



**GOULBURN
BROKEN**

CATCHMENT
MANAGEMENT
AUTHORITY

SHEPPARTON IRRIGATION REGION (AGRICULTURAL FLOODPLAINS) LAND AND WATER MANAGEMENT PLAN 2016-2020

THE 5TH AND FINAL UPDATE OF THE 1990-2020 PLAN BEFORE A MAJOR REVIEW

SIR PROFILE AND IMPLEMENTATION PROGRAM TASKS - PART B

This update was led by the Shepparton Irrigation Region People and Planning Integration Committee on behalf of the Goulburn Broken Catchment Management Authority, 2015 and we thank them for their contribution and leadership.

Thank you also to the following contributors: Rod McLennan, Helen Murdoch, Pat Feehan, Carl Walters, Rebecca Caldwell, Jenny Wilson, Terry Hunter, Megan McFarlane, Chris Nicholson, Lachlan Barnes, Simon Casanelia, Mark Turner, Neville Atkinson, James Burkitt, Rebecca Pike and Fiona Johnson.

© State of Victoria, Goulburn Broken Catchment Management Authority 2016.

Goulburn Broken Catchment Management Authority
168 Welsford Street, PO Box 1752
Shepparton VIC 3630
www.gbcma.vic.gov.au

Disclaimer: This publication may be of assistance, but the Goulburn Broken Catchment Management Authority and its partners do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purpose and therefore disclaim all liability from error, loss or other consequence which may arise from relying on any information in this publication.

ACKNOWLEDGMENT OF TRADITIONAL OWNERS

The Goulburn Broken Catchment Management Authority acknowledges the Traditional Owners of the land in the Goulburn Broken Catchment and strongly respects the rich culture and intrinsic connection the Traditional Owners have to the land.

TABLE OF CONTENTS

1	About the plan	5
1.1	Purpose of this plan	5
1.2	Evolution of the SIRLWMP	5
1.3	How Parts A and B of the LWMP relate	6
1.4	Review approach	6
2	All about the Shepparton Irrigation Region	7
2.1	The SIR at a glance	7
2.2	SIR natural resource issues in detail	8
3	Progress in managing natural resources	11
3.1	Vision	11
3.2	Understanding how progress is measured	11
3.3	Catchment condition (summarised as risks to the SIR)	15
3.4	Long-term plan implementation progress (since 1990)	16
3.5	Costs and indicative benefits of the SIRLWMP 2006-2015	19
4	Implementation	22
4.1	Farm Program	24
4.2	Drainage Program	25
4.3	Environment Program	27
4.4	People Program	30
4.5	Governance and partnerships	31
4.6	Program implementation cost estimates	34
5	Goulburn Broken CMA and other strategic documents relevant to the SIRLWMP	35
5.1	Regional Catchment Strategy (RCS)	35
5.2	Existing Goulburn Broken CMA biophysical strategies	36
5.3	Victorian Sustainable Irrigation Program (VSIP)	37
5.4	Murray-Darling Basin Plan (Basin Plan)	37
5.5	Basin Salinity Management 2030	37
5.6	Basin Water resource plans	37
5.7	Victorian Government	38
5.8	Other organisations' plans	38
5.9	Strategic links of SIRLWMP priorities with other Goulburn Broken CMA documents	39
6	Key stakeholders, roles and responsibilities	40
	Glossary and acronyms	42
	References	43
	Appendices	44
	Appendix 1: Resilience and social-ecological systems	44
	Appendix 2: Priorities for action summaries	46
	Appendix 3 Conceptual risk & opportunity heat map for managing critical attributes in the SIR	48

FIGURES

Figure 1. Shepparton Irrigation Region within the Goulburn Broken Catchment	7
Figure 2. SIRLWMP achievements 1990 to 2015	17
Figure 3. Planning hierarchy showing how vision is achieved by implementing priorities	22
Figure 4. Thirteen focus landscapes in the SIR	28
Figure 5. Priority waterways and wetlands in the SIR	29
Figure 6. Evolution of environmental stewardship	30
Figure 7. SIRLWMP implementation structure	31
Figure 8. Relationship between the RCS, sub-strategies and SES planning (GB CMA 2016)	35
Figure 9. Social-ecological systems (SEs) of the Goulburn Broken catchment (GB CMA 2013)	44
Figure 10. Risk and opportunity heat map (to manage critical attributes)	48

TABLES

Table 1. Evolution of annual catchment condition reporting in the SIR	11
Table 2. Critical attributes and associated thresholds and risks	13
Table 3. Long-term goals for critical attributes	14
Table 4. Catchment condition ratings for the SIR, with summaries of overall risks	15
Table 5. Whole farm planning achievements (GB CMA Annual Reports 2008-2015)	17
Table 6. Government investment, \$000	17
Table 7. Present value of program benefits and costs, 2006-2015	19
Table 8. Implementation program priorities	22
Table 9. Relationship of SIRLWMP's former and new implementation programs	23
Table 10. Relationship between priorities and critical attributes demonstrating benefits of integrated intervention	23
Table 11. Program and priority implementation cost estimates	34
Table 12. Goulburn Broken CMA Biophysical sub-strategies for the Goulburn Broken Catchment	36
Table 13. Strategic rationale for SIRLWMP priorities	38
Table 14. SIRLWMP implementation	40
Table 15. Implementation approach	45

1 ABOUT THE PLAN

1.1 PURPOSE OF THIS PLAN

This review and update of the Shepparton Irrigation Region Land and Water Management Plan (SIRLWMP) meets planning requirements of the Victorian Government and the Goulburn Broken Catchment Management Authority (GB CMA).

There is substantial overlap across plans that are required by both the Victorian Government (LWMP review) and the Goulburn Broken CMA (local plans), but each has additional requirements. This LWMP delivers the required content of both the LWMP review and the local plan.

1.1.1 STATE PURPOSE

The Department of Environment, Land, Water and Planning (DELWP) has set guidelines for preparing LWMPs that apply to designated irrigation areas in Victoria (DSE 2008). The 2008 guidelines are currently under review for update in 2017. The Goulburn Broken CMA has been part of the review and update process. The guidelines aim to support the development of LWMPs to achieve a consistent standard across the state.

The guidelines describe different processes for plan review and plan renewal. The detailed process for preparing new plans and renewal of existing plans is more comprehensive than the review of existing plans.

The Goulburn Broken CMA has considered the 2008 guidelines in the development of this document, a biophysical plan of the Goulburn Broken Regional Catchment Strategy (RCS), and has worked with DELWP to ensure the SIRLWMP meets Victorian Government requirements for LWMPs at this time. Previous plan titles have not always included the words “land and water management plan” (see 1.2 below); however, it is important to still state that this document is a land and water management plan, particularly to clarify why it is being presented to the Victorian Government and how it relates to legislation.

This document is one of the periodic reviews of the SIRLWMP that has been undertaken since its development in 1989 (see 1.2 below).

1.1.2 GOULBURN BROKEN CMA PURPOSE

This review and update implements the RCS’s strategic priorities to “update and develop strategies” and “plan at social-ecological system (SES) scale” (for the Agricultural Floodplains) (GB CMA 2013). SES local plans are the means of implementing the RCS, focusing effort on outcomes that promote resilience of the region’s SESs that are made up of inter-related land, water and biodiversity components, including productive agriculture. (Appendix 1 includes further details on resilience planning concepts and the Goulburn Broken Catchment’s SESs).

The Agricultural Floodplains SES spans the northern part of the Goulburn Catchment. This SES is strongly connected through irrigation infrastructure across the landscape, the resulting agricultural industries and communities it supports, and the inherent NRM issues associated with this production. The SIRLWMP, however, makes reference to the SIR. Whilst the boundaries of the Agricultural Floodplains SES and SIR largely overlap, the LWMP also takes into consideration the Rochester Irrigation Area which, whilst partially located in the North Central Catchment, forms part of the SIR and is managed accordingly. Hence that is why we refer to the SIR rather than the Agricultural Floodplains in this plan.

This review and update therefore aligns the SIRLWMP with the Goulburn Broken RCS and current environmental, social and economic circumstances (see Section 5 for information on the fit with the RCS, page 36).

1.2 EVOLUTION OF THE SIRLWMP

This SIRLWMP is the fifth review and update of the adaptive 30-year plan first prepared in 1989 (GBSPPAC 1989). Previous reviews were undertaken in 1995, 2001, 2006 and 2010.

The original plan was prepared in response to regional concerns about the obvious impacts of salinity and was called the Shepparton Irrigation Region Land and Water Salinity Management Plan (SIRLWSMP).

The plan has subsequently broadened to include a range of natural resource issues, such as water quality, biodiversity, river health, land-use, leadership and climate change. The plan will continue to evolve to meet the environmental, economic and social needs of the SIR, in a landscape that delivers food to the world, based on irrigated agriculture.

Over its life, the plan has also been known as the Shepparton Irrigation Region Catchment Integration Strategy (SIRCIS). This update is called the Shepparton Irrigation Region Land and Water Management Plan, remaining recognisable to stakeholders and reflecting its evolution, while reinforcing its relationship to the over-arching RCS.

Partnerships have always been the cornerstone of the SIRLWMP's success and 25-years of longevity. Community leaders first brought government attention to the impacts of salinity and together they created a visionary plan to balance productivity with sustainability as the region faced new challenges.

Implementation of the SIRLWMP is overseen by community and agency representatives through the Shepparton Irrigation Region People and Planning Integration Committee (SIRPPIC). The SIRPPIC is part of the community engagement structure of the Goulburn Broken CMA (see 4.5).

1.3 HOW PARTS A AND B OF THE LWMP RELATE

This SIRLWMP update comprises two parts:

- Part A: Growing the natural advantage establishes the planning framework that links the long-term vision with on-ground action and ongoing adaptation.
- Part B: SIR profile and Implementation Program tasks has more detailed context than Part A, includes more data on the SIR and SIRLWMP implementation progress, and lists tasks until 2020.

1.4 REVIEW APPROACH

This review has been focused as a 'soft review' with consideration for the LWMP guidelines as they are currently under review, especially works activities and associated costs and benefits. However, the plan proposes strategic directions and approaches and allows for updates as new or revised information becomes available rather than going to the detail of previous reviews. This is an appropriate approach given the changing nature of the SIR and the changing priorities for funding.

Detailed updates of works, priorities and costings will be undertaken at the program level, such as the Drainage Program, as required.

The approach to the review is consistent with the RCS's resilience or system thinking (see Appendix 1), steering away from detailed plans that imply we can forecast the long-term future with certainty and respond appropriately.

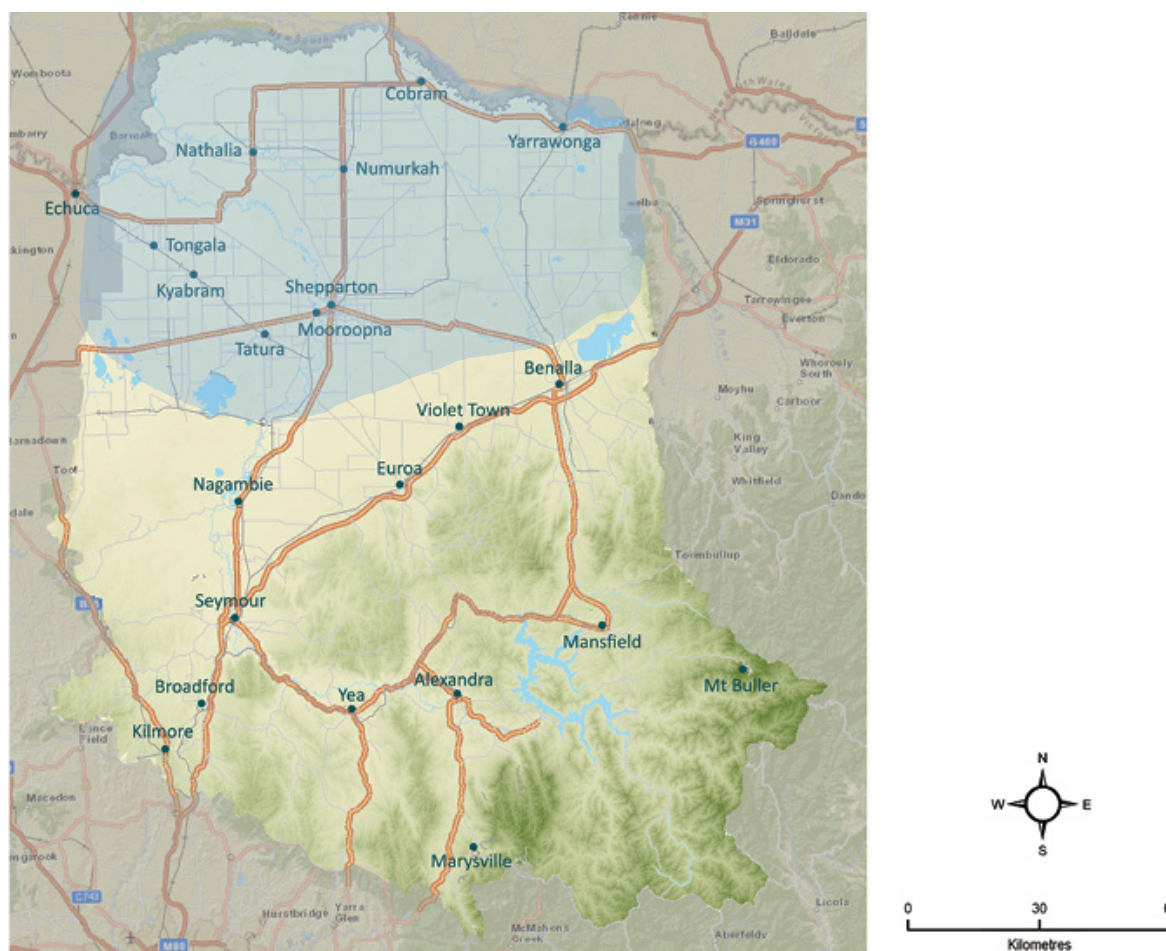
1.4.1 CONSULTATION AND ENGAGEMENT IN PREPARING THIS REVIEW AND UPDATE

In 2014 the Sustainable Irrigation Program Advisory Group (SIPAG) recommended a taskforce be initiated so that the community could lead the integrated action planning for natural resource management in the SIR. The purpose of the Taskforce was to lead the development of a local plan of action (a business plan) that creates a shared direction for the Agricultural Floodplains to manage priority issues in an integrated way. This includes:

- aligning the plan to strategies of the CMA, industry and other agencies with NRM responsibilities
- creating a way of promoting the region
- engaging with the broader community
- establishing a way to implement the plan.

The SIPAG Taskforce had 50 community and agency members. The group comprised current SIPAG members with additional community and agency invited to take part to increase broader geographic, industry and issue representation. On average 30 members attended the five meetings held throughout the process.

2 ALL ABOUT THE SHEPPARTON IRRIGATION REGION



Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, PC, NRCAN, Esri Japan (Hong Kong), Esri China (Thailand), TomTom, 2012

Figure 1. Shepparton Irrigation Region within the Goulburn Broken Catchment

2.1 THE SIR AT A GLANCE

- Comprises the northern floodplains of the Goulburn Broken Catchment, with the Murray River forming the boundary with New South Wales.
- A landscape highly modified for agriculture, with remaining vegetation fragmented and found mainly along waterways, wetlands and roadsides.
- Irrigation supports dairy, horticulture and cropping and a large food-processing sector, with major investment in on-farm and off-farm irrigation infrastructure.
- Contains the Barmah National Park, which is highly valued locally and internationally: it is Ramsar-listed and is an important breeding site for many bird species.
- Has a long history of community leadership in managing land and water problems.
- Further loss and decline of native vegetation; salinity; poor natural drainage; future farming options; and floods continue to threaten production and natural features.

2.2 SIR NATURAL RESOURCE ISSUES IN DETAIL

The SIR covers approximately 500,000 hectares, extending north from near the Waranga Basin to the River Murray on the border with New South Wales (Figure 1). Average annual rainfall is 400 millimetres. (Bureau of Meteorology 2012). The Region is part of two major river basins that cover two per cent of the Murray-Darling Basin, or about 10.5 per cent of Victoria.

Yorta Yorta Clans were the first people of the Region.

Following European settlement, most of the SIR's land was cleared for agriculture. Irrigated agriculture became the dominant land-use during the first half of the 20th century, and post-war soldier settlements and the post-1950 agricultural technology boom significantly influenced how land was used. Natural events such as flooding and drought have always impacted significantly on the region.

The majority of SIR residents live in the greater Shepparton area. The local government areas within the SIR are the City of Greater Shepparton, and Campaspe and Moira Shires. Major centres are Shepparton, Echuca and Cobram, and towns include Nathalia, Yarrowonga, Tatura, Kyabram, Tongala and Numurkah.

Agricultural production is the dominant land-use in the SIR. It is largely supported by the provision of irrigation water and drainage infrastructure, and by soils suitable for a range of farm production enterprises including dairy, horticulture and cropping. Agricultural production is supported by processing industries that are highly valued for the economic value they provide to the Region.

The SIR also boasts significant river ecosystems and wetlands including the Barmah and Lower Goulburn National Parks. The health of these areas is essential to Traditional Owners' cultural and spiritual connections to the land. There is a large number of Aboriginal cultural heritage sites.

2.2.1 BIODIVERSITY

The regional landscape has been highly modified from its original state since the 1880s. It now consists of one to three per cent native vegetation on private land, which is considered a 'relictual' landscape (generally defined as less than ten per cent native vegetation cover; McIntyre and Hobbs 1999). Overall however, with inclusion of the native vegetation cover remaining on public land, the SIR is considered a 'fragmented' landscape (10-60 per cent remaining native vegetation cover).

Prior to European settlement, the SIR landscape would have contained areas of open grassy woodlands interspersed with open grasslands, wetlands and waterways. River Red Gum forests and associated wetlands dominated the riverine environments, relying on inundation at varying times of the season. Grey Box and Yellow Box dominated woodlands were found on the Plains. Sand-ridge Woodlands were found at higher topography, containing species such as Yellow Box, Murray Pine and Buloke. There are remnants of the original vegetation communities throughout the Region, most prominently in areas such as Barmah and Lower Goulburn National Parks, Corop wetlands complex and the Broken Boosey National Park.

The current condition of biodiversity in the SIR is highly variable, with remaining native vegetation scarce and fragmented and particularly found in riverine environments, such as the Goulburn and Broken River systems, providing nature corridors throughout the SIR. Although some clearing of native vegetation continues, the region is fortunate to have some local landscapes that have large areas of agriculture complemented by significant areas of habitat: corridors, drainage lines, large patches and scattered remnants of native vegetation, and continuous and scattered wetlands and dams.

The biggest threats to the region's flora and fauna are the clearing, direct degradation and non-renewal of ageing habitat. Managing these threats provides opportunities to increase native vegetation quality and extent.

2.2.2 LAND

Agricultural production is the dominant land-use in the SIR. It is largely supported by the provision of irrigation water harvesting, storage and delivery, and drainage infrastructure, and has soils suitable for a range of farm production enterprises, including dairy, horticulture and cropping. Agricultural production is supported by processing industries that are highly valued for the economic value they provide to the Region.

Irrigated agriculture in the region is supported by the storage and diversion of flows from the Murray, Broken, Goulburn and Campaspe Rivers.

Erosion, organic matter decline, soil acidification, contamination, compaction, salinisation, sodicity, waterlogging and biodiversity decline are all threats related to agricultural land-uses.

Pest plant and animal invasion also threatens land-use, including Paterson's Curse, Fleabane, foxes and rabbits. New and emerging weeds such as Chilean Needle Grass and African Love Grass are also considered significant threats to the SIR.

Salinity continues to be the major threat in this region with soil salinisation linked to the salinity of, and depth of shallow watertables. Watertable depth, combined with poor drainage, also contributes to soil waterlogging in the SIR.

Poor natural drainage is an inherent feature of the intensively irrigated floodplains, and from the 1950s to the 1980s salinisation emerged as a major issue across the area. Prior to agricultural development and irrigation, the Region's groundwater levels are thought to have been around 15 to 30 metres 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.

2.2.3 IRRIGATED AGRICULTURE

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 about nine per cent of land in the SIR is adversely affected by shallow, saline watertables. Deep lead aquifers are considered to be in good condition, although water yield was affected during the 1997-2009 drought.

Salinity and high watertables first became a major concern around the Tatura and Bamawm areas in the 1930s. Successive wet years in the early 1970s caused severe salinity problems, affecting 50 per cent of the pear trees across the SIR at the time. By the mid-1980s, approximately 30 per cent of the SIR was underlain by shallow watertables (less than two metres deep) (SPPAC 1989)¹.

The (extrapolated) predicted salinity impacts if "nothing is done" showed that areas with high watertables would increase from 159,000 hectares in 1987 to 218,000 hectares in 2000 and 274,000 hectares in 2020, about 55 per cent of the SIR (SPPAC 1989). 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)¹. The actual watertable levels across the SIR were consistent with the predicted level up to mid-1990s. Since then, the implementation of works and the millennium drought have led to lowering of watertables and some stabilisation of the areas at high risk.

It was also established that the environment (SPPAC 1989, page 44) would be adversely affected if nothing was done to address the problems of high watertables and salinisation including:

- Destabilisation of river banks due to saline seepage from the high watertable.
- Death of riparian vegetation, leading to bank erosion and bed-widening in streams.
- The natural species in the wetlands will be replaced firstly by dense mass of floating couch grass then cumbungi and finally by salt-tolerant aquatic plants. Some wetlands will be replaced by lignum and saltbush.
- Remnant vegetation along streams and depressions and on the Plains will continue to decline due to waterlogging, salinity, old age and insect attack.

Landcare and the salinity pilot programs were formed to protect the landscape and, more recently, water policy and reform has been important, particularly the current technological irrigation improvements including the Connections Project and improved on-farm systems.

The condition of agricultural land-use is heavily influenced by the efficient delivery and use of water on farms. Long-term average historical delivery water losses were estimated to be more than 800 gegalitres a year in the Goulburn Murray Irrigation District (up to 2004-05), which encompasses the SIR (GMW 2009). Losses in any given year vary depending on customer deliveries in that year. For example, in a drought year, with lower customer deliveries there will be lower volumetric losses, but due to many of these losses being fixed they make up a higher percentage of volume released from storage. These losses were in part attributed to ageing and inefficient irrigation infrastructure. The Connections Project was initiated to reduce these losses through modernisation of the public irrigation delivery system.

Efficient on-farm water-use helps to minimise salinity, waterlogging and nutrient impacts by reducing surface runoff and seepage to the watertable. This is achieved through farm planning and farm infrastructure upgrades and water licences which describe maximum application rates for irrigation. Australian and Victorian Government and individual investment in significant infrastructure assets supports land and soil assets deemed best matched to irrigated agricultural production. A predicted outcome of this modernisation program is more land under dryland production, but the impact of this change on land and soil health is unknown. While improved irrigation efficiency helps reduce adverse impacts of irrigation, other than in severe drought, accessions to the watertable will exceed deep drainage, resulting in high watertables and salinity, thus highlighting the need for sub-surface drainage.

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

2.2.4 WATER

The SIR is mostly floodplain, with some sandhills near the Murray and Goulburn Rivers. The river ecosystems are a dominant feature across the landscape.

River regulation, and the associated timing and volume of flow in rivers and across the floodplain is the greatest threat to waterways, which are typically highly modified from their original state. Most waterways are currently in poor condition.

The health of rivers is also strongly influenced by the management and condition of upstream catchments and waterway systems.

Priority waterways include the Goulburn River, Seven Creeks, Gobarup Creek, Broken River and Broken Creek.

Wetlands form a critical part of the river ecosystems of the SIR. Current wetland condition is generally moderate to good. Wetlands on public land are in better condition than private land, where they are considered to be in generally poor condition. The biggest threats to wetlands are river regulation, drainage and landforming. Priority wetlands include Barmah Forest, Kanyapella Basin, Muckatah Depression, Gaynor Swamp, Wanalta Wetland Complex, Kinnairds Swamp, Black Swamp and Carlands Swamp.

The Goulburn Broken Catchment is in part characterised by widespread flooding on the extensive riverine plains, essentially downstream of the Hume Freeway. This flooding impacts on a number of rural cities such as Shepparton, Mooroopna, Kyabram, Yarrawonga, Cobram and Benalla and significant towns such as Numurkah, Nathalia, Tatura, Nagambie and Euroa. The riverine plains also support extensive and high value agriculture with an associated high density of rural and semi-rural settlement.

The wide and low-gradient attributes of the riverine plain result in extensive damage from riverine flooding and lasting economic and social disruption due to the long duration of events in many areas. Poor and even terminal drainage can also result in substantial impacts from overland flows and flash flooding in areas such as Yarrawonga and East Shepparton.

2.2.5 PEOPLE

In 2012, the Goulburn Valley had a population of 137,640, along with 63,770 jobs and an economy worth \$4.9 billion (gross value-added, excluding taxes). The unemployment rate, as of September 2013, was 5.8 per cent. Approximately half the region's residents and jobs were located in Greater Shepparton. Campaspe contained around 16,700 jobs and Moira almost 11,900 (GVIET 2014).

The core industry sectors in the region are agriculture (particularly fruit growing and dairy farming) and manufacturing (linked to food processing). Retail, healthcare, education and construction are also significant industry sectors and were the fastest growing industries between 2001 and 2011 (GVIET 2014).

The Region has a history of community leadership and involvement in Catchment management, particularly in relation to irrigation when faced with threats such as salinity. The Salinity Pilot Program Advisory Council broke new ground in the 1980s in its approach to engaging the community to manage the threat associated with rising watertables. The Salinity Pilot Program Advisory Council (SPPAC) responded to the salinity and waterlogging challenges by developing the SIRLWSMP in 1989 and the implementation started a year later.

Landcare networks and groups, the Goulburn Valley Environment Group (GVEG) and Catchment Management Networks (CMNs) are active in this region, playing a key role in production-focused and environmental advocacy and onground works programs. However, volunteer burnout and associated problems with ongoing group leadership and contributions are threats to the way people manage natural resources.

2.2.6 REGIONAL ECONOMY

The SIR creates agricultural products worth an estimated \$1.38 billion (Monticello 2012). This highlights the dependency of the SIR on agriculture and food manufacturing for employment, as well as the range of services that supports this production. There are many threats to the agricultural capacity needed to support local processing in the future.

3 PROGRESS IN MANAGING NATURAL RESOURCES

This section describes progress in managing the SIR’s natural resources since 1990 in terms of the works completed and the overall condition of the SIR as a social-ecological system.

3.1 VISION

The SIR Implementation Committee’s vision (GB CMA 2011) was:

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
- with recognition locally and internationally for its high quality produce
- with an enthusiastic and progressive community that is actively engaged in care of its natural resources.

An updated vision is proposed in section 4.

3.2 UNDERSTANDING HOW PROGRESS IS MEASURED

Methods of measuring and showing progress in natural resource management have changed continually since 1990. Fortunately, in the SIR there has been a consistent focus on the long-term vision (the essence of which has remained unchanged) and three levels of recording progress during these changes:

- two levels of long-term progress (cumulative works completed (against long-term SIRLWMP targets) and the overall condition of the system)
- outputs completed annually (against targets set against the level of funds received).

The condition of different elements of the social-ecological system has been measured consistently in terms of salinisation and River Murray Salinity. From the early 1990s, water quality in terms of phosphorus levels has also been measured as part of whole-of-Goulburn Broken Catchment reporting.

This section marks the next step in the evolution of communicating progress in the SIR: it adjusts the reporting of progress on salinity and water quality by extending it to the five critical attributes of the SIR (Table 1). Works are also categorised under revised programs according to the new priorities for action in section 4.

Table 1. Evolution of annual catchment condition reporting in the SIR

Catchment condition focus		Comments
From early 2000s until 2015-16	Critical attributes from 2015-16	
SIR salinity: watertables and River Murray salinity ⁱ	Watertables	Salinity-related issues are not lost: they are reported under “watertables” from 2015-16. Evidence includes: Watertable salinity and depths Salinity of environmental features
-	Native vegetation extent	Only reported as part of whole-of-Goulburn Broken Catchment previously
-	Water availability	
-	Water quality	Goulburn River phosphorus levels have been reported as part of whole-of-Goulburn Broken Catchment Salt disposed to River Murray ⁱ
-	Farm and food-processor viability	Ad hoc reporting previously

ⁱ Salt disposed to River Murray now reported under ‘water quality’

3.2.1 REFERENCE POINTS FOR MEASURING PROGRESS

Table 3 lists long-term goals for the SIR (from Part A). Goals for watertables and water quality were set in the 1990s. Goals for native vegetation and water availability (for agriculture) have been clearly articulated for the first time (Table 2), goals for water availability (for the environment) and farm and processor viability are still to be determined.

There is inconsistency between disciplines, such as biodiversity and salinity, and between different natural resource management regions in Australia, about how long-term progress is benchmarked: the reference point for measuring progress varies. This inconsistency applies especially to measurement of catchment condition. In many regions, no reference point or target has been defined at all.

EVOLUTION FROM MANAGING SINGLE ISSUES TO MANAGING RISKS TO THE RESILIENCE OF THE SES

The pre-1980s 'threat-based approach' to management (of salinity, for example) resulted in approaches that largely ignored the total health of the SIR, as a social-ecological system.

Development of the original SIRLWSMP during the late 1980s marked a significant step towards 'integrated catchment management', with environmental and socio-economic factors considered in many targets and approaches. Targets set for salinity and water quality in the 1990s considered the resilience of the region, although the language of 'resilience' and associated 'social-ecological systems' and 'thresholds' was not used until the 2000s.

Targets for native vegetation set for the Goulburn Broken Catchment in the late 1990s largely related to comparisons with a pre-European settlement benchmark for areas of 'ecological vegetation classes'. These native vegetation targets are evolving towards a consideration of the 'function' of native vegetation, including the context of future scenarios and contributions of native vegetation to biodiversity and broader needs of SESs.

From 2016, there is a focus on five critical attributes of the SIR, which presents an opportunity to use a risk management framework, which is a management tool that fosters shared understanding of problems and solutions.

Risk management frameworks are commonly used to focus on organisational or corporate risks, such as occupational health and safety or financial impropriety. These frameworks can also be applied to ecological risks². A risk framework also inherently considers thresholds (of risk tolerance), which are key thoughts when developing a 'resilient' system. (The visions for the SIR and broader Goulburn Broken Catchment imply the desire for resilient systems.)

Table 2 summarises outcomes of SIRPPIC meetings held in 2016 to input into high-level planning and annual priority setting. The risk ratings factor in the likelihood and consequence of various risks, which were first considered by a technical forum in 2015, following the process described in Appendix 1. The risk ratings and management response are expected to be updated annually, and alignment with the Goulburn Broken CMA's formal risk management procedure is being considered.

2. <http://www.epa.gov/superfund/programs/nrd/era.htm> <accessed 20 July 2016>

Table 2. Critical attributes and associated thresholds and risks as at March 2016

Critical attribute	Threshold considerations	Risk ⁱ
Watertables	Area with depths less than 2m and less than 5m Risk could increase quickly with wet conditions	Moderate
Water quality	The threshold is the relevant objective in State Environment Protection Policy (Water of Victoria) Salt concentrations in Goulburn River, Broken Creek and downstream (Murray River). Stream salt thresholds consider spikes and duration Phosphorus and nitrogen concentration and loads (five-year rolling averages) Partnerships	Moderate
Native vegetation extent	Areas with less than 10% and less than 30% cover of the broad landscape and areas with greater than 50m between habitats (for vertebrates, for connectivity of vegetation) ^{3, 4}	High
Water availability	Reliability of water volumes for irrigation Water volumes available for the environment, including seasonality Partnerships	High
Farm and food processor viability	Natural-resource based industry economics, especially primary production and food processing	Moderate-high (to be tested)

- i. the risk is based on the identity of the SES and related to the vision for the SIR: it's about the system, not individual sub-SES landscapes or sites and is based on thresholds and current trajectories towards these thresholds. Risk also considers controls in place as at the time of updating the risk rating. Processes to manage risks at specific sites or areas, such as important wetlands like the Corop Lakes, are expected to complement SES-scale risk management over time. Goulburn Broken CMA risk categories are: Intolerable, High, Significant, Moderate and Low.

3 Andren 1994

4 Bennet and Ford 1997

Table 3. Long-term goals for critical attributes

Critical attribute	General direction	Long-term goal ⁱ		
		Quantitative target ⁱⁱ		
Watertables	The long-term goal is to manage shallow watertables so that soil zones at risk are not salinised or waterlogged.	By 2020, minimise irrigation-related salinity impacts from shallow watertables within the SIR (500,000 hectares) by improved irrigation management on farms, improved surface water management within drainage catchments, and appropriate pumping, reuse and disposal of groundwater over 216,000 hectares. Stream salinity targets (which are directly related to watertable management) are listed under 'water quality'.		
Water quality	To maintain and improve water quality for the range of beneficial uses (values) (GB CMA 2014).	Murray-Darling Basin Authority salinity target (MDB Ministerial Council 2001). Manage the salinity impacts on the River Murray at Morgan (in South Australia) from implementation of the SIRLWMP, in accordance with the Murray-Darling Basin Authority's requirements, at or below the disposal entitlement allocated to Goulburn Broken CMA.		
		State Environment Protection Policy Environmental quality objectives (Victorian Government 2003).		
		Indicator	Percentile	Objective
		Total phosphorus	75th	< 45 micrograms per litre
		Total nitrogen	75th	< 900 micrograms per litre
		Dissolved oxygen	25th to maximum	> 85 and < 110% saturation
		Turbidity	75th	< 30 Nephelometric Turbidity Unit
		Electrical conductivity (indicates for salinity)	75th	< 500 microSiemens per centimetre
		pH (indicates for acidity)	25th to 75th	> 6.4 to < 7.7
		Goulburn Broken CMA (GB CMA 2014)		
Total phosphorus loads from the Catchment	Reduce potential total phosphorus loads from the Catchment by 65% by 2016 (from the benchmark of 361 tonnes).			
Total phosphorus loads from irrigation drains	Reduce total phosphorus loads from irrigation drains by 50% by 2016 (from the benchmark of 169 tonnes).			
Native vegetation extent ⁱⁱⁱ	Increase the extent of native vegetation within focus landscapes.	By 2030, the extent of native vegetation will be increased by 2% across nine focus landscapes (a total of 300 hectares per year).		
Water availability	Ensure that water is available to match the needs of the environment, agriculture and social consumption when required.	Maintain delivery of 880,000 megalitres for agriculture within the SIR (in an average season of 100% allocation).		
		A task during implementation of the SIRLWMP is to explore setting a volume target for environmental water requirements specific to the SIR.		
Farm and processor viability	To help farm and food-processors be viable, by supporting the natural base in a way that helps them adapt quickly to changing agricultural markets and demands.	A task during implementation of the SIRLWMP is to investigate setting specific targets (considering thresholds) for regional farm and food-processor viability. These targets have a relationship to water availability for agriculture.		

ⁱ Goals and targets are subject to change as new knowledge emerges

ⁱⁱ Considers threshold levels

ⁱⁱⁱ Native vegetation quality is included as a 5-year target under the priority 'Reconnect large areas of nature'

3.3 CATCHMENT CONDITION (SUMMARISED AS RISKS TO THE SIR)

Table 4 shows the condition of the SIR in 1990 and 2016. The 1990 condition is rated according to our understanding in 2016 of what the conditions were like in 1990. This reporting format is consistent with the Goulburn Broken CMA's annual report: the format is expected to evolve over time towards a greater emphasis on high-level risks to the system and associated threshold-oriented objectives (as indicated by the quantitative targets in Table 3).

Table 4. Catchment condition ratings for the SIR, with summaries of overall risks

Critical attribute	Catchment condition				
	1990	Certainty of rating	2016	Certainty of rating	3-year trend
Watertables	Poor	High	Satisfactory	High	↑
<p>The risks of salinisation and waterlogging have increased in recent years due to the return of wetter conditions. Watertables dropped about three metres during the millennium drought but quickly bounced back, with 170,000 hectares having a watertable within three metres of the surface in 2014. Subsequently, water tables have dropped due to the return of dry conditions (Terry Hunter pers. comm. 2016).</p> <p>The trend of the shallow watertable rise is concerning given how long it took for watertables to drop during the drought. The increased risk is clearly linked to rainfall on a wet (irrigated) catchment and limited funding over the last decade, particularly towards surface and sub-surface drainage works, has not helped mitigate this risk.</p> <p>A much better understanding of watertable and salinity behaviour and risk has been gained through the sub-surface drainage program's salt water balance project: the area at risk of salinity from high watertables is much less than mid-1990s due to a combination of program implementation and drought. Annual August watertable maps demonstrate resource condition to a high level (James Burkitt pers. comm. 2015).</p>					
Water quality	Very poor	Low	Satisfactory	High	↑
<p>There is continued uncertainty about the SIR's impact on River Murray salinity particularly with the significant changes in the SIR. MDBA modelling suggests the impact of reduced tail-water fraction (causing less dilution flows from drainage) is large, but the actual salt entering river is significantly reduced (James Burkitt pers. comm. 2015). Goulburn Broken CMA and Victoria's progress against salinity impact targets is monitored and reported annually to the MDBA, confirming the region's ongoing satisfactory contribution to the BSM 2030. (GB CMA 2015c).</p> <p>While groundwater salinity was one of the initial (1989) plan's key risks to farm production, assets and environmental features, salinity levels are generally below threshold levels of concern now. Salinity contributions from the region comply with targets managed under the BSM 2030.</p> <p>Targeted programs have significantly reduced nutrient loads in waterways and therefore improved water quality. The five-year rolling average phosphorus load from the Goulburn Broken Catchment is below the long-term target set in 1996, equating to a reduction of 80 per cent from the benchmark year of 1993-94 (GB CMA 2015a). Monitoring and responses are supported by well-established inter-agency agreements and shared strategies.</p>					
Native vegetation extent	Poor	Medium	Poor	Medium-High	●
<p>The regional landscape has been transformed since the 1880s, with more than 97 per cent of native vegetation on private land cleared for settlement and agriculture.</p> <p>Most remaining native vegetation is in public land reserves (such as the river red gum-dominated 28,500 hectare Barmah National Park) and corridors along waterways and roadsides. Areas of native vegetation away from these reserves and corridors are mainly isolated fragments and generally lack the shrubs, ground layers, fallen logs and other habitat elements needed to host a diversity of flora and fauna. Many local species have become extinct and others are under threat.</p>					

Critical attribute	Catchment condition				
	1990	Certainty of rating	2016	Certainty of rating	3-year trend
Water availability	Poor	Low	Good/Poor	Medium	●
<p>The Goulburn Broken CMA recognises the Murray, Goulburn and Campaspe Rivers as ‘working rivers’ in the Regional Waterway Strategy, aiming to sustain environmental values while meeting economic, social and recreational needs (GB CMA 2014). The ratings of good/poor in 2016 are from the perspectives of environment/consumption.</p> <p>River flows have markedly changed since previous generations dammed the catchment rivers to increase water reliability for downstream communities and agriculture. A sophisticated approach to sharing water between consumptive, environmental and recreational users has been developed through collaborations over many years. Rules secure the supply of good quality water for irrigated food production and food-processing industries, placing the region at a significant advantage.</p> <p>Increased environmental needs, population growth, and changing markets and agricultural demands drive the need to better understand how to optimise use of available water, especially when conditions are dry, as they largely have been since 2000. Trading rule changes in recent years is resulting in less controlled irrigation-water transfers between regions.</p> <p>Environmental water continues to be delivered to key wetlands and river reaches, as per environmental water management plans and Victorian Environmental Water Holder and Commonwealth Environmental Water Holder seasonal watering plans (Mark Turner pers. comm. 2015).</p> <p>Irrigation deliveries in the SIR reduced from about 1200+ GL in the 1990s to about 800 GL now, with an associated reduction in the irrigation footprint. Irrigation deliveries could be further reduced due to drought, water trade, and industry changes.</p>					
Farm and food-processor viability	To be determined				
<p>The region as a system is dominated by irrigated agriculture, with food production and processing being large contributors to the economy. Farmers face challenges to remain profitable in the face of a variable climate, variable domestic and world markets and increasingly expensive inputs, such as land, water, nutrients, oil, technology and skills. Industry diversity has helped develop the region’s resilience to variable domestic and world markets, but this varies depending on enterprise type, with lower value enterprises under significant pressure. Larger-scale farm enterprises have emerged in an attempt to increase production and profitability. The shift in farm type, size and mix has been accompanied by a change in the region’s food processing industries. Several long-established companies have either closed or been amalgamated over the last two decades, although smaller niche industries have emerged.</p>					

3.4 LONG-TERM PLAN IMPLEMENTATION PROGRESS (SINCE 1990)

3.4.1 WORKS ACHIEVED

Most of the planned actions identified in the 1990 SIRLWMP have been achieved (Figure 2). Progress towards long-term strategy implementation is satisfactory for some works, but falling behind in others. Regional infrastructure works (public drains and public groundwater pumps) continue to fall behind schedule due to revised State priorities and a significant decline in government investment over recent years.

Progress in improving land management practices on irrigation properties, which help reduce groundwater accessions and waterlogging on farms, is generally on track or ahead due to increased investment in farm water efficiency works by the Australian and Victorian governments and irrigators over the past five years.

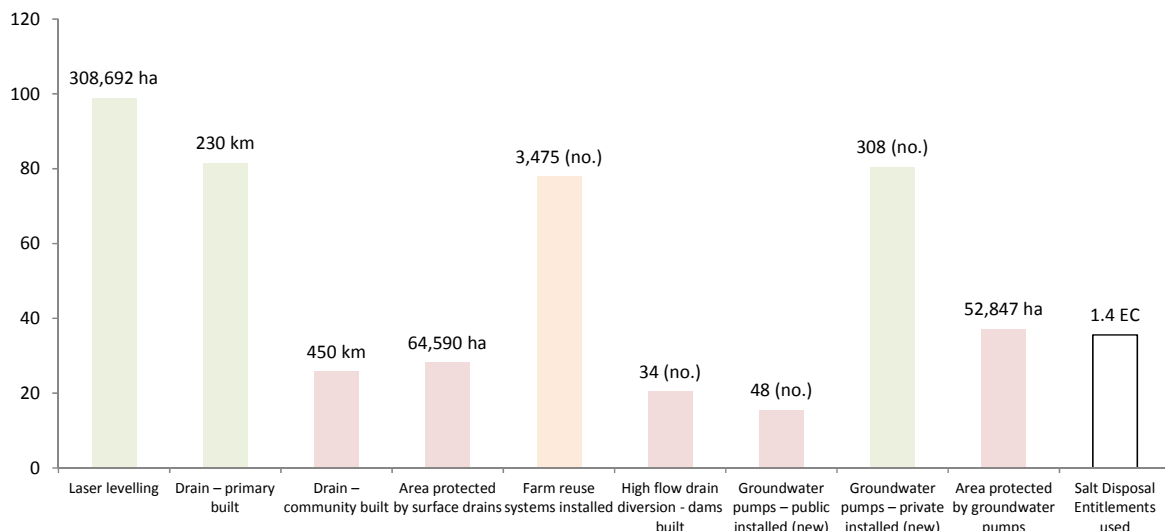
The SIR irrigation modernisation project, which began implementation in 2008 through the GMW Connections Project and the on-farm programs from 2009, are actually increasing the salinity impact of the SIR, however they are providing additional water to the environment which has a net benefit.

More than 1000 snags have been reintroduced into the Goulburn River in recent years to improve instream habitat (Mark Turner pers. comm. 2015).

Pest plant and animal management needs constant surveillance and investment. For example, garden escapees in urban areas and Arrowhead in streams continue to challenge waterway and riparian health. Land managers are required to undertake control activities under legislation (Mark Turner pers. comm. 2015).

i The method to set the cumulative target was modified from 2012-13 to be: 1990-2020 plan target multiplied by the number of years

Shepparton Irrigation Region Catchment Implementation Strategy's 1990-2015 target achieved, %ⁱ
(achievements listed on top of each bar)



since 1990 divided by 30. (Reference: GB CMA 2015c)

Figure 2. SIRLWMP achievements 1990 to 2015

The trend in whole farm planning achievements since 2008-09 reflects changing investment priorities (decreased funding for farm planning; Table 5).

Table 5. Whole farm planning achievements (Goulburn Broken CMA Annual Reports 2008-2015)

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-15	2014-15
Properties	247	212	256	223	170	79	71
Area	20,476	16,018	21,388	23,492	17,499	8,629	6,715

The trend in investment to implement the overall SIRLWMP is down (Table 6), accompanied by extended dry conditions and an associated decrease in available water. However, more water has been made available for the environment and the last five years has seen significant investment in on-farm infrastructure upgrades through the Farm Water Program.

Table 6. Government investment, \$000

2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16 ⁱ	Trend
8,607	29,630	45,786	45,499	35,367	14,713	21,157	↓

ⁱ Forecast based on funding advice at July 2015. (Reference: GB CMA 2015c)

3.4.2 IMPROVING MANAGEMENT CAPACITY (NON-WORKS ACHIEVEMENTS)

The SIRLWMP is a partnership between the community, groups and all levels of government. It has a range of formal and informal processes in place to ensure that the SIR community remains actively involved in its implementation. Whilst funding for on-ground works has declined over the last five years, there have been a range of achievements through the SIRLWMP partnership since the last plan review.

- Revised Irrigation Drainage Memorandum of Understanding (IDMOU).
- Allocation of grants to schools, Landcare and community groups to undertake community awareness and education across the SIR.
- Greater understanding of the hydrological balance and interaction between soil and salt in times of fluctuating shallow watertables (Salt and Water Balance project).
- Continued annual mapping of watertables and annual production of watertable risk map.
- Presentations by community and agency staff showcasing the SIR internationally in Iran and California, USA.

- 2015 celebration of 75th Farm and Environment Working Group, representing 20 years of continuous input into SIRLWMP.
- Taskforce established by community based Sustainable Irrigation Program Advisory Group to manage the renewal of integrated action planning for natural resource management in the Shepparton Irrigation Region.
- Local Government Agricultural Floodplains Reference Group entered its 25th year of operation in 2014-15.
- Launch of “The Story of John Dainton’s Role in Mending the Goulburn Broken” by John Northage in 2015.
- Fruit Industry Employment Program (FIEP) with 40 people affected by reduced fruit intake in the region working under the program in crews supervised by the Goulburn Broken CMA and its partners, Moira Shire, Greater Shepparton City Council, Parks Victoria, and Goulburn-Murray Water.
- Significant areas of riparian land have elevated protection because of changed legislative status. This includes the Broken Boosey State Park and associated natural feature reserves, the Lower Goulburn National Park, the Shepparton Regional Park, and Barmah National Park.
- Incentive programs for landholders are in place to provide ten-year management agreements for improving the condition of wetlands and terrestrial native vegetation. A market-based tender project was implemented in 2014 and a focus landscape project is being implemented to target strategic areas for biodiversity investment. However, key stakeholders believe that the introduction of the State Native Vegetation Permitted Clearing Regulations (2013) have led to widespread incremental loss of vegetation, countering efforts to improve biodiversity through other mechanisms (Rebecca Caldwell pers. comm. 2015).

GOULBURN BROKEN CMA’S THREE LEVELS OF MEASURING PROGRESS

Assessing progress in managing natural resources includes consideration of environmental (or biophysical) and associated social and economic elements, including the relationship between them.

There are many ways to categorise natural resources to facilitate and focus their management. Section 2.2 described natural resource features largely as broad categories of “assets” (Biodiversity, Land, Irrigated Agriculture, Water, People and Regional Economy).

Different funders have evolved different categorisations.

The Goulburn Broken CMA focuses on 13 highly connected “investment areas” that relate closely to the different investment areas within government. These investment areas are environmental and management capacity elements. Together, these elements form a complex, integrated, evolving social-ecological system in which humans are part of nature. Ratings of catchment condition for an investment area are therefore ratings of the social-ecological system’s condition related to that investment area (McLennan in GB CMA 2015).

The Goulburn Broken CMA also arranges data to inform three levels of progress:

1. Annual performance
2. Long-term strategy implementation progress
3. Catchment condition change.

Catchment condition for the SIR is reported in the Goulburn Broken CMA Annual Report as well as annual performance and long-term strategy implementation progress, largely in terms of the investment associated with salinisation and River Murray salinity. The reports have also been focused on management according to thresholds, consistent with the resilience approach.

Progress in other investment areas has been reported at broader Goulburn Broken Catchment-scale since the early 2000s.

The estimated condition of the SIR’s critical attributes in 2015 compared with 1990 condition is shown in Table 4. This rating system is likely to evolve towards an assessment the risk of breaching thresholds of the social-ecological system.

3.5 COSTS AND INDICATIVE BENEFITS OF THE SIRLWMP 2006-2015

This section is a high-level analysis of the impacts of the SIRLWMP since the last review.

The programs within the SIRLWMP (the Plan) were reviewed in 2005 and 2006. These program reviews identified the following economic benefits: water saving, labour saving, and productivity increase due to reduced waterlogging, salinity and flooding. The economic costs were capital and operating and maintenance costs. Some environmental benefits and costs were also identified and quantified, such as nutrient run-off downstream (decreased is a benefit and increased is a cost) and protection of remnant vegetation and wetlands.

The dry climatic conditions between 2003 and 2010 resulted in little works being undertaken, both by the government and landholders. The risk or threat of waterlogging, salinisation and flooding also eased during this period, known as the millennium drought.

The aim of this study was to review the economic benefit of the programs delivered under the Plan, 2006-2015. This broad-based review used discounted flow analysis at four per cent real discount rate for government projects over 30 years. The sensitivity of the results was tested using eight per cent real discount rate as a proxy landholder rate of return. The costs and benefits were adjusted using Consumer Price Index. The economic indicator was Net Present Value, which estimates the value or magnitude of an investment and how the costs and economic benefits balance out over the analysis period of 30 years.

The programs reviewed were:

- Farm Program
- Sub-surface Drainage Program (Groundwater and Salt Management Program)
- Surface Drainage Program
- Environment Program, and
- Farm Water Program (on-farm irrigation efficiency program).

Table 7. Present value of program benefits and costs, 2006-2015

	Present value Indicative benefits (\$M)		Present value Government costs (\$M)		Present value Landholder costs (\$M)		Net Present Value	
	4%	8%	4%	8%	4%	8%	4%	8%
	Groundwater & Salt Management	\$18.26	\$9.36	\$9.87	\$8.89	\$5.24	\$3.45	\$3.15
Farm Program	\$452.03	\$296.16	\$13.80	\$12.27	\$246.79	\$208.89	\$191.45	\$74.99
Environmental Program	\$8.14	\$5.85	\$4.35	\$3.91	no data	no data	\$3.79	\$1.94
Surface Drainage	\$3.06	\$1.87	\$15.76	\$14.44	\$17.57	\$15.07	-\$30.27	-\$27.65
Farm Water Program	\$52.96	\$39.93	\$61.35	\$46.38	\$30.92	\$19.00	-\$39.31	-\$25.45
Other programs								
Monitoring			\$3.67	\$3.31				
Program Support			\$13.18	\$12.05				
Tackling pests			\$0.49	\$0.46				
Research			\$1.59	\$1.43				
River Health Waterways			\$12.42	\$11.37				
Biodiversity			\$0.75	\$0.67				
Large Scale River Restoration			\$1.16	\$0.97				
Drought response			\$0.32	\$0.30				
Sustainable Irrigation Program (2010-2015)			no data	no data				

Notes: Costs not included:

- Sustainable irrigation program from 2010 to 2015, excluding Farm Water Program
- Landholder costs in Environment Program and other programs, if applicable.

3.5.1 MAJOR ASSUMPTIONS

GROUNDWATER AND SALT MANAGEMENT PROGRAM

Two pumps were commissioned between 2006 and 2015. The program activities during the period were mainly on monitoring as part of the SIRLWM Plan's commitments and obligations to the Murray-Darling Basin Plan.

One of the benefits of this Program is developing policies to manage public and private pumping. The Program develops maps and generates data to better manage the groundwater resources. Under pumping could lead to reduced ability to manage salinity whilst over pumping could have a long-term impact on the groundwater resource.

The value of benefits for the Program was assumed to be 25 per cent of the calculated benefits done in the 2005-06 review.

The government costs were taken from the Plan's annual reports, which included the capital costs of public pumps, financial incentives for private pumps, monitoring of groundwater table, extension and program support. The landholder costs were the operating and maintenance costs of private pumps and public pump access fees.

FARM PROGRAM

The activities under the Farm Program were providing incentives to landholders to develop whole farm plans, construct re-use systems and install automatic irrigation systems. The Program encourages landholders to improve their farm layout, mainly to save water and, to a certain extent, increase production, and save time and labour.

The analysis assumed that landforming can save 0.5ML/ha, subject to the irrigation water allocation. For example, in 2007-08, the allocation was 57 per cent, therefore, the water saving was 0.29ML/ha.

The benefits of improved irrigation systems were production benefits and labour savings. The water saving was assumed to be 1ML/ha subject to irrigation water allocation. The production benefits were valued at \$600/ha at 2015 value, per case study results of the Farm Water Program.

The government costs were taken from the Plan's annual reports which included financial incentives to whole farm planning and irrigation upgrade, extension and program support.

The landholders' costs at 2006 value were capital cost of laser grading (\$700/ha) and upgrade of irrigation system (\$3,250/ha). The operating and maintenance cost was \$60/ha at 2015 value.

ENVIRONMENT PROGRAM

The government costs of implementing the Environment Program was taken from annual reports. They included financial incentives to landholders to undertake activities on-farm to protect environmental assets such as wetland and remnant vegetation.

There was no data available on the landholders' contribution to the Environment Program.

SURFACE DRAINAGE PROGRAM

The indicative value of the benefits of the Surface Drainage Program was based on the review of the Program done in 2015. Due to lack of details on the drains constructed between 2006 and 2013, the weighted averages for the SIR of the production, road and environmental benefits were used. The use of the weighted average could have under or overestimated the value of the benefits.

The values used (2015 \$) were: production benefits at \$4.23/ha drained, roads at \$20.10/ha drained, and environmental benefits at \$11.13/ha drained.

The government costs were taken from the Plan's annual reports, which included the capital costs of drains, extension and program support.

FARM WATER PROGRAM

There were 362 successful applications from SIR for the Farm Water Program incentives Rounds 1, 2 and 3. The nominal value of the total payment to landholders for the three rounds was \$86 million. The nominal value of the landholder contributions was \$15 million.

The Goulburn Broken CMA also incurred administration costs and DEDJTR also had expenditure on staff to ensure applications met the requirements of the on-farm irrigation efficiency programs.

The benefits of the Program at 2015 value were: production (\$600/ha), water savings, and labour savings. The value of water was calculated as the weighted average of the permanent water trading in the SIR, excluding

trades with price of less than \$100/ML to remove outliers.

The government's costs included the capital cost of irrigation infrastructure, Goulburn Broken CMA administration cost, and DEDJTR staff cost.

The landholder costs included additional capital cost, calculated at about 15 per cent of the total capital costs and \$60/ha operating and maintenance cost at 2015 value.

3.5.2 ECONOMIC COSTS AND INDICATIVE BENEFITS

A summary of the costs of implementing the SIRLWSMP and the indicative benefits of five programs is shown in Table 7.

COSTS

The cost of implementing the Plan was shared by the government (32%) and landholders (68%).

The government provided financial incentives to farmers to:

- develop whole farm plans
- improve on-farm irrigation systems (drainage re-use, automatic irrigation system)
- construct community surface drains
- undertake environmental works
- investigate suitability of private groundwater pumps.

The government also paid for the capital costs of public groundwater pumps and primary surface drains.

The government paid for research and development, monitoring, extension and other program support.

The landholders paid for the operating and maintenance of the infrastructure on-farm. They also paid drainage access fees to public pumps and primary surface drains, which were included in their water bill, to Goulburn-Murray Water.

BENEFITS

The indicative values of the benefits of the five programs were \$505.81 million at four per cent and \$328.25 million at eight per cent. The Farm Program generated the highest benefit, contributing 83 per cent to the total value of benefits, followed by the Farm Water Program (11%).

3.5.3 ENVIRONMENTAL BENEFITS

The indicative present values of environmental benefits of the Surface Drainage Program were \$985,700 at four per cent and \$607,600 at eight per cent. These values have been included in Present Value Indicative Benefits in Table 7.

The indicative values of the wetland benefits of the Environment Program were \$2.09 million at four per cent and \$1.82 million at eight per cent. The indicative values of the benefits of protecting remnant vegetation were \$6.05 million at four per cent and \$4.03 million at eight per cent.

3.5.4 SOCIAL BENEFITS

There is no available data on the value of social benefits. However, based on the success of the Farm Water Program, the landholders in the SIR still put a positive value to the Plan. There were about 800 Farm Water Program applications in Rounds 1, 2 and 3.

3.5.5 SUMMARY AND CONCLUSION

The implementation of the SIRLWMP was hampered by the drought from 2006 to 2010.

At four per cent real discount rate, three programs have positive Net Present Values, which means the investments to these programs were financially attractive. The Surface Drainage Program and Farm Water Program have negative Net Present Values, which means the value of the benefits were not enough to cover the costs.

Using a higher discount rate showed only the Farm Program was financially attractive and to a certain extent the Environment Program also.

4 IMPLEMENTATION

This chapter lists priorities, 5-year targets and actions to be delivered through five revised implementation programs.

The SIRLWMP's overarching vision (listed in section 3) has been updated, and is complemented by a purpose (Figure 3).

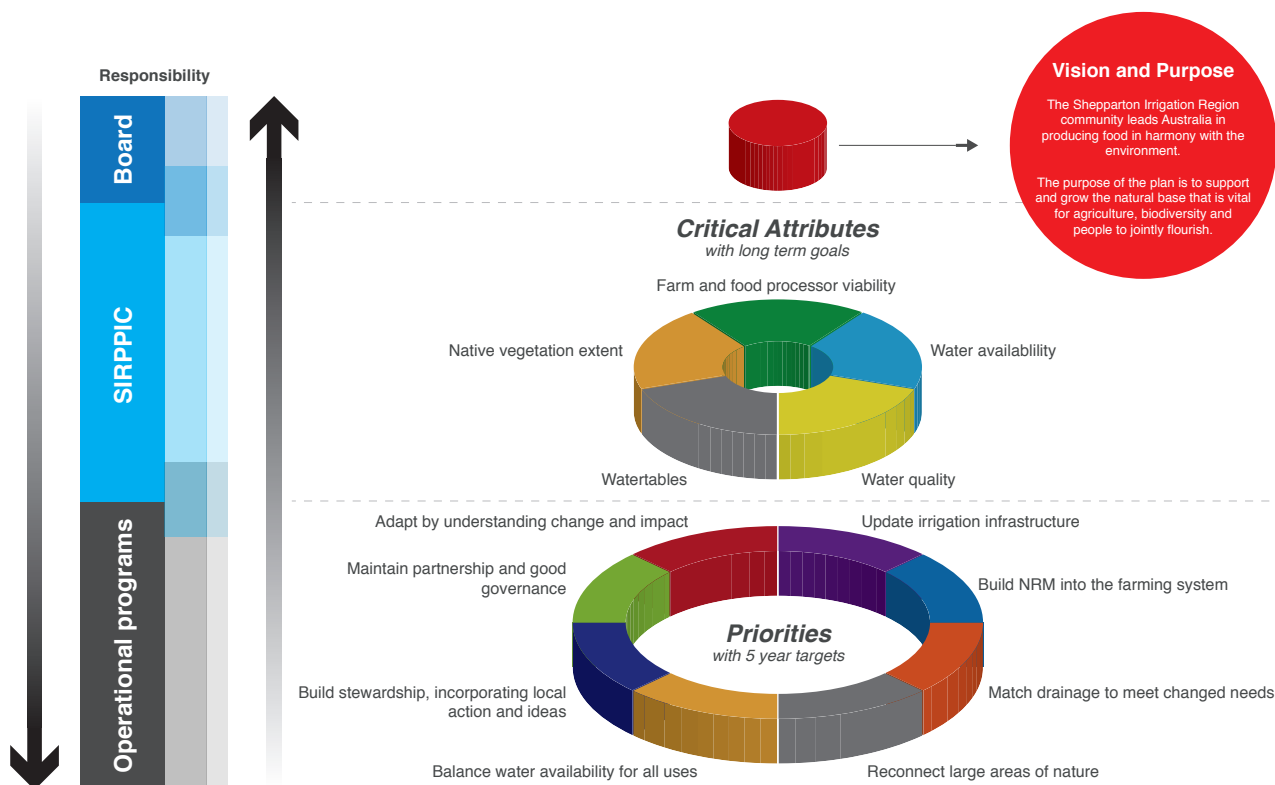


Figure 3. Planning hierarchy showing how vision is achieved by implementing priorities

Figure 3 also shows that eight priorities will guide action over the next five years, and they are organised (planned, implemented and monitored) into five implementation programs as shown in Table 8.

Table 8. Implementation program priorities

Implementation program	Priority
Farm	1. Update irrigation infrastructure, including the irrigation delivery system and farm design
	2. Build natural resource management into the farming system
Drainage	3. Match drainage to meet changed needs, aligning it with modernised irrigation delivery
Environment	4. Reconnect large areas of enhanced nature
	5. Balance water availability for all uses
People	6. Build stewardship, incorporating local action and ideas
Governance and Partnerships	7. Maintain partnerships and good governance
	8. Adapt by understanding change and impact

These programs provide a focus for managing the many details of implementation in an integrated operating environment.

The focus of the Farm, Drainage and Environment programs is to make onground change happen, while the People and Governance and partnership programs focus on broader supporting arrangements, which create the strategic and operating environments that help the right onground change to happen.

Some programs, priorities and actions are well-developed management responses that have been evolving since

implementation began in 1990, such as drainage to manage the shallow watertable threat. New ideas identified during this review, such as waste management, will need to be developed further into project to be considered for funding.

Funding to achieve some 5-year targets will not come directly through the Goulburn Broken CMA and be overseen by the SIRPPIC. However, SIRPPIC intends to help partners influence funding and implementation so that the targets can be achieved.

The categories of implementation programs have been adapted to match current funding trends and associated agency capacity (Table 9).

Table 9. Relationship of SIRLWMP’s former and new implementation programs

Early 1990s*	c. mid-1990s until 2016	From 2016
Farm	Farm and Environment	Farm
Environmental Protection		Environment
Surface Drainage	Surface Water	Drainage
Sub-surface Drainage	Sub-surface Water	
Program Support (including Community Support, Community Education, Planning, Program Management)	SIRLWMP Executive Officer and advisory committees	People
Monitoring		Governance and Partnerships

* from SPAC 1995

Appendix 2 summarises these priority actions and Chapter 5 lists where the strategic rationale behind the priorities is documented, including links to the Goulburn Broken RCS.

The priority actions and programs are described in detail below.

Table 10 (below) summarises the relationship between priorities and critical attributes. Knowing how all priorities impact on all critical attributes is important when making decisions.

Table 10. Relationship between priorities and critical attributes demonstrating benefits of integrated intervention

Priority	Watertables	Water quality	Native vegetation extent	Water availability	Farm and food-processor viability
1. Update irrigation infrastructure	High	High	Medium*	Very high	Very high
2. Build NRM into the farming system	Medium	Medium	Very high	Medium	High
3. Match drainage to meet changed needs	Very high	Medium	Medium	Low	High
4. Reconnect large areas of enhanced nature	Low	High	Very high	Low	Medium
5. Balance water availability for all uses	Low	Very high	High	Very high	Very high
6. Build stewardship, incorporating local action and ideas	Actions guided by these priorities emphasise the processes that enable overall resilience of the SIR to be factored into decisions about a specific critical attribute. Implementation of these actions creates a joint approach between community, business, and local, state and national government agency partners at different levels, which is essential in addressing problems and updating understanding.				
7. Maintain partnerships and good governance					
8. Adapt by understanding change and impact					

* opportunities from planning as part of updating irrigation infrastructure

4.1 FARM PROGRAM

The Farm Program goal is:

“to improve land management practices on private land within the Shepparton Irrigation Region to protect and enhance the environment, to improve economic viability, and to help rural communities make informed decisions.”

The Farm Program was originally oriented to tackle salinity issues on farms by preventing or reducing groundwater recharge. This program now prioritises farm planning and action to minimise off-farm impacts associated with irrigation and to implement sustainable farm technologies and practices to improve soil, save water, protect and enhance native vegetation, and increase production.

Actions include providing incentives for: developing a whole farm plan (WFP), undertaking laser grading, installing irrigation infrastructure (e.g. reuse and automatic irrigation systems), and implementing practices to improve decision-making and production. Water quality decline has been targeted by preventing nutrient rich water from leaving farms through irrigation management and layout improvements.

4.1.1 PRIORITY 1: UPGRADE IRRIGATION INFRASTRUCTURE

A need for water to meet increasing demands and an opportunity to save losses attributed to ageing irrigation infrastructure has seen investment by the Australian and Victorian Governments in irrigation system modernisation on an unprecedented scale. The Connections Project was initiated to reduce water losses through modernisation of the public irrigation delivery system and reallocate those savings to the environment and other water users. This project is being led by GMW.

Complementing the Connections Project, the Goulburn Broken CMA leads a consortium project called the Farm Water Program, which generates water savings on farms: the government contributes funds towards improvement of farm irrigation infrastructure in return for permanent water shares, calculated as savings generated by the works.

A fully-modernised irrigation delivery system complemented by modernised farm irrigation infrastructure is placing the region at the forefront in terms of efficient water use and productivity. Investment in infrastructure upgrades will be guided by principles that recognise climate change, regional priorities and the health of the environment.

FIVE-YEAR TARGETS AND ACTIONS

Over the next five years, this priority will be delivered by achieving targets through the following actions:

5-year target	Action
90% of the irrigation delivery system is modernised, with all irrigated land connected	Develop modernised whole farm plans to link farms with the delivery system
	Help accelerate delivery of the irrigation modernisation project by contributing to a technical advisory group
60% of irrigated farms have been redesigned to capitalise on, and align with, modernised irrigation delivery	Roll out the Farm Water Program
	Implement the government’s water use licence and irrigation development regulatory regime

4.1.2 PRIORITY 2: BUILD NATURAL RESOURCE MANAGEMENT INTO THE FARMING SYSTEM

WHOLE FARM PLANNING

Implementation of on-farm activities is guided by irrigation whole farm plans. Whole farm planning (WFP) includes the design and creation of a farm plan, associated extension and information services and any elements that ensure implementation proceeds in accordance to the designed whole farm plan.

WFP provides the bridge between changed farm practices and broader catchment and irrigation delivery system outcomes. It provides a strategic element to farm improvements. The approach to WFP has been driven by strong community leadership and has been an essential part of meeting a range of natural resource management obligations without the need for strong regulation. It supports farmers in planning to increase production with less water.

The improved knowledge provided by WFP increases the adoption of desirable actions in a more timely and coordinated manner, such as improved farm layout, irrigation practices, re-use systems, and irrigation systems. The 2015 WFP Strategy review (GB CMA 2015) identified several priorities for future delivery of whole farm planning across the SIR.

SOIL MANAGEMENT

The Goulburn Broken Land Health Statement (GB CMA 2014c) guides soil management across the catchment. In the SIR, soil issues commonly relate to irrigation, salinity and sodicity, productivity, fertiliser use, acidity, soil structure, compaction, and organic matter.

Irrigators are becoming increasingly interested in the benefits of a more holistic soil-management approach, including actions such as the use of organic soil amendments and the use of waste products from farm production.

FIVE-YEAR TARGETS AND ACTIONS

Over the next five years, this priority will be delivered by achieving targets through the following actions:

5-year target	Action
10% of farmers are assisted each year to make changes that improve farm viability and provide long-term public benefits	Help farmers develop holistic whole farm plans, using planning modules that help different goals to be integrated, such as those for the environment
	Encourage sustainable land management practices related to management of soils, saline groundwater, fertilisers, and renewable resources (such as waste products) through extension and other tools
All farmers and designers have ready access to information that allows them to factor environmental sensitivities into planning	Increase farm planning alignment between industry needs and government guidelines and regulations

4.2 DRAINAGE PROGRAM

The Drainage Program goal is:

“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 Shepparton Irrigation Region.”

The realisation that irrigation without drainage is unsustainable was one of the main reasons why the original SIRLWMP was prepared in the late 1980s. This understanding remains pertinent, with an added emphasis on tailoring drainage works to specific and changed risks in different areas.

The sub-surface drainage component of this program has provided strategic use of pumped groundwater to prevent rising groundwater levels.

The surface drainage component of the program has prevented groundwater recharge by providing a drainage network to remove irrigation-induced rainfall runoff.

These components have been managed and reported as separate programs previously, but are merged into one program in this update of the SIRLWMP.

4.2.1 PRIORITY 3: MATCH DRAINAGE TO MEET CHANGING NEEDS

SURFACE AND SUB-SURFACE DRAINAGE

The 2015 Drainage Program review (GB CMA 2015) highlighted substantial changes since the original SIRLWSMP was developed in the late 1980s, including:

- The overall water applied and the irrigation footprint have both approximately halved, so:
 - the need for drainage in all parts of the SIR has reduced
 - the irrigated areas at risk have reduced
 - the ability to relocate water within farms away from high risk areas has increased
 - the ability to relocate farms to areas with drainage, but not irrigated, is now possible, although relocation is not easy (as experienced with the GMW Connections Project)
- Changes in the pattern of runoff into irrigation drains is very different as climate changes. Flows into irrigation drains are lower for smaller rainfall events, and there is more unirrigated land, which generate lower runoff rates.

The risks posed in a dry sequence and with half the irrigation footprint are much diminished.

The growth of water trade and the much higher value of water means there are commercial drivers for irrigators to minimise losses of tail water and to reuse this water on-farm where possible and many farmers have set up their systems accordingly.

The emphasis of the Drainage Program is now about draining surface water, particularly after large rainfall events, through implementation of a hybrid drainage system (of constructed and natural drainage courses) in areas that still require drainage.

Sub-surface drainage needs to be adaptively managed to ensure it operates when and where required, being responsive to changing watertable conditions.

Farmers who can dispose of drainage water into channels have options, but there are still production losses in undrained areas and damage to public assets, such as roads.

SALT DISPOSAL

Salt disposal impacts from implementation of works, such as surface drains, are expressed as the average increase in salinity in the River Murray at Morgan (in electrical conductivity (EC) units). The 1988 MDBC Salinity and Drainage Strategy (MDBC 1988) directs how to manage catchment activities that result in an increased amount of salt discharging from catchments to the River Murray. Any works that increase the salt loads leaving the Catchment are classed as an accountable action. Any such accountable action by a catchment, such as the SIR, requires a Salt Disposal Entitlement (SDE) to be allocated by the Victorian Government and catchment management authorities must manage salinity discharges within this entitlement.

FLOODPLAIN MANAGEMENT

The approach taken in the Goulburn Broken Floodplain Management Strategy (GB CMA 2014a) is to favour activities that improve the resilience of communities to flooding. This approach is consistent with the RCS. The RCS includes floodplain management as a strategic priority: “plan for and manage floods” directing identified activities (“management measures”) to be achieved.

It closely links to actions in the Drainage Program.

FIVE-YEAR TARGETS AND ACTIONS

Over the next five years, this priority will be delivered by achieving targets through the following actions:

5-year target	Action
Irrigated land is protected from salinity and waterlogging threats by a coordinated private and public drainage network	Provide best farm practice information and extension about on-farm efficiency and on-farm collection and reuse of surface drainage water in undrained areas
	Provide drainage services in undrained sub-catchments, which involves community acceptance of natural drainage course declarations, where benefits exceed costs, including: maintenance, drains designed to a standard that address impacts of flood events, and installing larger reuse systems (that are consistent with farm dams legislation)
	Develop a long-term strategy for managing risks associated with channel disposal of drainage water
Groundwater pumps are ready to be used when required to mitigate risk from high watertables	Promote, through extension, understanding of the benefits of private pumping
	Maintain adaptive management of public pumps, including groundwater salt disposal
	Install new public pumps where private pumping is not appropriate, there is a demonstrated need, and the benefits exceed costs

4.3 ENVIRONMENT PROGRAM

Vegetation enhancement and protection works, including fencing, planting and weed and pest management, have previously been delivered within a discrete Environment Program.

Waterways works, including fencing and planting riparian and wetland vegetation, weed and pest management, instream improvements, erosion control, environmental water delivery, and monitoring, have previously been delivered within a discrete Waterways Program.

These two former programs are combined under the Environment Program in this update of the SIRLWMP.

4.3.1 PRIORITY 4: BALANCE WATER AVAILABILITY FOR ALL USERS

The region's rivers have long been recognised as 'working rivers', with management aimed at meeting social, economic and environmental objectives. The allocation and delivery of water for the environment reflect the government priority of helping the river environment sustain achievement of these multiple objectives.

Since 2010, water delivery for the environment has been helping the natural riverine features function, as well as recover from drought so that ecosystem services, such as natural filtering of water and provision of instream habitat for recreational fish, can continue to be delivered.

Environmental water purchase over the next five years will focus on meeting objectives that further improve floodplain and instream condition and water quality through delivery of environmental flows on priority waterways and wetlands within the SIR, complemented by onground works.

The continued emphasis on the environment and its water needs must be balanced with the needs of other water users, including irrigation, to maintain regional prosperity and well-being of farms, the processing sector and the community as a whole, particularly in dry times.

The region needs to continue collaborating with stakeholders across many jurisdictions to ensure that lessons learnt, especially those within Victoria's northern regions, are built into evolving Murray-Darling Basin-wide approaches to water-sharing and management.

Much of the region's remaining native vegetation is found along waterways and in and around wetlands, providing continuous habitat that act as key thoroughfares for isolated habitat to potentially connect with, especially habitat in focus landscapes. Important objectives of environmental flows include provision of water to protect and enhance this native vegetation.

FIVE-YEAR TARGETS AND ACTIONS

Over the next five years, this priority will be delivered by achieving targets through the following actions:

5-year target	Action
Five seasonal watering proposals are delivered for priority waterways and wetlands to meet environmental outcomes, with consideration of agricultural and social needs	Increase understanding of regional irrigation water sustainable supply limits and identify options to meet these needs
	Develop and implement annual environmental flow plans to meet objectives for priority waterways, especially erosion control, habitat establishment, and water quality management
Water quality is improved or maintained to meet set targets in waterways	Monitor and manage water quality risks associated with flows from drainage catchments (according to the Irrigation Drainage MOU)

4.3.2 PRIORITY 5: RECONNECT LARGE AREAS OF ENHANCED NATURE

TERRESTRIAL VEGETATION

The goal for the terrestrial environment across the SIR is:

“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.”

The Biodiversity Strategy for the Goulburn Broken Catchment 2010-15 outlines spatial priorities for revegetation and remnant enhancement within regions or ‘zones’. A paper on prioritising biodiversity zones in the Goulburn Broken Catchment was prepared in 2009 during development of the Biodiversity Strategy for the Goulburn Broken Catchment (Miles and Stothers 2010). The Goulburn Broken CMA also identified site-scale priorities through the Biodiversity Action Plan process.

This priority under the Environment Program targets biodiversity through incentives for remnant protection and biodiversity plantings, and contributing to planning schemes that control native vegetation removal, with direct offsetting where vegetation is removed.

High priority ‘focus’ landscapes within the SIR have been identified (Wilson et al. 2014), in which landholders will be targeted for incentives to manage remnants for conservation (Figure 4).

The focus landscapes will be managed as systems, with connectivity being increased. Wetlands, waterways and drainage lines are important features for long-term viability of wildlife associated with the landscapes. Identification of focus landscapes requires local knowledge and the application of a range of criteria (Wilson et al. 2014) within the context of National, State, Catchment and Regional priorities.

Connection, conservation and enhancement of remaining remnants in focus landscapes is particularly important and there will be an emphasis on working with local communities and landowners to change the management of these remnants before they degrade further.

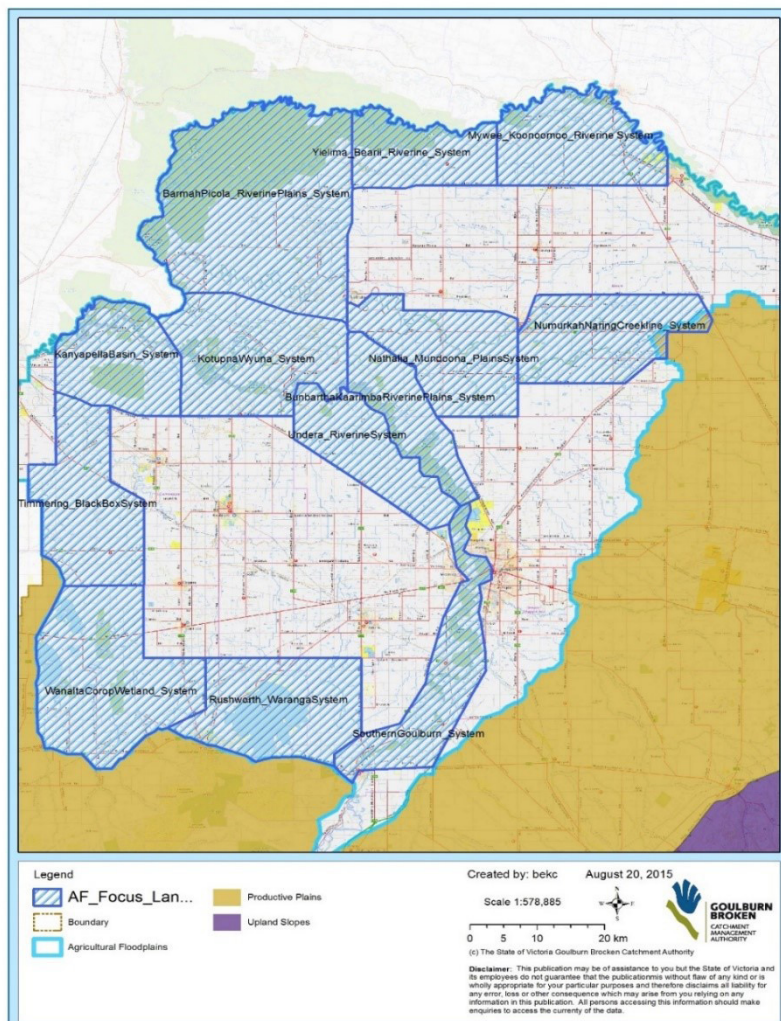


Figure 4. Thirteen focus landscapes in the SIR

WATERWAY MANAGEMENT AND WETLAND ENHANCEMENT

The goal for waterways across the SIR is:

“to protect and enhance the natural riverine features of the region, improve water quality, and the social, economic and cultural values they provide”.

The Goulburn Broken Waterway Strategy 2014-2022 (GB CMA 2014b) presents an integrated catchment planning framework for waterways and wetlands and is the primary guide for priority setting, maintenance and improvement of waterways and wetlands.

This Strategy has been prepared against a backdrop of a shifting focus of partner organisations; changed investment models; new plans and policies; and changing capacity of community groups to support implementation. It identifies priority waterways and wetlands for investment across the SIR into the next decade and identifies strategic challenges and opportunities (Figure 5).



Figure 5. Priority waterways and wetlands in the SIR

The Goulburn Broken Waterway Strategy also includes management planning for the Barmah Forest Ramsar Site in accordance with Action 12.3 of the Victorian Waterway Management Strategy (2013).

The target of investment in the Waterway Strategy is to improve riparian vegetation condition through onground works on priority waterways and wetlands within the SIR.

FIVE-YEAR TARGETS AND ACTIONS

Over the next five years, this priority will be delivered by achieving targets through the following actions:

5-year target	Action
Across three focus landscapes, the extent of native vegetation is increased by 300 ha each year	Fence remnant vegetation and revegetate corridors in priority focus landscapes
	Investigate the feasibility of a native vegetation management and offset scheme that protects and enhances local vegetation
	Fence wetlands on private land
Across three focus landscapes, 150 ha of native vegetation is enhanced each year	Revegetate 90 ha of riparian areas with indigenous species and improve 7565 ha of remnant riparian areas along priority reaches and wetlands
	Fence 13 km of riparian areas along priority reaches

4.4 PEOPLE PROGRAM

The goal of the People Program is

“to make the community a valued partner in identifying ways of increasing custodianship of the natural resource base and raising the profile of the region through promoting this custodianship as a competitive advantage”.

The People Program incorporates activities designed to encourage stewardship of natural resources and the environment, and community leadership within and beyond the SIR.

4.4.1 PRIORITY 6: BUILD STEWARDSHIP, INCORPORATING LOCAL ACTION AND IDEAS

This priority emphasises people and their relationship with the region’s natural resources. Activities encourage stewardship of natural resources and the environment and community leadership within and beyond the SIR to promote the region and manage issues of community concern, in partnership with agencies and policy-makers.

STEWARDSHIP

USEPA (EPA Innovation Action Council 2005) has plotted the evolution of environmental stewardship (Figure 6) and currently describes environmental stewardship as “behaviour that includes, but also exceeds, required compliance (or regulatory requirements). Stewards of the environment recycle wastes to the greatest extent possible, minimise or eliminate pollution at its source, and use energy and natural resources efficiently to reduce impacts on the environment.”

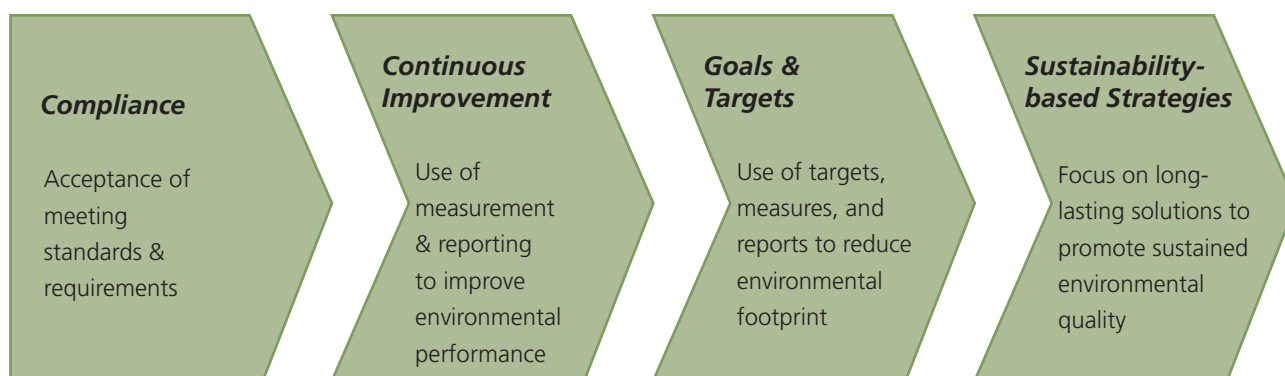


Figure 6. Evolution of environmental stewardship

Characteristics (or practices and behaviours) of sound environmental stewardship include:

- Protecting natural systems and using natural resources effectively and efficiently.
- Making environment a key part of internal priorities, values and ethics, leading by example.
- Exceeding required compliance.
- Investing in the future.
- Believing in shared responsibility.
- Holding one accountable.

There are a broad range of relevant issues that can be addressed as part of implementing “environmental stewardship”. Principles to be considered in deciding which issues to tackle include:

- Focus on significant environmental issues, both nationwide and regional in scope.
- Design for biggest impact (use right incentives; reduce significant barriers).
- Figure out the key behavioural leverage points for specific target groups.
- Don’t set up new challenge programs in isolation; build on existing efforts.

COMMUNITY LEADERSHIP, INNOVATION AND CAPACITY BUILDING

The SIRLWMP was first developed through the joint efforts of community leaders and government. Since then there has been an emphasis on building and supporting local leadership across the community and capitalising on that leadership and existing networks to develop ideas, test actions and engage with the broader community.

FIVE-YEAR TARGETS AND ACTIONS

Over the next five years, this priority will be delivered by achieving targets through the following actions:

5-year target	Action
Community-led ideas and actions and research have increased stewardship of the natural resource base	Develop a regional prospectus and marketing campaign
	Investigate activities that capture opportunities from climate change, including alternative sources of energy such as biofuels, solar and wind
	Promote the region as a responsible water steward
Community and industry groups, agencies, Traditional Owners and individuals have increased capacity to contribute to the SIR vision	Create leadership development opportunities for identified community members
	Develop synergies between regional partners, including the community, and promote initiatives that involve collective action

4.5 GOVERNANCE AND PARTNERSHIPS

The goal of this enabling program that oversees the implementation of the SIRLWMP is

“to continue to deliver projects and programs in an integrated way with clarity of roles and responsibilities for all partners”.

The SIR’s environmental features and systems are influenced and managed by many individuals, communities and organisations, which means that much of the work required to achieve the SIRLWMP vision will be undertaken by parties other than the Goulburn Broken CMA.

Strong relationships between partners are therefore critical at various levels and stages: when strategic directions and operational actions are first agreed, when work is undertaken, and when the plan is adapted to changed circumstances.

4.5.1 PRIORITY 7: MAINTAIN PARTNERSHIPS AND GOOD GOVERNANCE

To help build and maintain stakeholder relationships, the implementation structure will involve different combinations of community and agency members. These committees and working groups, which will result in informed decision-making that represents the regional view, will support the Goulburn Broken CMA Board in its implementation of the RCS. The implementation structure is shown in Figure 7.

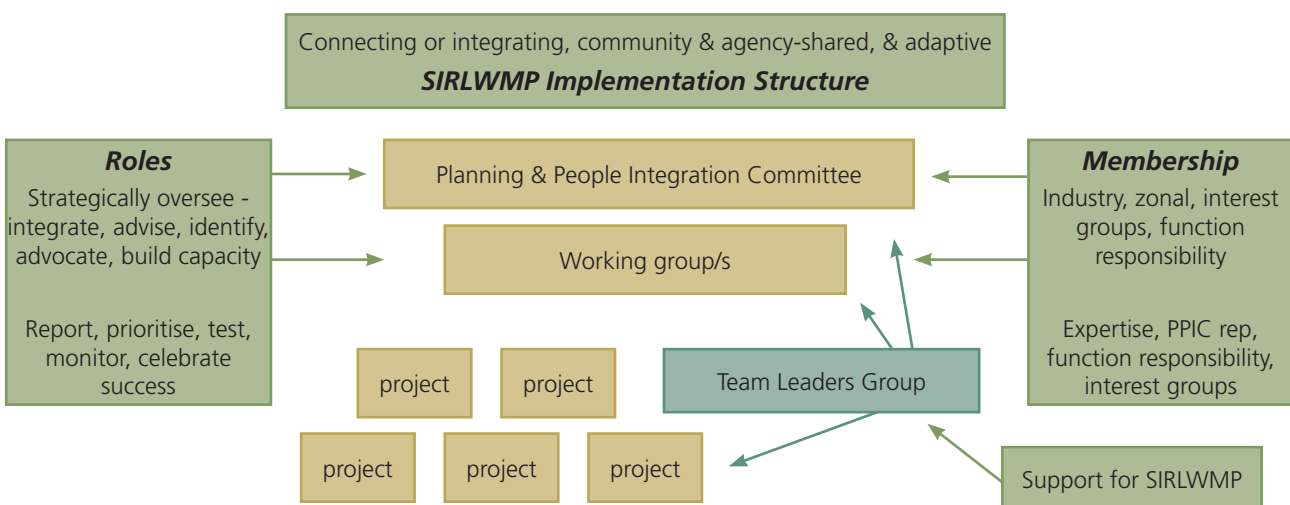


Figure 7. SIRLWMP implementation structure

GOULBURN BROKEN CMA BOARD

The Board of Directors of the Goulburn Broken CMA is responsible for setting strategic directions ensuring the effective management of natural resources in the Catchment. They are also responsible for signing off accountable actions and their review.

SHEPPARTON IRRIGATION REGION PEOPLE AND PLANNING INTEGRATION COMMITTEE (SIRPPIC)

Using the provisions of Section 19J of the Catchment and Land Protection Act 1994, the Goulburn Broken CMA can establish geographically-based implementation committees. An integration committee has been established for the SIR.

The charter of the Shepparton Irrigation Region People and Planning Integration Committee (Agricultural Floodplains) (GB CMA 2015a) sets out the role of the Group.

SIRPPIC regulates its own proceedings under the guidance and in-line with protocols established by the Goulburn Broken CMA Board and has the following roles and functions:

- Make recommendations to the Goulburn Broken CMA Board through the Sustainable Irrigation Program Manager
- Provide advice to the Goulburn Broken CMA Board about new and emerging challenges and opportunities on behalf of the community
- Advocate for Sustainable Irrigation Program initiatives in the Shepparton Irrigation Region
- Comment on SIR-relevant natural resource management strategies
- Share and celebrate successes with the community, including preparation of an SIR Achievement Summary
- Oversee development of the Shepparton Irrigation Region Land and Water Management Plan
- Monitor implementation performance of the Shepparton Irrigation Region Land and Water Management Plan Works Programs
- Assess risks to Shepparton Irrigation Region natural resources and recommend management responses
- Direct feasibility investigations of new ideas that deliver on the Shepparton Irrigation Region Land and Water Management Plan
- Feedback community, industry and agency comments that improve the efficiency and effectiveness of Shepparton Irrigation Region Land and Water Management Plan delivery.

WORKING GROUPS

Working groups are in place to oversee implementation of the SIRLWMP programs and major projects. They have various membership combinations, depending on their focus, that include community and relevant agencies. These groups form and meet with a regularity linked to program needs. There are some working groups that have been operating for almost the life of the plan, and will continue to do as long as the program needs persist.

SUSTAINABLE IRRIGATION PROGRAM TEAM LEADERS

Agency leaders with responsibilities for implementing the SIRLWMP programs operate teams to support the committees and working groups in their oversight of SIRLWMP implementation.

FIVE-YEAR TARGETS AND ACTIONS

Over the next five years, this priority will be delivered by achieving targets through the following actions:

5-year target	Action
Partners actively participate in SIRLWMP-led projects	Provide leadership, coordination and integration for the implementation of the SIRLWMP through participation in advisory meetings
	Prepare an annual work plan based on received funds
	Ensure indigenous Australians participate in decision-making
	Develop co-funded projects with partner organisations
SIRPPIC is accountable through demonstrated processes and actions that contribute to SIRLWMP implementation	Report on Murray-Darling Basin Salinity Management Strategy compliance activities
	Evaluate SIRLWMP progress and SIRPPIC performance according to an annually updated schedule
	Integrate cost-effective irrigation-related catchment reports for use by government and industry in formats suitable for marketing Victoria's environmental credentials of irrigation production
	Increase the accuracy of data on the extent of native vegetation losses and gains and the relationship to bird species

4.5.2 PRIORITY 8: ADAPT BY UNDERSTANDING CHANGE AND IMPACT

As well as maintaining partner relationships, close attention needs to be paid to evaluating progress, changes in circumstances, and potential new pathways.

In parallel to the LWMP Review, sub-strategy reviews have been, or are being, undertaken, including:

- Drainage Program (SIR)
- Whole Farm Planning Review (Statewide, high level)
- Farm Program (Statewide)
- Statewide Drainage Program
- Regional Waterways Strategy

Where possible, outcomes of these review have been considered. Program reviews to be undertaken include:

- Environment Program
- Farm Program (including detailed Whole Farm Planning)

MONITORING AND EVALUATION

Monitoring and evaluation is being approached differently in this update of the SIRLWMP because of the shift in how the challenge is defined: the aim is to position the region to ride frequent 'waves of change', rather than respond to them after they've gone through. In other words, the challenge is about making the SIRLWMP a live document, so that the SIR's people can continue to be proactive and responsive.

This approach still recognises the need for and value of a long-term monitoring program. Monitoring data underpins decision-making and continued investment in monitoring is an ongoing priority of the SIRLWMP.

Chapter 7 in Part A describes the context underpinning this challenge in detail, especially the complexity of the operating environment, uncertainties in understanding, and the difficulty in going from a written down action to achieving traction.

Making the right changes happen at the right time is often as much about organisational and cross-organisational culture as the quality of any written plans.

Chapter 7 in Part A also emphasises the need for clarity around what needs to be monitored and evaluated and by when, and who needs to be involved at various stages of the planning cycle (Figure 4 and Table 5 in Part A). 'Items of evidence' in Table 5 lists what needs to be monitored and evaluated.

Figure 1 in Part A indicates the levels of decision-making (and therefore evaluation) responsibility for the Goulburn Broken CMA Board, SIRPPIC, and operational programs.

The evaluation actions (listed in Table 5 of Part A) will be included during implementation of the 'accountability action' (listed in the Priority 7 table page 32: *Evaluate SIRLWMP progress and SIRPPIC performance according to an annually updated schedule*) and the 'adaptive action' (listed in the Priority 8 table page 35: *Continually evaluate relevance of SIRLWMP against changes in catchment conditions, critical attributes and risks and adapt program accordingly*).

BALANCING EFFORTS AND ATTENTION

Key roles for SIRPPIC are to continually identify 'hot issues' (by considering risks and opportunities) and to update the balance of efforts accordingly, from strategic planning to operational action. A high-level collective assessment of all issues is to be part of SIRPPIC's schedule. Risk and opportunity heat maps can guide the balancing of efforts in addressing critical attributes (Ernst and Young 2011; see Appendix 3).

ASSUMPTIONS, GAPS AND RESEARCH

While progress towards long-term goals for critical attributes can sometimes be directly measured, such as phosphorus levels in streams, understanding of progress in the short term often relies on data about onground changes and knowledge about the assumed impacts of these changes on goals. The equation: 'Outcomes = Outputs x Assumptions' is used as the basis for understanding progress and identifying knowledge gaps for research. In this plan, outcomes are described in terms of critical attribute goals. Outputs are listed as actions under various priorities above.

As the key evaluation questions listed in Table 5 of Part A are considered annually, gaps in the listed 'items of evidence' will emerge, which will create a comprehensive list of research priorities.

Several knowledge gaps were identified during the SIRLWMP review that are priorities for research, such as:

- improving understanding of all natural management risks and threats under the climate change scenarios
- increasing understanding of the relationship between farming systems, altered irrigation management practices and future water trade
- developing practical protocols for monitoring SIRLWMP impacts to maintain or enhance natural resource condition
- improving understanding of how to balance water-use between farms, industry and the environment
- committing more research and resources to nutrient concentration and management (more particularly groundwater) issues
- putting suitable measures in place to understand the impact of growing numbers of lifestyle farmers and large-scale farming systems on resource management and on-farm viability.

FIVE-YEAR TARGETS AND ACTIONS

Over the next five years, this priority will be delivered by achieving targets through the following actions:

5-year target	Action
SIRLWMP is adaptive through demonstrated processes that consider change, impacts and responses	Monitor and evaluate SIRLWMP progress and SIRPPIC performance according to an annually updated schedule.
	Continually evaluate relevance of SIRLWMP against changes in catchment condition, critical attributes and risks and adapt program accordingly. (Changes could be from improved technical understanding or result from social, economic, environmental and political shifts.)

The next planned review should occur in 2020. This will be the end of the life of the 30-year Shepparton Irrigation Region Land and Water Management Plan.

4.6 PROGRAM IMPLEMENTATION COST ESTIMATES

The cost of implementing this 2016-20 update of the SIRLWMP is estimated to be \$238,102,500 (Table 11).

Table 11. Program and priority implementation cost estimates

Implementation program	Priority	Costs, \$ estimate to end-of-plan life	
		Priority	Program
Farm	Update irrigation infrastructure, including the irrigation delivery system and farm design	155,000,000	163,000,000
	Build natural resource management into the farming system	8,000,000	
Drainage	Match drainage to meet changed needs, aligning it with modernised irrigation delivery	25,000,000	25,000,000
Environment	Balance water availability for all uses	750,000	47,177,500
	Reconnect large areas of enhanced nature	46,427,500	
People	Build stewardship, incorporating local action and ideas	1,000,000	1,000,000
Governance and partnerships	Maintain partnerships and good governance	1,725,000	1,925,000
	Adapt by understanding change and impact	200,000	
		Total	\$238,102,500

5 GOULBURN BROKEN CMA AND OTHER STRATEGIC DOCUMENTS RELEVANT TO THE SIRLWMP

5.1 REGIONAL CATCHMENT STRATEGY (RCS)

The Goulburn Broken CMA Regional Catchment Strategy (GB CMA 2013) provides the integrated planning framework or 'blueprint' for management of land, water and biodiversity resources. It is the overarching strategy for directing action, under which there are sub-strategies and action plans that implement priorities of government and the community.

The RCS is driven by a resilience approach which is applied at catchment and sub-catchment social-ecological system scales. The RCS also sets out a long-term vision for integrated catchment management. This SIRLWMP review closely aligns with the approach and principles set out in the RCS: it is part of planning at the sub-catchment scale and includes the Agricultural Floodplains SES and part of the North Central Catchment (which is in the west of the SIR).

The relationship between the RCS, sub-strategies and SES planning is shown in Figure 8. Relationship between the RCS, sub-strategies and SES planning (GB CMA 2016)

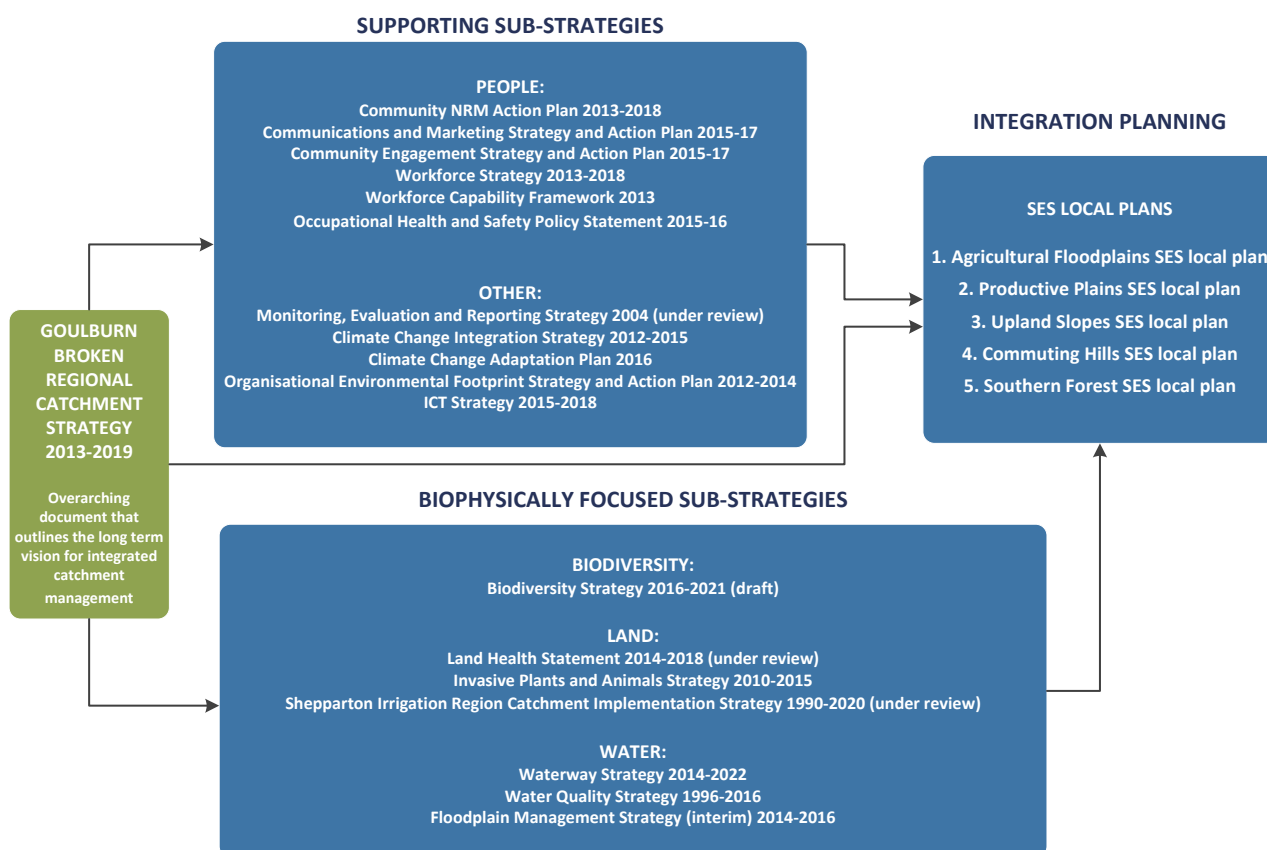


Figure 8. Relationship between the RCS, sub-strategies and SES planning (GB CMA 2016)

Implementation of the RCS is to be achieved via development of Local Plans for each SES. The Agricultural Floodplains SES will form the basis for the continuing implementation of the SIRLWMP (formerly known as the Shepparton Irrigation Region Catchment Implementation Strategy 1990-2020).

5.2 EXISTING GOULBURN BROKEN CMA BIOPHYSICAL STRATEGIES

Existing Goulburn Broken Region biophysical strategies operate at both catchment and sub-catchment scales. For SES Local Plan purposes, it would be ideal for the spatial scope of biophysical sub-strategy to line up with the spatial scope of SESs. This won't always be the case. SIRLWMP goals and implementation align with and plan for, at the sub-catchment scale, biophysical sub-strategy priorities. Table 12 summarises these strategies.

Table 12. Goulburn Broken CMA Biophysical sub-strategies for the Goulburn Broken Catchment

GB CMA Biophysical Sub-strategy (and reference)	Objective
Biodiversity Strategy (GB CMA 2010a)	<p>The Biodiversity Strategy aims to achieve the biodiversity vision by working towards the following three targets:</p> <ol style="list-style-type: none"> 1. Maintain extent and quality of all native habitat at 2005 levels in keeping with the goal of 'net gain' listed in Victoria's Biodiversity Strategy 1997. 2. Increase the extent of native vegetation in fragmented landscapes by 70,000 ha by 2030 to restore threatened Ecological Vegetation Classes (EVCs) and improve landscape connectivity. 3. Improve the quality of 90% of existing (2005) native vegetation by 10% by 2030.
Land Health Statement (GB CMA 2014c)	<p>The Land Health Statement aims to guide soil health investment in the Goulburn Broken catchment.</p> <p>This Land Health Statement defines land health and its surrogate, soil health, in the catchment. The purpose of promoting land health is:</p> <ul style="list-style-type: none"> • Protect the soil capital from the major degrading processes of erosion, organic matter decline, acidification, contamination, compaction, salinisation and biodiversity decline. • Restore or preserve ecosystem services from soil, including soil carbon cycling, soil structure stabilisation, soil biological activity and soil hydrology. • Protect other terrestrial and aquatic assets by reducing the impact of soil acidity, soil sodicity (including soil salinity), and water erosion.
Invasive Plant and Animal Strategy (GB CMA 2010b)	<p>The Invasive Plant and Animal Strategy (IPAS) is a high level document, guiding general direction for investment and effort. It is not an operational plan guiding day to day activities. It provides objectives and description of how to achieve objectives over a long term.</p>
Goulburn Broken Waterway Strategy 2014 - 2022 (GB CMA 2014b)	<p>The Waterway Strategy provides the integrated catchment planning framework and is the primary guide for priority setting, maintenance and improvement of waterways and wetlands in our region.</p>
Interim Floodplain Management Strategy (GB CMA 2014a)	<p>The approach taken in this strategy is to prioritise activities that improve the resilience of communities to flooding.</p>
Climate Change Adaptation Planning Strategy 2016-2019 (GB CMA 2015b)	<p>This Strategy</p> <ul style="list-style-type: none"> • identifies the major impacts of climate change to the Goulburn Broken Catchment's natural resource assets and systems • outlines priorities for climate change adaptation and mitigation and carbon farming activities to support the implementation of the RCS • provide information to partners within the Catchment to assist in regional NRM planning for the impacts of climate change.

5.3 VICTORIAN SUSTAINABLE IRRIGATION PROGRAM (VSIP)

The objective of the VSIP is to produce a productive, efficient and sustainable irrigation industry supported by improved irrigation infrastructure. It aims to produce long-term outcomes of:

- Increased water use efficiency and shared water savings between productive and environmental use.
- Reduced adverse environmental impacts of irrigation and protection of biodiversity.
- Implementation of the SIRLWMP supports achievement of SIP outcomes that are set, funded and monitored by the DELWP and regional partner agencies.
- Victorian Irrigation Drainage Strategic Directions (VIDSD).

Victorian Irrigation Drainage Strategic Directions drive land and water salinity management through surface and sub-surface works and actions, and is closely integrated with other farm and catchment programs. Managing salinity is a priority, however the VIDSD has moved to an integrated catchment management focus. The VIDSD supports drainage activities in the SIR.

The VIDSD is currently (2015) being reviewed.

5.4 MURRAY-DARLING BASIN PLAN (BASIN PLAN)

The Basin Plan provides a coordinated approach to water use across the Murray-Darling Basin's four States and the ACT. The Basin Plan is developed under the Water Act 2007 by the Murray-Darling Basin Authority (MDBA). It limits water use at environmentally sustainable levels by determining long-term average Sustainable Diversion Limits for both surface water and groundwater resources.

The MDBA has determined 10,873 Gigalitres per year (GL/yr) to be the volume of surface water that reflects an environmentally sustainable level of take as a long-term average with different limits for every river valley in the Basin. For groundwater, this volume is 3324 GL/yr.

The Plan is an adaptive framework. It aims to achieve a balance between environmental, economic and social considerations. It allows for further improvements in outcomes through a sustainable diversion limits adjustment mechanism and a constraints management strategy. The Plan is supported by Commonwealth investment in modernising irrigation infrastructure and voluntary water purchasing through the environmental water recovery strategy.

The Basin Plan includes:

- An environmental watering plan to optimise environmental outcomes for the Basin.
- A water quality and salinity management plan.
- Requirements that state water resource plans will need to comply with, if they are to be accredited.
- A mechanism to manage critical human water needs.
- Requirements for monitoring and evaluating the effectiveness of the implementation of the Basin Plan.

The RCS and SIRLWMP will be important instruments in implementation of the Basin Plan in the SIR.

5.5 BASIN SALINITY MANAGEMENT 2030

Management of salt within the SIR is essential to achieve a sustainable irrigation industry and protect the productive capacity of the region. Actions to manage salinity have significant benefits for agriculture, water quality, water availability and biodiversity. There is potentially a \$100 million direct negative impact on the region's production if no action is taken. The Murray-Darling Basin Authority recognises that management of salt to waterways from the SIR is required and regulates this action via obligations placed upon Victoria and the region under the Murray-Darling Basin Authority's Basin Salinity Management 2030.

5.6 BASIN WATER RESOURCE PLANS

Water resource plans are being developed under the Basin Plan to outline how a particular area of the Murray-Darling Basin's water resources will be managed to be consistent with the Basin Plan.

These plans include a water quality management plan that will encourage water planners to consider the impacts natural resource management activities, including land, may have on water quality.

5.7 VICTORIAN GOVERNMENT

The Victorian Government is continually developing and reviewing a number of strategies that guide a state-wide approach and investment in natural resource management, including Water for Victoria and Biodiversity 2037.

5.8 OTHER ORGANISATIONS' PLANS

Other organisations, including municipalities, agencies and authorities, have prepared strategies that can help RCS implementation, such as municipal environmental plans, Hume Regional Strategic Plan (Hume Regional Management Forum 2010).

5.9 STRATEGIC LINKS OF SIRLWMP PRIORITIES WITH OTHER GOULBURN BROKEN CMA DOCUMENTS

Strategic documents listed in Table 13 are not usually static: as the SIRLWMP is implemented, two-way interactions between custodians of SIRLWMP and those of other related strategies are needed. This could result in SIRLWMP objectives being updated, or highlight SIRLWMP gaps where more precise objectives and actions need to be developed or refined.

Table 13. Strategic rationale for SIRLWMP priorities

Program	Priority	RCS strategic objective and management measure	Where strategic rationale for priority is documented
Farm	1. Update irrigation infrastructure	<p>Influence regional water policy Influence water policy development and implementation to secure water for improving natural asset condition and social and economic wellbeing</p> <p>Use water efficiently on farms Modernise water delivery on irrigated land to provide ecological and productivity benefits</p>	<p>In project documentation GMW Connection Project mid-term review completed 2015 Murray-Darling Basin Salinity Management Strategy review underway Victorian Government Water for Victoria development</p>
	2. Build natural resource management into the farming system	<p>Capture opportunities from land development Deliver farm planning to integrate ecological and agricultural productivity benefits Promote land-use capability assessments and implementation, including use and management of water</p>	<p>Whole farm plan review completed 2014</p>
		<p>Establish sustainable agricultural practices Create awareness and acceptance of sustainable management practices to improve land and soil condition</p>	<p>Land Health Statement Action Plan</p>
Drainage	3. Match drainage to meet changing needs	<p>Manage risks to agricultural production Deliver surface and sub-surface drainage works across a modernised irrigation delivery system, including adaptive shallow groundwater management</p>	<p>Drainage Strategy review completed 2015</p>
		<p>Plan for and manage floods Plan and implement flood, fire and drought response and recovery</p>	<p>Interim Floodplain Management Strategy</p>
Environment	4. Reconnect large areas of enhanced nature	<p>Increase biodiversity in agricultural land-use Create awareness and acceptance of land management practices to enhance and protect terrestrial and aquatic habitat Work with landholders to protect and improve biodiversity on farms and build understanding of its contribution to sustainable and profitable farming</p> <p>Adapt to climate change variability risks Factor risks to natural assets into public land fire management plans</p>	<p>Priority landscapes paper prepared Regional Waterway Strategy prepared 2014 Biodiversity Strategy (GB CMA 2016) and Victorian Government Biodiversity 2037 drafted.</p>

Program	Priority	RCS strategic objective and management measure	Where strategic rationale for priority is documented
	5. Balance water-availability for all users	<p>Deliver water to waterways and wetlands Plan, deliver and monitor environmental water delivery to improve the condition of priority waterways and wetlands Prioritise protection of waterway and wetlands within the modernised irrigation delivery system</p> <p>Influence regional water policy Influence water policy development and implementation to secure water for improving natural asset condition and social and economic wellbeing</p>	Regional Waterway Strategy prepared 2014
People	6. Build stewardship, incorporating local action and ideas	<p>Increase biodiversity in agricultural land-use Identify environmental stewardship opportunities for land managers Work with landholders to protect and improve biodiversity on farms and build understanding of its contribution to sustainable and profitable farming</p> <p>Manage public lands collaboratively Collaborate with traditional owners in catchment management</p> <p>Adopt flexible engagement approaches Develop an engagement approach that matches landholder motivation with catchment management outcomes Develop an understanding of social capital and community connectivity</p>	Goulburn Broken Greenhouse Alliance Strategic Plan 2009 Municipal Environment Plans Community NRM Plan prepared in 2014 Yorta Yorta NRM Plan prepared in 2012
Governance and partnerships	7. Maintain partnerships and good governance	<p>Influence regional water policy Create opportunities for community leaders to contribute to water policy</p> <p>Provide adaptive management and leadership Build community and agency capacity to respond together to drivers of change</p>	GVIET (2014) has developed an industry and employment plan for the Goulburn Valley RMCG (2013) prepared a fruit growing industry roadmap
	8. Adapt by understanding change and impact	<p>Update and develop strategies Review and update existing strategic documents and sub-strategies and create new ones according to need</p> <p>Plan at SES scale Develop an adaptive planning process for social-ecological systems to build and enhance their resilience</p>	Goulburn Broken CMA Risk Assessment Framework

6 KEY STAKEHOLDERS, ROLES AND RESPONSIBILITIES

The successful implementation of the SIRLWMP depends on a range of partners working collaboratively. The partners are described in Table 14.

Table 14. SIRLWMP implementation

Agency / Authority / Organisation / Individual	Role relative to the development and implementation of the RCS
Australian Government – Department of the Environment	The Department of the Environment designs and implements the Australian Government’s policies and programs to protect and conserve the environment, water and heritage and promote climate action. Regionally, the Department of the Environment plays an important role in the implementation of the SIRLWMP, particularly in water policy development and implementation.
Australian Government – Department of Agriculture	The Department of Agriculture develops and implements policies and programs to ensure Australia’s agricultural, fisheries, food and forestry industries remain competitive, profitable and sustainable. Regionally the Department of Agriculture, contributes to the implementation of the SIRLWMP through funding priority projects that contribute to sustainable agriculture outcomes in the Catchment.
Victorian Government - Department of Environment, Land, Water and Planning	The Department of Environment, Land, Water and Planning (DELWP) creates liveable, inclusive and sustainable communities that support jobs and growth in Victoria. It recognises the link between the built and natural environment in the quality of our lives, and works to accommodate population growth while maintaining world class liveability and protecting our heritage for future generations. DELWP invests in the Sustainable Irrigation Program which includes grants for decision support and property planning to enable change in irrigation districts and investment in water use efficiency and salinity, waterlogging and water quality management.
Victorian Government – Department of Economic Development, Jobs, Transport and Resources	The Department of Economic Development, Jobs, Transport and Resources (DEDJTR) brings together many of the key functions that drive economic development and job creation across Victoria. These include transport and ports, energy, investment attraction and facilitation, trade, innovation, regional development and small business, together with key services to sectors such as agriculture, the creative industries, resources and tourism. Regionally, DEDJTR provides technical, extension and research services.
Environment Protection Authority	The Environment Protection Authority’s (EPA) sole role is to regulate pollution and has independent authority to make regulatory decisions under the Environment Protection Act and prioritises its compliance and enforcement activity by addressing the biggest risk to the environment and health. By effectively regulating pollution in the SIR, they strive to deliver clean air, healthy waterways, safe land and minimal disturbances from noise and odour and are important partners in the Irrigation Drainage Memorandum of Understanding.
Goulburn Broken Catchment Management Authority	The Goulburn Broken Catchment Management Authority (CMA) is a statutory authority established under the Catchment and Land Protection Act 1994. It plays a pivotal role in NRM in the Catchment. The Goulburn Broken CMA prepares the land and water management plans for irrigation regions in Victoria and coordinates and monitors their implementation. It does this by working with all tiers of government, other agencies, community groups, industry, individuals, and research and funding organisations.
Goulburn-Murray Water	Goulburn-Murray Water (GMW) aims to maximise water resource availability for customer use, while meeting key environmental goals and contributing to a sustainable and productive natural environment. GMW is committed to minimising and preventing any adverse impact on the environment caused by our activities. Activities and initiatives include catchment management (including salt interception management), surface and sub-surface drainage support, water quality and land management planning across the SIR.

Agency / Authority / Organisation / Individual	Role relative to the development and implementation of the RCS
Goulburn Valley Water	Goulburn Valley Water's (GVW) delivery of water and sewage services to its customers across the SIR and has a considerable impact on non-renewable natural resources. Primary objectives of the organisation include a commitment to improve environmental performance by minimising resource demand and preventing pollution of waterways.
Individuals / land managers	<p>Under the <i>Catchment and Land Protection Act 1994</i> and the <i>Water Act 1989</i>, responsibilities of land managers include (but are not limited to) take all reasonable steps to:</p> <ul style="list-style-type: none"> • Prevent the spread of, and as far as possible eradicate, established pest animals • Eradicate regionally prohibited weeds • Prevent the growth and spread of regionally controlled weeds • Conserve soil and avoid contributing to land degradation on someone else's land. <p>Land managers must also seek authority to interfere, obstruct or carry out works in relation to a waterway, bore or drainage course, or (in some cases) a private dam. Regionally, landholders across the Catchment invest significant resources (time, money and land) into activities that contribute to meeting the objectives of the RCS. This contribution is further outlined in the People section of the Assets of the Goulburn Broken Catchment supplement.</p>
Industry groups	Peak industry groups such as Murray Dairy and the Victorian Farmers Federation can strongly influence catchment management through their networks with regional land managers.
Community groups (e.g. CMNs, Landcare and environmental groups)	The SIR's natural resource management and sustainable farming groups mobilise community involvement, attract funding, and influence and implement significant projects in local areas, usually with an emphasis on onground works. They are represented on the SIRMWMP advisory groups.
Local government	Services provided by councils are diverse. They include property, economic, human, recreational and cultural services. Councils also enforce State and local laws relating to such matters as land use planning, environment protection, public health, traffic and parking and animal management. They maintain significant infrastructure, provide a range of services and enforce various laws for their communities. Local government plays a significant role in land-use planning with each municipality having a local planning scheme that describes directions and controls for developments, including agriculture. They also have other important roles including public awareness, engagement and education as well as local partnerships, such as RiverConnect.
Parks Victoria	Under the <i>Parks Victoria Act 1998</i> , Parks Victoria's (PV) responsibilities are to provide services to the State and its agencies for the management of parks, reserves and other public land. Parks Victoria's responsibilities encompass the management of: all areas reserved under the <i>National Parks Act 1975</i> , metropolitan waterways and adjacent land under the <i>Water Industry Act 1994</i> , nominated Crown land reserved under the <i>Crown Land (Reserves) Act 1978</i> , conservation reserves reserved under the <i>Crown Land (Reserves) Act 1978</i> and managed in accordance with approved land use recommendations under the <i>Land Conservation Act 1970</i> , areas reserved under the <i>Heritage Rivers Act 1992</i> , planning for all Ramsar sites, Regionally, Parks Victoria and the Goulburn Broken CMA work jointly in the delivery of Commonwealth and State funded projects.
Traditional Owners	The role of Traditional Owners is outlined in the introduction of this document. In addition, Registered Aboriginal Partners have responsibilities relating to the management of Aboriginal cultural heritage under the Act. These include evaluating Cultural Heritage Management Plans, providing advice on applications for Cultural Heritage Permits, decisions about Cultural Heritage Agreements and advice or application for interim or ongoing Protection Declarations.

GLOSSARY AND ACRONYMS

- Accountable action – a land or water management action that is expected to have a Significant Effect or a salinity impact the MDBA estimates will be significant
- Backbone – Publicly owned key regional irrigation channel system
- Biodiversity - the variety of life in the world or in a particular habitat or ecosystem
- BSM 2030 – Basin Salinity Management 2030 Strategy
- Connections Project – The modernisation project for the publicly-owned GMW delivery system
- DEDJTR – Department of Economic Development, Jobs, Transport and Resources
- DELWP – Department of Environment, Land, Water and Planning
- DSE – Department of Sustainability and Environment
- EC – electrical conductivity, a unit of measure of salt concentration in water
- Farm Water Program – The Goulburn Broken CMA managed on-farm efficiency water use program
- GB CMA – Goulburn Broken Catchment Management Authority
- GMID – Goulburn Murray Irrigation District
- GMLN – Goulburn Murray Landcare Network
- GMW – Goulburn-Murray Water
- GRSPAC – Goulburn Region Salinity Pilot Program Advisory Council (later SPAC)
- GVEG – Goulburn Valley Environment Group
- GVW – Goulburn Valley Water
- Intervention - an activity undertaken by a government to direct an economy or society.
- MDB – Murray-Darling Basin
- MDBA – Murray-Darling Basin Authority
- NRM – Natural resource management
- Offsets – The replacement of lost vegetation with new or protected areas of plantings or remnants
- Resilience - the ability of the system to absorb stress while continuing to function in a desired way.
- SDE – Sustainable Drainage Entitlement, the
- SDL – Sustainable Diversion Limit
- SIR – Shepparton Irrigation Region
- SIRCIS– Shepparton Irrigation Region Catchment Implementation Strategy, the name of the last iteration of the land and water management plan
- SIRLWMP – Shepparton Irrigation Region Land and Water Management Plan
- SIRPPIC - Shepparton Irrigation Region People and Planning Integration Committee
- SES - Social-Ecological System, linked and generally similar system of people and nature taking into account cultural, political, social, economic, ecological and technological components
- System - The set of variables and the interactions, processes and mechanisms that govern them.
- Thresholds - A breakpoint between two states of a system that must be exceeded to begin to produce some sort of effect or response.
- Vision - An aspirational statement outlining how the Catchment will look in 50 years' time.

REFERENCES

- DSE (2008). Guidelines for the preparation of Land and Water Management Plans that apply to designated irrigation areas of Victoria, Department of Sustainability and Environment.
- EPA Innovation Action Council (2005). Everyday choices: Opportunities for environmental stewardship - Technical Report. US Environment Protection Agency.
- Ernst and Young (2011) Turn risks and opportunities into results, accessed 20 October 2015
http://www.ey.com/Publication/vwLUAssets/The_top_10_risks_and_opportunities_for_global_organizations/%24FILE/Business%20Challenge%20main%20report-%20SCORED.pdf
- GB CMA (2004). Monitoring, Evaluation and Reporting Strategy for the Goulburn Broken Catchment, Goulburn Broken Catchment Management Authority.
- GB CMA (2009). Shepparton Irrigation Region Catchment Implementation Strategy 5-year Mid-term Review Plan for Groundwater and Salt Management Program and Surface Water Management Program 2010 - 2014.
- GB CMA (2010a). Biodiversity Strategy for the Goulburn Broken Catchment, Victoria 2010-2015, Goulburn Broken Catchment Management Authority.
- GB CMA (2010b). Goulburn Broken Invasive Plants and Animals Strategy 2010- 2015 Final, Goulburn Broken Catchment Management Authority.
- GB CMA (2011) Shepparton Irrigation Region Catchment Implementation Strategy 2011 Update. Shepparton, Victoria.
- GB CMA (2013). Goulburn Broken Regional Catchment Strategy 2013-2019. Shepparton, Victoria, Goulburn Broken Catchment Management Authority.
- GB CMA (2014a). Goulburn Broken Regional Floodplain Management Strategy (Interim) 2014 - 2016.
- GB CMA (2014b). Goulburn Broken Regional Waterway Strategy 2014 – 2022. Goulburn Broken Catchment Management Authority
- GB CMA (2014c). Land Health Statement (2014-2018) DRAFT, Goulburn Broken Catchment Management Authority.
- GB CMA (2015a). Charter. Shepparton Irrigation Region People and Planning Integration Committee (Agricultural Floodplains). Updated June 2015, Goulburn Broken Catchment Management Authority.
- GB CMA (2015b). Climate Change Adaptation Planning Strategy 2016-2019. draft 1, Goulburn Broken Catchment Management Authority.
- GB CMA (2015c). Annual Report 2014-15, Goulburn Broken Catchment Management Authority.
- GB CMA (2016). Annual Report 2015-16, Goulburn Broken Catchment Management Authority.
- GVIET (2014). Goulburn Valley Industry and Employment Plan, Goulburn Valley Industry and Employment Taskforce.
- Hume Regional Management Forum (2010). Hume Regional Plan - the Hume Strategy for Sustainable Communities.
- McIntyre, S and Hobbs, R. (1999). A framework for conceptualizing human effects on landscapes and its relevance to management and research models IN Fuller, J (2012). Birds and Habitats – relationships in changing landscapes. Cambridge University Press, New York.
- RMCG (2009). Mid Goulburn Broken & Upper Goulburn Sustainable Irrigation Action Plan (SIAP). Land and Water Management Plan for Irrigation in the Goulburn Broken Dryland Catchment Year 2008 - 2013, DSE and Goulburn Broken CMA.
- RMCG (2013). Goulburn Valley Fruit Growing Industry Roadmap. Final. Prepared by RMCG in conjunction with the Goulburn Valley Fruit Growers Strategic stakeholder Group.
- RMCG (2015). Shepparton Irrigation Region Drainage Program Review. Phase A Draft Report, Goulburn Murray Water and Goulburn Broken Catchment Management Authority.
- SPAC (1995). Goulburn Broken Salinity Program Advisory Council Annual Report 1994-95: Water, Land and People Working for a Sustainable Future, Institute for Sustainable Irrigated Agriculture, Tatura.
- Walker B., Abel N., Anderies J. and Ryan P. (2009). "Resilience, Adaptability and Transformability in the Goulburn-Broken catchment, Australia." Ecology and Society 14(1).
- Walker, B. H. and D. Salt (2012). Resilience Practice: Building Capacity to Absorb Disturbance and Maintain Function. Island Press, Washington, DC.
- Wilson, J., J. Castles, R. Caldwell, G. Deayton, C. Miles and K. Hill (2014). Prioritising landscapes in the Agricultural Floodplains Social -Ecological System in the Goulburn Broken Catchment, Goulburn Broken Catchment Management Authority.

APPENDICES

APPENDIX 1: RESILIENCE AND SOCIAL-ECOLOGICAL SYSTEMS

Most of this appendix has been adapted from Appendix E of the Climate Change Adaptation Plan for Natural Resource Management in the Goulburn Broken Catchment, Victoria 2016.

UNDERPINNING CONCEPTS IN DEVELOPING RESILIENCE

Appendix E: Adapting to multiple futures in the Shepparton Irrigation Region (GB CMA 2015b)

This SIRLWMP is underpinned by a number of fundamental concepts in developing resilience, many of which are embodied within the Goulburn Broken RCS, that have been aided by research in the SIR (e.g. Walker B. et al. 2009):

Resilience - the capacity of a system to absorb disturbance (drivers/stressors and shocks) and continue to function in a desired way.

Resilience thinking - the paradigm consisting of concepts, tools and approaches for applying resilience to social-ecological systems.

Risk - the potential or probability for a stressors or shock to affect parts of the system (including personal wellbeing).

Vulnerability - predisposition of parts of the system to be adversely impacted by stressor and shocks there include the capacity to respond in their definition.

Adaptability or adaptive capacity - the capacity of a system to adapt to be less vulnerable, to lower risk - capacity to absorb shocks, capacity to respond and change.

Adaptation pathways - focuses on tipping points (thresholds) as key loci around which to construct decision-making processes. It has some synergies with a resilience approach. The adaptation pathways process also makes explicit the difference between decision making and management that maintain the current system (Adaptation) and those that lead to more substantive changes in system structure, function, outputs and values.

PLANNING AND ACTION AT THE SES SCALE

Responding to issues such as climate variability, floods and fire requires a Catchment-scale approach and local action. Across the Catchment, the landscape, people, threats and priorities differ. Six social-ecological systems (SEs) have been identified through consultation and research. These SEs don't have sharp boundaries, but they do share similar characteristics and issues which give them a unique identity. They shape what can be done to build and maintain resilience so that the best combination of people, land, biodiversity and water outcomes, valued by the local community, can continue to be provided.

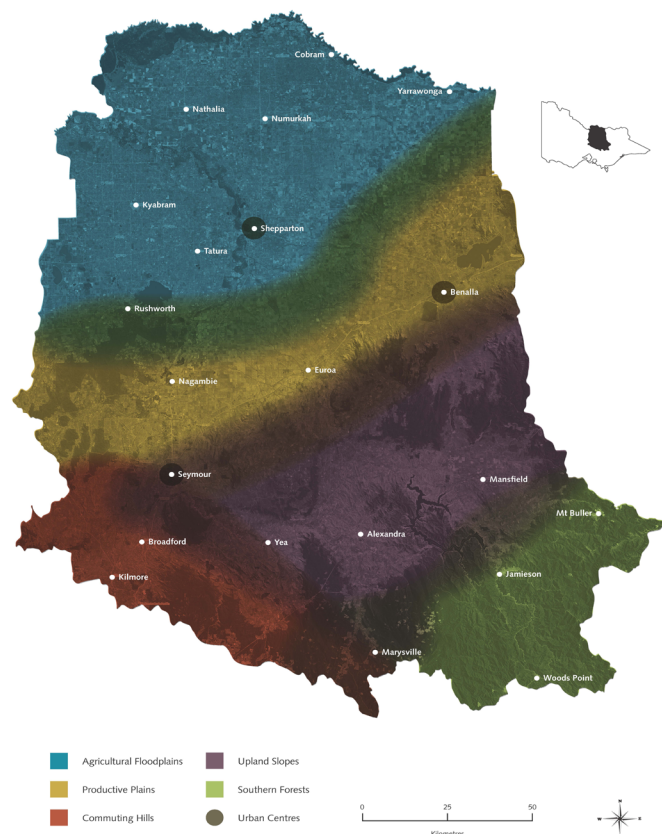


Figure 9. Social-ecological systems (SEs) of the Goulburn Broken Catchment (GB CMA 2013)

The RCS identifies six SES. The Agricultural Floodplains SES approximates with the area known to most people as the Shepparton Irrigation Region (SIR) (Figure 1).

The paradigm driving the development and implementation of the region's plans has changed. The process of updating plans, currently underway, uses resilience thinking that embeds an adaptive management process to the management of critical functional attributes of a system as set out in approach and described in Part A.

The process can be applied at a range of levels of detail. For example, a management board might focus at a strategic level on critical attributes listed in Part A. A program or project manager will require much more detail including an expanded set of indicators (for example, extent of native vegetation could be expanded to consider quality as well as quantity). The expanded set can be collapsed for upwards reporting.

Table 15. Implementation approach

Approach component	Description	Review response
Identify and describe key attributes of the region	These describe the identity or state of the region, at a high level. They are attributes of the region that if changed beyond a certain point (threshold), would result in a fundamental change in the state of the region. We deliberately tried to identify only five or six big ticket items.	The attributes identified are described in more detail in Part A
Identify thresholds for each attribute	The threshold is the point at which the key attribute changes and affects the fundamental state of the region. For example, clearing of more than 97% of the native vegetation in the region would represent a fundamental change to the nature of the region. Further work is required to identify or refine thresholds for other key attributes.	See Part A
Assess the risk to key attributes in the future	This step identifies the likelihood of thresholds being crossed for each key attribute in each of the identified scenarios. For example, in a hotter and drier future state an increase in the area with watertables at less than two metres in depth is unlikely but in a wetter future state it is highly likely. This provides valuable information about the direction of required management in the future.	See Part A
Assess current and potential future management actions that are, or could be, used to mitigate risks	Risks can be mitigated by implementing management actions. For example, the likelihood of the area of the region with watertables at less than two metres in depth can be mitigated (managed) by encouraging farmers to pump groundwater. The confidence the management action will achieve the desired outcome can also be assessed.	See Part A
Review and improvement	An annual planning cycle embedded within a longer, five-year adaptive planning cycle requires monitoring of thresholds and management actions that will oblige managers to evaluate the state of key attributes and if necessary, revise and improve plans. Management actions will be focused on things that matter.	This process is further described in Part A

APPENDIX 2: PRIORITIES FOR ACTION SUMMARIES

1. UPDATE IRRIGATION INFRASTRUCTURE

The GMW Connections Project was initiated to reduce water losses through modernisation of the public irrigation delivery system and to reallocate water savings to the environment and other water users. This project is being led by GMW.

Complementing the Connections Project, the Goulburn Broken CMA leads a consortium project called the Farm Water Program, which generates water savings on farms: the government contributes funds towards improvement of farm irrigation infrastructure and in return receives permanent water, calculated as savings generated by the works.

A fully-modernised irrigation delivery system complemented by modernised farm irrigation infrastructure is placing the region at the forefront of efficient water-use and productivity.

2. BUILD NATURAL RESOURCE MANAGEMENT INTO THE FARMING SYSTEM

Irrigation whole farm plans (WFP) guide implementation of farm activities. A WFP provides a strategic element to farm improvements: it provides the bridge between changed farm practices and broader catchment and distribution system outcomes.

Farmers adopt desirable actions in a more timely and coordinated manner through improved knowledge provided by WFPs and extension services. Farmers optimise use of their natural resources, increasing productivity while not putting these resources at further risk.

3. MATCH DRAINAGE TO MEET CHANGED NEEDS

Knowledge that irrigation without drainage is unsustainable was one of the main reasons why the original SIRLWMP was prepared in the late 1980s. This knowledge remains pertinent in this update, with an added emphasis on tailoring the type of drainage works to specific and changed risks in different areas.

The emphasis of the Drainage Program is now about draining surface water, particularly after large rainfall events, through implementation of a hybrid drainage system (of constructed and natural drainage courses) in areas that still require drainage.

Sub-surface drainage needs to be adaptively managed to ensure it operates when and where required, being responsive to changing watertable conditions.

4. RECONNECT LARGE AREAS OF ENHANCED NATURE

Significant biodiversity benefits will be achieved via incentives for protecting remnant native vegetation and for planting appropriate species, which will enhance existing remnants and develop better connections between large remnants. A key mechanism for delivering these benefits will be through high priority focus landscapes. Incentives will be targeted at landholders within these landscapes.

Contributions to planning schemes that control removal of native vegetation, and direct offsetting where vegetation is removed, are also important.

Providing water to native vegetation is a critical complementary activity, which is discussed under the next priority.

5. BALANCE WATER AVAILABILITY FOR ALL USES

The region needs to continue collaborating with stakeholders across many jurisdictions to ensure that lessons learnt, especially those within Victoria's northern regions, are built into evolving Murray-Darling Basin-wide approaches to water-sharing and management.

There also needs to be a continued emphasis on understanding water needs for the environment within the region, so these can be balanced and integrated with irrigation and other needs.

Much of the region's remaining native vegetation is found along waterways and in and around wetlands, providing continuous habitat that act as key thoroughfares for isolated habitat to potentially connect with, especially habitat in focus landscapes. Important objectives of environmental flows include provision of water to protect and enhance this native vegetation.

6. BUILD STEWARDSHIP, INCORPORATING LOCAL ACTION AND IDEAS

People and their relationship with the region's natural resources is critical to the success of the SIRLWMP over the next five years. Stewardship of natural resources and the environment will continue be encouraged. Community leaders will promote the region within and beyond its boundaries, and manage issues of community concern in partnership with agencies and policy-makers.

7. MAINTAIN PARTNERSHIPS AND GOOD GOVERNANCE

The region's environmental features and systems are influenced and managed by many individuals, communities and organisations, which means that much of the work required to achieve the SIRLWMP vision will be undertaken by parties other than the Goulburn Broken CMA. Strong relationships between partners will therefore be critical in firstly agreeing on the management desired and then undertaking the work.

8. ADAPT BY UNDERSTANDING CHANGE AND IMPACT

The region is widely known for being quick to respond to changing circumstances, thanks mainly to strong partner connectedness. However, the pace of change is increasing and the challenge now is to be positioned to ride the frequent 'waves of change', rather than respond to them after they've gone through.

Apart from maintaining partner relationships, close attention needs to be paid to evaluating progress, changes in circumstances, and potential new pathways.

Chapter 7 describes the approach to make adaptation a reality, with an emphasis on the knowledge about change and impact needed and the processes that enable new knowledge to be included in decision-making.

APPENDIX 3: CONCEPTUAL RISK AND OPPORTUNITY HEAT MAP FOR MANAGING CRITICAL ATTRIBUTES IN THE SIR

The structure of the following conceptual heat map has been adapted from a series prepared by Ernst and Young (2011). The ratings shown in Figure 10 are provided to demonstrate the concept. They have been determined by experts within the Sustainable Irrigation Program team and will require regular review.

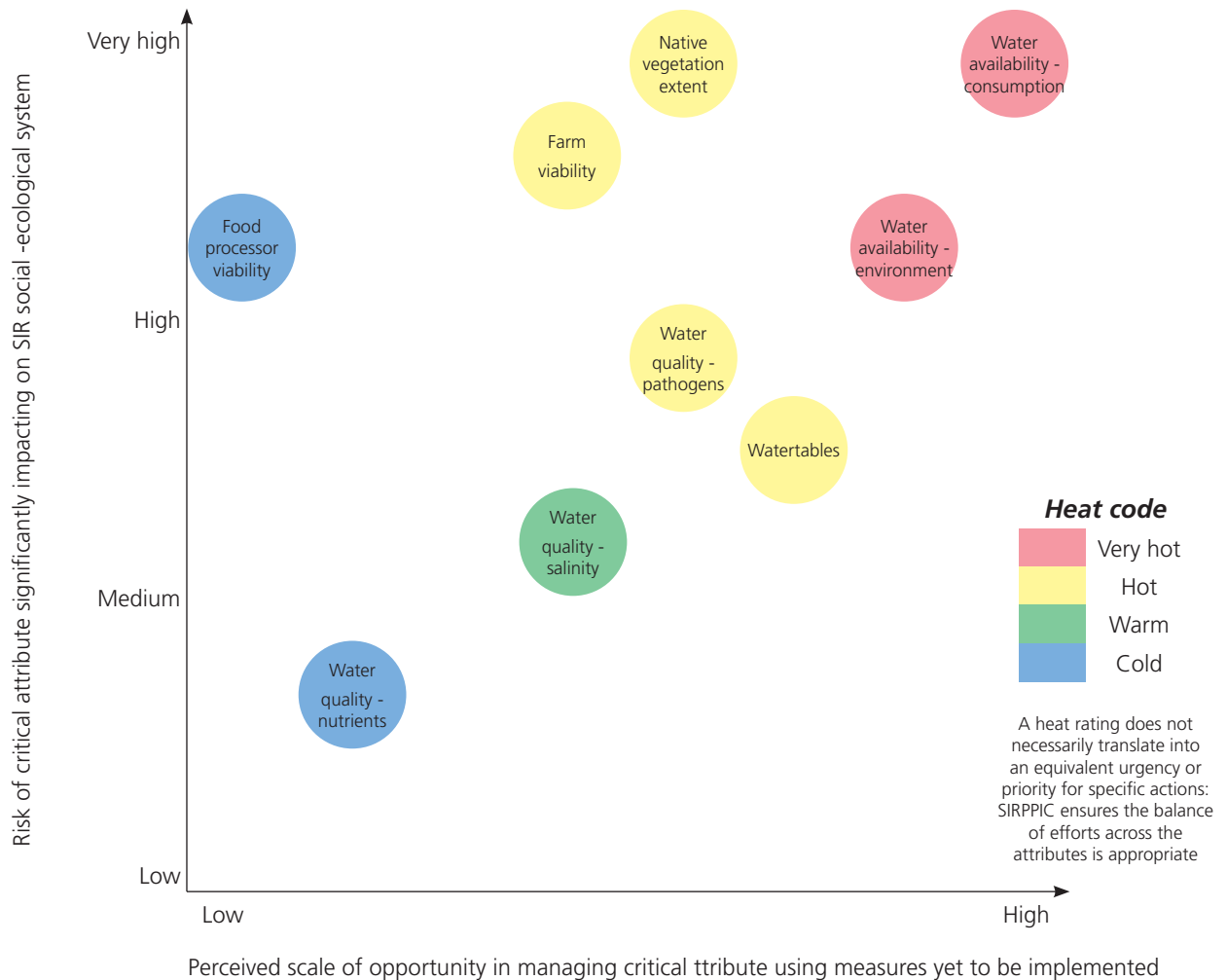


Figure 10. Risk and opportunity heat map (to manage critical attributes)

ACKNOWLEDGEMENT

We would like to acknowledge the Shepparton Irrigation Program People and Planning Integration Committee (SIRPPIC) for its efforts in leading the update of this plan and guiding its implementation. The efforts of community and agency on this and previous advisory bodies is testament to an ongoing commitment to growing the region's prosperity and the nature resources that underpin the irrigated agricultural production that makes us world leaders.

SIRPPIC MEMBERS



Back row left to right: Mark Turner GB CMA, Lachlan Barnes (DEDJTR), Doug Brown (community rep), Patrick Rochford (community rep), Kelvin Bruce (community rep, vice-Chair), Helen Reynolds (community rep, Chair), Allen Canobie (community rep), Carl Walters (GB CMA, SIP Manager), Jenny Wilson (GB CMA), Rebecca Caldwell (GB CMA)

Front row left to right: Helen Murdoch (GB CMA), Jenny Wilson (Murray Dairy), Darelle Siekman (GB CMA), Jennifer Savage (community rep), Heather DuVallon (community rep), Roger Wrigley (community rep), Alfred Heuperman (community rep), Murray McDonald (community rep), Barry Croke (community rep), James Burkitt (G-MW).

Absent: Andrea Smith (community rep)

OUR PARTNERS



NORTH CENTRAL
Catchment Management Authority
Connecting Rivers, Landscapes, People



Goulburn
Murray
Landcare



Dairy
Australia

Your Levy at Work

