage Program

The DESM is a computer model used to assess the economics of surface and sub-surface drainage projects. This model was developed by the MDBC and takes into account the 'market price' of benefits and costs of providing drainage in irrigation areas across the Basin.

The cost-benefit analysis of the SSDP used the DESM. The benefits included in the economic analysis are salinity, waterlogging[6] and flooding collectively referred to as agricultural benefits and reuse benefits. The road benefits were not included in the analysis. The costs include capital costs, operating and maintenance costs and program support. Downstream costs (increased salt load in the River Murray at Morgan, South Australia) or benefits (reduction in nutrient run-off) are also included in the analysis.

The analysis did not include the economic value of the groundwater resource use.

The works program started in 1990 with a completion date of 2030. According to P Alexander (pers comm, 2009):

> "*The SSDP works program is based on a program completion date of 2030. The economic evaluations were undertaken over the longer period of 30 years and the time until construction was completed from the reference date of the evaluation.*
>
> *As part of the GSMP 2005 review, figures were therefore determined for the periods 1990 to 2020, 1990 to 2030 and 2005 to 2035, to meet the needs of the evaluation requirements at the time."*

The economic analysis shows the SSDP is financially attractive with NPV of $48 million and BCR of 1.5:1 (

[5] The analysis of the Environment Program did not include the "Without the Program" scenario.

[6] The model identified two types of agricultural production losses due to waterlogging (MDBC, 1995 page 16):

- micro-waterlogging due to soils with poor internal drainage characteristics. Waterlogging due to irrigation is caused by poor, uneven layouts and lack of on-farm drainage. Waterlogging due to rainfall is similar in cause and impact to irrigation waterlogging. It may occur throughout the whole year although it is usually worst in spring and/or winter
- macro-waterlogging (flooding) due to run-off from other areas on the farm. The duration is longer than micro-flooding and the effects are more severe.

Table 24). Agricultural benefits account for more than 90 per cent of the benefits and 7 per cent are reuse benefits.

Table 24 Results of the cost-benefit analysis, Sub-surface Drainage Program

Activities	Net Present Value $M	Benefit-Cost Ratio
Private pumping		
Pump upgrades	$3.75	1.7
New pumps	$23.92	1.6
Public pumping		
Reuse pumps	$18.46	1.5
Evaporation basin pumps	$0.96	1.2
Horticulture	$0.61	1.2
Overall	**$47.70**	**1.5**

7.1.3. Surface Water Management Program

The cost-benefit analysis of the SWMP also used the DESM. The benefits included in the economic analysis are salinity, waterlogging, flooding, and roads benefits; and land use change/increased productivity benefits due to the provision of surface water management systems. The costs are capital costs; legal; survey and design; project management; operating and maintenance; program support and farm development costs associated with productivity benefits (land use change). Downstream costs (increased salt load in the River Murray at Morgan, South Australia) or benefits (reduction in nutrient run-off) are also included in the analysis.

Case studies done in 1998 in the SIR and in the Loddon Murray Region revealed there were land use changes to high value crops and/or increases in pasture productivity after the water management systems were constructed (Montecillo, O. 1999 unpublished report).

In some systems, the community consultation process started in 1992 and the systems were constructed between 2000 and 2006. To account for the long period before a water management system is constructed, two cost scenarios were analysed:

- period cost scenario covers all the Program costs incurred from 2000-2001 to 2005-2006
- system cost scenario covers the total cost of all systems completed during the review period 2000-2001 to 2005-2006. Some costs were incurred since 1992.

The results of the economic evaluation showed the SWMP is economic (using Systems Cost scenario) with NPV of $4 million, BCR of 1.35:1 and IRR of 6.3 per cent (Table 25). The BCR of 1.35:1 means for every dollar invested, $1.35 worth of benefits is generated. The positive economic indicators show the importance of finishing the construction of water management systems to be able to realise the benefits. Using the Period Cost scenario, the SWMP is marginally uneconomic with costs exceeding the benefits even if there is land use change. This is mainly due to the inclusion of costs of incomplete systems that are not yet generating any benefits.

Table 25 Result of the cost-benefit analysis, Surface Water Management Program

	System cost			Period cost		
Indicators	CSWMP	PSWMP	Program Total	CSWMP	PSWMP	Program Total
Present Value of Benefits	$2.75	$12.71	$15.46	$3.92	$18.65	$22.57
Present Value of Costs	$1.44	$9.99	$11.43	$6.67	$19.47	$26.14
Net Present Value	$1.31	$2.72	$4.03	($2.75)	($0.82)	($3.57)
Benefit-Cost Ratio	1.91	1.27	1.35	0.59	0.96	0.86
Internal Rate of Return	10.2%	5.9%	6.3%	less than 4%		

CSWMP - Community Surface Water Management Sub-program
PSWMP - Primary Surface Water Management Sub-program

The bulk of the benefits (78 per cent) are land use change/increased productivity benefits associated with the provision of surface water management systems (Table 26). If these benefits are not included in the analysis the SWMP is not economic with BCR of 0.3:1 and NPV of -$8 million.

Table 26 Proportion of economic benefits of the Surface Water Management Program

Benefits	% of total benefits
Increased productivity/land use change	78.1
Roads	7.7
Salinity	2.7
Waterlogging	3.6
Flooding	6.1
Downstream	1.8

Drainage Nutrient Removal Incentive Scheme

The DNRIS aims to encourage landowners to construct strategically located storages (drainage nutrient removal systems) to collect and use regional drainage water. The water and nutrients collected can be used productively, and are not lost to areas of the catchment where they may cause problems such as blue green algae blooms. These storages can increase the volume of water available to the irrigator and reduce the amount of nutrient rich water in the SIR and downstream catchments.

The benefits of the scheme are extra water available to landowners and reduced volume of nutrients entering the waterways. The costs are: capital cost, operating and maintenance and program support.

Four fill-in volume scenarios were identified (Table 27).

Table 27 Fill-in volume scenarios, Drainage Nutrient Removal Incentive Scheme

Scenarios	Years 1 and 2	Years 3 to 8	Years 9 to 30
1	no data	Actual data (2000-2001 to 2005-2006)	Average Years 3 to 8
2			Potential volume at 1x capacity
3			Potential volume at 1.5x capacity
4			Potential volume at 2x capacity

The results of the cost-benefit analysis show the Scheme is economic under all scenarios with BCR of at least 3:1 and IRR of about 30 per cent (Table 28).

Table 28 Result of the cost-benefit analysis, Drainage Nutrient Removal Incentive Scheme

Indicators	Scenario 1 (actual and average)	Scenario 2 (actual and 1x capacity)	Scenario 3 (actual and 1.5x capacity)	Scenario 4 (actual and 2x capacity)
Present value of benefits ($M)	$21.08	$20.51	$26.02	$31.53
Present value of cost ($M)	$6.87	$6.81	$7.36	$7.91
Net Present Value ($M)	$14.21	$13.70	$18.66	$23.62
Benefit:Cost Ratio	3.07	3.01	3.54	3.99
Internal Rate of Return	30.0%	29.7%	32.4%	34.6%

7.1.4. Waterways Program

The Waterways Program has no quantifiable economic benefits.

The total cost of implementing the Program from 2000-2001 to 2005-2006 is $11 million (at 2006 prices[7]) or an equivalent present value of $9.6 million.

7.2. Indicative value of environmental benefits

'Non-market' goods such environmental features have no explicit prices and the benefits of any intervention to protect or enhance them are difficult to quantify. Van Bueren and Bennett (2004, page 1) stated:

> *"The failure to account adequately for non-market values in the formal cost:benefit analysis of government policies to address resource degradation could result in environmental goods being under-supplied and/or lead to inefficient allocation of public expenditure".*

7.2.1. Methodology

There are tools that can be used to determine the value of environmental features such as Contingent Valuation Method, Travel Cost Method, Hedonic Price Method and Choice Modelling Technique. However, these methods are costly to undertake.

One of the tools that can be used to provide a pseudo market price or shadow price to 'non-market' goods that avoids the relatively expensive method is Benefit Transfer Technique[8]. This technique uses previous studies and transfers the values from one area (study site) to another area (policy site).

To estimate the indicative value of environmental features protected and/or enhanced in the SIR, the results of Choice Modelling studies in Western Australia and New South Wales were used in the Benefit Transfer Technique (Table 29). The response rates from these studies will be applied as the percentage of the household population who are willing to pay for the protection and enhancement of environmental features.

Table 29 'Study' and 'policy' sites and response rates

Attributes	'Study' sites	'Policy' sites	Response rates (% of household who are willing to pay for the attributes)
'Species' and 'Look'	Great Southern Region and Perth in Western Australia	Goulburn Broken Catchment and Melbourne	17%
'Wetlands'	Adelaide, Canberra and Wagga-Wagga and Griffith (New South Wales)	Melbourne, Canberra, City of Greater Shepparton and Benalla	30.2%

Choice Modelling is a method of valuing non-market goods where respondents evaluate a number of options or scenarios. That value is referred to as the implicit price that each household is willing to pay for the environmental attributes (Montecillo, 2006). The following were included in the analysis:

- endangered/threatened species protected ('Species' attribute)
- area of bushland protected or enhanced ('Look' attribute)
- area of wetlands protected or enhanced ('Wetlands' attribute).

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7 The expenditure data taken from GB CMA 2007g, (page 16) were adjusted using the Consumer Price Index published by the Australian Bureau of Statistics. (River Health Strategy - Waterways Five Year Review, Sept 2007).

8 Under Benefit Transfer Technique, the value estimates that have been developed for other cases ("source/study" estimates) are used to make informed decisions where an environmental exercise is not warranted given the scale of the proposed changes or cannot be afforded either in terms of time or money (the "target/policy" case). (Bennett and Morrison, 2001 page 7).

The implicit price for the 'Species' and 'Look' attributes are expressed as the price that each household will pay for these attributes for 20 years.

The implicit price for the 'Wetlands' attribute is a one-off payment that each household will pay for these attributes.

The analysis covered Farm and Environment, Sub-surface Drainage and Surface Water Management Programs. The value of environmental benefits of the Waterways Program was not quantified in that Program's review.

For details of the methodology, refer to Shepparton Irrigation Region Catchment Implementation Strategy Sub-surface Drainage Program Five-Year Review 2006-2007 Volume 2 - Compendium, pages 150-162.

7.2.2. Results

The results covered the analysis of the Farm and Environment, Sub-surface Drainage and Surface Water Management Programs. The output from the Waterways Program will be analysed in 2010-2011.

Table 30 shows each household in Melbourne is willing to pay $1.63 per year for 20 years to protect an endangered or threatened species and $1.80 per year for 20 years to protect or enhance 10,000 ha of bushland. The calculated implicit prices that households are willing to pay are higher in the Goulburn Broken Catchment.

For the 'Wetlands' attribute, each household in Melbourne, Canberra, City of Greater Shepparton and Benalla is willing to pay a one-off payment of $14.09 to protect or enhance 1,000 ha of wetland.

Table 30 Calculated implicit values of environmental attributes

Environmental attributes	Implicit prices (2006 prices)	
	Melbourne	Goulburn Broken Catchment
Species (per species)	$1.63	$2.08
Look (per 10,000 ha)	$1.80	$2.47
Wetlands (per 1,000 ha)	$14.09 (a)	

Note:
(a) Households in Melbourne, Canberra, City of Greater Shepparton and Benalla.

Using the calculated implicit prices and the response rates, the present values of the environmental benefits for each program are shown in

Table 31. The indicative value of the environmental benefits of the Farm and Environment Programs is $4.3 million. The environmental benefits of the SWMP have an indicative value of almost $1 million. The indicative value of the environmental benefits of the SSDP is $16 million.

Table 31 Indicative value of the environmental benefits of SIRCIS programs

SIRCIS Programs	Attributes	Quantities	Present Values ($M)	Comments
Farm and Environment Program (2001-2006)	'Look'	1,250ha	$0.79	2006 prices
	'Wetland'	550ha	$3.54	
	Program total		$4.33	
Sub-surface Drainage Program (1990 - 2035)	'Look'	7,610ha	$0.91	2005 prices
	'Wetland'	10ha	$0.05	
	Species	14 species	$16.10	
	Program total		$17.06	
Surface Water Management Program (2000-2006)	'Look'	35.6ha	$0.02	2006 prices
	'Wetland'	173ha	$0.96	
	Program total		$0.98	

Notes:

- The total environmental benefit of the SIRCIS was not calculated due to the differences in the review period.
- The benefits and costs of the SSDP were expressed in 2005 prices because the program review was done in 2006 and the other reviews were conducted in 2007. The economic analysis covered the period 1990 to 2035; however the implementation of the program is from 1990 to 2030.
- The value of environmental features protected or enhanced by the Waterways Program was not quantified.
- Rounding off error.

Sources: GB CMA 2007c, GB CMA 2007b and GB CMA 2007d

7.2.3. Summary

The Reviews show the investment to implement the Strategy is generally economic as shown in Table 32.

Table 32 Economic costs and benefits of SIRCIS programs

SIRCIS Programs	Net Present Values ($M)	Benefit-Cost Ratios	Internal Rates of Return	Assessment time frames	Comments
Farm and Environment Program	$59.66	1.71:1	9.9%	2001-2006	2006 prices
Sub-surface Drainage Program	$47.7	1.5:1	not available	1990 - 2035 (Note a)	2005 prices
Surface Water Management Program - System cost	$4.03	1.35:1	6.3%	2000-2006 (Note b)	2006 prices
Surface Water Management Program - Period cost	($3.57)	0.86:1	< 4%	2000-2006	2006 prices
Drainage Nutrient Removal Incentive Scheme	$13.7 to $23.62	3.01 to 3.99:1	29.7% to 34.6%	1998 to 2006 (Note c)	2006 prices
Waterways Program (Note d)	($9.6)	not available		2000-2006	2006 prices

Notes:

(a) The implementation period of SSDP is from 1990 to 2030 and the economic analysis covered the period from 1990 to 2035.

(b) For systems constructed between 2000 and 2006 but the costs were incurred from 1992.

(c) DNRIS is part of the SWMP but was not included in the review of the program. Four scenarios were included in the analysis of DNRIS.

(d) The review of the Waterways Program did not include an economic analysis. This figure is the present value of the government cost of implementing the Program.

- Rounding off errors.
- Net Present Value in brackets means the cost exceeds the benefits.

Table 33 shows the results of including the indicative value of environmental benefits to the economic costs and benefits.

Table 33 Economic and environmental costs and benefits of SIRCIS programs

Programs	Net Present Values ($M)	Benefit-Cost Ratios	Internal Rates of Return	Assessment time frames	Comments
Farm and Environment Program	$63.99	1.77:1	10.3%	2001-2006	2006 prices
Sub-surface Drainage Program	$64.76	1.72:1	not available	1990 - 2030 (Note a)	2005 prices
Surface Water Management Program - System cost	$5.02	1.44:1	6.9%	2000-2006 (Note b)	2006 prices
Surface Water Management Program - Period cost	($2.58)	0.90:1	< 4%	2000-2006	2006 prices
Drainage Nutrient Removal Incentive Scheme	$13.7 to $23.62	3.01 to 3.99:1	29.7% to 34.6%	1998 to 2006 (Note c)	2006 prices
Waterways Program (Note d)	($9.6)	not available	not available	2000-2006	2006 prices

Notes:

(a) The implementation period of SSDP is from 1990 to 2030 and the economic analysis covered the period from 1990 to 2035.

(b) For systems constructed between 2000 and 2006 but the costs were incurred from 1992.

(c) DNRIS is part of the SWMP but was not included in the review of the program. Four scenarios were included in the analysis of DNRIS.

(d) The review of the Waterways Program did not include an economic analysis. This figure is the present value of the government cost of implementing the Program.

- Rounding off errors.
- Net Present Value in brackets means the cost exceeds the benefits.
- The value of environmental features protected or enhanced by the Waterways Program was not quantified.

7.3. Environmental impact

7.3.1. Farm Program

The Farm Program demonstrates significant environmental benefit through a reduction in nutrient run-off and reduced accessions to groundwater. It is estimated a megalitre of water reused on farm contains 1.89 kg of total phosphorus.

The Environment Program activities conducted on private land can also be attributed to the Farm Program. This includes significant achievement in biodiversity protection and enhancement (fencing and planting) as well improving water management for valuable wetlands such as Reedy Swamp, Brays Swamp and Kinnairds Wetlands (GB CMA, 2007).

7.3.2. Sub-surface Drainage Program

The SSDP has demonstrated significant environmental benefits over the last 15 years, and these benefits will continue into the future such as protection and enhancement of wetlands, bushland and remnant vegetation and protection of endangered and threatened species.

7.3.3. Surface Water Management Program

The SWMP reported the environmental performance is demonstrated through the Program's integrated approach with:

- mapping native vegetation using the Geographical Information System (GIS). While this approach has a strong focus in the SSDP, it presents as an opportunity for the SWMP. A measure of the area of native vegetation protected at completion of works on new drains is

a recommendation for a five-year works program 2006-2011

- protecting wetlands. A number of surface water management systems protect wetlands including: Brays Swamp; Reedy Swamp; Kinnairds Wetland; and Dowdle Swamp. These wetlands, by being incorporated into the design of surface water management systems, have potential for delivery of environmental water. The wetlands then provide a mechanism for improving the water quality before outfalling to receiving waterways
- protecting and enhancing natural features. All new surface water management systems are designed to, where practicable, reduce accessions to groundwater and reinstate natural watering regimes
- reducing downstream impact. Nutrient exports and summer flows have been in sharp decline since 2000 and are now well below the GBWQS target. The value of reduced salt loads to the River Murray at Morgan is included in the cost-benefit analysis of the SWMP.

Nolan Review

During 2000 the State Government and the MDBC conducted an independent review of surface drainage in northern Victoria (Nolan ITU 2001). The review was overseen by a steering committee convened by the MDBC. The steering committee included representatives from the following entities:

- Environment Australia
- Commonwealth Department of Agriculture, Fisheries and Forestry
- Department of Land and Water Conservation NSW
- Victorian Department of Natural Resources and Environment (now DSE and DPI)
- Australian Conservation Foundation
- GB CMA
- NC CMA
- EPA
- G-MW.

The Program received positive feedback from the Review. This is a reflection of the strong contribution from agency staff and community members to sound integrated catchment management that considers economic, social and environmental outcomes.

In summary the report stated that:

> *"Overall, and in comparison to approaches being taken elsewhere, current Northern Victorian surface drainage programs are providing significant environmental benefits. The surface drainage programs are also performing at a high level, in regard to practices and approaches being taken to achieve beneficial environmental outcomes for the agricultural environment.*
>
> *The surface drainage programs (ie. design, construction, and operation) are currently operating with a high level of environmental sensitivity. Drain design, construction and operational practices are considered to be 'best practice' compared to elsewhere in Australia and overseas. There is a high degree of innovation and continual improvement".*

7.3.4. Waterways Program

The Waterways Program continues to provide environmental benefits to specific reaches of rivers and streams in the SIR. The major projects are control of weeds, stabilisation of river bank and river bed, fencing (of remnant vegetation, river and wetlands) and fish passage.

The Statewide Index of Stream Condition provides the yardstick of the success of the Waterways Program. The major aspects of river health are water quality, in-stream habitat, river hydrology, riparian condition and river channel form (GB CMA 2003b, page 11).

7.4. Social impact

Given the lack of current research relating to the financial value of social impacts in Australia, no attempt has been made to quantify the social benefits in dollar terms.

Similar to the economic and environmental assessment, the social assessment provides an indication of the social benefits attributed to the implementation of the Strategy.

The major social benefits of the Strategy are:

- capacity building
- confidence building
- community planning
- natural resources knowledge base-understanding of issues and processes.

The five-year review process of the Environment Program, Farm Program, SSDP and SWMP adopted the qualitative assessment framework that relies on feedback through case studies and workshops. The method was developed by Hydro Environmental Pty Ltd to assess the status of social considerations.

A set of developed social performance indicators, otherwise called social themes (Tables 31, 32 and 33) were considered by program participants, partner organisations, community and agency representatives, and given a score within -5 (being a strongly negative outcome) to +5 (indicates a strongly positive outcome).

The review of the Waterways Program did not identify the social impacts of the Program.

7.4.1. Farm and Environment Program

Within the Farm and Environment Program the Local Area Planning project has been able to document social benefits by looking at the community's capacity to manage and deal with change.

The reviews of the activities under the Farm Program identified the following social benefits. These include:

- **Whole Farm Planning process as a capacity building practice**

  The review of the Whole Farm Planning Program (Maskey et al, 2004) revealed the preparation of a WFP provided opportunity for landowners to plan for the adoption of best practice for irrigation as they undertook works to redevelop their properties.

  The consultation process involving the landowner, extension staff and irrigation surveyor and designer has improved the capacity of landowners to make informed decisions about best practices on farm.

- **Evidence of communities interacting with different agencies**

  The reviews of the Local Area Plans (LAP) provide evidence that the communities have strengthened their interaction and relationships with government agencies and local government as a result of local area planning.

- **Greater understanding of the SIRCIS**

  The communities felt they had a greater understanding of the issues affecting them at a local level, and how these local issues fit in with the goals of the SIRCIS.

- **Confidence building in the communities**

  Many community members identified an increase in confidence since the development of their LAP and they believe in their ability to organise a range of on-ground activities in their area. The LAP activities are further evidence to show how people come together to address their local issues and how they are able to demonstrate the benefits to a wider audience.

Regarding the Environment Program there was an overall feeling that group activities such as planting days, Landcare, local area planning activities and developing and implementing management plans were the most important cohesive activities for the community. The community have gained a better understanding of the importance of protecting and enhancing native vegetation. People have noticed positive changes to the landscape. Understandably these items were scored relatively high in the assessment (Table 34).

Table 34 Result of the social assessment, Environment Program, 2005-2006

Categories to measure social performance	Comments on appropriateness of category to the Environment Program	Scores (+5 / -5)
Community wellbeing	There was an overall feeling that community health due to aesthetics of the landscape and community activities were having a positive impact.	+2
Sense of community	Group activities such as planting days, Landcare, Local Area Plan activities and Management Plans were identified as important cohesive activities for community.	+2.5
Natural resources knowledge base	Community have gained a better understanding of the importance of protecting and enhancing native vegetation.	+2.5
Improved business confidence	Participants felt that the Environment Program had little impact on this category.	+1
Security of water supply	Similar to a sense of 'Improved business confidence', participants felt the Environment Program is not seen to have much impact on this.	+1
Changes in landscape	People have noticed positive changes in the landscape.	+3
Confidence in the Program	People identified the Environmental objectives are far too optimistic.	+2
Protection of significant cultural and historical sites	Most people did not put a comment here, people were unsure of linkages to the Environment Program. One comment was made that there were good links to AAV and some good sites being protected.	+2

Source: GB CMA 2007d, page 54.

7.4.2. Sub-surface Drainage Program

Table 35 presents a summary of the SSDP social assessment workshop outcomes.

Table 35 Result of the social assessment, Sub-surface Drainage Program, 2005-2006

Indicators	Scores (+5 / -5)
Community well-being	+2
Sense of community	+2
Natural resources knowledge base	+2.5
Improved business confidence	+2
Security of water supply	+2
Changes in landscape	+2
Confidence in the SSDP program	+2.5
Protection of significant cultural and historic sites	+1

Source: GB CMA 2007c, pages 75-76

In general the SSDP program has been assessed as generating significant social returns. The overall assessment of the social benefits is +2 or higher which is equivalent to an adjusted score of over seven out of 10 (SSDP 2006-2007 Review volume 1) and is considered a relatively high score.

The key outcomes from the social assessment are as follows:

- The SSDP has delivered a positive social impact up to June 2005 and is expected to continue to deliver a social benefit into the future.
- Overall the expectations are the same as those achieved by the Program to June 2005.
- The community related social themes were judged to be marginally less positive for the

future SSDP activities than they have been in the past.

- Confidence in the SSDP and its associated landscape, environmental, cultural and heritage benefits are expected to be greater in the future than they were in the past.

The community related social themes were judged to be marginally less positive for the future SSDP activities than they have been in the past. Social values identified within the SSDP include (but are not limited to): heritage, cultural and scenic landscapes, recreation and community knowledge, capacity and participation.

7.4.3. Surface Water Management Program

The social assessment of the SWMP has been carried out using the scoring method as outlined. Table 36 presents a summary of the outcomes of the SWMP Social Assessment Workshops.

Table 36 Result of the social assessment, Surface Water Management Program

Indicators	Comments on appropriateness of indicator to the Surface Water Management Program	Scores (+5 / -5)
Community well-being	There was a feeling that with new surface water management systems (SWMS), there was a generally positive feeling and improved economic performance, however there was nothing significant noted for existing SWMS.	+3
Sense of community	There was a sense that although community SWMS have not progressed as much in the past 5 years, the overall level of achievement in this indicator was high.	+3
Natural resources knowledge base	Extension activities associated with the Program are credited with the broader education of landholders around the region. The increased knowledge is not limited to drainage considerations but brings together aspects relating to environmental values and best farm management practices.	+4
Improved business confidence	It was felt that with SWMS, there was a greater level of confidence for development to occur.	+4
Access to water supply	Rules in place to control increase in water on undrained properties.	+3
Security of water supply	There were instances noted where existence of works had allowed additional water to be secured, although this was generally not widespread.	0 to +1
Changes in landscape	The landscape of the SIR is seen to be improved compared to previous times. Some debate whether people attributed the improvement to the SWMS or not. This was not material.	+3 to +4
Confidence in the Program	The general feeling is that Program confidence is positive; there are other external factors that may have had an impact on program implementation.	+3
Protection of significant cultural and historic sites	The process of assessing impacts of proposed works was seen to be positive as the sites would not have otherwise been identified.	+4

Source: GB CMA 2007b, pages 56-57

The results of the workshops indicated most social aspects of the strategy are viewed as having a very positive influence on society and the outlook for future benefits, as indicated by the scores, to be achieved through the plan was generally very optimistic.

7.4.4. Waterways Program

The review of the Waterways Program did not cover the social impacts.

7.5. Conclusion

It has been evident that the SIRCIS programs generate economic, environmental and social benefits. The overall future success of the Strategy depends on how the 'triple bottom line' outcomes are maximised and how potential trade-offs between these outcomes are identified and managed.

8. Future Directions

This section describes issues which are larger than the SIRCIS in the sense they are out of our direct control, but which nonetheless work to shape our future. Also described is the project through which the SIR community has considered the future - Goulburn Broken Irrigation Futures.

8.1. Drivers for change

8.1.1. Water reform

Water reform has been moving at a rapid pace since the 2003 SIRCIS. Victoria's reform agenda is detailed in the 2004 White Paper *"Our Water Our Future"*. Naturally, this agenda is, and will have, a large impact on the SIR. The introduction of Water Use Objectives and Water Use Licences is probably the key reform in terms of the SIRCIS.

Water Use Objectives:

- **Managing groundwater infiltration**
  To limit infiltration to groundwater systems arising from irrigation so as to minimise or avoid waterlogging, land salinisation, water salinisation and groundwater pollution.

- **Managing disposal of drainage**
  To control the disposal of drainage from irrigation so as to minimise or avoid waterlogging, salinisation and eutrophication of waterways, wetlands, native vegetation, native animal habitats, groundwater and other persons' property.

- **Minimising salinity**
  To ensure that, where limits on groundwater infiltration and controls on drainage disposal are not sufficient to manage identified risks of land or water salinisation, licence-holders are responsible for the full costs of measures to reduce those risks, or alternatively, the full cost of any necessary offsetting works.

- **Protecting biodiversity**
  To set corrective action thresholds and corrective action procedures where limits on groundwater infiltration and controls on drainage disposal are not sufficient to manage identified risks associated with water use, to specific wetlands, native vegetation stands, or native animal habitats.

- **Minimising cumulative effects of water use**
  To ensure that, where a series of individually acceptable expansions in water use within a defined area reaches a previously announced level, the combined impact on other people and the environment is dealt with by remedial action such as a communal drainage scheme, with water users in the area who expand their use after the announcement contributing to the capital cost in line with their expansion in use compared with total use (and remaining costs shared by government and water users in a way judged after due consultation, to be equitable).

Water Use Licences

Water Use Licences (WUL) govern water use on a property and are required before previously non-irrigated land may be irrigated. All irrigators who had a water right or diversion licence on 1 July 2007 were issued with a Water Use Licence that recognised the existing practices and conditions that applied to the property.

The WUL has four Standard Conditions:

- an Annual Use Limit (AUL) which sets the maximum volume of water that can be applied to a property; it recognises existing approved drainage
- a requirement for metering
- requirements for disposal of drainage in ways that meet with the Water Authority's standards, terms and conditions
- a requirement to obtain further approvals to grow rice.

The WUL provides a mechanism for the SIRCIS to develop new standards for irrigation and have these included in the WUL. SIR IC will be exploring and consulting about new standards before 1 July 2012 when the changes will be legislated. The *"Our Water Our Future"* reforms require CMAs to review the WUL conditions every five years. There is an expectation that standards should increase.

SIR IC will consider conditions such as the holding of a WUL requiring properties to have a reuse system installed and a certified WFP.

Regional Irrigation Development Guidelines

Regional Irrigation Development Guidelines (RIDG) are indirect requirements of WULs and serve to ensure developers meet the Water Use Objectives and Standard Conditions.

RIDG apply to the Goulburn Broken, North Central and North East Catchment Management Authority regions. In developing the RIDG, CMAs have worked in partnership to develop a suite of consistent guidelines to manage irrigation development across northern Victoria. The guidelines also apply to applications for or variations to, WUL for irrigation purposes where the proposed irrigation development:

- will occur on land for which there has never been a WUL
- involves an increase in the annual use limit in an existing WUL
- involves an increase in the area allowed to be irrigated in an existing WUL.

The SIR has had these guidelines in place long before the *"Our Water Our Future"* reforms. Developers have had to meet these guidelines as they applied at the time to obtain approval to transfer water onto previously unirrigated land. Additionally, irrigators wanting to transfer water onto land, either temporarily or permanently, have had to meet the Transferable Water Entitlement rules. This history has led to the current contents of the RIDG.

The guidelines cover issues such as Maximum Water Use, disposal of drainage, and protection of biodiversity.

Long Term Water Resource Planning

Another key reform is the introduction of long term water resource planning through the development of Regional Sustainable Water Strategies. These were developed over five regions. The discussion paper for the Northern Region Sustainable Water Strategy (NRSWS) was released in February 2008 for public consultation and the final document was released in November 2009.

The NRSWS aims to (DSE 2009 page 3):

- *identify and understand threats to water availability and quality, including the implications of climate change and variability*
- *help regional communities to adjust to reduced water availability*
- *ensure secure water entitlements for towns, industry and the environment*
- *encourage economically viable and sustainable agriculture*
- *improve choice and flexibility for entitlement-holders to manage the risks of climate change and variability.*

- *protect and where possible, improve the health of rivers, wetlands and aquifers from the impacts of drought, climate change and variability and other risks*
- *recognise and respond to indigenous and other cultural and heritage values associated with the region's rivers and catchment areas.*

8.1.2. Land use planning and lifestyle farming

The rural landscape has been evolving ever since European settlement. For a long time landowners have been leaving farming while regional and city populations have been increasing. For example, in the 1950s there were 35 Victorians for every farm in Victoria, by 2001 there were 150 Victorians for every farm, and it is expected this could rise to 350 by 2031 (Barr, N 2005). By extrapolating ABS figures and using the existing rate of decline in farm numbers, Barr expects this decline in "farms to people" ratio to continue and to have many implications for farming, the greatest being competition for land between farmers and the rest of the community.

The competition for land is evident in debates about the land uses allowed in Melbourne's Green Wedge Zones (which seek to protect amenity landscapes, biodiversity and agricultural land) and the Farming Zone (which seeks to restrict lifestyle living in order to preserve productive land and minimise landowner conflict about lifestyle expectations). These zones place considerable restrictions on subdivision and housing construction. Limiting subdivision and housing rights in Farming Zones is important to firstly maintain agriculturally viable land parcel sizes but also to act as a counter force to rising land values preventing farm aggregation. However, if selling your subdivided farm to fund retirement is your goal as opposed to farm family succession, then subdivision rights are very important.

Added to this are Melbourne's increasing population and what some term the 'cost of housing crisis'. This results in calls for release of more land for housing in order to reduce housing costs.

"Lifestyle farmer" is a term used to describe landowners who are looking for land for housing outside of major cities and regional centres in order to satisfy goals of amenity and lifestyle. They seek land which is larger than the usual urban block and often larger than Rural Living blocks of around 0.5 to 11 ha, preferably with some landscape value such as a water view, height in the landscape, or forest cover. As these people are looking for a home and not making an investment on which they require a return to capital they can afford to pay more for land than a farmer seeking to expand operations. They often have romantic expectations of a rural experience which does not include scare guns, frost fans, dust and irrigation pumps operating over night. This can lead to conflict between existing farmers and their new neighbours.

The lifestyle demographic is changing as technology improves and people find that combined with physical commuting, telecommuting is becoming a viable alternative to being in the office everyday. However, continuing rising oil and petrol prices may slow this growth.

Though some of these pressures are less acute in the SIR than they are in other parts of the Goulburn Broken Catchment and other parts of Victoria, lifestyle farming will continue to provide challenges for land use planning and the SIRCIS into the future. The impacts this has will only be known as the changes play out over time. In the SWMP for example, we may have more landowners and therefore a wider rate base to share the costs, however, as these farms may not be profitable, the landowners may be unwilling to invest in such infrastructure (GB CMA, 2007b).

8.1.3. Farm succession and business planning

This section discusses the results from the most recent "irrigation culture" survey regarding irrigators' thoughts about the future of their businesses. Land management improvements are driven by changes made by irrigators to the way they conduct their businesses. It follows, therefore, that what they expect for their future and that of their farm impacts greatly on the changes, if any, they make to their operation. Our programs need to be designed with these issues in mind.

The SIRCIS has a focus on dairy and mixed farming as these industries use most of the water and most of the land in the SIR.

The results of the survey indicate that (Ash, L 2006):

- 35 per cent of dairy farmers plan to sell up in less than five year's time while 43 per cent plan to be operating in more than 10 year's time
- 23 per cent of cropping and livestock property owners plan to sell up in less than five year's time, with 29 per cent considering selling up in six to 10 years time and 48 per cent plan to be operating for more than 10 years
- better educated farmers were much less optimistic about farm succession occurring
- mixed farmers are much more likely to believe someone in the family will take over the farm
- dairy farmers strongly agree their farm will still be irrigated in five year's time (83 per cent)
- mixed farmers were less sure than dairy farmers about the future irrigation of their property however 64 per cent still strongly agreed that it would be irrigated into the future
- those who had been permanently selling water right and purchasing temporary water were less likely to believe there would be farm succession (some evidence of this).

8.1.4. Changes to how land and water are managed

The demand for improved land and water management practices has gained momentum over the last 20 years. This is due partly in response to the forces driving the move of non-farmers to amenity landscapes as discussed above. It is also a consequence of increasing affluence within urban communities and increasing knowledge about the environment and the risks to it.

Environmental Management Systems and Quality Accreditation Schemes which accredit farm business practises were tools used in the mid 1990s to gain a price premium in the market. Increasingly they are becoming an essential pre-requisite of market access.

The requirement for improved practices is also being driven by the water debate: who owns it, who should own it, how should we allocate it, how much will there be in the future, what about the rivers?

All of these pressures will mean that landowners will need to continue to improve their land management practices in order to produce a smaller ecological footprint. Where these improvements provide a business benefit (e.g. automatic irrigation systems provide labour and time savings, while improving water use efficiency) change will occur more easily. Other changes, such as buying back water allocations for environmental water, will require social contracts in which all beneficiaries contribute to change.

8.1.5. Water savings programs

Barr (2005) argues the future of irrigation in the SIR is not at risk from competing amenity landowners (apart from specific areas, for example, along the Goulburn River) but rather from competing water users such as the environment and urban population. This is because land is not the limiting resource in the SIR, water is. It will be increasingly difficult for irrigation farmers to defeat declining terms of trade by increasing size through purchasing water.

Irrigators have long been improving their water use efficiency and can and will continue to do so. However, we are now seeing arguments over what should be done with the "saved" water. Currently, irrigators use any water saved to increase farm production, helping to win the battle against terms of trade. However, some in the community are arguing that when the government contributes financially to savings generation that water should go to the environment. This will be a crucial debate for irrigators going forward.

Over recent years, State and Federal Governments have introduced programs and reforms in relation to saving water and the environment. These programs include:

- The Murray Darling Basin Cap

- The Living Murray
- Transferable Water Entitlements and Water Trading
- Victorian Government White Paper - *"Our Water Our Future"*
- The Northern Region Sustainable Water Strategy.

CMAs will also have a vital role in the determination of the environmental entitlement as guided by the Northern Region Sustainable Water Strategies (NRSWS) platform.

This push for change is continuing and being generated by the following major initiatives:

8.1.5.1. Northern Victoria Irrigation Renewal Project (NVIRP)/FoodBowl Modernisation Project

This is the biggest major infrastructure project to happen in the SIR in generations. According to the DSE:

> *"The FoodBowl Modernisation Project is a program of works to upgrade irrigation infrastructure in the Goulburn Murray Irrigation District, which will capture water currently lost due to system inefficiencies and will provide an improved level of service for irrigators.*
>
> *The FoodBowl Modernisation Project is a $1 billion works program to modernise Victoria's FoodBowl region and upgrade its ageing irrigation infrastructure. This is an historic investment in the future of the FoodBowl region; on average, more than 800 billion litres (gigalitres) of water every year are being lost through leaks, system inefficiencies and evaporation. Modernising the current irrigation system will improve its efficiency and service to irrigators, underpinning future economic growth and regional prosperity.*
>
> *The project will provide confidence and growth for communities which are facing significant challenges because of the drought. The FoodBowl project will recover an estimated 225 billion litres of that lost water by 2012. The water savings will be shared equally between irrigators, the environment and Melbourne. Melbourne's share of the water savings, which is capped at 75 billion litres (gigalitres) per year will be transferred from 2010 through the Sugarloaf Pipeline. The first stage of the FoodBowl project is being funded by the Victorian Government ($600 million), Melbourne Water ($300 million) and Goulburn-Murray Water ($100 million).*
>
> *The positive legacy of a major investment in Victoria's northern irrigation region will result in:*
>
> - *a competitive advantage for irrigators*
> - *the opportunity to further grow our exports (particularly in agriculture and food sectors)*
> - *a significant reduction in risk for industry, stronger communities and a healthier environment*
> - *a drive in innovation in new and existing industries* (DSE 2007, page 1).

As outlined, this is an extremely important project and will have a significant impact on the ability to deliver the SIRCIS. We are still working through the implications of this with the community and our partner agencies.

Reconfiguration (removal/refinement of old infrastructure)

This project is now part of NVIRP.

The Victorian Government *"Our Water Our Future"* White Paper states:

> *"Old distribution systems need to be upgraded to cope with the demands of irrigated farms in the twenty-first century. But, if parts of distribution systems are becoming unviable, consideration must be given to phasing them out".*

Rationalisation of services is primarily an issue for north central Victoria. G-MW and its Water Service Committees realise that some parts of existing distribution systems need to be closed down. They were constructed in an era of bold development and in some places are just too spread out, as well as being on land that has turned out to be not suitable to irrigation (DSE 2004, page 82).

G-MW has responded to this policy driver by working with irrigators to undertake a Reconfiguration Program in two areas in the Goulburn Murray Irrigation District (GMID) to plan the future distribution system. It is working with irrigators to adapt individual properties to the reformed distribution system.

The reconfiguration will impact on how much water is used and where, thereby affecting where SIRCIS program works are required. Additionally, in the case of the SWMP, the assets created are used to further other program goals. For example, surface water management systems are used to dispose of salt pumped by groundwater pumps and are also used to deliver environmental water. If these systems are not required for their primary purpose because of reconfiguration, this will impact on how we meet these other goals.

8.1.5.2. Northern Region Sustainable Water Strategy

The Victorian Government has adapted the new Northern Region Sustainable Water Strategy (NRSWS) for the broader region into 2050; this strategy will deal with issues such as climate change and its impact on water quantity and timing, as well as planning for infrastructure needs. The SIR community will need to have significant input into the development of this Strategy.

8.1.5.3. National Water Initiative

The Coalition of Australian Governments signed this Initiative in 2004 in order to achieve a nationally compatible water market and optimise the economic, social and environmental outcomes of water management.

8.1.6. Water trading

In the context of the history of irrigation in Victoria, water trading is a relatively new phenomenon. Irrigation began around the 1900s with water being allocated to land when the State Rivers and Water Supply Commission was formed in 1906. Water was tied to land and could not be transferred separately.

It was not until 1987 that temporary water trading began. In 1989 the new *Water Act* allowed permanent trading of water rights and it was not until 1995 that temporary, and 1998 that permanent, trade between States became possible.

The main reason for introducing trade and moving from an allocation system based on equity to a market based system was to ensure water was being used for the highest value use possible. In other words, the greatest economic benefit is obtained for the water used as water moves within a market to maximise the financial return from the water.

The last 10 years has seen large volumes of water traded, temporarily and permanently, within and between States. Indeed, water traded is credited by many for allowing so many farmers to survive the recent low allocation years due to drought.

Between 2000-2001 and 2005-2006, more than 10,000ML of permanent water were traded out of the Shepparton and Central Goulburn Irrigation Districts (Table 37). Central Goulburn and Rochester Irrigation Districts registered net gains in temporary water (right and sales) during the same period.

The challenge now is to manage the trade out of the region to ensure the SIR remains a viable irrigation region. Since 2003-2004, over 14,500ML per year was reported to be permanently transferred out of the SIR (GB CMA 2007c, page 22).

Table 37 Net volume of water traded within and outside the SIR irrigation districts (ML)

Irrigation districts	2000 -2001	2001 -2002	2002 -2003	2003 -2004	2004 -2005	2005 -2006	Total
Permanent							
Shepparton	-79	-1,960.0	90.0	-2,114.0	-2,638.4	-3,471	-10,172.4
Central Goulburn	-1,409	-1,748.5	-739.8	-7,969.5	7,681.0	-7,216	-11,401.8
Rochester	-883	91.0	1,483.8	-4,037.5	3,689.5	-3,540	-3,196.2
Murray Valley	152	-191.0	533.0	-371.0	-564.5	-1,175	-1,616.5
Temporary (water right)							
Shepparton	-4,866.5	-5,155.5	4,939.7	-17,898.3	-15,609.3	-8,322	-46,911.9
Central Goulburn	25,924.7	36,390.7	32,409.6	21,477.1	7,997.0	26,170	150,369.1
Rochester	22,928.0	25,320.6	4,393.4	7,942.4	13,167.7	28,301	102,053.1
Murray Valley	1,481.0	3,992.0	9,680.2	19,111.9	19,851.4	6,268	60,384.5
Temporary (sales)							
Shepparton	0	30	221.8	39.4	20.0	457	768.2
Central Goulburn	0	85	373.0	1,574.3	65.0	340	2,437.3
Rochester	121.7	674	40.1	875.0	283.5	383	2,377.3
Murray Valley	-96.0	-176	1,016.7	433.0	1,338.0	-729	1,786.7

Notes:

- Negative figures indicate water trade out of the SIR is greater than water trade into the SIR, positive figures indicate water trade into the SIR is greater than water trade out of the SIR.
- The G-MW annual reports published only a summary of the trading therefore it is not possible to provide a total for SIR. Trading between farmers from these districts is considered SIR internal trading.

Source: G-MW (Annual Reports)

Government has responded to concerns about the permanent loss of water to regions by implementing a cap set at 2 per cent in 1994 (i.e. the net allowable permanent trade from an irrigation area was set at this limit). This limit was raised to 4 per cent per year in 2005 (T Hunter, pers comm, 2009) but exemptions from the 4 per cent cap on water trading were granted in 2009. Originally the trading limit was set to address the issue of stranded assets. More recently, however, it has been aimed at ensuring landholders have adequate time to adjust to reduced access to water.

Ash (2006) reported in the Irrigation Farm Survey 2004-2005 Summary Extract the following attitudes of Goulburn Murray Irrigation District irrigators regarding water trade:

- more than two-thirds of respondents felt it made a positive impact, with one quarter believing it had made a large positive impact
- one in 10 felt it had a negative impact on their ability to make a profit
- two-thirds felt it had made a positive impact on ease of operation with one in nine believing it had a negative impact.

Managing land use change as a result of water moving within the SIR and to downstream irrigators will impact on where our works are required. In particular this will affect the Sub-surface Drainage and Surface Water Management Programs. A flexible approach to SIRCIS implementation will be required.

8.1.7. Salt management (includes disposal requirements)

DSE and DPI (2005, page 9) stated:

> *"The initial request for the Shepparton Irrigation Region Land and Water Salinity Management Plan was for an SDE of 19.4EC. This was made up with 16.7EC for sub-surface works and 2.7EC for surface drainage works. The initial formal allocation to the region for the period 1990 to 1995 provided by the Victorian Government was 3.4EC. An additional 1.5EC was allocated to the GB CMA in 2001 for*

priority surface and sub-surface drainage works. This brought the formal SDE allocation for the region to 4.9EC. An indicative 30-year allocation of 10EC has been provided for implementation of the SIRCIS".

The need to maximise the benefits of limited salt disposal credits available to Victoria and the region is recognised in the SIRCIS. The SIR currently has 6.9EC and is in the process of applying for another 2EC to offset NVIRP impacts in the SIR.

SIR IC has investigated other options for management of salt within the region including conjunctive water use, serial biological concentration and evaporation basins. The farming community has some acceptance of conjunctive water use. There is a lesser degree of acceptance of serial biological concentration options because they require a higher level of management, have high infrastructure costs and are only marginally profitable. Evaporation basins have had limited acceptance and at this time landholders do not see them as part of the landscape. Further work is needed on maximising the use of salt credits and on developing opportunities for works that would generate further salt credits.

The review of the Salt Management Manual on a regular basis allows the management of this issue to be adaptive and respond to the changes such as climate variability and reduced dilution flows within the system.

8.2. Goulburn Broken Irrigation Futures Project

8.2.1. Background

The National Program for Sustainable Irrigation (DPI 2007, page 1) stated:

"The Goulburn Broken Irrigation Futures project was established to assist the regional community to plan for the future. It was a regional initiative, funded by the Goulburn Broken Catchment Management Authority, Goulburn-Murray Water, Victorian Department of Primary Industries, Victorian Department of Sustainability and Environment, the National Action Plan for Salinity and Water Quality, the Cooperative Research Centre for Irrigation Futures and the National Program for Sustainable Irrigation. The project adopted a scenario planning approach in collaboration with the region's stakeholders.

The project objectives were to:

- *develop a shared vision for the future of irrigation in the Goulburn Broken catchment over the next 30 years*
- *identify scenarios of major constraints and opportunities and of Regional response options*
- *understand the social, economic and environmental consequences of various scenarios*
- *facilitate key stakeholders to build consensus on preferred Regional strategies for future irrigation.*

As part of the project, participants discussed their aspirations for the community and the Region. The participants included primary producers, local government councillors and staff, G-MW Directors and staff, Government Agencies (DPI, DSE, GB CMA), and industry, business and community groups.

The Irrigation Futures Project developed the following aspirations for 2035 (DPI 2007 p23). To be:

- *seen as a world leader in food production (clean and green, export markets, growth)*
- *efficient users of water, and have appropriate water distribution systems*
- *recognised and valued as stewards of the land (proud to be farmers/irrigators, recognised for contribution to economy and community, keeping natural resource condition in good shape for future generations)*
- *achieving a balance between environmental, social and economic demands (industry exists in harmony with environment and community)*
- *a vibrant, prosperous (businesses, region, employment, eco/ag tourism, service industries) and diverse community*

- *a great place to live (community well-being, social networks, well-serviced, appropriate/maintained infrastructure, amenities)*
- *home to happy people who have time for leisure*
- *creating all kinds of opportunities for all (in particular young people and new farmers)*
- *embracing new and existing technology*
- *investing in the environment (biodiversity, healthy rivers, native vegetation, etc.)*
- *continuing to have access to water resources for irrigation*
- *planning strategically and making collaborative decisions (displaying community leadership, co-operation, working together as a wider community)*
- *actively participating in decision-making processes and implementation programs*
- *managing change (preparedness, adaptability, innovation, learning culture).*

8.2.2. Scenarios

Four scenarios were developed to facilitate the community thinking about how we might respond to opportunities and challenges we are likely to face over the next 30 years. The scenarios were summarised during the Farm Program Review (GB CMA 2007a, page 63) as:

8.2.2.1. Moving on

The cost-price squeeze continues to pressure farms to increase sizes and invest in technology. The number of lifestyle properties will continue to grow. There is an expectation from consumers of "clean-green" food but not widespread willingness to pay more for it. Climate change starts to produce noticeable warmer and drier winters and hotter and wetter summers, with a reduction in chilling hours. There is an increased demand for high quality "bush" niche products.

8.2.2.2. New frontiers

Communication technological developments, demographic and attitudinal changes lead to a new wave of exodus of the urban population to live and work in rural areas. There is greater demand for amenity including improved environmental flows and water quality. Agricultural production in Australia declines due to a combination of increased regulation on agricultural practices, free trade agreements, climate changes and diseases. Government purchases land no longer used for agricultural production and uses it for recreational, aesthetic and environmental purposes. An international conflict over oil causes a period of technological innovations. Synthetic food products become the primary source of food, leaving a small niche of authentic food production.

8.2.2.3. Pendulum

Strong community concern for the environment leads to the Greens holding the balance of power in the Senate. A commitment of 3,500GL to the River Murray over 10 years is made. In Victoria, medium reliability water is purchased by the government for environmental flows, and high reliability water entitlement is reduced. There is a dramatic decline in rural areas. The environmental outcomes from increased river flows have not matched expectations. Reduced availability of water and multinational monopolies of the food industry can cause increases in food price. The Murray Darling Basin cap on diversions is increased. An auction of the reallocated water releases funds to rebuild irrigation infrastructure throughout the Basin. In addition, major flooding events return, and climate change is acknowledged as a natural process that operates on long cycles.

8.2.2.4. Drying up

The war on terror expands, causing a major world recession. Australia is unable to export its products during this period despite good crops, resulting in the loss of major export markets. China emerges from the recession to become a significant exporter of high value horticultural products, taking advantage of its low labour cost. At the same time, China relies on importing bulk agricultural commodities to provide food for its large population. As Australia recovers from recession and adapts for the New World market, it is hit by a severe drought lasting for eight years. The government provides some special assistance to regional

communities to ease the widespread hardship. On the other hand, the scheduled review of water allocation under the 2004 White Paper commences, and water allocation for irrigation is further reduced because of the perceived climate change.

8.2.3. Program responses to the scenarios

Each SIRCIS Program used these scenarios to consider how the Program should be shaped to meet the challenges of the future.

8.2.3.1. Environment Program

The Environment Program review identified many challenges and opportunities through exploring the scenarios (Table 38).

Table 38 Challenges and opportunities, Environment Program

Scenarios	Challenges	Opportunities
Moving On	Larger farms Less volunteerism Irrigation reconfiguration - more rain-fed properties	Bigger company - more money, ability to spend on environment Greater focus on protection and enhancement of natural features Improved utilisation of technology
	Free trade - increased risk of pests and diseases Climate change and variability Lifestyle farmers - harder to engage and target with messages; less aware of legal responsibilities Less social cohesion Increasing political influence	-
New Frontiers	Lifestyle subdivisions driving native vegetation removal Dropping watertable - unknown impact on native vegetation Wetlands - Environmental Water Allocations and inadequate infrastructure	Government purchase land for environment Change in land use Engaging with new style land managers Better implementation of Native Vegetation Framework Different and targeted extension approach for new land managers (Practice Change work) Engage with Local Government: engagement tools / Best Management Practices / Biodiversity Action Planning / extension information from High Value Environmental Features project
Pendulum	Resentment to green ideas and biodiversity Less individual investment in environment Total costs for goods paid by consumers	Less “loss” of biodiversity Redesign of irrigation system to mimic natural system and allow large biodiversity corridors
Drying Up	Less interest in environment due to drought/survival mode Genetically modified plants - creation of environmental weeds, cross species transfer	Good for native plants - less intense agriculture Learn from previous experience - new research

Source: GB CMA 2007d, page 57

8.2.3.2. Farm Program

The Farm Program review identified many challenges and opportunities through exploring the scenarios (Table 39).

Table 39 Challenges and opportunities, Farm Program

Scenarios	Challenges	Opportunities
Moving On	Larger corporate style farms	Larger operations – greater capacity to fund works
	Increase in lifestyle properties - harder to engage and target with messages; less aware of legal responsibilities	Diversity in community, skills and time
	Decrease in volunteers - challenges for Local Area Plans	Need to conduct activities that appeal to volunteers
	Climate change and variability - more difficult to get people to do salinity work	Drier climate - less accessions to groundwater
	Irrigation system privatised	Opportunity to improve farm systems at the same time
	Land use changed - more rain-fed properties	Local Government to play role in planning these changes
	More pressurised irrigation systems	Improved utilisation of technology
	Increasing political influence	Opportunity to increase funding for Farm Program activities
New Frontiers	More lifestyle landowners	Need for education of natural resource management issues with these landowners - change delivery methods to appeal to amenity values
	More volunteers	More skills and experience and enthusiasm for community groups
	New enterprises developed	New skills required to work with these landowners
	Reduced irrigation water available	Landowners encouraged to plan changes to enterprise
	Irrigated area reduces	Land available for non-agricultural purposes
Pendulum	Conflict and change as Government buys water for environment	-
	Reduced irrigation water available – first period	Landowners encouraged to plan changes to enterprise
	Increased irrigation water available – second period	Whole farm planning and Local Government land use planning used to expand irrigation in suitable areas
Drying Up	Landowners in survival mode	Difficult to encourage natural resource management activities - Farm Program role to support landowners
	Reduced irrigation water available	Landowners encouraged to plan changes to enterprise
	Irrigated area reduces	Land available for non-agricultural purposes

Source: GB CMA 2007a, page 64

8.2.3.3. Sub-surface Drainage Program

The Program Review identified the following strategies to assist the Program in meeting future challenges (GB CMA 2007c, page 84):

- be community driven with a science based approach
- adopt a long-term integrated, adaptive and strategic planning approach with regards to SSDP infrastructure
- focus on private works in the short term and delay public works as long as possible
- design works which are multipurpose (e.g. pumps which can be used for 'resource extraction' and 'salinity control').
- ensure new public works complement the intent of the G-MW supply infrastructure rationalisation plans
- maintain its strong knowledge base through good documentation and succession planning
- protect agricultural and natural assets from salinisation and the effects of salt

- ensure the protection of native biodiversity in the region
- ensure effective management of salt within and external to the region
- use up-to-date, cost effective technology and management systems
- have access to a well informed SSDP advisory community.

8.2.3.4. Surface Water Management Program

The Program Review identified the following strategies to assist the Program meet future challenges (GB CMA 2007b, page 32):

- look at a more cost effective system; is there a less expensive first option? Look for opportunities to integrate with other programs to explore possible flexibility and possible cost savings
- monitor changing community attitudes and evaluate the implications (this applies to all programs)
- have a high level of communication with new irrigation development, particularly horticulture
- assess whether level of service is still applicable, look at opportunities to provide variable service
- look at all priority setting for works in catchments
- develop stronger links with local government to ensure an understanding and inclusion of issues such as drainage requirements for sub-divisions
- maintenance of works for next flood
- become involved in policy change to ensure expectations are not unrealistic
- exchange information amongst stakeholders.

8.2.3.5. Waterways Program

The Program review identified the following challenges and opportunities of the Goulburn Broken Irrigation Futures Scenario and their implications for the Program (

Table 40).

8.2.4. What does this mean?

In summary, this work suggests the future is not easy to predict. What is important, is we ensure our strategies and processes are flexible enough to deal with an ever changing world. It also reinforces the importance of the Monitoring, Evaluation and Reporting Strategy. It is in this context that adaptive management and ongoing review are important. We need to change our program even if the SIRCIS is not formally under review when new information comes to light.

Table 40 Challenges, opportunities and implications, Waterways Program

Challenges and opportunities	Implications for the Waterways Program
Changing community composition, attitudes and values: • Increased recreation and urban pressures from lifestyle residents • Community preferences for wetland management eg ephemeral *versus* permanent • Continuity and maintenance of existing works • Conflict in the community • Urban developments	Influence land use planning and development to: • ensure alignment between RCS and municipal strategic statements • meet flood plain management, cultural and biodiversity requirements. Develop and improve relationships with investors, through good reporting and communication practices. Improve internal relationships (within CMA), particularly with the Environment Program and look for complementary activities. Monitor and evaluate the short and long term benefits of management of the environmental water reserve. Increase understanding of the impact of environmental and transfer flows on riverine health. Increase understanding of land use change on runoff quantity and quality Improve understanding of community attitudes and values toward Program activities. Continue to re-evaluate priorities for management
Land use change: • Landscape planning – directing changes in land use to preferred areas • Land purchases by government or private investors for conservation and biodiversity purposes • Alternative industries eg ecotourism, plantations • Increased connectivity of waterways and riparian vegetation • Abandoned agricultural land	
• Climate variability and change • Dry conditions • Decrease in floodplain and wetland inundation and connectivity • Reduce area of irrigated agriculture - opportunity to buy water for environment • (Increasing) community understanding of drought • Promote weed emergence during low crop cover and low management • Increase value of water right - improving farm management and encourage water recycling	
Wet conditions: • Floods decrease motivation for good farm water management causing increase in salt and nutrient loads	
River condition: • Stress on water resources • Decline in water quality as water becomes limited • Transfer flows create unseasonal flow conditions • Irrigation water storage on farm, piping of irrigation water • Loss of ecological communities	
Government priorities: • Investment in natural resource management increases or decreases	

Source: GB CMA 2007g, page 23

9. Risk Assessment

This section assesses the risks to the asset base in the region and also the risks associated with the implementation of the Strategy.

The SIRCIS Risk Assessment has been undertaken in accordance with the Land and Water Management Plan Guidelines. It is a high level risk assessment and covers all of the SIRCIS programs. More detailed risk assessments can be found in the individual program reviews and the Goulburn Broken Regional River Health Strategy.

The Risk Assessment gives each asset a ranking depending on the risks the asset faces.

The resulting risk scores are dependent on funding levels and priorities remaining essentially unchanged. For example, if the funding for groundwater pumping is withdrawn by the government, the risk of land salinisation and consequent biodiversity loss will dramatically increase.

Annual investment decisions are made through the Regional Catchment Investment Plan (RCIP) where competing priorities are balanced against funding source priorities, and our expectations of where works programs are likely to succeed given prevailing conditions.

Determining our priorities for action is not a simple matter of addressing the risks in strict order of their risk rankings. Priorities are influenced by many other factors including the concerns outlined in this chapter.

Additional information about risk assessment is in Appendix 1.

9.1. Legal obligations

As natural resource managers, both SIR IC and landowners are governed by numerous legislation and policy initiatives which regulate the SIRCIS response to issues and controls suitable actions (Appendix 9).

9.2. Government funding priorities

The SIRCIS is largely dependent on Government funding to implement its programs. Government (both State and Federal), funding priorities and programs change over time. In order to receive funding, implementation of the SIRCIS must reflect these changing priorities.

These are issues that will influence government funding decisions and will determine whether programs are supported by the local community.

9.3. Support from the local community

Many of our actions require financial and time commitment from landowners. Naturally, community support is required for this. For example, our major incentive of Whole Farm Planning relies on landowners requesting they take part in the incentive scheme.

10. Recommended Targets and Actions

This section covers a summary of the targets and actions of each of the SIRCIS programs in response to the risks the region faces. Together these targets and actions make up the works program for the SIRCIS.

The program reviews provide details on the implementation programs and targets (GB CMA 2007a, GB CMA 2007b, GB CMA 2007c and GB CMA 2007d).

10.1. Environment Program

The targets presented below for 2010-2011 (Table 41) have been developed in the context of the Goulburn Broken Native Vegetation Management Strategy targets (Table 42).

Table 41 Targets, Environment Program, SIR

Activities		**2006-2011**	**2011-2020**
Environmental Incentive	Protect remnant vegetation	200ha	400ha
	Fence wetland remnants	50ha	150ha
	Revegetate native vegetation within or next to remnants	200ha	400ha
Tree Growing Incentive	Revegetate native vegetation away from remnants	150ha	300ha
	Revegetate adjacent to SWMS	25ha	50
Environmental Assessments	Assess land drained by primary SWMS	6,240ha	122,235
	Assess land drained by community SWMS	18,200ha	86,860
	Assess land for Public Salinity Control Pumps (number)	18	207
	Assess land for Public Salinity Control Pumps (area served)	3,580ha	41,420ha
Mandatory Monitoring	Monitor of wetlands	3	completed in 2009
	Monitor of terrestrial sites	4	
Environmental Management Plans	Deliver Environmental Water Allocations to priority wetlands	30,180ML	59,820
	Improve management of water in wetlands	4,963ha	3,081
	Develop Wetland Environmental Management Plans	6 plans	9
Environmental Management Plans	Develop Terrestrial Environmental Management Plans	3 plans	completed in 2006
	Improve management of terrestrial reserves	232ha	22ha
High Value Environmental Features (HVEF) for Sub-surface Drainage	Monitor bores installed	15 HVEF sites	
	Regular monitoring of groundwater	all HVEF sites	
	Regular monitoring of soil salinity		
	Protect site from sub-surface drainage works	1 HVEF site	-
	Document the design and operating principles applicable for the protection of HVEF from salinisation and waterlogging		

Table 42 Targets and links, Goulburn Broken Native Vegetation Management Strategy

Goals	Indicators	Aspirational targets for SIRCIS
Maintain or increase the extent of all native vegetation types	Area of remnant vegetation protected and revegetated less remnant vegetation removed	8,596 ha by 2030
Enhance quality of existing native vegetation	Area of remnant vegetation protected	48,658 ha by 2010
Increase the cover of all 'endangered' and applicable 'vulnerable' EVCs	Area revegetated (naturally regenerated, planted, etc)	64,857 ha by 2030
Increase viability of threatened species and the extent and quality of threatened ecological communities.	Sites flora protected (no.) Sites fauna protected (no.) Area protected (ha)	None set – however it is worth recording action

Note:

- All 'endangered' EVCs are below 10% pre-European cover and some 'vulnerable' EVCs are below 15%.

Source: GB CMA 2007d, page 16

10.2. Farm Program

In addition to continuing to strive to increase the uptake of all SIRCIS activities and to enhance the skills, knowledge and input of community and staff, the program targets for 2006 to 2020 are presented in Table 43.

Table 43 Targets, Farm Program SIR

Activities	2006-2011	2011-2020
WFP - survey and design - number	1,034	1,400
WFP - survey and design - ha	69,646	100,000
WFP - certification - number	553	1,250
Automatic irrigated systems constructed - number	54	100
Automatic irrigated systems constructed (area serviced) - ha	2,619	5,000
Drainage reuse systems constructed - number	270	500
Drainage reuse systems constructed (area serviced) - ha	15,853	30,000

Notes:

- By 2020, 100% of the farms in the SIR will have a WFP.
- The targets for the construction of automatic irrigation and drainage reuse systems assume funding is available.

10.3. Sub-surface Drainage Program

A revised full implementation timeframe of 2030 was established by the program review. This extension of time is required due to the number of works still to be implemented, and the historic and projected funding levels.

The area to be served by the program in the original plan was 171,300 ha. This area has been revised to 185,000 ha by the SSDP Baseline Statistics project. This project determined that the area to be served should be the area which is at risk of salinisation and water logging where the installation of works could cost effectively be installed and would have a positive influence. The project also determined our emphasis should be on the delivery of outcomes, i.e. the area served, rather than outputs, i.e. the number of pumps installed.

This new target of 185,000 ha being served by the program minus the achievement to June 2005 of 75,000 ha, leaves 111,800 ha still to be served by the program. Table 44 describes the physical works required to serve the remaining 111,800 ha.

Table 44 Targets, Sub-surface Drainage Program, SIR

Works	Unit	Works delivered to 30 June 2005	Target works to be implemented to 30 June 2030	Works still to be delivered (2005-2006 to 2029-2030)
Public pumps				
Public pasture pumps – channels or drains	number	43	375	332
Public pasture pumps – basins	number	0	50	50
Private pumps				
Private pasture pumps installed		254	541	287
Private pasture pumps upgraded	number	59	112	53
Non-SSDP private pasture pumps	number	443	443	0
Private horticulture pumps installed	number	20	50	30
Tile drainage				
Area with tile drains	ha	16	300	284

10.4. Surface Water Management Program

Waterways Program

The sections or "reaches" of rivers in the Goulburn Broken Catchment have been sorted into management units. Each of these units has been assessed for risks and had targets developed for them. The management units within the SIR are L1, L2, L3 and part of L5 (P Feehan, pers comm, 2010) and are described as:

L1 - Lower Goulburn River and Floodplain (Goulburn Basin Reaches 1 to 8).

L2 - Lower Broken Creek (Broken Basin Reaches 21 to 24, 28, 30 and 31).

L3 - Strathbogie Plains

L5 - Lower Broken River (Broken Basin Reaches 1 and 2).

Table 46 is a summary of the activities and targets of the Waterways Program.

Table 45 describes the construction program required to complete the works for the SWMP. In addition, the program will continue with the metering program and the monitoring of the following parameters of water quality in the systems: level and flow; salt; nutrients and suspended solids, turbidity and pH. The works include surface water management systems (SWMS) and drainage course declarations (DCD).

10.5. Waterways Program

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L1 - Lower Goulburn River and Floodplain (Goulburn Basin Reaches 1 to 8).

L2 - Lower Broken Creek (Broken Basin Reaches 21 to 24, 28, 30 and 31).

L3 - Strathbogie Plains

L5 - Lower Broken River (Broken Basin Reaches 1 and 2).

Table 46 is a summary of the activities and targets of the Waterways Program.

Table 45 Works remaining, Surface Water Management Program, SIR

SWMS areas	Area of catchment ha	Area serviced 2006 ha	Area remaining requiring SWMS or service ha	Length of new primary SWMS km	Length of community SWMS km	Length of DCD km	Length of primary SWMS remodelling km
Lockington	20,440	1,780	3,620	-	46.8	120	-
Bamawn	11,570	190	1,550	-	13.2	-	-
Wharparilla	9,470	6,180	3,290	-	35.7	-	-
Campaspe	11,180	186	7,214	-	58.6	20	-
Strathallan	9,240	-	4,360	-	28	-	-
Total Rochester WSC area	**61,900**	**8,336**	**20,034**	**0**	**182.3**	**140**	**0**
Deakin	46,230	2,842	18,368	15	157.05	15	-
Corop Lakes	48,620	4,400	34,450	15	121.8	143	-
Tongala	14,930	-	2,160	-	14.1	-	-
Mosquito	45,990	12,010	22,110	20.7	213.7	56	-
Coram	7,100	-	1,660	-	19.1	-	-
Wyuna	22,750	2,136	12,204	-	124.9	-	-
Rodney	17,230	6,480	4,200	-	61.3	-	-
Coomboona	15,360	2,030	6,870	-	53.9	-	-
Ardmona	9,420	2,400	3,330		25.7		
Toolamba	8,740	2,940	1,470		25.6		
Total Central Goulburn WSC area	**236,370**	**35,238**	**106,822**	**50.7**	**817.2**	**214**	**0**
Kialla	17,110	1,040	4,930	-	48.1	14	-
Total Shepparton South WSC area	**17,110**	**1,040**	**4,930**	**0**	**48.1**	**14**	**0**
Shepparton	9,800	292	540	-	2.4	-	-
Tallygaroopna	37,110	200	27,008	13.5	217.6	53	5
Invergordon	19,180		5,480		24.4		
Kaarimba	8,900		5,830		51		
Total Shepparton North WSC area	**74,990**	**492**	**38,858**	**13.5**	**295.4**	**53**	**5**
Barmah/Nathalia	55,200	400	26,940	37.5	185.1		
Strathmerton	33,630	1,800	6,510	7.4	180.5		
Muckatah	40,040	5,199	29,441	29.13	146.7		
Total Murray Valley WSC area	**128,870**	**7,399**	**62,891**	**74**	**512.3**	**0**	**0**
Total remaining works (2006-2020)	519,240	52,505	233,535	138.2	1,855.3	421	5
Total cost of remaining works (2006-2020)	-	-	-	$26.13M	$133.08M	$10.54M	$0.38M

Note:

- The targets presented in this table are different from the SWMP Program review based on updates from S Green, pers comm, 2010.

Table 46 Waterways Program target 2006-2007 to 2015-2016

Waterways	Targets
Goulburn River	Enhance floodplain to river linkages over 30 km of stream
	Fencing and revegetation – 40 km frontage
	Adoption of current recommended practice for "*Managing grazing in the riparian zone*" and control grazing – 390 km frontage
	Enhance aquatic refugia to protect in-stream habitat - 142.5 km of river with habitat improvement works
	Erosion control (near stream) - stabilise banks – 65 km of stream
Lower Broken Creek	Fencing and revegetation – 245 km frontage (Broken Creek); 60 km (Nine Mile Creek); 115 km (Pine Lodge Creek)
	Adoption of current recommended practice for "*Managing grazing in the riparian zone*" and control grazing – 245 km frontage
Lower Broken River	Provide and monitor fish passage at Gowangardie and Casey's Weir - 2 fishways
	Fencing and revegetation – 125 km frontage
Other reaches - targets are for the whole of Goulburn Broken Catchment	Riparian weed control – 25 km
	Fencing and revegetation – 400 km
	Adoption of current recommended practice for "*Managing grazing in the riparian zone*" and control grazing – 400 km frontage

The following activities cover the whole of the Goulburn Broken Catchment unless specified:

- complete the Goulburn Environmental Flow project, undertake economic assessment of improved river health, and implement recommendations with negotiated environmental flow regimes by 2010
- review bulk entitlement for the Goulburn River as part of Victoria's contribution to the Living Murray process
- review the operating procedures of the Goulburn Weir with a view to optimising water levels for the protection of the aquatic ecosystem
- investigate the implementation of key recommendations from the Goulburn River Audit (2005)
- minimise nutrient run-off into irrigation drains by implementation of on-farm best management practice by irrigators as outlined in the Irrigation Drainage Program of the Water Quality Strategy (SIR)
- remove phosphorous from irrigation drains through water reuse, sediment removal and nutrient stripping, as outlined in the Irrigation Drainage Program of the Water Quality Strategy (SIR)
- minimise nutrient discharge to rivers by reducing nutrient generation to wastewater facilities, and from wastewater sources by disposal to land and/or improved treatment. This action has not been costed as it will be implemented independent of the Regional River Health Strategy
- implement Best Management Practice (BMP) for urban drainage as outlined in the Urban Stormwater Management Program of the Water Quality Strategy
- conduct an Ecological Risk Assessment in Management Unit for turbidity, salinity, dissolved oxygen and pH, using *Guidelines for Environmental Management Risk-based Assessment of Ecosystem Protection* to determine further work required
- monitor assets at risk - significant EVC (box woodland), wetland condition, and Murray cod and develop actions to reduce threat if assets decline
- monitor assets at risk from threat - wetland conditions in Barmah forest and modify environmental flow if conditions decline
- support actions within the Murray Darling Basin Native Fish Management Strategy to determine further work required (costed under MDBC Strategy)
- develop a Flow Rehabilitation Plan (Broken Creek)
- implement Broken Creek environmental flow project, undertake risk analyses of values, threats and mitigation measures, and implement negotiated environmental flow regimes

- co-ordinate management of Rices Weir and associated fishway with environmental water requirement of Goose Swamp
- review connections between agencies with regard to co-ordinating river health regulation and management
- develop and implement an agency education and awareness campaign to ensure agency understanding and knowledge about river health issues
- review agency activities with regard to river health implications.

Sources: GB CMA 2007g, pages 24-38 and P Feehan, pers comm, 2010

11. Implementation Plan

This section describes the fundamentals of implementing the SIRCIS: coordination, economics, cash flow and funding, catchment standards and deciding which actions to take.

11.1. Plan coordination

SIR IC is responsible for overseeing implementation, coordination and reporting of the Plan. This self-nominated committee is appointed by the GB CMA Board.

The Plan Coordination Team, which provides executive and technical support for the implementation of the Plan, is headed by an Executive Officer.

The SIR has an extensive community engagement network (refer to Figure 8 in section 2.5.7). All of the working groups contain representation from local landowners, irrigators, environmentalists as well as agency staff.

11.2. Why is it working?

Based on the experience of SIR IC over the past two decades and the review of national standards for the National Action Plan (NAP) and other government guidelines, seven Integrated Catchment Management (ICM) principles were identified to guide the way that SIR IC does business. These ICMs are summarised below:

1. Partnerships fostered:

- communication will be optimised
- roles will be defined
- our diverse communities and agencies actively engaged.

2. Priorities rigorously assessed:

- priorities based on the best available scientific, economic and sociological information
- causes of problems targeted in geographic areas that maximise community return on investment
- priorities for works consider risks and multiple benefits.

3. Costs shared fairly:

- costs and benefits shared transparently and equitably
- 'triple bottom line' accountability
- clear link with supporting legislation.

4. Large scale focused on:

- land use changes to better match land capability across broad areas.

5. Cultural heritage included:

- Aboriginal and non-Aboriginal cultural values factored into all decisions.

6. Accountabilities clear (strong link with the partnerships principle):

- project proposals align with the priorities of the SIRCIS
- progress reports clearly link to regional, state and national targets and needs.

7. **Adaptive Management Systems at all scales:**

- management systems in place for individuals, sub-catchments, whole of catchment and industries.

The SIRCIS principles are underpinned by the values that the community would like to see promoted through the implementation of the Strategy. See Section 11.5 for details on values and behaviours.

SIR IC believes that by following these principles it will be able to continue to implement a long term catchment strategy. At the same time it can manage the changing political scene, funding priorities, agency responsibilities, scientific knowledge and landholder capability.

Since the Strategy has commenced SIR IC has expended a lot of effort in creating and retaining partnerships to ensure effective delivery of the SIRCIS. SIR IC considers as essential the following principles of effective catchment partnerships:

- **mutual benefits**: all parties benefit from their dealings with each other
- **collaboration**: cooperation is used instead of competition. Communication is open, honest, on-going, formal and informal
- **acknowledgment**: we recognise and advocate for our partners
- **roles and responsibilities:** our boundaries are clear and understood
- **differences:** we identify and resolve our differences early
- **commitment**: we have a shared long-term vision, dedication and trust
- **good governance**: we make good decisions and manage processes well.

SIR IC has formal partnerships with its partner agencies. It commits a lot of effort to renewing the partnership with the landholders and community groups (irrigators, Landcare and local government). It utilises a variety of tools and mechanisms (local area plans, communication strategies and actions, monitoring, evaluation and reporting strategies and actions, Municipal Catchment Coordinators, Landcare networks, Landcare awards, farm incentive matrices, Memoranda of Understanding, reporting days, and community input into the formal decision-making process) to strengthen these partnerships.

11.3. Overall cost-sharing

The SIRCIS has well developed cost-sharing principles and arrangements that have been consistently applied to natural resource management programs. These principles will continue to be used to guide investment over the next five years. The principles are:

Duty of Care

Natural resource users and managers have a duty of care to ensure they do not damage the natural resource base. They are responsible for making good any damage incurred as a result of their actions.

Beneficiary Pays

When it is not possible to attribute damage, then the primary beneficiaries should pay. Existing and future users are expected to pay for activities which provide private benefits. Contributions from secondary beneficiaries will be negotiated with the primary beneficiaries.

Government Contributions for Public Benefit

Government contributes primarily for activities that produce public benefits. Governments may contribute to land and water management activities that have a private benefit, where the cumulative uptake of these activities provides significant public benefit and government support is required to facilitate this uptake.

Positive Benefit-Cost Ratio

Before Government will contribute to any land or water management activity, the activity must be technically sound, the benefits must justify the costs and it must be considered a priority activity.

Statewide Policy and Monitoring

Government will contribute to the cost of statewide planning, statewide resource monitoring and assessment, and research and investigations where they are crucial to sustainable land and water management.

The GB CMA has identified four groups of beneficiaries which SIR IC has adopted: the Federal, State and local governments (as representatives of the regional community) and the landowners. The GB CMA considers the most appropriate policy is for the beneficiaries to share equally the 'public' component of the costs. Landholders will continue to pay for the major proportion of the required farm activities. In applying these principles, it is important that the final outcome is realistic and is administratively simple to implement.

The Victorian Government, in endorsing the SIRLWSMP (1990) provided endorsement for cost-sharing of the overall cost of implementing the Plan - this was 41.5 per cent landowner, 41.5 per cent State and Federal Governments and 17 per cent Local Government.

The following tables describe the cost-sharing arrangements for specific management actions (on-ground works) within the Catchment. The tables were extracted from the report "Review of SIRCIS Cost-Shares" (URS 2007). These arrangements reflect previous Victorian Government investment decisions and policy initiatives such as:

- Shepparton Irrigation Region Land and Water Salinity Management Plan, Draft (1989)
- Victorian Government Support for Salinity Management Plans (1990)
- Water for Growth (2001)
- Goulburn Broken Water Quality Strategy, Draft (1997)
- Victorian Government Water Quality Funding (1995).

11.3.1. Actual cost-share

The actual cost-share based on the five-year review of the Programs is shown in

Table 47, 48 and 49. Note:

- The Farm Program has the lowest government share of the cost with 12 per cent and the landholders with 88 per cent.
- The actual cost-share in the Environment Program is 74 per cent government share and 26 per cent landholder share.
- The Government's share in the SSDP is 70 per cent and the landholders paid for 30 per cent of the cost.
- The Government paid for the bulk of the investment required in the construction and operation of SWMS. In the SWMP, the government's share is 89 per cent and the landholders paid for 11 per cent of the cost (8.1:1).
- The review of the Waterways Program did not cover the actual cost-share.

Table 47 Actual cost-share by activity, Farm and Environment Programs

Activities	Actual cost-share - 2001 to 2006 review	
	Government	Landholders
WFP -Survey and Design	48.3%	51.7%
WFP - Plan certification	50%	50%
WFP - Financial assessment	50.1%	49.9%
Land forming	0%	100%
On-Farm Drainage	0%	100%
On-Farm Reuse - Structures	47.8% of capital expenditure	52.2% of capital expenditure 100% of Operation and Maintenance (O and M)
On-Farm Reuse - Pump/motor/structures		
On-Farm Reuse -Connection to electricity		
Automatic Irrigation	39.5% of capital expenditure	60.5% of capital expenditure 100% of O and M
Tree growing	48% of initial cost 100% O and M	52% of initial cost 100% O and M
Environmental incentives	66% of initial cost 100% maintenance cost	34% of initial cost 100% maintenance cost
Program support	100%	0%
Overall Farm Program (Note a)	12%	88%
Overall Environment Program	74% of initial cost	26% of initial cost

Note:

(a) Overall Program cost-share was based on the costs incurred from 2001 to 2006 and projected Operation and Maintenance (O and M) cost until 2031.

Sources: GB CMA 2007a and GB CMA 2007d

Table 48 Actual cost-share, Sub-surface Drainage Program

Activities	Cost-share through to full implementation	
	Government	Landholders
Private pumps - pasture	61%	39%
Private pumps - horticulture	68%	32%
Public pumps	71%	29%
Monitoring	90%	10%
Program support	100%	0%
Program development	100%	0%
Overall Sub-surface Drainage Program	**70%**	**30%**

Source: GB CMA 2007c

Note:

- The cost-share for Farm Exploratory Drilling Service and installation of tile drainage is not available.

Table 49 Actual cost-share, Surface Water Management Program

Activities	Actual cost-share - 2001 to 2006 review (system cost method)	
	Government	**Landholders**
SWMS - Primary	100% of the cost of: feasibility study, survey and design and initial capital costs	100% O and M and depreciation
SWMS - Community	66% of the present value of survey, design, construction and program support costs for systems constructed between 2001 and 2006 (no land use change scenario)	• 34% of the present value costs of survey, design and construction costs for systems constructed between 2001 and 2006. • 100% O and M
Drainage nutrient removal	17% of systems constructed from 1998 to 2006	• 83% of systems constructed from 1998 to 2006 • 100% O and M
Program support	100%	0%
Overall Surface Water Management Program	**89% (see notes)**	**11% (see notes)**

Notes:

- Overall Program cost-share excludes drainage nutrient removal.
- Overall Program cost-share was based on costs incurred from 2001 to 2006 and projected costs until 2031.

Source: GB CMA 2007b

11.3.2. Current cost-share (2009)

The SIRCIS provides incentives as a tool for supporting landowners to undertake farm and biodiversity improvements. Many of the incentives promote works that lead to gains in water use efficiency, nutrient management, biodiversity and farm planning. An approved WFP is required to be able to access most of incentive schemes.

The following tables (

Table 50 to Table 53) present the current cost-share for various activities.

Table 50 Current cost-share arrangement Farm and Environment Programs

Activities	Current cost-share 2009-2010		Comments
	Government	Landholders	
WFP - broadacre farms Topographical survey Design, computation	85% of cost up to $44.45/ha up to $51.05/ha	15% or greater	-
WFP - horticulture Base Plan Sub-surface and surface drainage design Irrigation design	85% of cost Up to $194.90/ha Up to $64.95/ha Up to $64.95/ha	15% or greater	Established orchards and vineyards
WFP Financial analysis Plan certification	85% of cost up to $935/property up to $256.70/property	15% or greater	Broadacre farms and horticulture
Land forming	0%	100%	-
On-farm drainage	0%	100% capital cost 100% O and M	-
Tree growing and/or environmental incentives Fencing Revegetation	Per cent of the cost up to a maximum of: $5/m $2.50/plant	100% O and M	The incentive rate is calculated using a cost-share matrix and assessment against 10 criteria for tree growing and 9 criteria for environmental incentives. Maximum incentive of $25,000 per landholder/property (includes both tree and environmental incentives).
Direct seeding	$800/ha based on 3km/ha		
Program support	100%	0%	-

Notes:

- The incentive for drainage reuse and automatic irrigation systems has been suspended for new applicants.
- Tree growing and environmental incentives - wide corridors, large revegetation projects and the implementation of other sustainable practices score highly. Higher scores receive higher incentive rates.

Table 51 Current cost-share arrangement Sub-surface Drainage Program

Activities	Current cost-share 2009-2010		Comments
	Government	Landholders	
Farm Exploratory Drilling Service - unsuccessful	100%	-	Landholder pays $825 deposit, if unsuccessful deposit returned.
Farm Exploratory Drilling Service - successful	Balance of the cost	$825 deposit	If no system installed within 2 years, farmer to pay 25% costs.
Tile Drainage	Between $700/ha and $1,400/ha	100% O and M	The level of incentive depends on existing water management works such as pressurised irrigation systems and effective surface drainage system.
Groundwater pumping - horticulture (new systems)	$200/ML of groundwater that can be pumped in 100 days, up to a maximum of 80% of total cost (whichever is lower)	• 20% or greater • 100% O and M	All shallow groundwater pumps within the SIR will be licensed according to the SIR Groundwater Management Plan.
Groundwater pumping - horticulture (system upgrades)	$200/ML of extra water that can be pumped in 100 days, up to a maximum of 80% of total cost (whichever is lower)	-	

Activities	Current cost-share 2009-2010		Comments
	Government	Landholders	
Groundwater pumping - horticulture (conversion to electric motor)	$1,000 plus $10/ML of groundwater that can be pumped in 100 days, up to a maximum of 80% of total cost (whichever is lower)	-	
Groundwater pumping - non horticulture (installation and upgrade of existing groundwater pumping systems)	Up to a maximum of $20,000 per property	-	Subject to a cost-share matrix and assessment against 10 criteria. Higher scores receive higher incentive rates. Percentage of the costs is determined from scoring the property for activities that are part of the SIRCIS.
Groundwater pumping - non horticulture (conversion to electric motor)	Up to $4,000 of the approved total cost	-	
Monitoring	100%	0%	-
Program support	100%	0%	-
Program development	100%	0%	-

Table 52 Current cost-share arrangement Surface Water Management Program

Activities	Current cost-share 2009-2010		Comments
	Government	Landholders	
SWMS - Primary	100% of cost of feasibility study, survey and design and initial capital costs	100% O and M and depreciation	-
SWMS - Community Survey and design Construction	 90% 50%	100% O and M 10% 50%	-
Drainage nutrient removal	25% of the cost of constructing a system up to a maximum of $26,0000 or $30,000 for 'best practice' systems	75% or greater 100% O and M	Incentive to construct water storage of at least 50ML with pump to divert water from G-MW primary SWMS and then use the water for irrigation.
Program support	100%	0%	-

Note:

- The incentive scheme for water harvesting has been absorbed into the cost-sharing arrangements for community SWMS.

Table 53 Current cost-share arrangement Waterways Program

Activities	Current cost-share 2009-2010		Comments
	Government	Landholders	
Fencing of waterways	$2.00 to $6.50 per metre	Balance of cost	-
Provision of off-creek watering points	up to 75% of installed costs	25% or greater	-
Individual property outfall to natural waterways:	-	-	A reuse system will be required to prevent small flows leaving the property.
Design of outfall structure	50%	50%	
Construction of outfall structure	50%	50%	
Maintenance	0%	100%	
Program support	100%	0%	-

11.4. Funding and program of expenditure

The climate for investment is affected by numerous factors such as:

- the perceived need to invest,
- climate and seasonal variability,
- government priorities and initiatives, and
- the economic position of the regional community.

Since the implementation of the SIRCIS began in 1990, there has been tremendous investment by all stakeholders. This reflects the recognition of the importance of outcomes to the region and State. It is critical this willingness to invest continues, and the SIRCIS remains responsive to investor requirements.

The cost of implementing the planned activities from 2006-2007 to 2010-2011 is about $78 million (

Table 54). SIR IC believes this represents a balance between the needs of the catchment, likely government funding, and our community's ability to participate in the activities (

Table 55).

Table 54 SIRCIS program of expenditure 2006-2007 to 2010-2011

Activities	2006-2007 ($'000)	2007-2008 ($'000)	2008-2009 ($'000)	2009-2010 ($'000)	2010-2011 ($'000)	5 year total ($'000)
Farm and Environment Program						
Program Support (Farm and Environment teams)	$1,482.5	$1,250.0	$1,500.0	$1,500.0	$1,500.0	$7,232.5
Implementation:						
WFP	$286.7	$468.3	$1,050.0	$1,050.0	$1,050.0	$3,905.0
Automation	$56.3	$38.1	$76.5	$76.5	$76.5	$323.9
Reuse systems	$593.7	$501.8	$600.0	$600.0	$600.0	$2,895.5
Environmental Management Grants	$120.2	$120.2	$120.2	$120.2	$120.2	$601.0
Tree Growing Incentive	$72.3	$72.3	$72.3	$72.3	$72.3	$361.5
Total implementation cost	$1,129.2	$1,200.7	$1,919.0	$1,919.0	$1,919.0	$8,086.9
Total cost- Farm and Environment Program	**$2,611.7**	**$2,450.7**	**$3,419.0**	**$3,419.0**	**$3,419.0**	**$15,319.4**
Sub-surface Drainage Program						
Program Support:						
DPI extension	$110	$110	$110	$110	$110	$550
G-MW management, support and extension	$600	$600	$600	$600	$600	$3,000
Total Program Support cost	$710	$710	$710	$710	$710	$3,550
Implementation:						
Public pumps	$660	$660	$660	$660	$660	$3,300
Private pumps	$920	$920	$920	$920	$920	$4,600
Horticulture		$120	$240	$240	$240	$840
Salt disposal						
Evaporation basins						
Tile drainage						
Total implementation cost	$1,580	$1,700	$1,820	$1,820	$1,820	$8,740
Program development	$1,200	$800	$800	$950	$1,000	$4,750
Monitoring	$820	$820	$820	$820	$820	$4,100
Total cost - Sub-surface Drainage Program	**$4,310**	**$4,030**	**$4,150**	**$4,300**	**$4,350**	**$21,140**
Surface Water Management Program						
Program Support	$200	$200	$200	$200	$200	$1,000
Implementation:						
Community SWMS	$500	$500	$500	$500	$500	$2,500
Primary SWMS	$4,000	$4,000	$4,000	$4,000	$4,000	$20,000
Total implementation cost	$4,500	$4,500	$4,500	$4,500	$4,500	$22,500
Other	**$1,055**	**$1,055**	**$1,055**	**$1,055**	**$1,055**	**$5,275**
Total cost- Surface Water Management Program	**$5,555**	**$5,555**	**$5,555**	**$5,555**	**$5,555**	**$27,775**
Total cost- Waterways Program	**$2,500**	**$2,500**	**$2,750**	**$3,000**	**$3,000**	**$13,750**
Grand total - SIRCIS	**$14,976.7**	**$14,535.7**	**$15,874.0**	**$16,274.0**	**$16,324.0**	**$77,984.4**

Note:

- Details of activities of the Waterways Program are not available.

Table 55 SIRCIS budget expenditure 2006 to 2020 (full implementation)

Programs	2006-2020 ($M)
Farm and Environment Program	$46
Sub-surface Drainage Program (funding to 2030)	$175
Surface Water Management Program	$170
Waterways Program	$41
SIRCIS total funding	$432

Notes:

- Figures going later than 2010-2011 involve a degree of speculation and not all Programs have calculated the figures in the same way.
- Some analyses have assumed a steady rate of implementation whilst others have assumed an acceleration of some activities during different parts of the SIRCIS.
- The SSDP budget was calculated to a finish date of 2030.
- See Program reviews for more information about costs.

11.5. Catchment values and behaviours

SIR IC is governed by a charter which amongst other things requires the following values and behaviours:

Respect of the community – Implementing natural resource management actions cannot occur without the support, guidance and active participation of the community.

Quality – The management actions and works actions promoted by the SIRCIS will be delivered to a high standard dictated by community expectations.

Learning and adapting – We must strive for excellence in our monitoring and evaluation processes. They must be transparent and invite community scrutiny, and we must achieve best practice in reviewing and adjusting our efforts to accommodate new research findings and revised community expectations.

Safety focus - Knowing and following safety practices and procedures as well as identifying, assessing and controlling workplace hazards.

Collaboration - Working together as well as sharing ideas, knowledge and results to achieve outcomes.

Engagement - Demonstrating a willingness to be involved, acting responsively and with a sense of urgency, taking pride in your work and respecting SIR IC achievements; enhancing its reputation wherever possible.

Commitment to improvement - Initiating and implementing new ideas and seeking to do things in better ways.

Managing people - Engaging, guiding and motivating staff.

11.6. Deciding which actions to take

Generally, actions are taken to either to:

- reduce the risk of current and future threats; or
- remedy the impacts of past and current threats

The criteria for deciding what action, amongst a range of actions, to take include:

- relative risk rating of all threats to benefits flowing from natural assets;
- costs and benefits of action, including details of who should pay; and
- government priorities and funding levels.

SIR IC is committed to working with partners to prioritise and implement actions on Federal and State lists,

such as the Murray Darling Salinity and Drainage Strategy and Victorian Action Statements and National Recovery Plans that contain specific actions.

11.6.1. Programs: historical emphasis and new issues

The understanding of the SIR community of which threats pose the greatest risk to assets and where the most difference can be made, is reflected in the programs that have been developed over the past 15 years. These programs (and their associated investment plans and technical reports) contain a myriad of actions and it is not appropriate to list them all in this overarching document. Although often single-issue focused, the programs do take into account triple bottom line outcomes and the relationship with other natural resource management issues.

This update of the SIRCIS highlights the fact that the actions described in the original SIRLWSMP are still valid and relevant. We need to respond to the challenge of climate change as we continue to address threats of salinity and high watertables, nutrients and pest plants and animals and ensure biodiversity assets are protected and enhanced. In all cases we must increase our efforts.

11.6.2. The multiple issues approach to decision making

Selecting the appropriate action or mix of actions is difficult in natural resource management because the components of the environment are highly interconnected. Actions usually have an impact on those specifically targeted as well as on other assets. This can create further risk and opportunity. Integration of actions is particularly important for biodiversity, which is affected (either positively or negatively) by virtually every natural resource management action.

Historically, actions were selected to target specific threats or assets. Although it is still useful to do this, we are more aware of the other risks and opportunities these actions present. Prioritisation principles differ slightly from asset to asset and threat to threat, usually reflecting the natural resource management discipline from which they are derived. Programs and background papers detail these principles. We are making substantial efforts to develop greater consistency and transparency in decision-making.

The focus for allocating investment is shifting away from discrete issues such as salinity and biodiversity to management actions that generate multiple issue benefits. This has major implications for all levels of planning and implementation and especially for monitoring, evaluation and review programs.

Cost-benefit analyses to set priorities for salinity and water quality management have been pioneered in the SIR and continue to be refined. Similar approaches are being advocated by Australia's leaders in biodiversity decision-making such as Possingham et al (2002) to encourage debate on the methodology and refinement of the data.

12. Assumptions Used in the Reviews

12.1. Salinity

a. The area of land protected by a surface water management system is 92 ha for every kilometre of primary SWMS and 65 ha for every kilometre of community SWMS[9].

b. Surface water management systems reduce accessions to groundwater by 11.5 per cent.

c. In general 1ML of shallow groundwater pumped (both public and private pumps) protects 1 ha of land. Similarly 1 ha of tile drainage equates to 1 ha of area served. However, the area served by the SSDP private pasture pump is based on the assumption that 1ML of Licence Entitlement equates to 0.6 ha of area served. This assumption was based on the average SIR pump extraction compared to Licence Entitlement for the period 2000-2001 to 2004-2005 which was approximately 60 per cent. This is a more conservative assumption than currently used for reporting the area served to the SIRCIS (ie. 1ML of licence entitlement equates to 1 ha of the area served (GB CMA 2007c, page61; GB CMA 2007f, page 12)

d. Figures used to calculate 1EC rise in the River Murray at Morgan, South Australia are 6,800t/EC for the SIRCIS, 6,500 t/EC for private pumps and 6,000 t/EC for public pumps. (It is also assumed if the works had been in existence before the MDBC's 1975-1985 benchmark period, discharges from drains would follow a similar pattern to that shown by existing drains and discharges from public and private pumps would be scheduled to hit specified target flows in the River Murray.) These assumptions were confirmed in the Salt Audit conducted by SKM in 2004.

e. Figures used to calculate salt loads from SWMS are 0.0022 EC/km for a primary SWMS and 0.00024EC/km for a community SWMS. Monitoring showed the salt load was reduced therefore it was considered as a downstream benefit. The Salt Audit now assumes an EC benefit credit from drains.

f. There is a reduction of 17.5 per cent of accessions to groundwater on the average farm laid out in accordance to a WFP (including laser grading 10 per cent and installation of farm drainage 7.5 per cent).

g. The installation of a farm drainage reuse system saves 0.67ML/ha (on an average area serviced of 60 ha) of irrigation tailwater not entering the drainage system. Every 1ML of water reused intercepts 237.5 kg of salt entering the drainage system.

h. Each farm reuse system is on average 10ML and is used 10 times during the season.

i. Each new public pump protects 200 ha.

j. There will be enough Salt Disposal Allocations given to the SIR to fully implement the Sub-Surface Drainage Strategy.

k. When it rains in a catchment (during the irrigation season), all the rain turns to runoff in 25 per cent of catchment, 25 per cent has little runoff, 25 per cent has a lot of runoff, and 25 per cent has no runoff.

l. When regional drainage goes through a catchment, farm infrastructure is improved to take advantage of the drainage service.

m. New SWMS are designed to provide drainage for a one-in-two year rainfall event.

[9] The new standard for underway and designed is 270ha for every km of primary drain and 89ha for every km of community drain.

12.2. Water quality

a. Filter strips and waterway management actions could account for an annual reduction of 6.6t (20 per cent of 32.8t) of treatable phosphorous from dryland sources.

b. A reduction of 8.25ML of runoff is achieved by an automatic irrigation system installed on an average property, which retains 3kg of phosphorus and 130kg of nitrogen on the farm.

c. Every megalitre of reused water equates to a decrease of 1.89kg of total phosphorus, a decrease of 4.73kg of nitrogen, and a decrease of 75.85kg of suspended solids entering the drainage system.

d. Reducing phosphorus reduces other critical nutrients including nitrogen.

e. Reducing nutrient concentrations into the River Murray will reduce the risk of nutrients from the SIR causing or contributing to algal blooms downstream.

13. Knowledge Gaps and Research and Development Needs

In general, integrated catchment management involves decisions based on information from different disciplines, such as salinity, bio-diversity and sociology.

During the current SIRCIS review process a number of knowledge gaps were identified. Some actions within the strategy may need to be revisited on the basis of successful filling of these gaps.

There are still many challenges to overcome, such as:

a. Improving our understanding of all natural management risks and threats under the climate change scenarios.

b. Increasing our understanding of altered irrigation management practices and future water trade.

c. Developing practical and easy to use protocols for monitoring and evaluating changes in irrigation strategies and their impacts on the region in order to maintain or improve water management on farms.

d. Improving our understanding of the biophysical and socio-economic issues in natural resource management.

e. Increasing our knowledge of water use efficiency on farms.

f. Improving our understanding of balancing water usage among farm, industry and environment components.

g. Committing more research and resources to nutrient concentration and management (more particularly groundwater) issues.

h. Improving our understanding of groundwater nutrients and trends in groundwater salinity.

i. Reducing our knowledge gap on salt management - internal redistribution and removal of salt and its subsequent impact on downstream users.

j. Conducting detailed analysis on land use changes in the catchment.

k. Identifying and implementing suitable measures to tackle the impact on resource management of the growing numbers of lifestyle farmers in the region.

14. Conclusion and Recommendations

14.1. Conclusion

The SIRCIS has significant achievements in its first 15 years (1990-2006). The community engagement has been identified as one of the main strengths of the program. The strategic approaches of the past have served us well and we continue on this path. The economic, environmental and social objectives were focussed to be equitable and affordable to the individual and the regional community. The overall future success of the strategy depends on how the 'triple bottom line' outcomes are maximised and how potential trade-offs between these outcomes are identified and managed. A total of $78 million has been spent implementing the program during 2001-2006 and its estimated $354 million is required towards full implementation by 2020.

The SIRCIS has evolved throughout the years of implementation from a land and salinity plan to a whole of catchment approach incorporating issues such as biodiversity. As the plan moves forward more evolution is anticipated to ensure that the SIRCIS continues to meet the needs of the catchment community.

14.2. Recommendations

The overarching recommendation is that the SIRCIS continues to be implemented.

The following recommendations apply across the SIRCIS Programs:

- Close linkages be developed and maintained with the agencies implementing NVIRP works to ensure our opportunities are maximised for our programs and for NVIRP.
- SIR IC to develop a policy for standard conditions under Water Use Licences.
- Update annually the incentive table detailing current rates of payment and policy justification.
- SIR IC to continue to develop responses to climate change as its impacts emerge.
- The SIRCIS Programs are revised as land and water use change due to the combined impacts of modernisation, climate change, environmental flows and drought.
- The study of the regional economy is relatively outdated. An in-depth study of the regional economy (Input-Output Analysis) be undertaken in conjunction with the 2011 review (the ABS will also conduct a Census of Agriculture in 2011).
- A more robust economic analysis be conducted in 2011 when the Strategy and the programs will be reviewed after 20 years of implementation. The review will address some of the limitations of the 2005-2006 reviews. The review should also include an assessment of the catchment and agronomic benefits and costs of all programs, both market 'priced' and 'unpriced' benefits and costs.

The following recommendations are high level, strategic recommendations applying to individual programs.

14.3. Environment Program

- The Environment Program further integrates Biodiversity Action Planning into local government and public land management planning.
- The Environment Program undertakes an estimate of the actual works required from 2010-2011 to 2020 to complete the environment component of the SIRCIS.
- The Environment Program develops a Program Engagement Plan. The engagement of the community and indeed stakeholders will ultimately enhance people's capacity to understand problems and seek opportunities, consider options and find solutions, make decisions and take action.

14.4. Farm Program

- The challenges and opportunities identified by the Irrigation Futures scenarios be reviewed and the relevant issues incorporated in the development of the Program.
- Continue to closely monitor the outcomes from the Local Area Planning approach and utilise the learning for the future development of the Program.
- Target activities in specific risk areas and specific community groups.

14.5. Sub-surface Drainage Program

- Review the salt-water balance of the SIR, with particular reference to the changes in land use due to issues of modernisation, drought and climate change.
- Continue to implement the recommendations of the Sub-surface Drainage Program Research and Investigation Strategic Plan.
- Limited data on the nutrient concentration of the region's groundwater resources has made it difficult to ascertain whether the management of nutrients is an important issue for the implementation of the SSDP. It is essential the Monitoring Program be extended to include routine sampling and analysis of groundwater nutrients at strategic sites across the SIR.

14.6. Surface Water Management Program

- Ensure the cost-share arrangements being reassessed under the Regional Catchment Strategy review will provide sufficient incentive for community surface water management schemes to proceed when conditions allow.
- Ensure sufficient data is available to determine the impacts of water trade, modernisation and configuration on the design capacity methodology currently used.
- Develop future landscape objectives for SIR sub-catchments in accordance with Irrigation Futures objectives.

14.7. Waterways Program

- Develop an MER strategy. An effective MER Program is essential to ensure actions outlined under the GBRRHS lead to the achievement of both the management action or implementation targets and the resource condition targets.
- Undertake a process to incorporate the predictions of climate change, land use change and social trends into the planning of the river health and cross discipline programs.
- Play a major role and provide input to river health and water quality issues while the community develops their Local Area Plans.

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Acts and Legislation: Main Commonwealth and State Acts, Legislation and Policy documents that influence natural resource management in the SIR are provided in Appendix 9

16. Appendices

Appendix 1 Shepparton Irrigation Region Catchment Implementation Strategy Risk Assessment

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Water yield**
1. Asset Item: **Quantity**

Value:
GB catchment covers 2 per cent of the MDBC area and generates 11 per cent of the water resources; on an area basis the SIR covers about 22 per cent of the GB catchment.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Declined water availability	Altered flow patterns and quantity of water in rivers and creeks from harvesting, storing and delivering water, leading to biodiversity loss.	Possible	Major	High	Might occur at sometime - shouldn't be a big problem as the region has conservative allocation policy, will be implementing the NRSWS, community is focussed on environmental allocations.	Not a direct SIRCIS responsibility, however we provide input into State Policy Development including allocation policies.
Climate change	Demand for water will increase, less water will mean less demand for surface drainage and then more accessions when rain does occur, increased use of groundwater will lead to greater local distribution and storage of salt in upper soil profile leading to increase in watertable levels. Reduced rainfall, reduced snowfall, increased evaporation, longer and more frequent periods of drought.	Likely	Major	Extreme	Climate change is a reality, will lead to increased competition for water, impacts on demand for drainage uncertain due to possibility of more summer storm dominated rainfall.	GB CMA is currently developing a climate change strategy.

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Water yield**
2. Asset Item: **Hydrology**

Value:
The SIR has about 850 km of rivers and streams within the Goulburn and Broken River Basins. Of these about 38 per cent were rated as “moderate” in condition, 59 per cent were in “poor” condition and 3 per cent were in “very poor” condition as measured by the International Organization for Standardization (ISO) ratings.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Culverts, regulators and in-stream water storage management, flood levee banks	Reduction of average annual downstream flow leading to biodiversity loss, some wetland assets receive no water.	Likely	Moderate	High	Has happened due to past practices, less likely to occur in future, some remedial works occurring such as using drainage assets to supply environmental flows.	Flow patterns should be protected now through flooding and earthwork planning controls, situation should improve as surface water management assets are used to deliver environmental water.
Increased demand for water (urban and rural)	Less water within the system for the environment (accelerated from the influence of climate change).	Likely	Major	Extreme	-	Not a direct SIRCIS responsibility, however we provide input into State Policy Development including allocation policies.
Climate change	Reduced rainfall, reduced snowfall, increased evaporation, longer and more frequent periods of drought, resulting in changes to flow magnitudes and regimes.	Certain	Major	Extreme	-	GB CMA is currently developing a climate change strategy.

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Water yield**
3. Asset Item: **Physical Form**

Value:
The SIR has about 850 km of rivers and streams within the Goulburn and Broken River Basins. Of these about 38 per cent were rated as “moderate” in condition, 59 per cent were in “poor” condition and 3 per cent were in “very poor” condition as measured by the International Organization for Standardization (ISO) ratings.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Changed flow patterns	Reversal of natural regime leading to biodiversity loss, some wetland assets receive no water.	Likely	Moderate	High	Has happened due to past practices, less likely to occur in future. Some remedial works occurring such as using drainage assets to supply environmental flows. Results of past practices may yet materialise, for example, when we get another big flood.	Flow patterns should be protected now through flooding and earthwork planning controls. Situation should improve as surface water management assets are used to deliver water for the environment.
Stock grazing	Causes active degradation of biodiversity values on-site and downstream, contributes to poor water quality (nutrients and sediment).	Unlikely	Minor	Low	Unlikely now due to CMA programs and crown frontage licensing reforms.	Incentive provided for landowners to fence off waterways and provide alternative stock watering.
Climate change	More intense rainfall events, changes in erosion and sediment generation, transport and delivery rates.	Likely	Major	Extreme	-	GB CMA is currently developing a climate change strategy.
Poor frontage management practices (recreation, inappropriate management, soil disturbance, rubbish dumping)	Loss of natural regeneration, soil disturbance, pollution entering the river.	Certain	Moderate	High	-	Working with partners such as local government councils on education campaigns and River Connect Project in Greater Shepparton (see note).

Note:

- River Connect Project is a major initiative to improve the condition of the Goulburn River and its surrounds between Shepparton and Mooroopna and raise awareness about the vital role of the river as the lifeblood of the communities.

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Water yield**
4. Asset Item: **Streamside zone**

Value:
The SIR has about 850 km of rivers and streams within the Goulburn and Broken River Basins. Of these about 38 per cent were rated as “moderate” in condition, 59 per cent were in “poor” condition and 3 per cent were in “very poor” condition as measured by the International Organization for Standardization (ISO) ratings.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Stock grazing	Causes active degradation of biodiversity values on-site and downstream, contributes to poor water quality (nutrients and sediment).	Unlikely	Minor	Low	Unlikely now due to CMA programs and crown frontage licensing reforms.	Incentive provided for landowners to fence off waterways and provide alternative stock watering.
Pest plants and pest animals	Linear reserves provide pathways for weed species which are highly competitive with native vegetation, pest animal species damaging existing vegetation and reducing rates of recruitment.	Likely	Moderate	High	Occurs in most circumstances - extends beyond the immediate area of the source of impact however still within the local area.	DPI as a partner runs a pest plant and animal program working with the community to achieve control of priority pests and enforcing the *Catchment and Land Protection Act 1994* where voluntary compliance is not achieved.
Climate change	Changes in vegetation communities and health of in stream riparian and floodplain communities.	Likely	Moderate	High	Likely to increase the stress on rivers already under pressure. Streams may exhibit higher water temperature, reduced oxygen levels, and other pollutant loads affecting water quality and habitat values for aquatic and riparian species.	GB CMA is currently developing a climate change strategy.

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Water yield**
5. Asset Item: **Water Quality**

Value:
The SIR has about 850 km of rivers and streams within the Goulburn and Broken River Basins. Of these about 38 per cent were rated as “moderate” in condition, 59 per cent were in “poor” condition and 3 per cent were in “very poor” condition as measured by the International Organization for Standardization (ISO) ratings.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Salinity	Increase in salt loads to rivers	Likely	Major	Extreme	Despite impact of drought on lowering groundwater levels, a salinity problem is still expected when wet winters return.	Salinity works - Whole Farm Planning, groundwater pumping, SWMS, laser grading.
Irrigation	Increase in nitrogen and phosphorus loads to rivers through drainage networks increasing risk of algal blooms downstream.	Unlikely	Major	High	Affects agricultural, human and ecological use of the water.	Water quality program - reducing outfall from surface water management systems through improved irrigation management and layout, improved effluent pond management, fertiliser best management practices.
Climate change	Reduced flows leading to higher concentrations of nutrients and salt. Increase in water temperature. Increased sediment flows leading to greater turbidity.	Likely	Moderate	High	Likely to increase the stress on rivers already under pressure. Streams may exhibit higher water temperature, reduced oxygen levels, and other pollutant loads affecting water quality and habitat values for aquatic and riparian species.	GB CMA is currently developing a climate change strategy.
Urban issues - sewerage treatments plants, asset construction (eg new housing estates), litter	Phosphorous and Nitrogen to river along with sediment and litter.	Possible	Minor	Medium	-	Improved sewerage treatment plant discharges by urban water authorities, stormwater action plans by councils.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Intensive animal industries, eg fish farms and piggeries	Phosphorous and nitrogen to river.	Unlikely	Minor	Low	Very few fish farms in the SIR, however upstream farms can have an impact. The impact should be well controlled due to the implementation of the GB Water Quality Strategy.	Participated in developing state-wide dairy feed pad controls and in identifying the locations of intensive animal industries such as piggeries controlled by planning permits.
Stock grazing	Animal production provides additions to nutrients in streams.	Unlikely	Minor	Low	Unlikely now due to CMA programs and crown frontage licensing reforms.	Incentive provided for landowners to fence off waterways and provide alternative stock watering.

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Water yield**
6. Asset Item: **Aquatic life**

Value:
Significant aquatic species in the lower Goulburn and Broken river basins within the SIR area include Crimson spotted rainbow fish, Murray cod, Golden perch, Trout cod, and Silver perch (inclusive of small bodied fish and bug communities).

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Salinity	Increase in salt loads to rivers reducing water quality.	Likely	Moderate	High	Lose sensitive species only.	Salinity works - Whole Farm Planning, groundwater pumping, SWMS, laser grading.
Water quality	Reduced water quality affects habitat availability.	Likely	Moderate	High	Lose sensitive species only.	Water quality program such as reducing outfall from SWMS through improved irrigation management and layout, improved effluent pond management and fertiliser BMPs.
Changed flow patterns	Undesirable low flows diminish deep water pools and degrade habitat, un-seasonal flows.	Likely	Major	Extreme	Goulburn River is a heritage river and changed flow patterns could cause loss of items of national significance.	Flow patterns should be protected now through flooding and earthwork planning controls. Situation should improve as surface water management assets are used to deliver environmental water.
Pest weeds	Impact on the quality of native vegetation, which in turn impacts upon biodiversity, river health and water quality.	Likely	Moderate	High	Lose sensitive species only	DPI as a partner runs a pest plant and animal program, focussed on working with the community to achieve control of priority pests and enforcing the *Catchment and Land Protection Act 1994* where voluntary compliance is not achieved.
Climate change	Reduced flows leading to higher concentrations of nutrients and salt. Increase in water temperature.	Likely	Major	Extreme	Likely to increase the stress on rivers already under pressure. Streams may	GB CMA is currently developing a climate change strategy.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
	Increased sediment flow leading to greater turbidity.				exhibit higher water temperature, reduced oxygen levels and other pollutant loads affecting water quality and habitat values for aquatic and riparian species.	
Irrigation	Poorly managed farms can cause significant quantities of nutrients to enter rivers.	Unlikely	Major (affects agricultural, human and ecological use of the water)	High	Unlikely as we have been implementing Whole Farm Planning, fertiliser BMPs and New Irrigation Development Guidelines.	Water quality program such as reducing outfall from SWMS through improved irrigation management and layout, improved effluent pond management and fertiliser BMPs.
Culverts, regulators and in-stream water storage management	Barriers within streams can prevent migrations of native fish.	Unlikely	Major	High	CMA program to remove fish barriers in Gowangardie Weir, Nillahcootie Lake remain on Broken River, Goulburn Weir and Eildon remain on Goulburn River.	Waterways Program is removing fish barriers along the major rivers and streams

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Wetlands**
7. Asset Item: **Significant Wetlands**

Value:
Eight significant wetlands including one Ramsar listed.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Irrigation	Increased nutrient levels in the river systems.	Likely	Major	Extreme	-	Water quality program such as reducing outfall from SWMS through improved irrigation management and layout, improved effluent pond management and fertiliser BMPs.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Pest plant and animals	Reduce vegetation communities and a threat to native animal species.	Likely	Major	Extreme	-	DPI as a partner runs a pest plant and animal program, focussed on working with the community to achieve control of priority pests and enforcing the *Catchment and Land Protection Act 1994* where voluntary compliance is not achieved.
Grazing	Reduce vegetation communities and a threat to native animal species.	Likely	Major	Extreme	-	Environment Program incentives are addressing this problem in conjunction with Biodiversity Action Planning.
Salinity	Increased salt level.	Likely	Major	Extreme	-	Salinity works (Whole Farm Planning, groundwater pumping, SWMS, laser grading).
Water quality	Increased nutrient levels affect wetlands and fringe vegetation causing declines in biodiversity.	Likely	Major	Extreme	-	SIRCIS programs addressing this include farm planning (improving water quality leaving farms) and surface water management (improving water quality leaving drains).
Culverts, regulators and in-stream water storage management	Many wetlands no longer connected due to infrastructure development.	Likely	Major	Extreme	There is a risk modernised assets will not have been planned with thought to the full implications, eg wetlands may be cut off from water when new channels go in or conversely are not replaced.	SIR IC working closely with partner agencies to ensure all issues are considered during the redesign of the irrigation system.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Changed flow patterns	Controlled flows have reduced wetting of floodplain wetlands, including draining of wetlands.	Likely	Major	Extreme	-	Flow patterns should be protected now through flooding and earthwork planning controls, situation should improve as surface water management assets are used to deliver environmental water.

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Floodplains**
8. Asset Item: **Storage areas**
9. Asset Item: **Nutrient and high flow protection**

Value:
Most recent flooding event occurred October 1993 recording a 100-year Average Recurrence Interval (ARI).

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Changed flow patterns	Loss of floodplain services resulting in: • reduced capacity of floodwaters to release slowly as stream height recedes, in turn increasing the risk of channel erosion • loss of opportunity for nutrients, debris and sediments to settle out during flooding events protecting waterways from high sediment and nutrient loads.	Likely	Major	Extreme	Likely in that it has happened in the past through farm and regional asset development and flood protection measures. New barriers less likely to be built in future due to floodplain management with planning permits and WFP certification.	Flow patterns should be protected now through flooding and earthwork planning controls. Situation should improve as surface water management assets are used to deliver environmental water.

Asset: **Environment**
Primary Asset: **Water**
Secondary Asset: **Groundwater**
10. Asset Item: **Water quality - shallow system**

Value:
The SIR has about 850 km of rivers and streams within the Goulburn and Broken River Basins. Of these about 38 per cent were rated as “moderate” in condition, 59 per cent were in “poor” condition and 3 per cent were in “very poor” condition as measured by the International Organization for Standardization (ISO) ratings.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Increased salt, nutrients and possible pesticide contami-nation	Biodiversity loss, if water gets too salty won't be able to pump and dispose for protection as won't have the salt credits to allow for disposal.	Likely	Minor	Medium	-	Salinity works - Whole Farm Planning, groundwater pumping, SWMS, laser grading.

Asset: **Environment**
Primary Asset: **Land**
Secondary Asset: **Soil Health**
11. Asset Item: **Physical, chemical, biological**

Value:
The total SIR area is 500,000 ha. Of this 317,000 ha is irrigated with varying degrees of soil fertility.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Cultivating, cropping and pasture management	Can damage existing native vegetation, prevent natural regeneration of remnant vegetation and encourage pest plants.	Unlikely	Moderate	Medium	Only likely to occur with poor practice farmers.	Farm Program and Environment Program incentives (Whole Farm Planning, environment incentives).

Asset: **Environment**
Primary Asset: **Biodiversity**
Secondary Asset: **Native Flora**
12. Asset Item: **Extent**

Value:
Only 2 to 3 per cent of native vegetation cover remains since European settlement

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Intensive agriculture	Cleared extensively for agriculture, leaving only 2 to 3% of native vegetation cover.	Certain	Major	Extreme	-	Environment Program incentives are addressing this problem, in conjunction with Biodiversity Action Planning.
Decline of EVC's	Reduced availability of habitat isolating populations and limiting gene flow, smaller populations are less resilient and more vulnerable to threats such as plague locusts.	Likely	Major	Extreme	-	Environment Program incentives are addressing this problem, in conjunction with Biodiversity Action Planning.
Pest animals	Increased number of predators (foxes, cats, wild dogs, etc) reduces native fauna population.	Likely	Major	Extreme	-	Environment Program incentives are addressing this problem, in conjunction with Biodiversity Action Planning.

Culverts, regulators and in-stream water storage management	Fish and aquatic species prevented from migrating affecting fish population.	Unlikely	Major	High	CMA program to remove fish barriers	Waterways Program is removing fish barriers along the major rivers and streams, and has incentives to improve stream health eg removing domestic stock watering from rivers.

Asset: **Environment**
Primary Asset: **Biodiversity**
Secondary Asset: **Native Flora**
13. Asset Item: **Condition**

Value:
Only 2 to 3 per cent of native vegetation cover remains since European settlement.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Fragment-ation	Further fragmentation, smaller populations are less resilient and more vulnerable to threats such as plague locusts.	Possible	Major	High	People ignore NVR	Environment Program incentives are addressing this problem, in conjunction with Biodiversity Action Planning.

Asset: **Environment**
Primary Asset: **Biodiversity**
Secondary Asset: **Native Flora**
14. Asset Item: **Trends**

Value:
Only 2 to 3 per cent of native vegetation cover remains since European settlement

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Decline in extent and condition	Populations below conservation status threshold, work done today won't have benefits until 2100.	Likely	Major	Extreme	-	Environment Program incentives are addressing this problem, in conjunction with Biodiversity Action Planning.

Asset: **Environment**
Primary Asset: **Atmosphere**
Secondary Asset: **Climate**
15. Asset Item: **Climate Stability**

Value:
The SIR's primary industries (horticulture, dairy, cropping and livestock) would suffer negative impacts from climate change.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Climate change	Temperature increase, annual rainfall decrease, reduced snowfalls, longer and more frequent droughts and increase in frequency of fire risk days.	Certain	Catastrophic	Extreme	-	GB CMA is currently developing a climate change strategy.

Asset: **Economic**
Primary Asset: **Infrastructure**
Secondary Asset: **Capital Assets**
16. Asset Item: **Irrigation systems (G-MW and privately owned); flood protection systems (eg levee banks)**

Value:
G-MW has total assets worth $3.4 billion across its entire network which includes $2.2 billion within the SIR.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
No investment in irrigation systems	System collapses under weight of maintenance costs, no irrigation, no economy.	Unlikely	Catastrophic	High	For G-MW owned systems, NVIRP should resolve this.	-
Levee banks may fail during a large flood event	Damage to transport and irrigation assets as well as private losses on farm.	Unlikely	Catastrophic	High	-	-

Asset: **Economic**
Primary Asset: **Infrastructure**
Secondary Asset: **Capital Assets**
17. Asset Item: **Transport systems**

Value:
Agriculture in the region (valued at $1.3 billion in 2005-2006) relies on reliable transport system for efficient movement of inputs and outputs to the sector.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
No investment in system	Can't get goods to market efficiently, no economy.	Unlikely	Catastrophic	High	-	Investment in freight hub. Roads protected by SWMP and SSDP.

Asset: **Economic**
Primary Asset: **Agriculture**
Secondary Asset: **Irrigated agriculture**
18. Asset Item: **Irrigation infrastructure**

Value:
The gross value of agricultural production in the SIR was $1.3 billion in 2005-2006. It represents about 16 per cent of Victoria's gross value of agricultural production from 9 per cent of the Victoria's agricultural land.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
No investment in the system	System collapses under weight of maintenance costs. No irrigation will lead to low value economic activities.	Unlikely	Catastrophic	High	NVIRP should resolve this.	-

Asset: **Economic**
Primary Asset: **Agriculture**
Secondary Asset: **Irrigated agriculture**
19. Asset Item: **Agricultural production and food manufacturing**

Value:
The gross value of agricultural production in the SIR was $1.3 billion in 2005-2006. It represents about 16 per cent of Victoria's gross value of agricultural production from 9 per cent of the Victoria's agricultural land.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Loss of production due to loss of water and soil assets	No irrigation will lead to low economic activities.	Unlikely	Catastrophic	High	Unlikely due to implementation of the SIRCIS.	-
Climate change	Annual rainfall decrease leading to low inflows to storages. Longer and more frequent drought periods and increase in frequency of fire risk days.	Certain	Catastrophic	Extreme	-	GB CMA is currently developing a climate change strategy.

Asset: **Economic**
Primary Asset: **Agriculture**
Secondary Asset: **Irrigated agriculture**
20. Asset Item: **Employment**

Value:
The gross value of agricultural production in the SIR represents about 16 per cent of Victoria's gross value of agricultural production from 9 per cent of the State's agricultural land. Agriculture and agriculture support services account for 14 per cent of employment and food manufacturing accounts for 9 per cent of employment in the SIR in 2005-2006.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Loss of production due to loss of water and soil assets	No irrigation will lead to low economic activities and high unemployment.	Unlikely	Catastrophic	High	Unlikely due to implementation of the SIRCIS.	-

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Climate change	Annual rainfall decrease leading to low inflows to storages. Longer and more frequent drought periods and increase in frequency of fire risk days.	Certain	Catastrophic	Extreme	-	GB CMA is currently developing a climate change strategy.

Asset: **Economic**
Primary Asset: **Agriculture**
Secondary Asset: **Irrigated agriculture**
21. Asset Item: **Groundwater (deep lead and shallow systems)**

Value:
The deep lead groundwater system has capacity of about 70GL/year and the shallow systems have a combined total capacity of about 80GL/year.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Reduced water availability for irrigation	No irrigation will lead to low economic activities.	Likely	Moderate	High	-	**Deep lead:** Groundwater protection plans are in place to protect the resource, eg CDLWSPA and KWSPA **Shallow systems:** SSDP addresses both quality and quantity issues.

Asset: **Economic**
Primary Asset: **Agriculture**
Secondary Asset: **Irrigated agriculture**
22. Asset Item: **Surface water and water trading**

Value:
About 992,000ML of permanent water entitlements were allocated to the SIR in 2005-2006 and 965,000 in 2006-2007.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Surface water: Reduced water available for irrigation	No irrigation will lead to low economic activities.	Unlikely	Catastrophic	High	GB CMA climate change policy and the NRSWS will be important in addressing this risk.	Irrigation management programs and incentive schemes (Whole Farm Planning, automatic irrigation systems, irrigation scheduling, laser grading) to improve water use efficiency.

Water trading: Water prices become so high most farmers are priced out of the market	-	-	-	-	SIR irrigators will continue to advocate for fair trading rules.	-

Asset: **Economic**
Primary Asset: **Regional Development**
Secondary Asset: **Area value**
23. Asset Item: **Tourism**

Value:
The SIR has about 850 km of rivers and streams within the Goulburn and Broken River Basins (580 km in the Goulburn River Basin and 270 km in the Broken River Basin). The Goulburn River below Eildon is one of only 18 declared Heritage Rivers in Victoria, (very high nature conservation, recreational, social or cultural value). The Broken River and Broken Creek are considered to be of High Community Value.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
Loss of rivers as attractive place for camping and fishing	Reduced economic activities.	Unlikely	Catastrophic	High	Unlikely due to implementation of the SIRCIS.	-

Asset: **Social**
Primary Asset: **Regional Development**
Secondary Asset: **Population**
24. Asset Item: **Population growth**

Value:
Predicted annual population growth of 1 per cent to 2031 compared to Victoria's 0.7 per cent.

Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
No employment opportunities due to loss of agriculture	The SIR is not an attractive place to live, residents leave and in-migration does not occur.	Unlikely	Catastrophic	High	Unlikely due to implementation of the SIRCIS.	-

Secondary Asset: Community

Asset items	Values	Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
25. **Cultural heritage**	The SIR has many cultural assets such as scar trees and middens, and spiritual values and attachment.	Loss of these due to inappropriate development.	Loss of cultural heritage.	Unlikely	Major	High	Unlikely due to implementation of state and national government heritage protection laws.	-
26. **Organisational partnerships**	The SIRCIS is operated through a partnership arrangement with agencies such as GB CMA, DPI, DSE, G-MW.	Partners cease working together, may work against each other's priorities or compete with each other, loss of focus for the SIRCIS.	All of the risks being addressed by the SIRCIS are not addressed, region collapses biologically and economically.	Unlikely	Catastrophic	Extreme	The SIR community will continue to place high importance on maintaining partnerships.	-
27. **Communities of interest, eg the farming community**	The SIRCIS is effective when the "community" is engaged.	Community is affected by large stressors currently, eg drought, change due to water reform, etc, if the stressors become too great the community can't maintain its capacity.	All of the risks being addressed by the SIRCIS are not addressed, region collapses biologically and economically.	Unlikely	Catastrophic	Extreme	Out of direct control of the SIRCIS. However, the SIRCIS will continue to support the community in whatever ways possible to make sure it is knowledgeable and remains engaged.	-
28. **Recreation**	Our environment, especially water environments are prized by some for their recreation opportunities, eg fishing.	Community may be affected by a reduced quality of environment (ie algal blooms, degraded riparian zones, poor water quality and loss of species).	Reduced recreation options.	Likely	Moderate	High	Unlikely due to implementation of the SIRCIS.	-

Asset items	Values	Threats	Impacts	Likelihood	Consequences	Risks	Comments	SIRCIS Response
29. **Aesthetics**	-	Community may be affected by a reduced quality of environment (ie algal blooms, degraded riparian zones, poor water quality and loss of species)	Reduced aesthetics	Likely	Moderate	High	Unlikely due to implementation of the SIRCIS	-
30. **Human consumption**	-	Community may be affected by a reduced quality of environment (ie algal blooms, degraded riparian zones, poor water quality and loss of species)	Reduced volume	Likely	Moderate	High	Unlikely due to implementation of the SIRCIS and NRSWS	-
31. **Environment**	A healthy environment has an intrinsic value for many in our community	Community may be affected by a reduced quality of environment (ie algal blooms, degraded riparian zones, poor water quality and loss of species)	Reduced environment	Likely	Moderate	High	Some people place a social value on a healthy environment	-

Appendix 2 Country of Birth of Residents in the Shepparton Irrigation Region (1996, 2001 and 2006)

Birthplace (countries)	1996	2001	2006
Australia	97,431	99,248	100,620
Bosnia and Herzegovina	14	9	12
Canada	56	56	70
China (excl. SARs and Taiwan Province)	53	49	74
Croatia	75	80	77
Egypt	29	27	24
Fiji	33	46	37
Former Yugoslav Republic of Macedonia (FYROM)	92	92	99
Germany	298	285	268
Greece	290	251	243
Hong Kong (SAR of China)	39	35	30
India	139	201	270
Indonesia	17	23	22
Iraq	14	375	470
Ireland	111	110	120
Italy	2,030	1,813	1,587
Japan	30	21	17
Korea, Republic of (South)	13	10	17
Lebanon	14	16	17
Malaysia	67	69	72
Malta	57	69	66
Netherlands	504	467	464
New Zealand	708	976	1,163
Papua New Guinea	23	36	36
Philippines	190	233	269
Poland	77	65	53
Singapore	11	11	15
South Africa	27	73	133
South Eastern Europe (Note a)			81
Sri Lanka	38	48	78
Thailand	4	35	63
Turkey	304	357	346
United Kingdom	2,711	2,618	2,551
United States of America	79	74	108
Viet Nam	11	11	25
Yugoslavia (Note b)	151	125	
Total (Note c)	**105,740**	**108,014**	**109,597**

Notes:

(a) South Eastern Europe includes persons who stated their birthplace as Yugoslavia

(b) In 1996 was known as 'Former Yugoslav Republic' and in 2001 was known as 'Yugoslavia, Federal Republic'

(c) The total excludes persons who stated they were overseas visitors, those born elsewhere and those who did not state their country of birth

- Data set includes Campaspe South (which is outside the SIR).

Source: ABS 2007

Appendix 3 Environment Program Review 2005-06 Executive Summary and Recommendations

1. Executive summary

The Environment Program is a key delivery program for the Shepparton Irrigation Region Catchment Implementation Strategy and supports the other four programs: Sub-surface Drainage, Farm, Surface Water Management and Waterways.

The Environment Program provides a key service to the Sub-surface Drainage and Surface Water Management Programs in particular by providing Environmental Assessments of planned and completed works. In addition, key projects of the Environment Program such as Tree Growing and Environmental Incentives contribute to biodiversity protection and enhancement, largely on private land. This is achieved by working in close partnership with private land managers.

A summary of the key Environment Program achievements is provided in the following table. This table links the Environment Program with the four Programs.

Environment Program link to SIRCIS Programs	Outputs	Achieved 2001-2006
Farm	Remnant vegetation protected (ha)	533
	Fence wetland remnant (ha)	27
	Revegetation - plant natives within or next to remnants (ha)	270
	Revegetation - plant natives away from remnants (ha)	197
	Environmental Water Allocation (ML) (does not include Barmah EWAs but will in future with SIR IC being an integral part of the Barmah Community Reference Group)	516
	Statutory planning referrals (no.)	510
	Improved water management of environmental feature (wetland, ha)	272
Surface Water	Environmental assessment of impact of planned primary and community surface water management system (no.)	2
	Monitoring of water quality and macro-invertebrates in wetlands (no.)	4
	Post environmental assessment and final alignment checks (no.)	69
	Area planted adjacent to surface water management systems (ha)	31
Sub-surface Drainage	Environmental assessment of impact of planned public groundwater control pump (no.)	13
	Site assessments of high value environmental features for sub-surface drainage (no.)	131
	Bio-diversity Action Planning Vegetation Quality Assessments (no.)	541
Waterways	Length of fencing (km)	249
	Area of frontage protected (ha)	202
	Off-stream watering points (no.)	106
Capacity building - planning and priority setting	Wetland management plans developed (no.)	3
	Terrestrial management plans developed (no.)	3
	Site visits (no.)	1,000
	Bio-diversity Action Planning workshops (no.)	9
	Media coverage (e.g. Bush and Land, no.)	200
	Schools engaged in program activities (no.)	18
	Landcare groups supported by the Program (no.)	8
	Presentations to forums/touring groups/delegations (no.)	24

This is the third review of the Shepparton Irrigation Region Catchment Implementation Strategy and its Environment Program. The scope of this review is to:

- capture key achievements between 2000-2001 and 2005-2006
- demonstrate program effectiveness, efficiency and appropriateness
- integrate Goulburn Broken Irrigation Futures work to identify challenges and opportunities facing the program (and indeed the Shepparton Irrigation Region Catchment Implementation Strategy) for the next six years.

As a review of the Shepparton Irrigation Region Catchment Implementation Strategy, the focus is to describe and document what are 'known' (achievements) rather than test assumptions and principles underpinning the Environment Program. In 2011, renewal of the Shepparton Irrigation Region Catchment Implementation Strategy will provide the trigger to undertake such a detailed study.

2. Summary of key findings

2.1. Triple bottom line

2.1.1. Economic performance

The Environment Program has made a significant contribution to the economic benefits to the region. The benefits are described below:

- The financial value of the benefits of the Environment Program to the region is significant.
- The Benefit-Cost Ratio of the Environment Program is 1:1.53 with an Internal Rate of Return of 8.3 per cent.
- The ratio of the Present Value of total government cost and total landholder cost is $2.1 million: $0.72 million or 2.92:1 or 74 per cent government: 26 per cent landholder. This indicates the government and the community are partners in the investment of biodiversity protection and enhancement.

In summary, the results of the desktop valuation of the impacts of the Environment Program show a significant environmental and economic benefit.

2.1.2. Social assessment

As part of the review process, a social assessment was undertaken against eight categories including: Community Wellbeing; Sense of Community; Natural Resources Knowledge Base; Improved Business Confidence; Security of Water Supply; Changes in Landscape; Confidence in the Program and Protection of Significant Cultural and Historical Sites. In summary, the assessment identified:

- Group activities such as tree planting days, Landcare and Local Area Plan activities and preparation of Environmental Management Plans were important cohesive activities for community involvement in the Environment Program.
- The community have gained a better understanding of the importance of protecting and enhancing native vegetation.

2.1.3. Environmental performance

Each of the five-year review documents will include a Triple Bottom Line Assessment (including Environmental Performance). The Environmental Performance of the Environment Program is judged by the strength and assessment of each Program's incorporation of protecting and enhancing biodiversity features across the region.

This inter-dependency is highlighted through the Surface Water Management and Sub-surface Drainage Programs (SSDP). For example:

- A number of surface water management systems protect wetlands including: Brays Swamp; Reedy Swamp; Kinnairds Wetland; and Dowdle Swamp. These wetlands, by being incorporated into the design of surface water management systems, have potential for delivery of environmental water. The wetlands then provide a mechanism for improving the water quality that outfalls to receiving waterways.
- All new surface water management systems are designed to, where practicable, protect and enhance natural features by reducing accessions to groundwater and reinstate natural watering regimes.
- The SSDP has been assessed as being environmentally attractive through protection of some 22,000 ha of high value environmental features in the Shepparton Irrigation Region. The value placed on the protection of these features was put at $88.1 million.

2.2. Looking forward - the next five years

In addition to the capture of key achievements, the Environment Program incorporated the Goulburn Broken Irrigation Futures project to undertake forward planning and identify challenges and opportunities resulting from the four scenarios: 'Moving On', 'New Frontiers', the 'Pendulum' and 'Drying Up'.

The four scenarios assisted in the identification of the following areas to consider in future delivery of the Environment Program:

- land use change
- environmental flows
- lifestyle farming / land ownership
- changing government priorities
- changing population
- climate change and variability
- rainfall.

Further, these issues are common across most, if not all programs and will provide the strategic platform for the Shepparton Irrigation Region Catchment Implementation Strategy over the next five years.

While a large portion of this review documents achievements and progress for key projects, perhaps the most significant component is setting recommendations for the Environment Program and agreeing on annual and five-year targets for works. There have been a number of recommendations developed to assist in providing the Environment Program with a logical direction for planning, meeting targets and improvement to delivery.

The recommendations can be broadly categorised into the following themes:

2.2.1. Monitoring, Evaluation and Reporting:

- Develop key evaluation projects to demonstrate value (against the Triple Bottom Line) of the Environment Program leading up to a major review in 2011.
- Review and refinement of monitoring projects.

2.2.2. Data management:

- Examine requirements of information needs and data collection processes for the Program.

2.2.3. Review priorities:

- Design and develop a Business Plan based on: priority setting; resources aligned to priorities; establishment of vision, mission and objectives; target setting and reporting.
- Further develop action plans and processes to document challenges and opportunities identified through analysis of the Goulburn Broken Irrigation Futures scenarios.

2.2.4. Program management:

- Develop capacity in the program to manage key themes.
- Review the needs of the program in engaging with key stakeholders, partners and community bodies.

2.2.5. Works:

- Linking recommendations for annual and five-year targets to activities described through extension, communication, engagement, management plan and incentive projects.

3. Summary of recommendations

Recommendation 1:	The Environment Program continues to deliver existing projects.
Recommendation 2:	The Environment Program consults the community (via the Farm and Environment Program Working Group) when making changes to Program delivery, priorities and target setting.
Recommendation 3:	The Environment Program is not reviewed as a stand-alone program in 2011.
Recommendation 4:	The team sitting within the Department of Primary Industries, Sustainable Irrigated Landscapes-Goulburn Broken, currently called the Environment Management Program, change its name to Environment Team.
Recommendation 5:	The Environment Program investigates use of other 'policy instruments' to deliver works and incentives.
Recommendation 6:	The Environment Program further integrates Biodiversity Action Planning into local government and public land management planning.
Recommendation 7:	The Environment Program develops a Business Plan.
Recommendation 8:	The Environment Program develops an Engagement Plan.
Recommendation 9:	The Environment Program forms a leadership group to coordinate and take responsibility for responding to and delivery of review recommendations.
Recommendation 10:	The Environment Program develops an Evaluation Plan.
Recommendation 11:	The Environment Program undertakes the following key actions prior to the Environment Program major revision in 2010-2011.
Recommendation 12:	The Environment Program completes Environmental Assessments for 1,248 ha of land drained by Primary Surface Water Management Systems and 3,640 ha of land drained by Community Surface Water Management Systems annually.
Recommendation 13:	The Environment Program protects 40 ha of remnant vegetation and fences 10 ha of wetland remnants through the Environmental Incentive project annually.

Recommendation 14:	The Environment Program revegetates 40 ha of native vegetation within remnants, 30 ha away from remnants and 5 ha (adjacent to surface water management systems) through the Tree Growing Incentive annually.
Recommendation 15:	The Environment Program completes Environmental Assessments for 18 Public Salinity Control Pumps serving an area of 3,580 ha from 2005-2006 to 2010-2011.
Recommendation 16:	The Environment Program adopts the Whole Farm Planning approach and reconfiguration planning using Environmental Management Systems and Performance Standards for Natural Features information and activities by June 2008.
Recommendation 17:	The Environment Program continues to monitor three wetlands and four terrestrial sites as part of the Mandatory Monitoring Project.
Recommendation 18:	The Environment Program develops existing and new environmental management plans by 2011 and secures 30,000ML of Environmental Water Allocation for priority wetlands.
Recommendation 19:	The Environment Program develops new wetland environmental management plans to improve water management in 5,000 ha.
Recommendation 20:	The Environment Program develops six new wetland environmental management plans and three terrestrial management plans, signed off by stakeholders, by June 2011.

Appendix 4 Farm Program Review 2005-06 Executive Summary and Recommendations

1. Executive summary

The Farm Program is a key implementation program of the Shepparton Irrigation Region Catchment Implementation Strategy (SIRCIS). The Shepparton Irrigation Region Implementation Committee (SIRIC) is the community based group that has the responsibility of implementing the Goulburn Broken Catchment Management Authority (GB CMA) Regional Catchment Strategy in the Shepparton Irrigation Region.

The Farm Program is designed to work with private landowners to encourage them to adopt improved natural resource management practices on their properties. There are four key activities within the Program. They are the preparation of WFPs, installation of drainage reuse systems, installation of automatic irrigation systems and Local Area Plan projects. The Farm Program activities focus on extension based projects that work with individuals and groups of landowners. The projects also provide financial incentives for targeted works to increase the rate of adoption of these activities.

The Farm Program Review 2006-2007 has been conducted to assess the performance of the Farm Program for the period July 2001 to June 2006 against the targets that have been set as part of the SIRCIS. This review has focussed on the effectiveness and efficiency of the Farm Program in delivering the activities.

The effectiveness of the Program is measured by how well the intended targets, outputs and outcomes of the Program have been achieved. To determine the efficiency of the Program, the delivery process of the Program has been examined and has focused on the satisfaction level of participants with the Farm Program.

The Farm Program Review in 2001 included an Action Plan to provide a guide of the future activities for the Farm Program for the next five years (2000 to 2006). One of the first tasks of the 2006-2007 review has been to go through the Action Plan and document the achievements that have been made against the planned activities. This audit showed the majority of activities have been acted on and achieved the desired outcomes.

The review has found the Farm Program has been successful in meeting the targets set and in some cases exceeding these targets. There has continued to be a high level of satisfaction by landowners to Farm Program activities. The review has found the use of extension projects and financial incentives has been an important factor in the success of Farm Program activities.

The Farm Program has introduced water use efficiency as an important driver in the projects being implemented and this is one of the significant changes to the Farm Program since the previous review in 2000. The Farm Program now includes projects to encourage the development and use of drainage reuse systems and automatic irrigation systems. While these projects are compatible with management practices of the previous drivers of minimising salinity and control of nutrients from leaving properties, water use efficiency also raises landowner awareness of the need to manage irrigation water efficiently.

The development and implementation of Local Area Plans has been used as a tool to increase the involvement of communities in natural resource management in the Shepparton Irrigation Region. This process builds on the philosophy of community ownership of natural resource management first developed in the Shepparton Irrigation Region Land and Water Salinity Management plan prepared in the late 1980s.

The Local Area Plan project, while not clearly increasing SIRCIS activities, has brought about an increased capacity of the community in these local catchments to develop and implement activities in their communities.

The economic benefit: cost ratios of the Farm Program using a discount rate of 4 per cent and 8 per cent are 1.77:1 and 1.21:1 respectively. The financial benefit: cost ratio for the landowners using a discount rate of 8 per cent is 1.27:1. The economic analysis of the Farm Program showed the Program is financially profitable from the landowners' perspective and also economically viable from the viewpoint of society as a whole. The

ratio of the Present Value of Total Government costs and Total Private cost to implement the Farm Program is 1:7.3 (12 per cent Public : 88 per cent Private). This result indicates the Government and community are partners in the investment of improved irrigation management.

The Farm Program activities have contributed to achieve significant environmental benefits for the region. The activities of the program have helped reduce water, nutrient and salt leaving the region and thus reduced the need for, and the costs of, salt disposal. It has also played a role in changing the attitude of landowners towards environmental considerations. The program, through its Local Area Plan projects, has been able to demonstrate social benefits by building community capacity to manage and deal with change.

The Farm Program has been pro-active in working in partnership with other Programs to bring about synergy to achieve outcomes relevant to the goals of the Program. The involvement of the Farm Program in the "Efficient Irrigation Project" has been hailed as a model to implement projects with research and extension partnership. This project developed information to support both landowners and catchment planners in making informed decisions on investment in border-check and sprinkler irrigation systems. Farm Program staff worked alongside researchers in this project to ensure the work was relevant and the results from the project were being developed and delivered throughout the life of the project.

The review has looked forward to forecast what changes the Farm Program will need to be aware of and respond to in the immediate future. The Farm Program has worked with the "Irrigation Futures in the Goulburn Broken Catchment" project conducted by the Department of Primary Industries. That work shows there is likely to be a large change in the way landowners will manage their land and water in the future.

A major challenge for the Farm Program is to work towards the smooth transition of the water reform changes that will come into effect from July 2007 and the Farm Program Review concludes with a series of recommendations to address these issues for the future of the Farm Program.

2. Recommendations

Recommendation 1:	The Farm Program continues to deliver the existing projects.
Recommendation 2:	The Farm Program continues to review policies related to incentives and explore innovative approaches to Program delivery.
Recommendation 3:	The Farm Program continues to develop collaborative processes and formalise them.
Recommendation 4.1:	The Farm Program identifies the lessons learnt from the Local Area Plan processes and explores tools and techniques to capture changes in capacity building.
Recommendation 4.2:	The Farm Program continues to closely monitor the outcomes from the Local Area Planning approach and utilise the learnings for the future development of the Program.
Recommendation 5:	Any changes to the Farm Program are made with appropriate consultation with the community.
Recommendation 6.1:	The Farm Program reviews the challenges and opportunities identified by the Irrigation Futures scenarios and incorporates the relevant issues in the development of the Program.
Recommendation 6.2:	The Farm Program develops and implements training activities to enhance Farm Program staff skills to incorporate new water reform programs.

Recommendation 6.3:	The Farm Program works in partnership with Goulburn Broken Catchment Management Authority, Goulburn-Murray Water and the Department of Sustainability and Environment to incorporate activities in the reconfiguration and modernisation processes.
Recommendation 7.1:	The Farm Program takes the initiatives to be involved in projects to achieve mutual benefits between projects and the Farm Program.
Recommendation 7.2:	The Farm Program develops and packages the results of the "Soil hydraulic properties in the Shepparton Irrigation Region" and "Bayesian network" research projects to meet the needs of the users of the information.
Recommendation 8.1:	The Farm Program targets its activities in specific risk areas and specific community groups.
Recommendation 8.2:	The Farm Program develops relevant policies and communicates its impact to community.
Recommendation 9:	The Farm Program reviews the short and long-term goals and objectives and works towards developing criteria to measure goals and objectives.
Recommendation 10:	The Farm Program identifies Key Evaluation Questions for the next review and receives feedback from key stakeholders.

Appendix 5 Sub-surface Drainage Program Review Executive Summary

1. Introduction

The Sub-surface Drainage Program (SSDP) is a key implementation program of the Shepparton Irrigation Regional Catchment Implementation Strategy (SIRCIS). The stakeholder engagement process, adaptive management, strategic focus and financial support provide significant benefits to the smooth implementation of the SIRCIS and the delivery of key catchment strategy outcomes.

Overall the SSDP has been shown to deliver significant economic, environmental and social benefits at local, regional and State level. These benefits are expected to continue and strengthen as the Program delivers works that will serve some 185,000 ha of land, including 9,000 ha of key environmental features.

2. SSDP five-year review

This is the third review that has been undertaken of the SSDP since the Plan was endorsed and the Program commenced in 1990. The review focuses on the achievements between 2000-2001 and 2004-2005 (i.e. 2000 and 2005), and identifies the challenges and targets for the next six years.

While considerable consultation has been undertaken in the preparation of the SSDP 5-year review, it is expected a wider community consultation program will be embarked upon as part of the 2011 revision of the SSDP.

The focus of the SSDP five-year review is to present what is 'known' rather than to test the assumptions and principles which underpin the SSDP whilst enabling 'adaptive management' adoption of developments over the last 5 years. The review also identifies factors which have influenced and are likely to influence the future implementation of the SSDP. Although not a primary aim of the review, a number of the assumptions and principles of the SSDP have been clarified.

3. SSDP achievements: 2000 to 2005

Key achievements of the SSDP between 2000 and 2005 include:

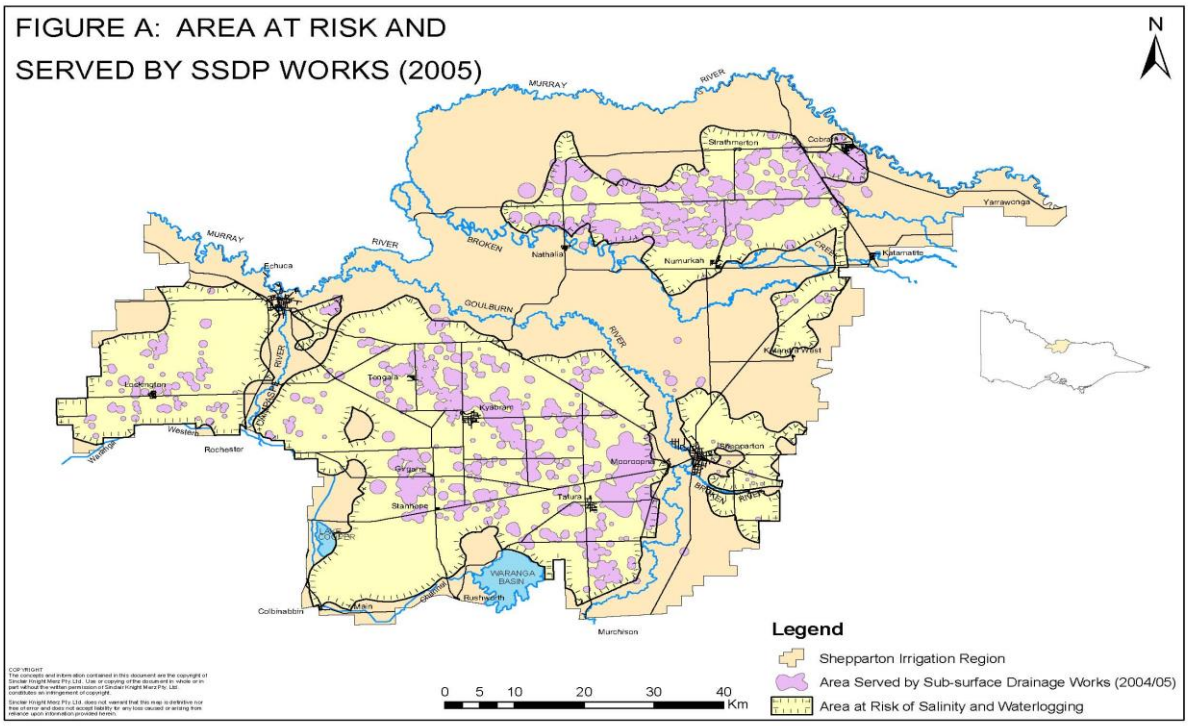
- an additional 15,500 ha of irrigated agricultural land at risk of land salinisation and waterlogging being served by the following works:
  - installation of 22 new public pumps discharging to regional channels and drains
  - installation of 116 new private pumps to serve areas of pasture
  - upgrading of 13 existing private pumps to serve areas of pasture
  - installation of one new private pump to serve an area of horticulture.

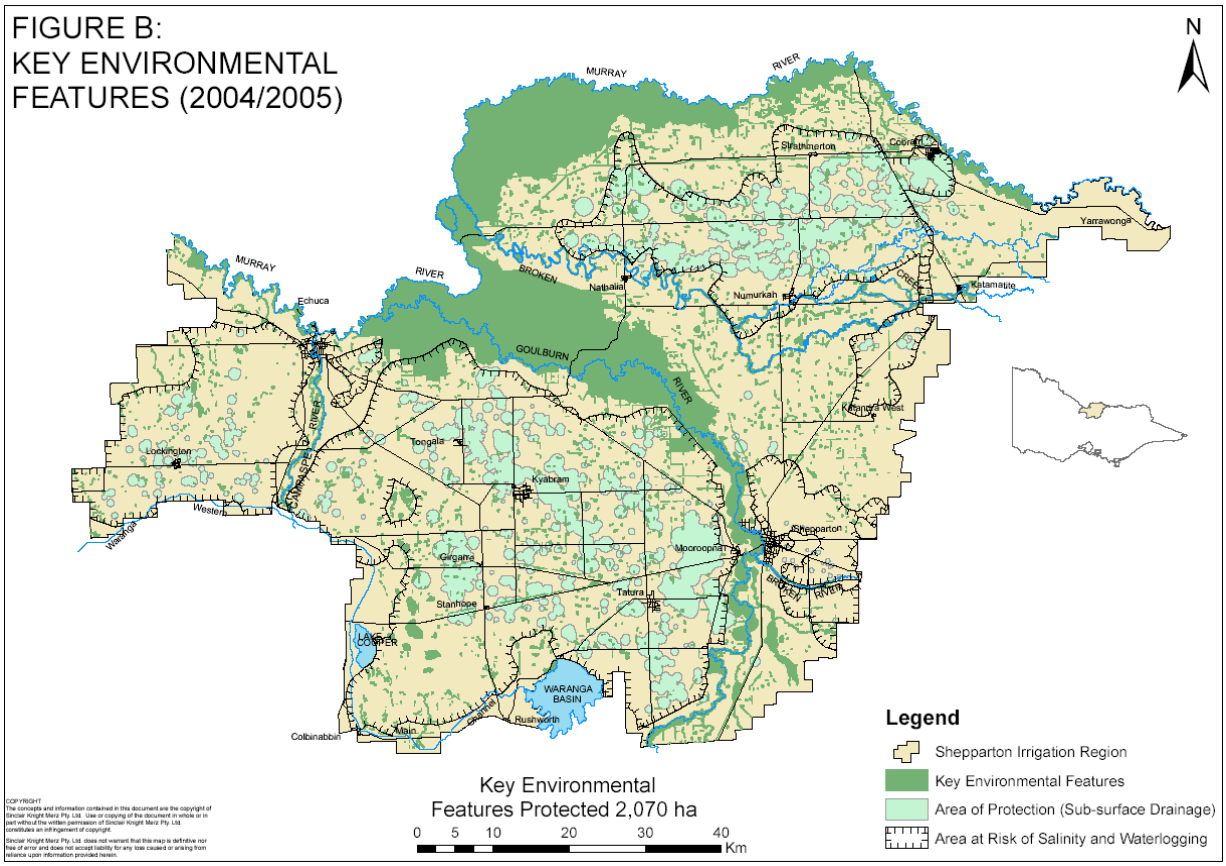
  This brings the total area served by SSDP works to 73,200 ha (refer to Figure A).

- around 2,070 ha of key environmental features in the SIR have been served by the installation of private and public pumps since 1990 (refer to Figure B)
- significant contributions to water savings by controlling the level of salt in the soil profile (improving water use efficiency) and harvesting additional water for reuse
- further refinement of the adaptive management approach to the delivery of the SSDP outputs and outcomes
- establishment of a strategic plan for the Research and Investigation component of the SSDP
- formation of the agency based high level Sub-surface Drainage Coordinating Group to coordinate agency input to the SSDP
- reinvigoration of the Sub-surface Drainage Working Group to undertake a more strategic role

- establishment of a Grouped Salt Project Steering Committee to manage the SIRCIS salt related projects
- strengthening of technical capacity in the areas of research and investigation, and on-ground works
- strengthening of relationships between Goulburn-Murray Water, the Department of Primary Industries and PIRVic in particular, which has created a more united approach to the management of salt in the region (e.g. joint project submissions, targeted extension, etc.)
- improved dissemination of information to the community
- increased focus of salt management and reporting to meet MDBC requirements
- greater focus on managing available groundwater resources in the SIR, including:
    - implementation of an extensive metering Program (i.e. 523 meters fitted to private groundwater pumps)
    - aligning the groundwater entitlement limits under the SIR WSPA Groundwater Management Plan with the SIRCIS.

The average annual expenditure of the SSDP over the reporting period was approximately $4.5M per year. The works delivered under the program resulted in an estimated Salt Disposal Entitlement uptake of 0.92EC (post SIR salt audit).





4. SSDP achievements against targets

Overall, the level of implementation between 2000 and 2005 was slightly lower than the targets set as part of the SSDP 2000 review. In terms of pumps installed, only 152 pumps were installed compared to the target of 216 pumps, and the actual area served was 15,490 ha compared to the target area served of 24,850 ha (after adding the Non-SSDP private pumps installed for the period).

This lower than projected delivery between 2000 and 2005 impacted on the achievement of the cumulative targets set for the SSDP at the commencement of the Program, with the total pumps being 18 less than the implementation target and the area served being 21,700 ha less than the target set as at June 2005.

The main reasons for the SSDP implementation targets not being achieved over the five-year period were:

- funding constraints, with the total funds requested to implement the required works not received by the SSDP
- better monitoring of area served by adjusting for the impact of overlapping pumps (i.e. the 2000 implementation targets did double count the overlapping areas served whereas this review does not)
- an assumption that the area served per private pump is lower (average 90 ha) than that assumed as part of the 2000 SSDP review (average over 100 ha)
- adapting the assumption that 1ML of pump licence volume equates to 0.6 ha served instead of 1 ha as was the case in the past
- drier than average climatic conditions over the period which meant the need and drive for the implementation of sub-surface drainage works, particularly from a landowner perspective, was less than projected
- recognition of the need for further 'Research and Investigation (R and I)' prior to the implementation of certain sub-surface drainage works (e.g. installation of pumps which discharge to evaporation basins).

One of the benefits of the lower than projected level of implementation was that the salt disposal impact of the SSDP was significantly less than its Salt Disposal Entitlement (SDE) allocation from the Victorian Government.

5. Looking forward: changes to the underlying philosophy of the SSDP

A key outcome of the SSDP five-year review has been a fundamental change in the delivery philosophy of the Program, with greater emphasis now being placed on the delivery of 'outcomes' (i.e. area served) as opposed to 'outputs' (i.e. the number of pumps installed), as has been the case in the past.

A further fundamental shift occurred in the determination of the area served. Prior to the SSDP five-year review the projected area served included the double counting of overlap between the area served by specific sub-surface drainage pumps. For the first time, this review excludes double counting of overlap in setting future targets and in determining achievement of historic targets. The previous approach adopted led to an over estimate of the area actually served by specific sub-surface drainage works.

Based on the knowledge gained since the 2000 SSDP review, there have been a number of changes to the assumptions underlying the calculation of the area served by SSD works. This includes a change to the area served per private pump installed. As part of the SSDP five-year review it was assumed that 1ML of licence entitlement equates to 0.6 ha of area served. This compares to the previous assumption that 1ML of licence entitlement equates to 1 ha. The change in assumption reflects the average volume pumped compared to licence entitlement between 2000 and 2005 (being 60 per cent).

6. Looking forward: delivery targets

The revised total area at risk of waterlogging and land salinisation is 350,350 ha. This area, which includes 165,350 ha of C type land, is outlined in Figure A. To date, cost efficient solutions for protecting the C type areas have not been developed. This review and the implementation targets therefore focus on the 185,000 ha of land at risk which is underlain by aquifers (B type areas).

The revised target area to be served by the SSDP of 185,000 ha is based on a revised delivery timeframe of 2030. This area served, which is 13,700 ha more than the area of 171,300 ha assumed in the 2000 SSDP review, includes 37,390 ha to be served by non-SSDP private pumps.

Based on the target of 185,000 ha, and the SSDP achievement to 2005 of 73,200 ha served, there is 111,800 ha remaining to be served by future SSDP works.

As part of this five-year review the SSDP implementation date has been increased from 2023 to 2030. The planned implementation rate is shown in Figure C and requires an additional 1,650ha/yr to be served over the next six years and then an additional 5,360 ha to be served in each year for the remaining 19 years of the SSDP.

Within the total area of 185,000 ha, it is expected the sub-surface drainage works implemented under the SSDP will serve an estimated 9,000 ha of key environmental features in the SIR. This represents approximately 60 per cent of the total area of key environmental features (estimated to be 15,090 ha) at risk due to land salinisation and waterlogging.

The total package of sub-surface drainage works to be implemented to serve the 185,000 ha includes:

- 1,571 pumps
- 50 evaporation basins
- 300 ha of tile drainage.

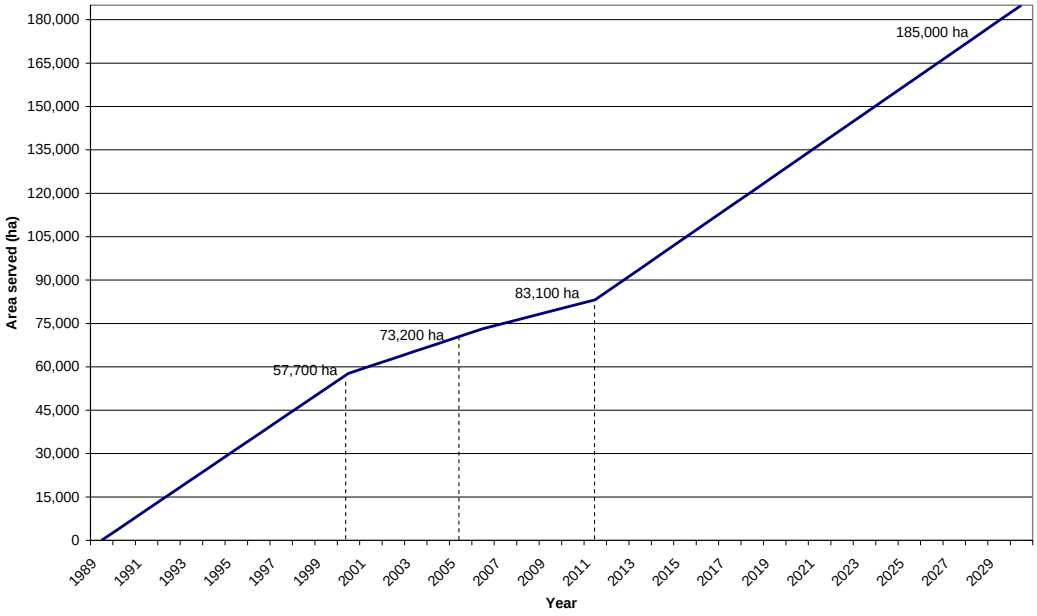


Figure C: Area Served at different Implementation Timeframe

Table A presents a summary of the SSD works delivered to 2005 and the works remaining to be delivered based on the 2030 delivery targets.

Table A: SSD Works Delivered and Still to be Delivered Under the SSDP

SSD Works	Works Delivered to 30 June 2005	Target Works to be Implemented to 30 June 2030	Works Still to be Delivered (2005/06 – 2029/30)
Public Pasture Pumps (channels or drains)	43 pumps	375 pumps	332 pumps
Public Pasture Pumps (basins)	0 pumps	50 pumps	50 pumps
Private Pasture Pumps installed	254 pumps	541 pumps	287 pumps
Private Pasture Pumps upgraded	59 pumps	112 pumps	53 pumps
Non-SSDP Private Pasture Pumps	443 pumps	443 pumps	0 pumps
Private Horticulture Pumps installed	20 pumps	50 pumps	30 pumps
Tile Drainage	16ha	300ha	284ha

The revised total cost to implement the SSDP, including capital cost of works and Program Support and Development, is estimated to be $225.5M (based on 2005 dollars and GST exclusive). In terms of 2005 dollars, of this $225.5M needed to fully implement the SSDP, $51M had been spent by 1 July 2005. This leaves $174.5M to be raised and spent between 2005 and 2030.

A breakdown of the total cost is as follows:

- Private Pasture Pump Program - $72.9M
- Private Horticulture Program - $119.1M
- Public Pump Program - $11.1M
- Program Support - $12.8M
- Program Development - $9.6M

The revised salt disposal requirement of the SSDP is 12.4EC without allowing for the undefined C type area which, in the past has included an allowance of an additional 3.8EC.

Based on the current uptake of 2.98EC, a further Salt Disposal Entitlement of 9.42EC will need to be allocated to the SSDP to enable full implementation. While the current uptake of SDEs is below the GB CMA allocation, further SDEs will need to be sought as implementation of the SSDP progresses.

7. Economic, environmental and social benefits

Overall the SSDP has been shown to be delivering significant economic, environmental and social benefits at local, regional and state level. These benefits are expected to continue and strengthen as the program is fully implemented.

As part of the SSDP five-year review, separate assessments have been undertaken on the economic, environmental and social components of the SSDP. Based on these assessments the SSDP has been shown to be:

- economic (financially attractive) – with a BCR ranging between 1.4 and 1.9 over the different reporting timeframes assessed and an NPV of between $22.9M and $74.4M
- environmentally attractive – serving some 9,000 ha of key environmental features with a value of $17M
- socially beneficial – delivering a medium level social benefit to the regional community.

Table B presents a summary of the outcomes of the economic, environmental and social assessments undertaken as part of the SSDP five-year review.

Table B: Triple-bottom Line Assessment

Assessment	1990/1991 to 2019/2020 (30 Years)	1990/1991 to 2029/2030 (40 Years)	2005/2006 to 2034/2035 (30 Years)
Economic			
Benefit: Cost Ratio (4% discount rate)	1.4	1.5	1.9
Net Present Value ($M) (A) (4% discount rate)	$22.9M	$47.7M	$74.4M
Indicative value of environmental benefits			
Net Present Value ($M) (B) (4% discount rate)	$16.4M	$17.0M	$44.9M
Total ($M) (A + B)	$39.3M	$64.7M	$119.3M
Social			
Expected Social Benefits	Medium Level Social Benefits		

On this basis, continued government investment in the SSDP should be attractive. The strong strategic and adaptive management approach adopted by the Program will ensure there is little risk of the benefits detailed in the five-year SSDP review not being realised.

8. Risk assessment

As part of the five-year SSDP review, an assessment was undertaken of the risks posed to different stakeholder organisations as a result of their involvement in the implementation of the SSDP. It was concluded from the risk assessment that the risk is far greater to the majority of stakeholders if the SSDP is not implemented than is posed by its implementation.

While the risk assessment did identify that the SSDP posed an element of risk to each stakeholder group, it also highlighted that strategies have already been developed, or are being developed, by most organisations to address these areas of risk. For example, the GB CMA has commenced the development of a 'Salt Register',

to enable the transparent tracking and reporting of salt uptake across the region. The register will overcome a number of uncertainties which currently exist around the accuracy of the data, and will allow for easier integration of any future Murray Darling Basin Commission (MDBC) imposed rule changes.

9. Challenges to the implementation of the program

Climate change is having a significant impact on the management of land and water resources, as is evident in the implementation of the SSDP. These impacts include:

- reduced groundwater levels
- reduced irrigation water allocations
- strong fluctuations in demand for incentives based on reduced water allocations
- reduced investment in low value agriculture.

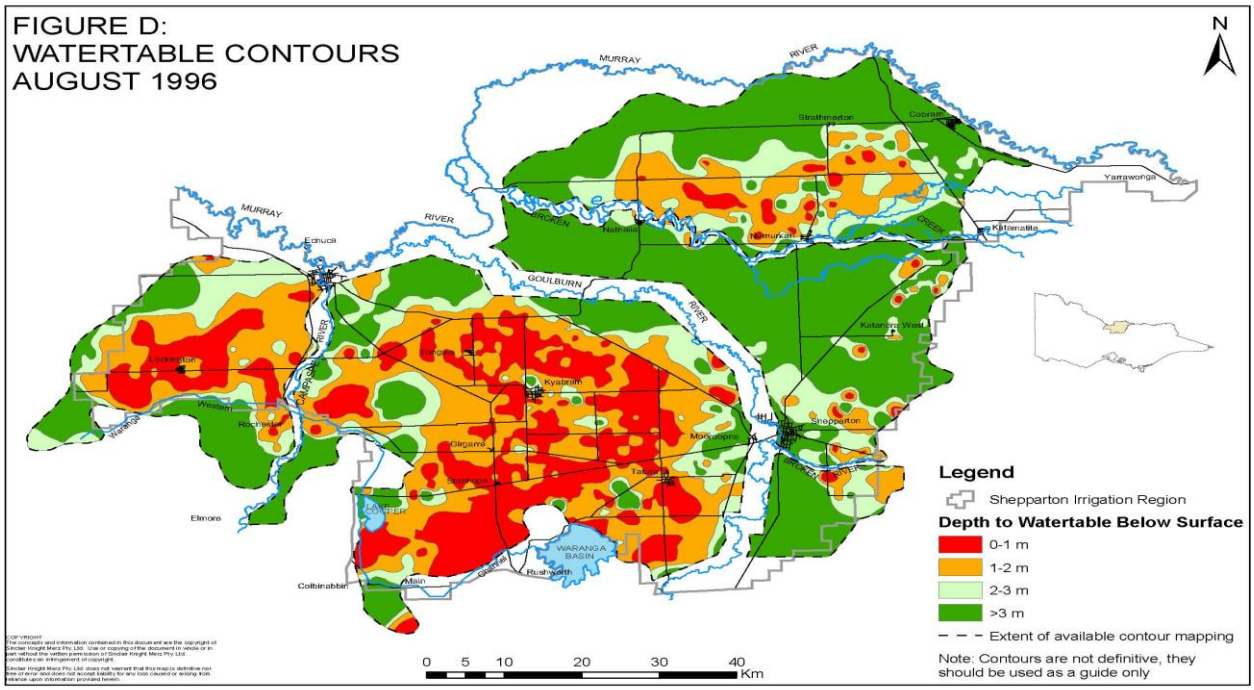
As shown in Figure D and Figure E, the drier than average weather conditions have had a significant impact on groundwater levels across the SIR between 1996 and 2005. Based on current climatic forecasts this trend is expected to continue, at least in the immediate future. Predicting the extent and breadth of the impact on the SSDP will be a major challenge over the next six years.

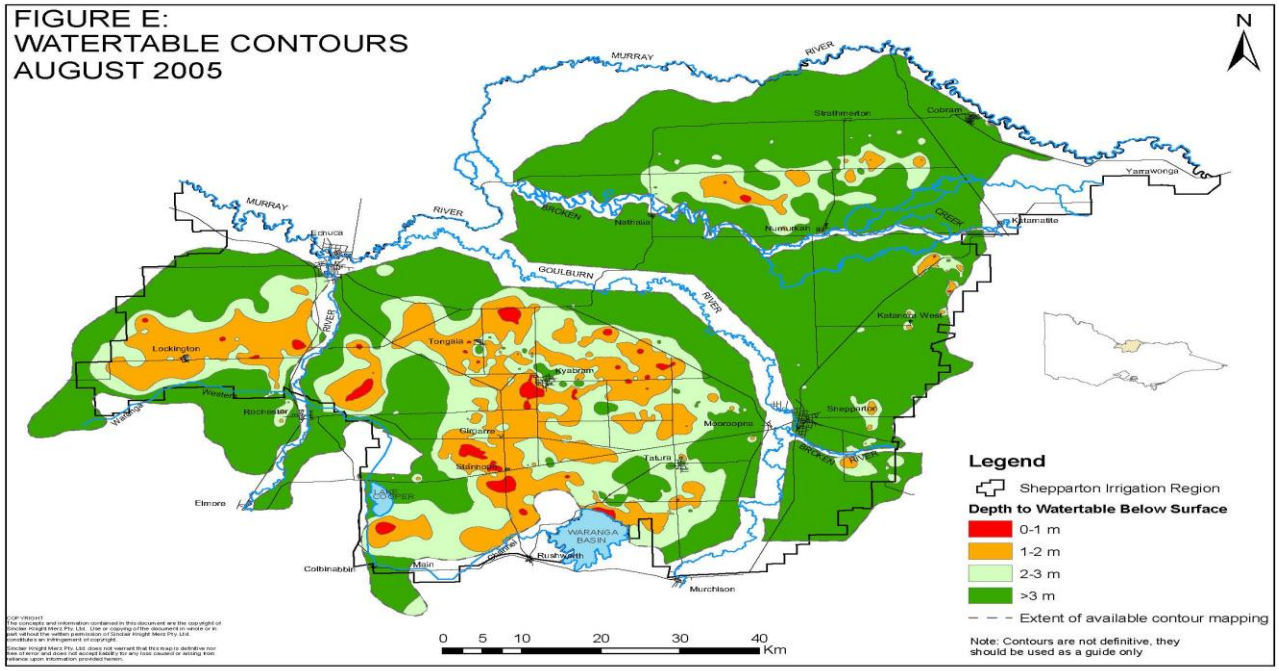
Water supply and drainage system reconfiguration, and improving the understanding of the impact of the presence of SSD works on water use efficiency are also two important issues which need to be addressed by the SSDP. The impact of reconfiguration planning of the current delivery system could be significant in terms of the SSDP assets that are currently in the ground and proposed works. The SSDP needs to take a more proactive role in system rationalisation planning, and ensure any impacts are taken into account in its future implementation.

The benefits of the SSDP both in terms of additional water directly generated, and increased production efficiency due to reduced waterlogging and salinisation are yet to be fully explored and realised. Greater emphasis needs to be placed on these factors as they became future drivers to the success and implementation of the SSDP.

Other key challenges identified for the current and future successful achievement of the SSDP, include:

- reduced water availability for irrigators
- changes in land use resulting from water trading and industry changes
- managing salt disposal at a local and regional scale
- maintaining a strong relationship with other organisations with natural resource management responsibility, in particular G-MW
- maintaining landowner support and participation in implementation
- broadening the scope of the SSDWG to have a catchment wide responsibility
- future use of different 'Market Based Instruments' to support implementation
- future funding security
- maintaining the strategic adaptive management approach to planning and implementation
- advancing and using best available scientific and engineering knowledge.





10. 2011 SSDP major revision

The 2011 SSDP review will involve a major revision of the Program, including its underlying philosophy and principles. In order for such a significant revision to take place, there are a number of key actions which need to be undertaken prior to 2011. These include:

- determining the applicability of the current underlying principles which govern the works required under the SSDP (e.g. area at risk, area to be served, standard of service to be provided, area served per pump, etc.)
- improving the governance relating to current data management systems
- determining the standard of service needs to serve environmental features

- more accurately determining proposed actions as well as salt disposal needs and credit generation under Schedule C
- reviewing the SDE needs and sourcing SDE credits to support full Program implementation
- quantifying the volume of water generated through the achievement of water use efficiency improvements and resource generation
- determining the extent of the change in water use efficiency attributed to the SSDP works
- confirming the area of watertable affected by SSDP works
- ensuring data generated as part of the SSDP five-year review is used and built upon over the next six years
- assessing the required standards of service needs relative to the current standards being delivered under the program
- site specific research into changes in rainfall totals, temporal patterns and intensities associated with storm events
- quantifying the actual environmental benefits directly and indirectly delivered through the program
- improving the understanding of groundwater nutrients and trends in groundwater salinity
- determining the actual split in investment between the key stakeholders in the delivery of the program
- undertaking the necessary investigations to quantify the road benefits to be delivered through the program. This information will be included as part of the economic assessment
- understanding the impacts of water supply system rationalisation on existing and proposed SSDP works
- establishing a works program which requires completion of sub-regional planning, water supply system rationalisation arrangements to be known and resolving any issues with the redistribution of salts within the SIR via water supply channels and drains
- further refining the SSDP and its delivery to ensure outputs and outcomes meet the needs of the community and are delivered in the most cost effective way
- ensuring the key actions outlined above are addressed in the most cost effective way.

A number of the actions outlined above are included in the current SSDP Research and Investigations (R and I) Program or in the new issues to be addressed by the R and I Program.

The delivery of these actions through the SSDP Strategic Investigation component of the Program will assist in ensuring the 2011 review is carried out in an efficient and timely fashion, and is based on the best available information.

Appendix 6 Surface Water Management Program Review 2005-2006 Executive Summary and Recommendations

1. Review context

A review of the Shepparton Irrigation Region (SIR) Surface Water Management Program (SWMP) has been carried out twice since the Program began. The purpose of this review is to look at the achievements of the past six years (July 2000-June 2006) and to provide the necessary direction to ensure the current investment strategy is on track for completion over the next five years (2006-2011). A more comprehensive review is scheduled to be completed in 2011.

This review focuses heavily on the nature and impacts of the changes in both water and natural resources management over the past decade. In addition, it provides an overview of the status of the whole Program and where the impacts of various changes in management might influence future implementation.

2. Adaptation to a changing environment

The implementation of the SWMP has been influenced by a number of changes in water and natural resources management over the past six years. The changing nature of management within these sectors has required program managers to work within and adapt to a significant number of new and revised initiatives. These were grouped into the following three general categories for further analysis:

- Policy and Strategy Influences - A total of 24 external policies and strategies were examined to identify the influence they may have had on SWMP implementation. These were grouped to consider the impact of legislative changes at a State and Federal level, as well as local policy and strategies. The introduction of legislative change has generally been reflected in a more inclusive and comprehensive process for the design, approval and construction of surface water management systems (SWMS).
- External Influences - A list of 15 external influences, which have emerged over the past six years and have been recognised as having an indirect influence on the Program, were identified through the Steering Committee. These issues may not necessarily be fully controlled by SWMP managers, but their impacts have to be considered and managed. This group includes issues such as deregulation, climate change, water trade and institutional change. These influences have manifested themselves in various ways, some positive and some negative.
- Proactive Management - This group of changes was developed to reflect the response by the SWMP managers as they adapt to the changes they face. The key changes identified in this grouping include development of the Irrigation Drainage Memorandum of Understanding (IDMOU), participation in the Irrigation Futures Program, the need to move towards national frameworks such as Monitoring, Evaluation and Reporting (MER), the move to develop management tools such as Catchment Asset and Operation Plans (CAOP) and revision of guidelines for design and construction to better reflect changes in policy.

Many of the initiatives within these groups of changes have had a significant influence on the direction of the SWMP over the past six years, and in turn will influence the future of the Program. The recommendations from this review capture the necessary actions to address the effect of these changes.

3. Achievements 2000-2006

There have been considerable achievements over the past six years, with the majority of on-ground works being completed under the Primary Surface Water Management Program (PSWMP). The PSWMP has largely followed the Program priorities developed in the original Surface Drainage Strategy. During the past six years, the PSWMP has constructed 63 km of SWMS. These SWMS provide direct drainage for 5,773 ha within the SIR.

Further, this implementation work has provided the opportunity for approximately 14,381 ha of Community Surface Water Management Systems (CSWMS) to proceed through provision of a suitable outfall.

The Community Surface Water Management Program (CSWMP) has seen 33.75 km of CSWMS constructed, directly serving 2,202 ha. A further 312 km of CSWMS, servicing an area of around 27,795 ha, were or are currently in the process of being surveyed and designed during the review period but have not yet been constructed. Construction has generally not commenced due to lack of community support which is required under the guidelines for developing these systems. The drought continues to render SWMS a low priority amongst landholder groups, so this situation is not expected to change until the drought breaks.

Program staff from Goulburn-Murray Water (G-MW), the Department of Primary Industries (DPI) and the Goulburn Broken Catchment Management Authority (GB CMA) have continued to work on a range of activities which are not always directly related to on-ground implementation works but are required to meet the changing management environment. The key areas where achievements of the program are recognised include:

- Retrofitting and remodelling - Retrofitting of existing SWMS to current standards has focussed on Murray Valley Drain 13 through G-MW's Advanced Maintenance Program. This type of work is likely to gain greater importance in the future as the PSWMP implementation nears completion. Remodelling works were completed on the Deakin Main (9.7 km) and Deakin 16 (7.4 km) systems.
- Drainage diversion strategies - A policy for assessing and managing drainage diversion licensing was completed in 2000. Assessments of resource availability are now generally complete.
- Monitoring, review and reporting of data collected under SWMP and other programs have been regularly undertaken during the review period.
- Metering - G-MW has employed a number of diversion inspectors to meter all low flow diversions.
- Government response to Nolan Review has led to a number of aspects of the Program being modified or improved. The response confirms the Program is leading the way with respect to best practice in surface water management.
- Development and implementation of the IDMOU has been a lengthy process but represents an agreement between a number of partner organisations to address the potential negative impact of irrigation activities on downstream water bodies.
- Salinity audit - An audit of the downstream salinity impacts of both the SSDP and SWMP was completed during the review period. This was a significant body of work undertaken in an attempt to improve the methodology for estimating the salinity impact of works.
- Murray Valley Drain 11 Planning Process - Significant time and effort was invested in preparation of a submission for the planning panel addressing concerns about downstream impacts of the proposed SWMS.
- Management interactions at Program and cross-program levels have continued to be a strong focus in promoting partnerships and a cooperative approach within the region.

4. Performance 2000-2006

The performance of the SWMP from 2000-2006 has been assessed in line with the triple bottom line indicators - economic, environmental and social. This type of assessment has not been completed before and there will be aspects of the methodology that require additional work prior to the next review being undertaken. The nature of the assessments for this review is detailed as follows:

Economic performance indicators: A number of economic indicators have been used previously to assess the overall viability of the Program however, the methodology for deriving these has not been consistent from one assessment to the next.

The preferred indicators include:

- Present Value of costs (including construction costs, operation and maintenance costs and downstream impacts);
- Present Value of benefits (including salinity, waterlogging, flooding, roads, reuse and land-use change); and
- Benefit to cost ratio (Present Value benefits / Present Value costs).

Calculations indicate the benefit to cost ratio for the overall Program is currently 1.16:1, although further work is required in the coming year/s to develop a more appropriate methodology for assessing financial status of the Program into the future.

Additional indicators that provide a more realistic view of actual progress relate to unit costs for implementation. As can be seen from the following indicators, the average cost of implementation has increased from the previous reviews:

- PSWMS - $200,000/km (a 13 per cent increase from $177,000/km in 2000)
- CSWMS - $76,000/km (a 12 per cent increase from $68,000/km in 2000)

Further increases in these costs are expected in line with inflation and as the more complex and therefore difficult to implement systems are tackled (ie most of the more cost effective components of the plan have already been implemented).

It is useful to note inflation, as measured by the Consumer Price Index (CPI), has risen by around 21 per cent between 1999-2000 and 2005-2006.

Environmental performance indicators: The Environmental Management Program (EMP) is being reviewed independently however the SWMP and the Environmental Management Program are closely linked. There has been considerable work undertaken by the EMP in direct support of the SWMP with respect to environmental performance. The focus has included works assessment for proposed construction activities, mapping the areas of native vegetation (protection and enhancement), development of wetland health initiatives and working with the implementation team in integrating the environmental requirements into the design of new systems.

Specific wetlands addressed during the review period include Brays Swamp, Reedy Swamp, Mansfield Swamp and Kinnairds Wetland.

Mapping of native vegetation planting is now regularly undertaken as a part of the standard recording process, with the proportion attributed to the SWMP shown in Table 1.

Table 1 Vegetation Planted

Year	Total Vegetation Planted (ha)	Area Planted adjacent to SWMS (ha)	Proportion attributed to SWMP (%)
2000-2001	79.9	4.9	6
2001-2002	59.2	12.65	21
2002-2003	58.1	7.55	13
2003-2004	44.4	8.47	19
2004-2005	18.1	0.40	2
2005-2006	48.26	1.60	3
Total	307.96	35.57	10.6

Source: DPI Tatura 2007 (A Sislov).

Social performance indicators: The social aspects of SWMP have not previously been considered, however a recent assessment framework developed by consultants HydroEnvironmental proposes a qualitative method that relies on feedback through case studies and workshops. This method was adopted to assess the status of social considerations. The results of the workshop, shown in Table 2, indicated most social aspects of the strategy are viewed as having a very positive influence on society. It is noted that although the views of those

included in this assessment are likely to be adversely influenced by the current drought conditions, the outlook for future benefits to be achieved through the plan was generally optimistic.

Table 2 Social assessment

Indicator	Comment on appropriateness of Indicator to SWMS	Score (+5 / -5)
Community well-being	There was a feeling with new SWMS, there was a generally positive feeling and improved economic performance, however, there was nothing significant noted for existing SWMS.	+3
Sense of community	There was a sense that although CSWMS have not progressed as much in the past five years, the overall level of achievement in this category was high.	+3
Natural resources knowledge base	Extension activities associated with the program are credited with the broader education of landholders around the region. The increased knowledge is not limited to drainage considerations but also brings together aspects relating to environmental values and best farm management practices.	+4
Improved business confidence	It was felt with SWMS, there was a greater level of confidence for development to occur.	+4
Access to water supply	Rules in place to control increase in water on undrained properties.	+3
Security of water supply	There were instances noted where existence of works had allowed additional water to be secured, although this was generally not widespread.	0 to +1
Changes in landscape	The landscape of the SIR is seen to be improved compared to previous times. Some debate whether people attributed the improvement to the SWMS or not. This was not material.	+3 to +4
Confidence in the Program	The general feeling is program confidence is positive; there are other external factors that may have had an impact on program implementation.	+3
Protection of significant cultural and historic sites	The process of assessing impacts of proposed works was seen to be positive as the sites would not have otherwise been identified.	+4

5. Future of the SWMP

The area of the SIR which is not serviced by a SWMS is currently 233,535 ha which represents around 44 per cent of the total of the SIR. Although the benefits that the SWMP provides (including reduced waterlogging, flooding and salinity, protection of roads, reuse and land-use change) may have been largely realised due to alternative influences (ie dryer climatic conditions and improved irrigation management than when the benefits of the Program were first calculated), the projected benefits of the SWMP have not and will not be fully realised until the appropriate infrastructure is put in place.

The value of the already significant investment in the PSWMP to date is potentially at risk if the remaining works are not completed. It is crucial to the future improvement of irrigated farming in the SIR that the works program be implemented in a timely manner.

The future works required to achieve the desired outcomes of the SWMP fall into the following four general areas:

5.1. Primary Surface Water Management Program (PSWMP)

The PSWMP has followed the Program priorities developed in the 1995 Surface Drainage Strategy and although there are still some significant works to be constructed, it is likely the focus will move to operating and maintenance (of previously constructed SWMS) following the 2011 review. It is essential the PSWMS continue in its current form if the projected economic benefits of the strategy are to be fully realised. Of the 130 km of SWMS remaining in the works program, most of this is either at the survey and design phase or well into construction. Funding of around $4 million per year is required to ensure the short term Program targets are met by 2011.

5.2. Community Surface Water Management Program (CSWMP)

The implementation of the CSWMP has and is likely to continue to slow considerably as a number of external factors such as climate cycles, terms of trade and funding arrangements influence the ability of the community to commit the required resources. The Program is dependent on the construction of PSWMS to enable outfall to occur and this construction will largely be complete by 2011.

During the review period, 22 CSWMS have been designed, yet most have not received enough community support to proceed with construction. Although this lack of support has allowed funding to be directed to additional works under the PSWMP, it is also likely to have impacted upon the realisation of benefits assumed for the total SWMP investment required in the region.

It appears an alternative implementation model may be required to achieve the necessary uptake of the community program. This would need to be decided pending the outcome of the cost-sharing review being undertaken by consultants URS as well as any return to more prosperous climatic conditions.

An appropriate prioritisation policy is in place to fund the implementation of CSWMS as community support arises.

5.3. Other planned works

The PSWMP works which are required to complement the capital works described above include:

- Retrofitting and remodelling - no works are specifically planned before 2011. Developments under the IDMOU may influence decisions to increase the amount of retrofitting to achieve its objectives.
- Metering - to be continued in line with current program.
- Monitoring - is required to assess performance and will need to continue in accordance with current arrangements. It is likely increased monitoring will be required to achieve the IDMOU objectives.

5.4. Strategic focus

A number of specific aspects of the strategy have been identified as requiring additional work to provide a more targeted program in the interim and a more rigorous and strategic review of the SWMP status in 2011. These aspects include:

- Review of economic benefits - There is a need to address the deficiencies in the current economic performance indicators by undertaking a detailed review of the benefits and costs of surface water management.
- Future landscapes - Recognition that irrigation landscapes will change in the future and a suitable action plan to address potential future scenarios will need to be developed.
- Integrated monitoring objectives - Current performance indicators are heavily output based. The MER process requires that targets for outcomes also be developed which will require data from this program to be integrated with other catchment information. Although the flow gauging of newly constructed SWMS has been implemented and existing sites linked to the program are maintained, there may be a requirement, with various new initiatives such as MER, IDMOU and CAOP, to undertake a review of monitoring requirements. This may also be beneficial at a Catchment Implementation Strategy level.
- Future management of the Program - A refocus on overall Program management will assist in progressing the strategic aspects of the Program at the same time as the implementation programs for PSWMS and CSWMS continue. Improved coordination at this level, both across Program and agency boundaries, could assist in short term staff reassignments between management and implementation levels to maintain and build capability.

6. Summary of recommendations

This review has considered the past six years of the SWMP, the changes in policy and strategy, and the external influences as well as the implementation of both the 1995 and 2000 programs. As a result the following recommendations, aimed at providing some logical direction for improvements in the SWMP management over the next five years, have been developed.

6.1. Program continuation

It is recommended:

6.1.1. Funding of $4M per year for the next five years be sought to continue implementation of the PSWMP in order to maximise the likelihood that the SWMP benefits are realised.

6.1.2. Funding of $500,000 per year for the next five years be sought to continue implementation of CSWMS. Until conditions return to a wetter climate, emerging priorities for CSWMS funding should be prioritised in accordance with existing policy and managed within this budget allowance.

6.1.3. Funding of $135,000 per year be sought to continue monitoring and metering activities and $200,000 for SWMS management and IDMOU activities.

6.2. Information management and coordination

It is recommended that the following tasks be completed to address the information management issues that currently exist:

6.2.1. Examine user requirements of SWMP information and agree on data collection requirements, data handling, ownership, and reporting formats.

6.2.2. Upgrade SWMP map bases to a more functional GIS platform.

6.2.3. Examine options for a compatible reporting system or database for implementation work projections of both the PSWMP and CSWMP.

6.3. Staff and knowledge management

It is recommended that:

6.3.1. Development and co-ordination of documented procedures for PSWMS and CSWMS be completed in the 2007-2008 financial year.

6.3.2. Collation of available documents relating to the SWMP be completed and indexed for uploading to a common access point for program managers.

6.4. Economic viability review

It is recommended that:

6.4.1. An economic review be undertaken in the 2007-2008 financial year including a review of all the catchment and agronomic benefits that can be reasonably quantified.

6.5. Irrigation landscapes development and coordination

It is recommended that SWMP managers:

6.5.1. Revise the objectives of the SWMP to include 'facilitating increases in water use efficiency and irrigation management' and address any issues with the alignment with the needs of government investors.

6.5.2. Engage in a process of developing outcomes based MER targets which is coordinated with the requirements of government investors, IDMOU, CAOP and reconfiguration/modernisation objectives and targets.

6.5.3. Develop future landscape objectives for SIR sub-catchments in accordance with irrigation futures objectives.

6.5.4. Ensure that the SWMP has a stronger alignment with the reconfiguration and modernisation project.

6.6. Program / Project management

It is recommended that:

6.6.1. Program Managers continue to exercise flexible practices to meet the challenge of continually changing circumstances.

6.6.2. A renewed focus on the role of the Project/Program Manager be made and if necessary appoint a new full-time project manager to facilitate the implementation of the review outcomes, and the co-ordination of the SWMP.

6.6.3. A standard reporting format be adopted, similar to the format used for this review, for tracking and reporting expenditure, recording completion of works, reporting environmental performance and reporting social performance.

6.7. Review of program options

It is recommended that:

6.7.1. The current design principles be maintained as valid until 2011 or until such time as additional information is obtained which suggests changes may improve performance.

6.7.2. Sufficient data be made available by 2011 to assess the impacts of water trade, modernisation and reconfiguration on the design capacity methodology currently used.

6.7.3. Additional technical work be undertaken before 2011 to determine the viability of Drainage Course Declarations as a component of the overall SWMP.

6.7.4. Managers ensure the cost-share arrangements being reassessed under the RCS review will provide sufficient incentive for CSWMS to proceed when conditions allow.

6.7.5. An investigation be carried out into the use of Section 32 agreements to ensure existing or potential commitments to SWMS are made known to new owners as part of the land purchase process. If necessary, GB CMA commence state level negotiations to ensure this occurs.

Implementation of these recommendations prior to the next review will assist in setting the priorities for 2011 and beyond.

Appendix 7 River Health - Waterways Program Review 2000-2001 to 2005-2006 Executive Summary and Recommendations

This report presents the results of programs undertaken as part of a review of the Shepparton Irrigation Region Waterway Implementation Plan 2001-2005.

The Shepparton Irrigation Region Waterways Program aims to protect and enhance the natural riverine features in the region, improve water quality, and the social, economic and cultural values they provide.

The Program has inputs from a variety of stakeholders including GB CMA, DPI, DSE, Goulburn Murray Landcare Network, Landcare Groups, Local Government, Parks Victoria and landholders.

The Waterways Working Group, via its community members' inputs and landholder/community perspective to the Program, encourages community involvement in meetings and helps ensure the Program is aligned with the Regional Catchment Strategy and Program targets.

This review has valued the contribution of the Shepparton Irrigation Region Environment Program which has contributed towards the identification of cross program opportunities. The future will see stronger involvement of the programs in the delivery of both environmental and river health initiatives.

This five-year review for the River Health and Water Quality Program (for the period 2000-2001 to 2005-2006) provides the opportunity to collate the achievements and outputs from contributors to the Program and establishes future directions for the Program to protect and enhance the quality of river and water quality assets for both local and regional communities.

A number of significant achievements in both strategic and implementation areas have resulted in this period. These include:

- a very strong partnership approach with all stakeholders (community and agencies)
- completion of a Management Strategy and Action Plan for the lower Broken Creek
- assessment of Licensed Crown Water Frontages in the Shepparton Urban area
- establishment and launch of the RiverConnect Program
- initiation of a Management Plan for Greens Swamp
- IDMOU Decision Support System established along the Broken Creek
- commencement of urban stormwater initiatives with local government
- successful implementation of an Annual River Health/Waterway Program ~$1.3M
- completion of an Environmental Flow Study for the Goulburn River
- being awarded the Thiess National Riverprize in 2001
- input to Regional River Health Strategy.

Future programs within the SIR "Waterways Program" will be based on the following strategic reviews:

- Regional River Health Strategy
- Lower Goulburn River Waterway Strategy
- Lower Broken Creek Strategy.
- Western Catchment Waterway Health Strategy
- Kialla Streams Management Plan.

Key recommendations from the review include:

- continues to deliver projects in line with the Regional River Health Strategy
- seeks cross program input into the development of the RCIP
- identifies opportunities to consult the community (via Cross Program Working Groups)

- establishes a process to participate and meet with the Environment Program on a regular basis to identify opportunities for joint initiatives (includes Wetland Management Group formation)
- works with other programs (Environment Program) to review Program delivery, incentives and explore appropriateness of other 'instruments' to deliver incentives
- develops a strong Annual Investment Plan (incorporating input from other Programs)
- supports cross program/integrated communication and participation actions
- identifies key messages for use in communication initiatives
- establishes a process to evaluate the effectiveness of the Program Evaluation Plan
- undertakes a mid term review of the RRHS in 2009-2010
- provides input on River Health and Water Quality issues during the development of LAPs
- undertakes a process to incorporate the predictions of climate change, land use change and social trends into the planning of river health and cross discipline programs
- develops a Monitoring, Evaluation and Reporting Strategy/Plan
- investigates use of Biodiversity Action Plan for linking activities and priorities with cross program activities
- undertakes a process to incorporate emerging priorities and needs into the planning of the river health and cross discipline programs.

Appendix 8 Shepparton Irrigation Region Implementation Committee Partners - Roles of Regional Stakeholders

Goulburn Broken Catchment Management Authority (GB CMA)

The GB CMA is responsible for the preparation of the Regional Catchment Strategy (RCS) and reporting on progress towards Strategy targets and outcomes. The Authority is also responsible for works on waterways, regional drainage and floodplain management. The GB CMA also coordinates Commonwealth and State natural resource management investment in the region. Through its Implementation Committees the Authority provides strong community ownership and input to the GBRCS, SIRCIS and their supporting programs.

Department of Sustainability and Environment (DSE)

DSE provides technical and extension support for the development and implementation of the GBRCS and the SIRCIS and their programs. DSE is also responsible for State-wide land use planning and the implementation of the Planning and Environment Act, 1989.

Department of Primary Industries (DPI)

DPI provides technical and extension support for developing and implementing the GBRCS and the SIRCIS. Of particular importance is the research and development input provided by the DPI's research institutes and extension services to landowners.

Local Government

The catchment includes the municipalities of Moira, Campaspe and the City of Greater Shepparton. Local Governments are central to the implementation of both the GBRCS and the SIRCIS through their responsibilities for land use planning, development approvals, rates and a variety of services such as road construction and maintenance. The local governments also contribute 17 per cent to the cost of works.

Goulburn-Murray Water (G-MW)

G-MW provides irrigation, drainage, water supply and management of specific water supply catchments. G-MW licenses surface and groundwater extractions and plays a major role in irrigation salinity management, water quality management and regional economic development. G-MW also contributes significantly to the achievement of other riverine health outcomes.

Urban Water Authorities

Goulburn Valley Water and Coliban Water provide water and wastewater services to urban communities in the SIR. The Authorities manage specific water supply catchments and contribute to the water quality outcomes of the region by investment in improved wastewater management services.

Environment Protection Authority (EPA)

The EPA coordinates all activities relating to the discharge of waste into the environment and the generation, storage, treatment, transport and disposal of industrial waste. They seek to control pollution and protect the quality of the environment.

Northern Victoria Irrigation Renewal Project (NVIRP)

NVIRP is responsible for implementing the Northern Victoria Irrigation Renewal Project (Foodbowl Modernisation Project). It will be important for SIR IC to work closely with this organisation to ensure our programs operate in a mutually beneficial fashion.

Landholders

Achieving the GBRCS and the SIRCIS outcomes requires changes in the way we manage our natural assets. Landholders are critical to the success of the Strategies. Under the *Catchment and Land Protection Act 1994*, landholders are required to: 1) avoid causing or contributing to land degradation which causes or may cause damage to land of another owner; 2) conserve soil; 3) protect water resources; 4) eradicate regionally prohibited weeds; 5) prevent the growth and spread of regionally controlled weeds; and 6) prevent the spread of, and as far as possible eradicate, established pest animals.

Goulburn Murray Landcare Network, Local Area Planning, Landcare

The Goulburn Murray Landcare Network supports the activities of Landcare groups in the SIR and makes a big contribution to revegetation and remnant protection by coordinating Greencorps and Work for the Dole groups. These programs provide training for participants and labour to construct fencing around remnants and planting.

Local Area Plan groups have been active in remnant protection, revegetation and improving biodiversity outcomes in some public land reserves.

Landcare groups enable the community to participate directly in natural resource management, particularly through identifying and setting direction for on-ground works and mobilising community involvement in their local area.

Parks Victoria

Parks Victoria manages State and National Parks to ensure the conservation values of the parks and reserves network is protected.

Indigenous groups

Aboriginal cultural history is an important source of information for achieving the GBRCS and the SIRCIS outcomes and aboriginal community engagement is a key area for the next five years.

Universities and TAFE

Universities and TAFE Colleges operating in the region must continue to provide a high level of service and to produce graduates with an extensive knowledge of natural resource management issues. They have an ongoing role in providing support to natural resource managers through student and staff involvement in catchment initiatives.

Trust for Nature

Trust for Nature is a non-profit organisation which works to protect remnant vegetation. The Trust focuses on a conservation covenant program and the purchase and re-selling of high conservation value land through its revolving fund. They assist community groups to purchase property, provide information and seek to add value to regional research.

Trust for Nature issues Conservation Covenants to provide long-term protection to valuable remnant vegetation on private land.

VicRoads

VicRoads is responsible for maintaining and improving the condition and performance of Victoria's arterial roads, bridges and major culverts. VicRoads is actively involved in developing roadside management plans for its major roads. These plans will assist in managing roadside environments and include sections on pest plants and animals, retention of significant roadside areas, maintenance strategies and maintenance of firebreaks.

Industry

Through its operating practices and peak industry groups such as Murray Dairy, industry is able to exert strong influence over natural resource management outcomes by supporting landowners to make changes as well as providing expertise to SIR IC to assist with policy making.

Environment groups

These groups are major contributors to the outcomes of the SIRCIS by either involvement in shaping the direction of the SIRCIS or by delivering on ground works. The groups include Greening Australia Victoria, the region's Environment Alliance Network, the Goulburn Valley Environment Group, the Australian Conservation Foundation and the Australian Trust for Conservation Volunteers.

The Superb Parrot Group have provided valuable on-ground support by planting corridors in the northern part of the catchment, to provide habitat for the endangered Superb Parrot.

The Goulburn Valley Environment Group has been active in not only highlighting biodiversity issues in the region but also in revegetating roadsides, particularly developing a corridor from Waranga Basin to the Goulburn River.

Appendix 9 Main Commonwealth and State Legislation and Policy Documents that Influence Natural Resource Management in the Shepparton Irrigation Region

Jurisdictional Area	Legislation, Policies and Programs	Relevance to the SIR
International Agreements	JAMBA (Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment)	Some of the species migrate to wetlands in the SIR.
	CAMBA (Agreement between the Government of Australia and the Government of the People's Republic of China for the protection of Migratory Birds in danger of extinction and their environment)	Some of the species migrate to wetlands in the SIR.
	Ramsar (Signatory to the Convention on Wetlands of International Importance)	The SIR contains the Barmah Forest which is a Ramsar listed wetland.
Commonwealth Legislation	*Environment Protection and Biodiversity Conservation Act 1999*	Controls actions which might impact on issues of seven different issues of national importance, the relevant ones to the SIR being: • wetlands of international importance often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed • nationally threatened species and ecological communities • migratory species.
	Aboriginal and Torres Strait Islander Heritage Protection Act 1987	Protects heritage issues such as Scar Trees from development.
	Native Title Act 1993	Controls issues of traditional land ownership by indigenous people.
Commonwealth Policy	National Strategy for Ecologically Sustainable Development 1992	The core objectives are: • to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations • to provide for equity within and between generations • to protect biological diversity and maintain essential ecological processes and life-support systems. These objectives are helping to guide SIRCIS' policy development.
	Inter-governmental Agreement on the Environment 1992	Provides a mechanism by which to facilitate: • a cooperative national approach to the environment • a better definition of the roles of the respective governments • a reduction in the number of disputes between the Commonwealth and the States and Territories on environment issues • greater certainty of government and business

Jurisdictional Area	Legislation, Policies and Programs	Relevance to the SIR
		decision making • better environment protection.
	National Strategy for the Conservation of Australia's Biological Diversity 1996	Provides policy support for our biodiversity responses.
	National Water Quality Management Strategy 1994	This Strategy led to the Goulburn Broken Water Quality Strategy 1996 and 2002.
	The National Landcare Program	Helps to guide our Landcare Program.
	Murray-Darling 2001 Guidelines and Agreements	Drives water use efficiency policy.
Murray-Darling Basin Ministerial Council	Murray-Darling Act. (Commonwealth, Victorian Act 1993) and Agreement	Controls water use and drainage in the Basin.
	Basin Salinity Management Strategy 2001	Controls salt disposal in the Basin.
	Water Diversion Cap 1993	Prevents the diversion of water for consumptive use above that which was being diverted in 1993-1994.
	Algal Management Strategy 1994	The goal of the Strategy is to reduce the frequency and intensity of algal blooms and other water quality problems associated with nutrient pollution in the Murray-Darling Basin through a framework of coordinated planning and management actions. This Strategy helped in the development of SIR's first Water Quality Strategy in 1996.
	The Living Murray Project 2002	This is a plan to return environmental flows to the River Murray.
	Basin Sustainability Plan 1996	The goal of the Basin Sustainability Plan is to promote and coordinate effective planning and management for the equitable, efficient and sustainable use of the water, land and other environmental resources of the Murray-Darling Basin.
Victorian Legislation	*Water Act 1989*	Controls the use of water in Victoria.
	Catchment and Land Protection Act 1994	Provides the legislative power for the creation of the GB CMA, and provides for the protection of land.
	Environment Protection Act 1970	Victoria's primary environment protection legislation, with a basic philosophy of preventing pollution and environmental damage by setting environmental quality objectives and establishing programs to meet them.
	Land Acquisition Act 1985	Provides for the acquisition of land when necessary for public projects such as surface water management systems.
	Planning and Environment Act 1987	Provides for orderly planning of land use in Victoria, contains the Native Vegetation Retention Controls.
	Flora and Fauna Guarantee Act 1988	The Act is the key piece of Victorian legislation for the conservation of threatened species and to mange potentially threatening processes.
	Local Government Act 1989	Provides a mechanism for funding of projects such as community surface water management systems.
Victorian Policies	The State Environmental Protection Policy - Waters of Victoria (2003)	Sets the framework for government agencies, businesses and the community to work together, to protect and rehabilitate Victoria's surface water environments.

Jurisdictional Area	Legislation, Policies and Programs	Relevance to the SIR
	Victoria's *Salt Action - Joint Action* 1988	The policy basis for the original SIR Land and Water Management Plan.
	Native Vegetation Retention Controls 1989	Controls the removal of native vegetation through the Planning Permit System.
	Nutrient Management Strategy for Inland Waters	This Strategy was launched in 1995 in response to the increased number of reports of potentially toxic blue-green algal blooms and to prevent further deterioration of water quality in Victorian waterways. It provides a policy and planning framework to assist local communities and the State Government in identifying and managing particular nutrient problems and to minimise the potential for the development of algal blooms.
	Biodiversity Strategy 1997	Sets the direction for the protection of Biodiversity in Victoria.
	Victorian River Health Strategy 2002	Sets the direction for the protection of River Health in Victoria.
	Our Water Our Future (Government White Paper)	A long-term plan for water in Victoria - sets out 110 initiatives for water conservation aimed at every sector of the community, seeking to provide water to sustain growth over the next 50 years.
	NRSWS 2009 and the determinations and policies relating to unbundling and water use licences (ref:*www.waterregister.vic.gov.au>unbundling>Unbundled Entitlements)*	
	Northern Victoria Irrigation Renewal Project (Foodbowl Modernisation Project)	A $2 billion program of works to modernise and upgrade aging irrigation infrastructure in Northern Victoria.
Goulburn Broken Catchment	Goulburn Broken CMA Regional Catchment Strategy 2003	Sets the direction for the protection of natural assets within the Goulburn Broken Catchment.
	Goulburn Broken Water Quality Strategy 1996, 2003	Sets the direction for the protection of water quality in the Goulburn Broken Catchment.
	Goulburn Broken Regional River Health Strategy 2005	Sets the direction for the protection of the Goulburn Broken Catchment Rivers and waterways.
	Goulburn Broken Native Vegetation Management Strategy 2003	Sets the direction for the protection of native vegetation in the Goulburn Broken Catchment.

Appendix 10 Papers and Presentations: a small sample

Year	Topic	Conference/Journal
1992	Effects of increasing natural resource management costs on pressure for structural adjustment in the Shepparton Irrigation Region	36th Annual Conference, Australian Agric. Econ. Soc.
1993	Development and Implementation of community driven natural resource management plans for Salinity Control in Northern Victoria	National Conference on Land Management for Salinity Control
1995	A Community Solution to Groundwater Control	International Association Hydrogeology Congress, Canada
1995	Redesigned Farm Uses 25% Less Water	Australian Farm Journal
1995	Local Government and Natural Resource Management – The Shepparton Irrigation Region Experience	The Role of Local Government in Natural Resource Management Conference
1995	Ability of Farmers to Pay Natural Resource Protection Costs	Annual Farm Management Conference, Moonambel
1995	Shepparton Irrigation Region Land and Water Salinity Management Plan - Community Involvement	Murray Darling Basin Commission Workshop
1995	Sharing the Costs of Groundwater Pumping	Murray Darling Basin Commission Workshop
1996	Irrigation with Saline Water in the SIR	Productive Use of Saline Lands Conference, Albany
1997	Balancing Irrigation and the Environment – the Mid Murray Approach	Australian National Committee on Irrigation and Drainage, Deniliquin
1997	Community Involvement in Catchment Management	Australasian Pacific Extension Network, Albury
1997	More than a Question of Numbers	National Landcare Conference, Adelaide
1997	Community Surface Drains – A Community Success Story	Australasian Pacific Extension Network
1997	Managing Wetlands in an Irrigated Catchment, Poster Presentation	Wetland Care Australian Convention
1998	Watertable Watch – Community Awareness to Action	National Agricultural Awareness Conference, Canada
1999	Community Involvement in Successful Catchment Management, SIR	Australian National Council on Irrigation and Drainage, Mount Gambier, SA
2000	Native Vegetation and Orchards	Horticulture in NRE – Awareness 2000 Conference
2000	Management of Saline Drainage Water on Farms in Northern Victoria	Proc. Xth World Water Congress, Melbourne
2000	Enhancing Diversity of Participation in Landcare	Changing Landscapes – Shaping Futures
2001	Water Use Efficiency at the Farm and Regional Level: The Economics of Response and the Furphy of Excellence	45th Ann. Conf. Aust. Agric. Econ. Soc., Adelaide
2001	GIS applications in Irrigation Water Management	ESRI (Environmental Systems Research Institute) Australia User Conference, Darling Harbour, Sydney
2002	Local Government And Salinity, The Shepparton Irrigation Region Experience	Murray Darling Basin Association Local Government Salinity Summit, Echuca
2002	Aligning Planning Activities With Catchment Management Authorities – Best Practice	Victorian Catchment Management Forum, Hamilton
2005	Landowners' attitudes on the benefits and barriers of adopting pressurised irrigation systems on broad acre farms	Irrigation Association of Australia (IAA) Conference, Townsville
2005	"Linkages between farmers, extension and research" at	Australian National Committee on Irrigation and Drainage Conference Mildura
2006	Strengthening Indigenous Relationships in the Community Surface Water Management Program – Paper and Verbal presentation	Australian National Committee on Irrigation and Drainage Conference, Darwin