Shepparton Irrigation Region Catchment Implementation Strategy

Sub-surface Drainage Program

Five Year Review

2006/2007

Volume 2 - Compendium

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

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Department of Sustainability and Environment
Department of Primary Industries

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Structure of this SSDP 5-Year Review Report (2000-2005) Compendium

The documentation for the SSDP 5-Year Review Report (2000-2005) review comprises two separate volumes:

- Volume 1 – The main SSDP 5-Year Review Report (2000-2005)
- Volume 2 – A compendium of supporting technical reports and reference material (i.e. this document).

This is Volume 2 and includes copies of key technical reports and reference material used to support the preparation of the SSDP 5-Year Review Report (Volume 1). The technical reports are as provided by the authors and have not been edited by Hydro Environmental who managed the preparation of the Review and authored the Volume 1.

Related Sections of 5-Year Review Report (Volume 1)

The compendium includes the technical reports and supporting information listed in the **Table C1**. **Table C1** also shows the respective sections and page numbers in the SSDP 5-Year Review Report (Volume 1) which draw on the information included in this Compendium (Volume 2).

Table C1: Linkage between Compendium Reference Numbers and Volume Numbers

Compendium Section No.	Technical Reports / Reference Material	SSDP 5-Year Review Report (Vol. 1)	
		Section	Page No.
A.	Original SSDP Objectives	1.3	3
B.	Study Area Features	3.1	7
C.	Land use Data	4.3.3	21
D.	Projected SSDP Salt Disposal Entitlements	4.4.7 / 4.8.3	36 / 51
E.	SSDP Research and Investigation Strategic Plan	4.5 / 6.3	37 / 67
F.	SSDP Baseline Statistics	5.0	58
G.	Consultation Strategy	6.9	71
H.	Economic Assessment	7.1	72
I.	Environmental Impact Assessment	7.2	74
J.	Social Assessment	7.3	75
K.	Risk Assessment	8	79
L.	Future Irrigation Scenarios	9.2.2	82

Table of Contents

Section A – Original Plan SSDP Objectives

The original objectives of the SSDP as outlined in the Shepparton Irrigation Region Land and Water Management Plan (SIRLWSMP) (1989) were:

> "To, where possible and justified, protect and reclaim the Shepparton Irrigation Region's land and water resources from Stalinisation".

The preferred package of works adopted by the Draft Plan (1989) aimed to serve some 213,000 ha by the year 2020 by means of:

1. Implementing management arguments for 395 existing (i.e. entirely landholder funded) and 365 new private pumps to serve 85,000 ha of current and future high groundwater level areas.
2. Approximately 425 public pumps and some 50 disposal basins to serve a further 85,000 ha in areas where private pumping and farm reuse was not feasible.
3. Tile drainage and small capacity pumps beneath 14,000 hectares to protect the productive capacity of 43,000 ha where prospects for large scale pumping were limited."

Section B – Study Area Features

The following is an extract from the 1995 – 2000 5 Year SSDP Review (SKM, 2002).

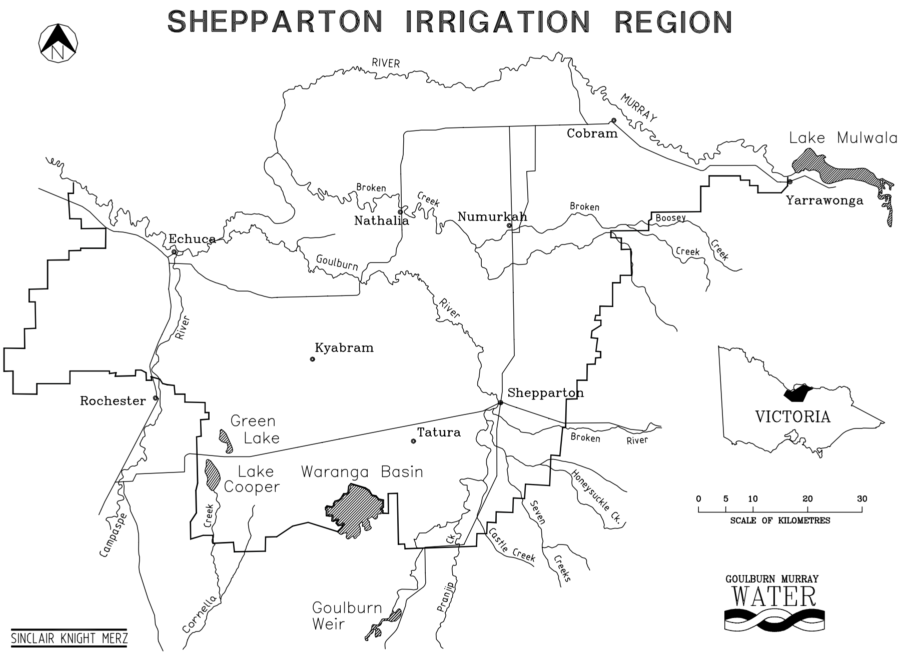
Background

This chapter provides some brief background information on the SIRCS and the Sub-Surface Drainage Program.

Location

The Shepparton Irrigation Region (SIR) is located within the Murray Darling Basin on the southern edge of Riverine Plain in Northern Victoria. The area covers some 674,400 ha (as defined by the SIR Groundwater Supply Protection Area plan boundary) including about 446,400 ha of irrigated farm holdings (1996/97 Irrigated Farm Census, G-MW) within the Rochester, Central Goulburn, Shepparton and Murray Valley Irrigation Areas.

Note: The Campaspe Irrigation District adjoins the Rochester Area. The western part of the District (approximately 5000 ha) has it's own salinity management plan and is not part of the SIR in terms of the catchment strategy. There are fundamental differences between the Campaspe West SMP and the Shepparton Catchment Strategy but these are not described in this appendix.



Climate, Soils and Land Use

The climate is semi arid with an average rainfall of between 380 and 500 mm/year. As evaporation in the region averages 1,350 mm/year, irrigation is necessary to support summer, autumn and spring growing crops.

The soils in the Region fall into two main groups, the "red – brown earths" and the "grey – brown soils of heavy texture". The first includes the coarser surface sediments deposited close to ancestral stream courses. The second group were deposited further out on the flood plain.

Irrigation development in the Region commenced with the establishment of the Rodney Irrigation Trust under the Irrigation Act of 1886. Currently (June, 2000), approximately 316,850 ha of land within the SIR is developed for irrigation (1996/97 Irrigated Farm Census, G-MW).

Irrigation application traditionally was by flood irrigation of pastures and a mixture of flood and furrow irrigation for horticulture. Over the past twenty years, pasture irrigation has improved water use efficiency through laser controlled grading of irrigation bays. Very few pasture developments have moved to overhead sprays or travelling irrigators. Horticulture is now mostly irrigated with under tree mini sprinkler systems. Irrigation intensities are typically in the range of 4 to 10 ML/ha /yr with perennial pasture typically requiring 10 ML/ha/yr and horticulture 7 ML/ha/yr.

The salinity of surface water for irrigation within the system generally varies from about 50 to 150 EC (without groundwater pump inputs) depending on the source of supply, time of year and location within the system.

Regional Hydrogeology

The Riverine Plains of the Shepparton Irrigation Region comprise unconsolidated alluvial deposits having a comparatively flat surface and gentle north westerly slope of around 1 in 2500. The depth of the unconsolidated deposits above bedrock varies, typically ranging from 20 to 150 m thick with a maximum recorded thickness of approximately 200 m.

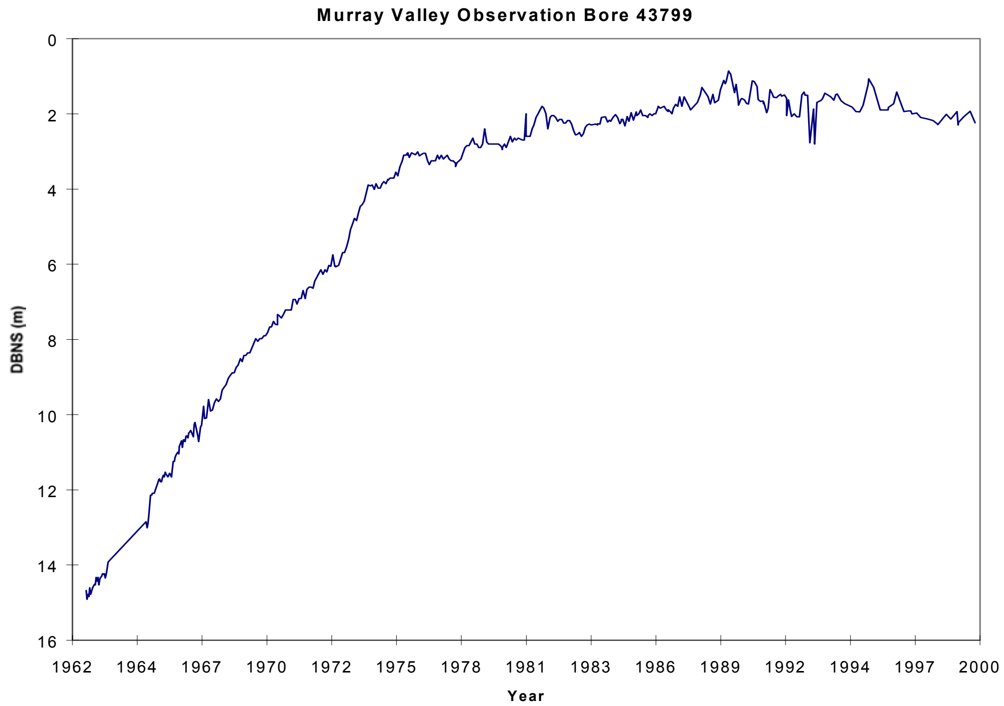
The sedimentary sequence is complex and changes with depth, with the deeper deposits generally being coarser grained. The deepest formation, called the Renmark Group, mostly occurs to the north and west of the area. The overlying Calivil Formation is more extensive in the Shepparton Irrigation Region and generally follows the present day courses of the Murray, Goulburn and Campaspe rivers. The hydraulically undifferentiated Calivil Formation and Renmark Group aquifers are commonly referred to as the "Deep Lead".

Alluvial sediments of the Shepparton Formation overly the Calivil/Renmark aquifer and extend from surface to typically 80 m deep. Although the Shepparton Formation is often thought of as one hydrogeological unit, the mixture of predominantly clays and silts interspersed with lesser quantities of sand and gravel form a complex system of aquifers and aquitards. The unit is often divided hydrogeologically into the Upper (< 25 m) and Lower Shepparton Formations.

Nature of the Problem

Prior to European settlement, groundwater levels were more than 30 m below surface. Clearing of native vegetation and irrigation development have disrupted the natural hydrologic cycle and the Upper Shepparton Formation aquifers and enclosing clay aquitards have become saturated.

The hydrograph for Murray Valley observation bore 43799 below shows typical rises in groundwater levels observed across the Region over time.



Groundwater levels are now at less than 2 m below surface over much of the Shepparton Irrigation Region. Studies undertaken during the development of the RIR GWMP (now SIRCS) (1989) estimated that approximately 274,000 ha would be subject to groundwater levels within 2 m of surface by the year 2020. The area subject to high groundwater levels in August 1996 (a wet winter) was approximately 268,000 ha. The area declined to approximately 157,000 ha in August 1999 and further declined to 61,650 ha in August 2006 (refer SKM) due to a combination of pumping and prevailing dry conditions since 1997.

Groundwater pressures in the deep regional aquifer system (Deep Lead) have also shown rising trends in the past. These trends have been reversed in recent years in parts of the

Campaspe and Murray systems due to Deep Lead pumping. However, local scale recharge and discharge processes in the Upper Shepparton Formation are the dominant contributors to salinity problems in the Region. In addition, the hydraulic connection between the deep regional aquifer system and the shallow systems is understood to be generally poor beneath the Irrigation Region. A recent R&I project is aimed at determining more precisely the interconnection between the deep and shallow aquifers in the SIR.

Section C – Land use Data

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

GOULBURN-MURRAY WATER

State Government Victoria Department of Sustainability and Environment

Land Use Information for 1996/97 and 2003/04 to support the 2005 SSDP 5-Year Review

June 2007

1. Purpose of Paper

The purpose of this paper is to present the land use information collated by the Department of Primary Industries for 1996/97 and 2003/04 to support the Sub-surface Drainage Program 5-Year Review: 2000 – 2005.

2. Background

The Sub-surface Drainage Program (SSDP) is a key Program of the Shepparton Irrigation Region Catchment Implementation Strategy (SIRCIS). The SSDP Review: 2000-2005 is the third Review that has been undertaken since the Plan was endorsed and the Program commenced in 1990.

The Department of Primary Industries (DPI) was engaged during May and June 2007 to collate land use regime information to support the SSDP Review: 2000-2005. Land use information was sourced from the G-MW culture census for 1996/97 and through local government valuation databases for 2003/04 (Spatial Sciences Section, PIRVic, DPI, 2007)[1].

Horticultural land use for 2003/04 is sourced from SPC-Ardmona through their horticulture census database. Irrigated pastures and seasonal crops are a much more dynamic land cover than fixed horticulture and therefore have required a different approach. These land uses require Landsat TM (Landsat Information Mapper) satellite imagery which captures the instantaneous response of the ground cover including vegetation, water and ground temperature. Standard image processing techniques convert satellite data into more meaningful information than visual interpretation alone can provide (Spatial Sciences Section, PIRVic, DPI, 2007).

Satellite data was used to develop a seasonal profile of water use on a pixel by pixel basis and then to convert the seasonal information into land cover classes. A number of Landsat scenes were acquired for the 1996/97 and 2003/04 irrigation seasons to broadly represent spring, summer and autumn (Spatial Sciences Section, PIRVic, DPI, 2007).

Land use information was then summarised according to irrigation areas in the Shepparton Irrigation Region (SIR) through the use of a Geographic Information System (GIS).

The following sections detail the background information collated by the DPI to support the SSDP 5-Year Review: 2000 – 2005.

[1] This information can be linked spatially to the statewide property cadastre as maintained by the Department of Sustainability and Environment (DSE) as part of their Vicmap Property dataset. This dataset is updated on a continual basis with no property details being more than four years old. The dataset includes property numbers, council land classifications and agricultural activity descriptions (Spatial Sciences Section, PIRVic, DPI, 2007).

3. Results

3.1. Change in Land Use

Irrigation areas within the SIR were categorised into the following five land use enterprises: dairying, grazing, horticulture, mixed farming and lifestyle farming. Changing trends within these enterprises were analysed for the years 1996/97 and 2003/04. Raw data for each of these years is presented in **Appendix A.** The change in land use between these two years is shown in **Table 1. Table 1** is included in **Volume 1** (**Table 4**) of the SSDP Review: 2000-2005.

Table 1: Change in Enterprise Area between 1996/97 to 2003/04

Land Use	Area (Ha)		
	1996/97	2003/04	Change (%)
Dairying	198,817 ha	189,866 ha	5% reduction
Grazing	100,741 ha	60,793 ha	40% reduction
Horticulture	20,127 ha	15,464 ha	23% reduction
Mixed Farming	89,547 ha	121,448 ha	36% increase
Lifestyle	N/A	22,255 ha	N/A
Total Area	**409,232 ha**	**409,826 ha**	

Source: (DPI, Andrew Macalister).

Some key trends in the information collated for the years 1996/97 and 2003/04 include:

1. A reduction in the areas of grazing and horticulture
2. An increase in the area of mixed farming
3. The introduction of a new land use category referred to a 'Lifestyle Faming' (i.e. farms which are generally not financially viable in their own right with the owner having a supplementary off-farm income).

3.2. Land Use in SSDP Target Area

To enable the viability of the SSDP to be verified the land use in the area at risk and the area protected by the SSDP works was established. The distribution of land use regimes within the area served by SSDP works and within the area at risk of waterlogging and salinisation for 2003/04 is presented in **Appendix B.**

Row 1 titled "*Defined area at risk*" and Row 6 titled "*SSDP including non-SSDP pumps*" formed the basis for the summary table presented in **Table 2.** This table is included in **Volume 1** (**Table 5**) of the SSDP Review: 2000-2005.

Row 1 focuses on the area of each land use regimes that is at risk of salinisation and waterlogging in 2003/04. Row 6 details the area of each land use regime that was protected by the SSDP (including non-SSDP pumps) in 2003/04.

For the SSDP Economic Evaluation a 60:20:20 ratio was adopted for perennial pasture, annual pasture and cropping, and dryland respectively which is close to the 75% irrigated and 25% dryland. This is compared with 45:30:25 for the area currently served for 2003/04 and 25:30:45 for the area at risk.

The SSDP works are focussed on the areas of high irrigation intensity and the use of 2003/04 (a year of 100% water allocation but no sales) is believed to be a conservative representation of what will happen in the future. The land use assumptions used in the Economic Evaluation are therefore thought to be reasonable.

Table 2: Distribution of Area Served and at Risk in 2003/04

Land Use	Area at Risk of Salinisation and Waterlogging (%)	*Area Served by existing SSDP Works (%)
Horticulture	2%	3%
Perennial Pasture	23%	42%
Annual Pasture and Cropping	30%	30%
Other (Non-irrigated)	45%	25%
Total	100%	100%

Source: (DPI, Andrew Macalister)
Note: *Percentages include non-SSDP private pumps.

4. Conclusion

Land use information has been collated by the Department of Primary Industries for 2003/04 and **Table 1** and **Table 2** of this report have been prepared to support the 2005 Sub-surface Drainage Program 5-Year Review.

Appendix A

Appendix A: Changes in Enterprise Area for the years 1996/97 and 2003/04

Irrigation area within the SIR for the years 1996/97 and 2003/04 are presented in **Table A1** and **Table A2** respectively.

Table A1: 1996/97 Irrigation Area within the SIR

	Irrigation Area 1996/97				
Land Classification	**Central Goulburn**	**Murray Valley**	**Rochester**	**Shepparton**	**Total**
Dairy Production	79,251	53,670	38,049	27,846	198,817
Grazing	34,101	27,355	20,145	19,140	100,741
Horticulture	5,341	4,535	3,594	6,658	20,127
Mixed Farming	18,541	32,165	21,510	17,330	89,547
Lifestyle					
Total	**137,235**	**117,725**	**83,299**	**70,974**	**409,232**

Table A2: 2003/04 Irrigation Area within the SIR

	Irrigation Area 2003/04*				
Land Classification	**Central Goulburn**	**Murray Valley**	**Rochester**	**Shepparton**	**Total**
Dairy Production	80,930	50,597	33,273	25,067	189,866
Grazing	5,806	44,179	1,537	9,271	60,793
Horticulture	5,135	3,794	496	6,039	15,464
Mixed Farming	43,223	8,934	38,673	30,618	121,448
Lifestyle	11,710	3,078	3,040	4,427	22,255
Total	**146,803**	**110,583**	**77,018**	**75,422**	**409,826**

* Total area irrigated was determined for the area as outlined in **Section 2** and then adjusted to suit the known areas of each entity.

Appendix B

Appendix B: Distribution of Area Served and at Risk in 2003/04

The land use figures presented in **Table B1** are based on 2003/04 which was a year of 100% water allocation and dryer than average. The figures summarised in the SSDP Review: 2000 – 2005 were those highlighted in rows 1 and 6.

Row 1 titled "*Defined area at risk*" and Row 6 titled "*SSDP including non-SSDP pumps*" formed the basis for the summary table presented in **Table 2** of this report. Row 1 focuses on the area of each land use regimes that is at risk of salinisation and waterlogging in 2003/04. Row 6 details the area of each land use regime that was protected by the SSDP (including non-SSDP pumps) in 2003/04.

Table B1: Distribution of Area Served and at Risk in 2003/04

ITEM	Total Area	Perennial Pasture	Annual Pasture and Crops	Permanent Plantings	Other	Perennial Pasture	Annual Pasture and Crops	Permanent Plantings	Other
1. Defined area at risk	**354,553**	82,664	104,913	8,015	158,961	23%	30%	2%	45%
2. SSDP Whole	**41,255**	16,922	12,490	861	10,982	**41%**	**30%**	**2%**	**27%**
3. SSDP Public Pump Program	**9,249**	3,739	2,885	55	2,570	40%	31%	1%	28%
4. SSDP Private Pump Program									
New Pump Area	**26,199**	9,965	8,007	428	7,799	38%	31%	2%	30%
Upgraded Pump Area	**7,864**	3,307	2,261	145	2,151	42%	29%	2%	27%
5. SSDP Horticulture Pumps	**388**	19	65	266	38	5%	17%	69%	10%
6. SSDP inc non-SSDP pumps	**72,697**	31,071	21,637	1,967	18,022	43%	30%	3%	25%
Non-SSDP pumps	**40,266**	16,968	11,695	1,144	10,459	42%	29%	3%	26%

Data based on 2003/04 Data

SSDP Economic Assessment (March, 2004):
"This is based on an average mix of 60% perennial pasture,20% of annual pasture and 20% of dryland within the gross areas served."

ACTUAL
"This is based on an average mix of 45% perennial pasture,30% of annual pasture and 25% of dryland within the gross areas served."

Section D – Projected SSDP Salt Disposal Entitlements

Projected Sub-surface Drainage Program
Salt Disposal Entitlement Needs to 2030

December 2006

Hydro Environmental

TABLE OF CONTENTS

1. Purpose of Paper

The purpose of this paper is to document the Shepparton Irrigation Region Subsurface Drainage Program (SSDP) Salt Disposal needs for inclusion in the 2000-2005 SSDP 5 Year Review (2007).

2. Report

2.1. Approach

As the 5 Year SSDP Review did not involve a detailed revision of the 1990 SSDP, the significant analytical and modelling effort required to accurately determine the salt loads and the consequential impact at Morgan was not warranted. The salt disposal needs for the SSDP review were therefore determined on a pro-rata basis using the 2002, 5 year review figures in Table 5.2 (on page 30 of that review document) as a basis and changing each of the requirements based on the area to be served in each category listed.

It should also be noted that the SSDP implementation period has been extended from the 2023 set in the 2002 review to 2030 as part of the 2005 Review.

2.2. General Analysis

Table 1, which shows the SSDP salt load predictions s at 2002, is a reproduction of Table 5.2 in the 2000 SSDP 5 Year Review.

Table 1: Salt Disposal Needs as Shown in 2002 SSDP Review - Table 5.2

Ownership	Private			Public			Total
Management Area Type	C	Low B3	High B3 Private	High B3 Public	B2	B1	
		85,000		85,000			170,000
Total Area (ha) 2023	71,000	73,000	12,000	57,000	18,000	10,000	241,000
Area Drained (ha)	1,300	73,000	12,000	57,000	18,000	10,000	171,300
Winter Salt Load (t)	1,300	15,500	3,600	31,920	16,800	0	69,120
Summer Salt Load (t)	0	0	0	7,980	4,200	0	12,180
Total (t)	1,300	15,500	3,600	39,900	21,000	0	81,300
Approx Salt Impact (EC)	**0.2**	**2.3**	**0.5**	**5.8**	**3.1**	**0**	**11.9**

Note: 1. Sourced from SKM's Sub-Surface Drainage Program Review 1999/2000 (pg 30 Table 5.2)
2. These figures do not include an allowance for C Type areas of 3.8 EC.

As a result of the investigations undertaken as part of the SSDP Baseline Statistics Project (refer to the 2005 SSDP Review Report Volume 2) the area to be protected by the SSDP by the year 2030 has increased from 170,000 ha to 183,000 ha. The difference in the nominal area to be protected by each type of SSDP work can be determined by reference to the differences between the figures presented in Table 1 and Table 2. The main difference being that the private pumps are now expected to protect 100,000 ha compared to the 85,000 ha as assumed in the year 2002 Review.

The new area of C Type land has been calculated to be 116,000 ha by assuming the following:
60,220 ha Corop Area x 0.7 (70%) + (71,000 ha (Old C Type Area) x (177,000 (New C Type area from Baseline statistics)/170,000 (Old B type area))) = 42,000 + 73,923 = 115,923 ha.
= 116,000 ha (say).

Table 2: 2005 Salt Disposal Needs Including the Area Serviced by Non Plan Pumps

Total Area Served - 2005 Review							
Ownership	**Private**			**Public**			**Total**
Management Area Type	**C**	**Low B3**	**High B3 Private**	**High B3 Public**	**B2**	**B1**	
	1,300	98,700		85,000			185,000
Total Area (ha) 2030	116,000	84,700	14,000	57,000	18,000	10,000	299,700
Area Drained (ha)	1,300	84,700	14,000	57,000	18,000	10,000	185,000
Winter Salt Load (t)	1,300	18,000	4,200	31,920	16,800	0	72,220
Summer Salt Load (t)	0	0	0	7,980	4,200	0	12,180
Total (t)	1,300	18,000	4,200	39,900	21,000	0	84,400
Approx Salt Impact (EC)	**0.2**	**2.7**	**0.6**	**5.8**	**3.1**	**0.0**	**12.4**

Note: 1. These figures do not include an allowance for C Type areas of 3.8 EC.

A small amount (1,300 ha) of the C Type area has already been protected, however, the remaining 114,700 ha has been excluded from the project SSDP salt load because of the uncertainty regarding the type of works to be installed, the location of the area and the expected volume and quality of the water to be extracted. The 2002 5 year review assumed this area would require an additional 3.8 EC of salt disposal credits.

To simplify the calculations the 2005 SSDP 5 Year Review (2007), new salt loads have been determined by assuming the requirements are proportional to the change in total area to be served in each management area type. **Table 2** shows the recalculated salt disposal needs are 12.4 EC compared to 11.9 EC reported in the 2002 SSDP Review.

The corresponding average overall relationship between salt generated and EC impact at Morgan is 6,800 t/EC. The SIR Salinity Audit - Final Report Sept 2006 (which applies to works up to 30th June 2004) reported an average overall relationship between salt generated and EC impact at Morgan for private pumps would be 6,500 t/EC and for public pumps would be 6,000 t/EC. Using these figures, which would be overly conservative, the total impact for all pumps would be approx 13.8 EC.

2.3. Economic Analysis

The economic evaluation used for the SSDP 5 Year Review (2007) determined the difference in the benefits between the "No Program" and "With Program" Scenarios. This effectively means that the Non Plan private pumps are excluded from the analysis with the division between management area types being as shown in **Table 3**.

On a pro-rata basis this means that the total area to be protected would be 147,300 ha. If a pro-rata apportionment of the 2002 SSDP Review salt loads this corresponds to the salt disposal entitlement requirements of 11.1 EC.

■ **Table 3: Economic Evaluation Salt Load Requirements excluding area serviced by non plan pumps**

Total Area Drained by SSDP - 2005 Review							
Ownership	**Private**			**Public**			**Total**
Management Area Type	**C**	**Low B3**	**High B3 Private**	**High B3 Public**	**B2**	**B1**	
	1,300	61,000		85,000			147,300
Total Area (ha) 2030	116,000	52,400	8,600	57,000	18,000	10,000	262,000
Area Drained (ha)	1,300	52,400	8,600	57,000	18,000	10,000	147,300
Winter Salt Load (t)	1,300	11,100	2,600	31,920	16,800	0	63,720
Summer Salt Load (t)	0	0	0	7,980	4,200	0	12,180
Total (t)	1,300	11,100	2,600	39,900	21,000	0	75,900
Approx Salt Impact (EC)	**0.2**	**1.7**	**0.4**	**5.8**	**3.1**	**0.0**	**11.1**

Note: 1. These figures do not include an allowance for C Type areas of 3.8 EC.

2.4. Short Term Requirements for Salt Disposal

For the SSDP 5 Year Review (2007) it was necessary to provided an indication of the salt disposal needs for the proceeding 6 year period to 2011 and to identify the indicative salt disposal requirement to 2011. This calculation was undertaken before the SSDP Salt Audit project was completed. It was therefore assumed that the 2002 Review figures would be pro-rata-ed as indicated in Table 4.

■ **Table 4: Short Term Salt Disposal Requirements**

Item		**2006-11**	**1990 - 2011**	**2030**
Non Plan Private				
Area	ha	0	37,700	37,700
Salt Discharge	EC	0	1.2	1.2
Private Plan				
Pumps	ha	5,020	26,460	51,000
Upgrades	ha	1,230	6,210	10,000
Total	ha	6,250	32,670	61,000
Salt Discharge	EC	0.22	1.12	2.10
Public				
Area	ha	3,580	12,550	75,000
Salt Discharge	EC	0.42	1.49	8.90
C Type areas				
Area	ha	140	546	1300
Salt Discharge	EC	0.02	0.08	0.20
Total Salt Disposal Needs (EC)		**0.7**	**3.9**	**12.4**

Note: 1. These figures do not include an allowance for C Type areas of 3.8 EC

3. Conclusions

It is concluded that the salt disposal requirements of the SSDP are as follows:

i) For full SSDP implementation by 2030 is 12.4 EC (excluding the 3.8 EC which may be required to undertake the protection of the C Type areas). This total is comparable with the 11.9 EC estimated in 2002

ii) For full SSDP implementation by 2030 (excluding the Non Plan Private pumps is 11.1 EC excluding the 3.8 EC which may be required to undertake the protection of the C Type areas)

iii) The indicative requirements for salt disposal over the next 6 years is an additional 0.7 EC over the year 2006 figures bringing the indicative total SSDP requirements to the year 2011 to 3.9 EC.

xxxxXXXXxxxx

Section E – SSDP Research and Investigation Strategic Plan

Hydro Environmental

Shepparton Irrigation Region Catchment Strategy

Sub-surface Drainage Program Research and Investigation Strategic Plan Revision 2007-11

This Document has not been included a copy can be obtained from Goulburn-Murray Water Reference Doc # 2253024

June 2007

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1.0 Purpose

Hydro Environmental was engaged by G-MW to review the current Sub-surface Drainage Program (SSDP) Research and Investigation (R&I) Strategic Plan.

This is the first revision that has been undertaken on the SSDP R&I Strategic Plan since its inception in 2003. This revision focuses on the development and implementation planning of the SSDP R&I Strategic Plan for the period 2007-11.

The timing of the SSDP R&I Strategic Plan (2007-11) has been set to coincide with the development of the SSDP 5-Year Review which is scheduled for 2010/11.

1.1 Objectives of the Project

The specific objectives of the overall project were to:

1. Confirm the issues related to the SIR SSDP which are to be dealt with over the next four years
2. Classify the issues as strategic, research or operational (including Groundwater Management Plan) issues
3. Develop a reporting framework including a process for the development of revised priorities
4. Develop projects and sub-project outlines to deal with the highest priority issues
5. Establish realistic objectives for priority projects
6. Identify what works have been completed, are already in progress or are programmed
7. Review current priorities
8. Formulate a R&I based work program with 1-year and 4-year objectives and milestones
9. Identify resource requirements.

2.0 Summary of R&I Project Outputs

In summary:

1. The 2007-11 SSDP R&I Strategic Plan has resulted in the outputs identified in **Table 1**
2. The brief outlines for all 73 projects are included under Major Project Headings in **Attachment 10** of the full document Goulburn-Murray Water Reference Doc # 2253024. However, only 41 of these are expected to be addressed if the budget is limited to a maximum of $900,000 per year
3. The proposed projects to be implemented in 2007/08 projects are listed in **Table 2**.

Table 1: Summary of 2007 R&I Review Process

Item	Identified	Identified and developed to projects	To be addressed by the proposed Implementation Program
New Issues	333	88	21
New Issues addressed by modifying current projects	9	-	8
New Projects Developed	-	37	14
Projects being implemented as of 1 July 2007	22	-	22
Budget and Expenditure	-	-	$800,000 (2007/8 and 2008/09) $900,000 (2009/10 and 2010/11)
Total number of Projects in the new Program	73	73	41

Table 2: SSDP R&I Strategic Plan Projects to commence in 2007/08

No.	Project ID	Project Title	Status
1.	GG02 001	Development and Management of the SSDP R&I Strategic Plan	Current
2.	GG02 002 & 10	Review SSDP Management Structure AND Improvement in Communication between SSDP Mgmt. Stakeholders (& funding bodies)	Current
3.	GG02 003	Drainage Catchment Scale Planning	Current
4.	GI03 014	Assessment of Chemical Elements/Compounds in Groundwater	Current
5.	GG03 020	Develop management options for "C-Type" areas	Current
6.	GG03 030	Evaporation basin design, ownership and promotion	Current
7.	GG03 045	Investigation of New Technologies	Current
8.	GG03 047	Aquifer Relationships/Deep Lead Impacts	Current
9.	GG03 048	Salt Audit Model - User Manual	Current
10.	GC04 005	Review of SIRCS Cost Shares	Current
11.	GG04 049	Watertable behavior analysis	Current/New
12.	GG05 026	Review of salt conveyance practices	Current
13.	GG06 007	Review Impact of Projected Changes in Groundwater Levels and Salinity	Current
14.	GG06 031	Operation and Design Review of "Salinity Plan Bore" Groundwater Pumps	Current
15.	GG06 034	Phase A Operation Principles	Current
16.	GI06 054	Impact of water trade on agricultural ecosystems	Current
17.	GI06 055	Mt Scobie Partial Conjunctive re-use study	Current
18.	GG07 009P	Indicative quantification of water resources generated by SSDP	New
19.	GI07 021P	Succession planning for community education and involvement	New
20.	GG07 027P	Periodic forensic analysis of surface water monitoring data	New
21.	GI07 037P	Establish a trial to determine SSDP requirements for high value environmental features	New

Section F – SSDP Baseline Statistics

Shepparton Irrigation Region Catchment Strategy

Sub-surface Drainage Program Baseline Statistics

FINAL

November 2006

Document History

Revision	Date Issued	Reviewed By	Approved By	Date Approved	Revision Type
1	6 October 2006	Peter Alexander	Charles Bird	6 October 2006	Draft 1
2	24 October 2006	Peter Alexander	Charles Bird	24 October 2006	Draft 2

Distribution of Copies

Revision	Copy No.	Quantity	Issued To
1	Draft 1	1	Terry Hunter, Peter Dickinson, James Burkitt, Heinz Kleindienst, Martin Brownlee, Ken Sampson, Chris Solum
2	Draft 2	1	Terry Hunter
3	Final	1	Attached to SSDP 2000 – 2005 Review

Table of Contents

List of Tables

List of Figures

1 PURPOSE

The purpose of this report is to present the base line statistics, such as the area served[1] (protected) by each type of salinity and groundwater management systems, associated with the implementation of the Shepparton Irrigation Region Catchment Strategy (SIRCS) Sub-surface Drainage Program (SSDP).

2 BACKGROUND

The SIRCS is half way through its 30 year implementation program. The SSDP is a major program of the SIRCS.

The mission of the SSDP 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*."

This mission is partly achieved by the implementation and operation of salinity and groundwater management systems, such as public groundwater pumps, private groundwater pumps and tile drainage systems.

It is important that the implementation, operation and area served[1] by these systems be recorded for reporting purposes. However, the data management systems in which this data is recorded are not centralised and there is some discrepancy between the data sources.

The need to have greater certainty associated with the number of salinity and groundwater management systems and areas served at the start of the SSDP was agreed at a workshop of key stakeholders held on 1 February 2006, as part of the SSDP 2000 - 2005 Review risk assessment. As a result, Hydro Environmental has been engaged to assist Goulburn-Murray Water to determine the underlying (base line) statistics associated with the implementation of the SSDP.

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[1] The area served is considered to be the area over which there is some drawdown in groundwater pressures/water level in response to groundwater pump operation, or some watertable drawdown due to the operation of tile drains.

3 SSDP TARGET SERVED AREA

During the course of the project, it became apparent that the basis on which the area served by the SSDP needed to be understood to determine which type, and how many, salinity and groundwater management systems should be included to achieve full SSDP implementation. This need became apparent as a result of the change in focus with the SSDP becoming more outcome focussed.

3.1 Previous Target Area to be served by the SSDP

In the last review the SSDP (SKM, 2002) the target area to be served by the SSDP was identified to be 171,300 ha, which comprised:

- Pasture – 170,000 ha
    - 85,000 ha served by Public pumps
    - 85,000 ha served by Private pumps
- Horticulture – 1,300 ha
    - 1,000 ha served by low volume groundwater pumps
    - 300 ha served by tile drainage systems.

It was concluded that the target for pasture areas (170,000 ha) was based on the Type B management areas (aquifers with medium – high yield) within the projected year 2020 0-2 m watertable contour. This is supported by the projected 2020 high watertables and aquifer characteristics quantified in **Table 1** and shown in **Figure 1**. As shown in **Figure 1**, some areas of the Type B management areas are located outside of the SIR, and therefore need to be excluded from the target area.

Table 1: Area of High Watertables and within Aquifer Classes

High Yielding Aquifers	**1987** (ha)	**2020** (projected) (ha)
< 1,700 EC (Type B_3)	33,200	52,300
1,700 - 3,300 EC (Type B_3)	11,575	15,650
3,300 - 5,000 EC (Type B_3)	45,525	71,575
5,000 - 11,700 EC (Type B_2)	10,900	20,275
> 11,700 EC (Type B_1)	4,250	10,500
	105,450	**170,300**

Source: Adapted from: Goulburn Broken Region Salinity Pilot Program Advisory Council, 1989, p.61.

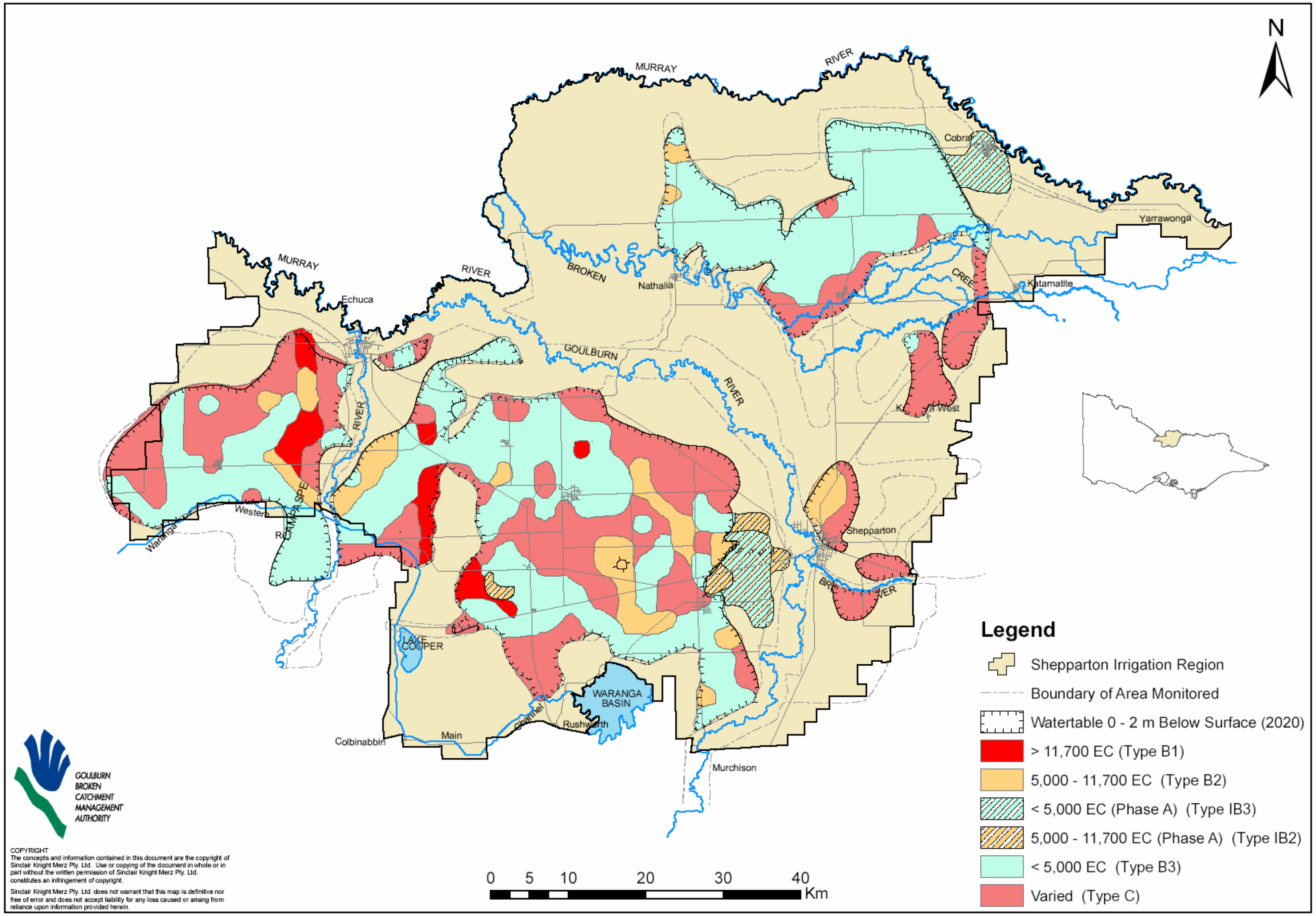
3.2 Revised Target Area to be served by the SSSP

It was agreed that the area at risk of salinisation and waterlogging in the SIR be defined and mapped to determine the target area to be served by the SSDP (Alexander, P, Hunter, T, and Kleindienst, H, 2006, pers. comm. 29 March). A map of the defined area at risk of salinisation and waterlogging in the SIR is shown in **Figure 2**. This map was prepared taking the following into consideration:

- Projected 2020 0-2 m watertable contour within the SIR (refer to **Attachment 1**)
- The area covered by the 1996 0-3 m watertable contour that extends beyond the projected year 2020 0-2 m watertable contour within the SIR. This takes into consideration the improved water level information now available after expansion of the groundwater monitoring network (refer to **Attachment 1**).

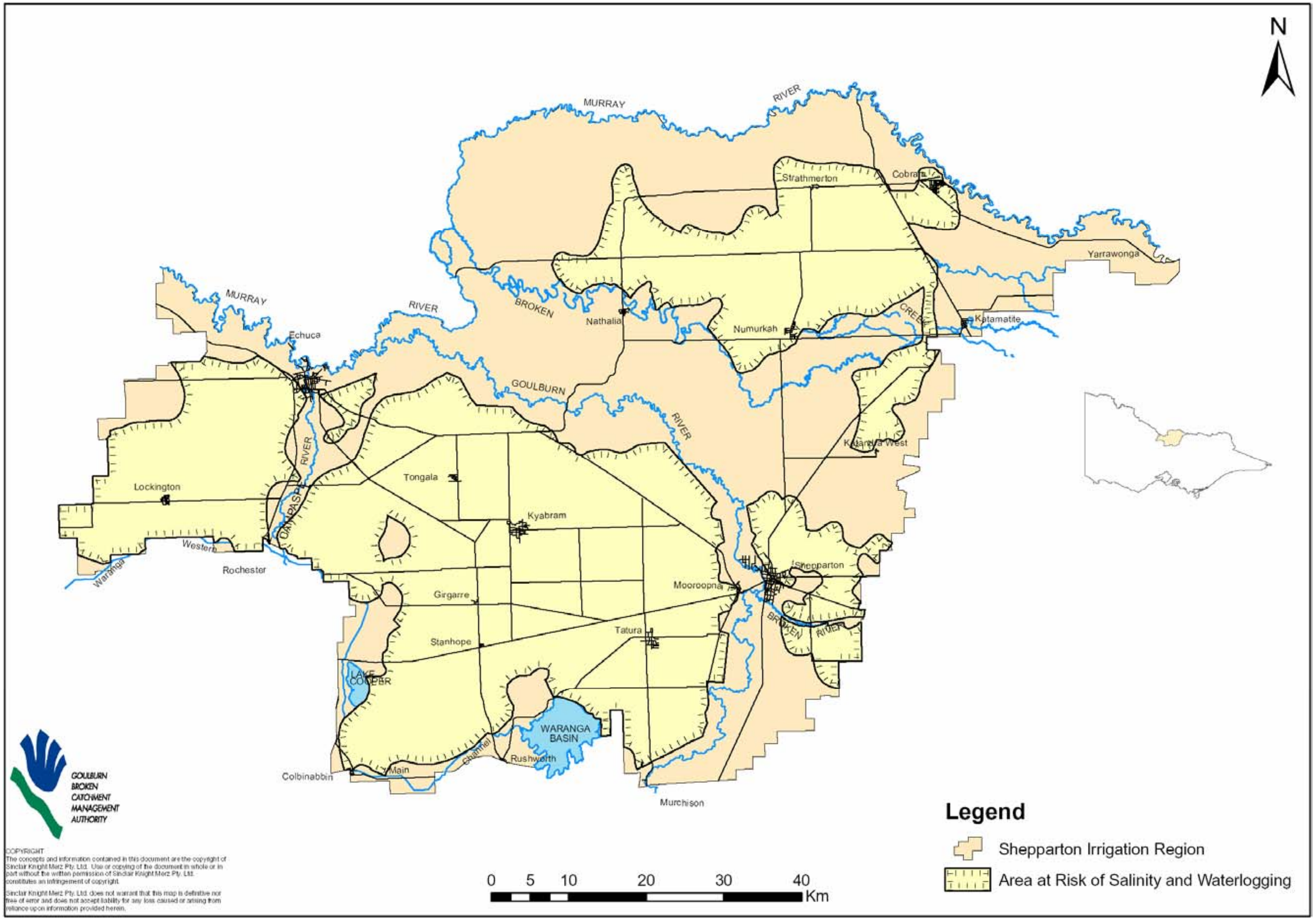
- The area of influence of Phase A groundwater pumps that occur outside the 1996 0-3 m and the projected 2020 0-2 m watertable contour.

Figure 1: Shepparton Irrigation Region Management Areas and Projected 2020 0-2m Watertable Contour



Source: Adapted from: Goulburn Broken Region Salinity Pilot Program Advisory Council, 1989, p.65.

Figure 2: Defined Area at Risk of Salinisation and Waterlogging in the SIR



As indicated in **Section 3.1**, it was concluded that the target set in 1990 for pasture areas (170,000 ha) was based on the Type B management areas (aquifers with medium – high yield) within the projected 2020 0-2 m watertable contour. The revised target area to be served by the SSDP was determined to be **185,000 ha**. The methodology followed to determine the revised target area is summarised in **Figure 3** and presented in detail in **Attachment 2**.

Figure 3: Summary of Methodology to determine the Revised SSDP Target Service Area

Type B Management Area (high - medium yielding aquifers) within the projected 2020 0-2 m watertable contour within the SIR	177,337 ha
+	
Area of 1996 0-3 m watertable contour that extends beyond the projected 2020 0-2 m watertable contour	60,220 ha
X	
Assumed[(i)] relative proportion of B Type Management Area within the Total Area of 1996 0-3 m contour that extends beyond the projected 2020 0-2 m watertable contour	30%
+	
Phase A Area outside of the Composite Boundary	6,423 ha
-	
Area currently served by Phase A pumps and the Girgarre Evaporation Basin System (installed prior to SSDP)	-19,749 ha
+	
Area currently served by pumps that have been installed and upgraded with SSDP assistance (Capital Grants) outside of the Defined Area at Risk of Salinity and Waterlogging	2,901 ha
=	
Area at Risk to be served by the SSDP	**185,000 ha**

(i) We have a sound understanding that the majority of the additional area outside the 2020 0-2 m boundary is C Type, and have assumed that only 30% of this area is B Type.

4 SSDP BASELINE STATISTICS

4.1 Scope

It was agreed that SSDP implementation base line statistics be determined for the years 1 January 1988, 30 June 1990, 30 June 2005 and the change from 30 June 2000 to 30 June 2005, for each of the following zones:

- the SIR
- each of the G-MW Irrigation Areas (IAs)
- Goulburn-Broken Catchment Management Authority (GB CMA) and North Central CMA (NC CMA) within the SIR.

Where possible, for the abovementioned dates and zones, determine the:

- number of salinity and groundwater management systems and areas served by each of these systems
- area served by each of the system types without considering overlap
- area served by each of the system types after allowing for overlap (i.e. areas of overlap are not double counted).

For the purpose of this report, the area served is considered to be the area over which there is some drawdown in groundwater pressures/water level in response to groundwater pump operation, or some watertable drawdown due to the operation of tile drains.

Salinity and groundwater management systems to be considered as part of this study include:

(i) SSDP Private Pasture pumps
(ii) SSDP Public pumps
(iii) SSDP Private Horticulture pumps (watertable control)
(iv) SSDP tile drains
(v) Phase A pumps (watertable control)
(vi) Girgarre evaporation basin system pumps
(vii) Non-SSDP Private pumps.

4.2 SSDP Baseline Statistics Summary

A map of the current area served by the SSDP works within the SIR is presented in **Figure 4.**

A map of the current area served by the SSDP works plus Public Phase A pumps and Girgarre Evaporation Basin System infrastructure within the SIR is presented in **Figure 5.**

A summary of the SSDP baseline statistics (i.e. number of pumps and area served) is presented in **Table 2**. The key points in the table include:

- The target area to be served by the SSDP is 185,000 ha, requiring approximately 1,570 pumps, 50 evaporation basins and 300 ha of tile drainage
- The SSDP currently serves an area of approximately 73,000 ha
- The remaining area to be served by the SSDP is approximately 112,000 ha
- Target area to be served by the Private pumps is approximately 99,000 ha, requiring approximately 1,100 pumps
- 756 pumps Private pumps currently serve an area of approximately 66,000 ha (not allowing for overlap with SSDP Public pumps)
- The remaining area to be served by the SSDP Private Pasture pumps is approximately 32,000 ha, by approximately 340 SSDP Capital Grant pumps
- Target area to be served by the SSDP Public pumps is approximately 85,000 ha, requiring approximately 425 pumps, of which 50 will discharge to evaporation basins
- 43 pumps SSDP Public pumps currently serve an area of approximately 9,000 ha (not allowing for overlap with Private pumps)
- The remaining area to be served by the SSDP Public pumps is approximately 76,000 ha, by approximately 382 SSDP Capital Grant pumps which 50 will discharge to evaporation basins
- There are currently no evaporation basins installed with SSDP assistance, and the target to be installed remains at 50. The area served by evaporation basins installed with SSDP is included under SSDP Public pumps
- Target area to be served by the Private Horticulture pumps is approximately 1,000 ha, requiring approximately 50 pumps
- Private Horticulture pumps currently serve an area of approximately 400 ha (not allowing for overlap with SSDP Public pumps or Private Pasture pumps) with 20 pumps
- The remaining area to be served by the SSDP Private Horticulture pumps is approximately 600 ha, with approximately 30 SSDP Capital Grant Horticulture pumps
- Only 16 ha of tile drains have currently been installed with SSDP Capital Grant assistance, leaving 300 ha to be installed by 2029/30.

Figure 4: Area Currently Served by the SSDP within SIR – June 2005

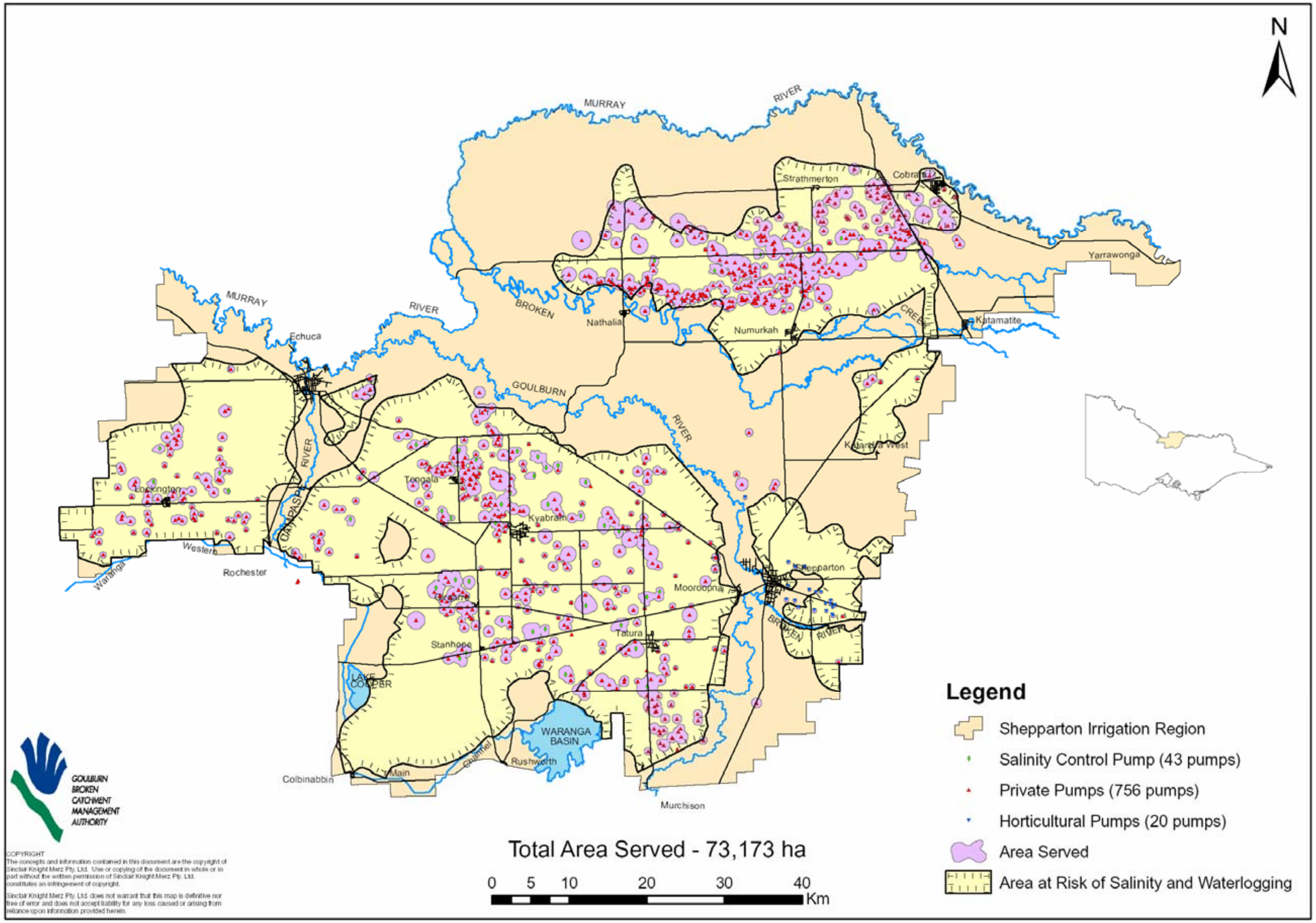


Figure 5: Area Currently Served by the SSDP, Phase A pumps and Girgarre Infrastructure within the SIR – June 2005

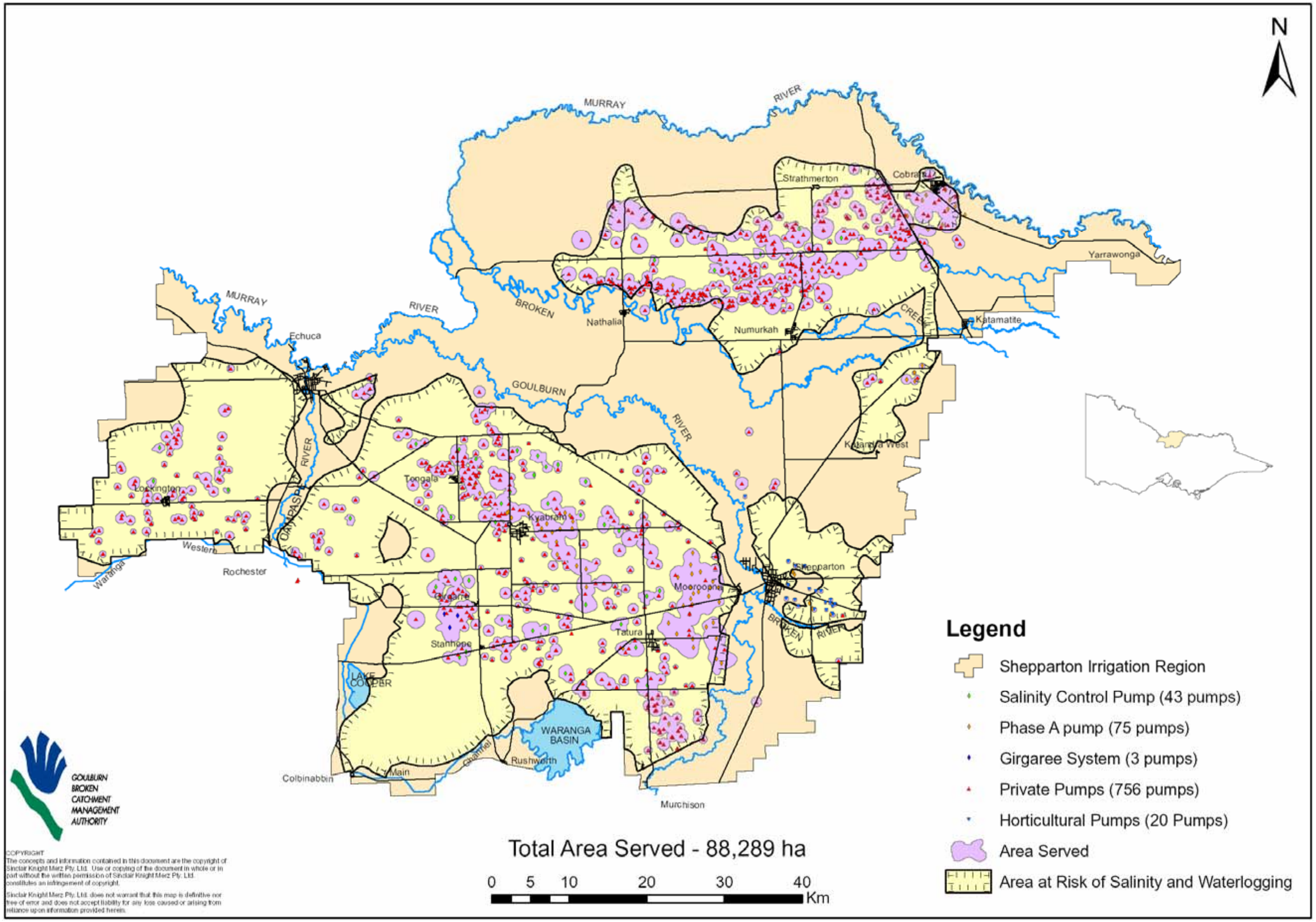


Table 2: SSDP Baseline Statistics Summary

Sub-surface Drainage Protection Elements	Achieved by June 30 2000		Achieved by June 30 2005		End of Plan Target (set October 2006)		Remaining Works and Area to be Served	
	(No.)	Area Served (ha)	(No.)	Area Served (ha)	(No.)	Area Served (ha)	(No.)	Area Served (ha)
Area Served by SSDP (allowing for overlap)	**667**	**59,511**	**819**	**73,173**	**1,571**	**185,000**	**752**	**111,827**
Area Served by SSDP (not allowing for overlap)	**667**	**59,380**	**819**	**75,484**				
Private Pumps	**627**	**54,502**	**756**	**65,830**	**1,096**	**98,640**	**340**	**32,810**
SSDP Private Pumps (New + Upgrades)	*238*	*25,328*	*313*	*32,671*	*653*	*58,770*	*340*	*26,099*
New Pumps installed with Capital Grant Assistance	192	20,201	254	26,729	541	48,690	287	21,961
Existing Pumps upgraded with Capital Grant Assistance	46	6,126	59	7,858	112	10,080	53	2,222
Non-SSDP Private Pumps within Area at Risk	*389*	*35,311*	*443*	*40,213*	*443*	*39,870*	*0*	*-343*
Public Pumps (Reuse + Evaporation Basins)	**21**	**4,487**	**43**	**9,249**	**425**	**85,000**	**382**	**75,751**
Evaporation Basins	**0**	**0**	**0**	**0**	**50**	**-**	**50**	**-**
Horticulture Private Pumps (New)	**19**	**375**	**20**	**389**	**50**	**1,000**	**30**	**611**
New Pumps installed with Capital Grant Assistance	19	375	20	389	50	1,000	30	611
Horticulture Tile Drains	**-**	**15.9**	**-**	**15.9**	**-**	**300**	**-**	**284**

The pre-SSDP figures below are additional to those above

Phase A Pumps	76	18,405	75	18,392				
Girgarre pumps	3	1,357	3	1,357				
Total Area Served by Phase A and Girgarre Pumps (allowing for overlap with area served by SSDP)			78	15,116				

LEGEND

Area served has been estimated by multiplying the number of pumps by the average area served per pump in June 2005.
Number of non-SSDP pumps within area at risk has been estimated (Hunter, T 2006, pers.comm. 15 September).
The negative area served figure is due to the increased overlap with existing pumps.

4.3 SSDP Private Pasture pumps

SSDP Private Pasture pumps are privately owned by landholders and operate to provide local salinity control and the landholder with access to a groundwater resource.

SSDP Private Pasture pumps can be classified as:

a. **New** SSDP Private Pasture pumps which are new pumps that have been installed with SSDP Capital Grant assistance
b. **Upgraded** SSDP Private Pasture pumps which are existing pumps that have been upgraded with SSDP Capital Grant assistance.

SSDP Private Pasture pumps include low yield pumps (Type C Area pumps).

SSDP Private Pasture pumps do not include voluntary Salinity Plan (SPB) Bore pumps.

4.3.1 Assumptions

The area served by SSDP Private Pasture pumps is based on the assumption that 1 ML of Licence Entitlement equates to 0.6 ha of area served. This assumption was based on the average SIR private pump extraction compared to Licence Entitlement for the period 2000/01 – 04/05, which was approximately 60 %. Refer to **Attachment 3** for further details. This is a more conservative assumption than that currently used for reporting area served to the SIRCS, namely 1 ML of Licence Entitlement equates to 1 ha of area served.

Some SSDP funded Private Pasture pumps are located outside the currently defined area at risk of salinisation and waterlogging (refer to **Figure 2**). These pumps were installed or upgraded with SSDP Capital Grant assistance because at the time of assessment they were located in areas at risk of salinity.

4.3.2 Number of SSDP Private Pasture pumps

There were two main data sources that were cross-checked to determine the new number of SSDP Private Pasture pumps installed with SSDP Capital Grant assistance:

(i) G-MW's Billing and Customer Care System (BICCS) database, at 30 June 2006. The G-MW BICCS database captures the groundwater pumps that are licensed with G-MW at that point in time
(ii) G-MW SPB spreadsheet (DOCS #1658990).

Additional references used to identify the new number of SSDP Private Pasture pumps installed with SSDP Capital Grant assistance included:

(i) Sub-surface Drainage Program Review 1999/2000 (SKM, 2002)
(ii) Reporting undertaken by James Burkitt (G-MW) (Burkitt, J 2006, pers. comm.).

It became apparent early in the investigation that a number of inconsistencies between the data sources and references (i.e. data did not match). The number of new SSDP Private Pasture pumps reported by James Burkitt was greater than the number of SSDP Private Pasture pumps recorded in the SPB spreadsheet (DOCS #1658990). Additionally, not all of new SSDP Private

Pasture pumps recorded in the SPB spreadsheet could be found in the G-MW BICCS database, at 30 June 2005.

The discrepancy between the SPB spreadsheet and G-MW BICCS database could be due to delays in licensing information being uploaded and data entry errors. However, the discrepancy between the number of new SSDP Private Pasture pumps reported by James Burkitt (257 new SSDP Private pumps) and the number of SSDP Private Pasture pumps recorded in the SPB spreadsheet (248 new SSDP Private pumps) is unable to be explained. It is assumed that some of the pumps which received Capital Grants early in the SSDP were not correctly recorded.

G-MW has reported to the SIRCS that 257 new SSDP Private Pasture pumps had been installed by June 2005. This includes the installation of 63 new SSDP Private Pasture pumps during the period 2000/01 – 04/05. This indicates that 194 new SSDP Private Pasture pumps were installed by June 2000, which can be correlated with the number of new SSDP Private Pasture pumps reported in the Sub-surface Drainage Program Review 1999/2000 (SKM, 2002).

In view of these assumptions, for the purpose of reporting the number of new SSDP Private Pasture pumps SSDP 2000 – 2005 Review, G-MW has directed that 254 is the correct number of new SSDP Private Pasture pumps that have been installed by 30 June 2005 (Burkitt, J 2006, pers. comm., June).

The number of SSDP Private Pasture pumps that will be used for reporting purposes in the SSDP 2000 – 2005 Review is presented in **Table 3** and **Table 4**.

Table 3: Number of New SSDP Private Pasture pumps

	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	0	0	101	142[i]	41
Murray Valley IA	0	0	52	62	10
Shepparton IA	0	0	6	9	3
Rochester IA – GB CMA	0	0	6	6	0
Rochester IA – NC CMA	0	0	19	27	8
Details Unknown	0	0	6[ii]	6[ii]	0
SIR			190	252	62
Outside SIR - Campaspe ID	0	0	2	2	0
Total	0	0	192[iii]	254[iv]	62[v]

Table 4: New SSDP Private Pasture pumps in GB CMA and NC CMA

	1988	1990	2000	2005	2000 - 2005
GB CMA	0	0	165	219	54
NC CMA	0	0	21	29	8
Details Unknown	0	0	6[ii]	6[ii]	0

The following comments refer to the notations in **Table 3** and **Table 4**.

(i) The licence entitlement and coordinates for two SSDP Private Pasture pumps (ID: G8006074/01 and 112546), which are known to be located in Central Goulburn IA were not identified in the BICCS database. As a result, the data recorded in the G-MW SPB spreadsheet was used for each of these pumps.

(ii) G-MW has concluded that the details of six SSDP Private Pasture pumps are unknown. It is believed that the reporting errors were incurred during the early stages of the program (1990's), and as a result it will be very difficult to rectify the data discrepancies. The SPB spreadsheet will be amended to note the discrepancy and justification (Hunter, T 2006, pers. comm., 26 July).

(iii) The SSDP Review 1999/2000 (SKM, 2002) reports that 194 SSDP Capital Grant pumps were installed by 30 June 2000. G-MW has indicated that only 192 were installed by this time, with the discrepancy due to reporting errors made prior to 2000. (Burkitt, J 2006, pers. comm., 18 July).

(iv) Only 248 new SSDP Private pumps have been recorded in the SPB spreadsheet (DOCS #1658990). G-MW has indicated that 254 new SSDP Private pumps were installed by 30 June 2005 (Burkitt, J 2006, pers. comm., 18 July). There is evidence to support a figure between 248 and 257, however there is no firm data to support this figure which is provided by G-MW.

(v) G-MW has indicated that 62 new SSDP Private pumps were installed over the past five years (Burkitt, J 2006, pers. comm., 18 July). This is one less than the figure reported to SIRCS for the past five years.

4.3.3 Area served by New SSDP Private Pasture pumps

The area served by new SSDP Private Pasture pumps without considering overlap is presented in Table 5 and Table 6.

Table 5: Area Served by New SSDP Private Pasture pumps without considering Overlap

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	0	0	[i]	14,051	[i]
Murray Valley IA	0	0	[i]	10,639	[i]
Shepparton IA	0	0	[i]	756	[i]
Rochester IA – GB CMA	0	0	[i]	483	[i]
Rochester IA – NC CMA	0	0	[i]	2,314	[i]
Details Unknown	0	0	[i]	689[ii]	[i]
SIR	0	0	[i]	28,931	[i]
Outside SIR (Campaspe ID)	0	0	[i]	149	[i]
Total	0	0	22,043	29,080	7,037
Av. Area Served/Pump				115	

Table 6: Area Served by New SSDP Private Pasture pumps <u>without</u> considering Overlap in GB CMA and NC CMA

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Goulburn Broken CMA	0	0	i	25,929	i
North Central CMA	0	0	i	2,463	i
Details Unknown	0	0	i	689[ii]	i

The area served by new SSDP Private Pasture pumps after allowing for overlap is presented in Table 7 and Table 8.

Table 7: Area Served by New SSDP Private Pasture pumps allowing for Overlap

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	0	0	i	13,072	i
Murray Valley IA	0	0	i	9,635	i
Shepparton IA	0	0	i	730	i
Rochester IA – GB CMA	0	0	i	464	i
Rochester IA – NC CMA	0	0	i	2,191	i
Details Unknown	0	0	i	636[ii]	i
SIR	0	0	i	26,728	i
Outside SIR (Campaspe ID)	0	0	i	106	i
Total	0	0	20,364	26,834	6,470
Av. Area Served/Pump				106	

Table 8: Area Served by New SSDP Private Pasture pumps allowing for Overlap in GB CMA and NC CMA

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Goulburn Broken CMA	0	0	i	23,901	i
North Central CMA	0	0	i	2,297	i
Details Unknown	0	0	i	636[ii]	i

The following comments refer to the notations in **Table 5**, **Table 6**, and **Table 7** and **Table 8**.

(i) This figure is unable to be determined.

(ii) Area served was estimated by multiplying the number of pumps by the average area served by new SSDP Private Pasture pumps.

4.3.4 Number of Existing Private Pumps Upgraded with Capital Grant Assistance

The main data sources used to determine the number of existing Private pumps upgraded with SSDP Capital Grant assistance, include:

(i) G-MW SPB spreadsheet (DOCS #1658990)

(ii) Sub-surface Drainage Program Review 1999/2000 (SKM, 2002)

(iii) Reporting undertaken by James Burkitt (G-MW) (Burkitt, J 2006, pers. comm.).

James Burkitt reported that 70 SSDP Capital Grants had been given for Private pump upgrades by June 2005. However, the number of pumps upgraded with SSDP Capital Grant assistance identified in the SPB spreadsheet only totals 59. This discrepancy of 11 is due to an overlap where existing SSDP Private pumps have also been upgraded with SSDP Capital Grant assistance. This overlap can be due to either, multiple upgrades to a single pump, or upgrades to pumps that were originally installed with SSDP Capital Grant assistance (Burkitt, J 2006, pers. comm., 17 October).

The SPB spreadsheet will be amended to note the discrepancy and justification (Burkitt, J 2006, pers. comm., 17 October).

The number of existing Private pumps upgraded with SSDP Capital Grant assistance and the number of SSDP Capital Grants given is presented in **Table 9** and **Table 10.**

Table 9: Number of Existing Private Pumps Upgraded with Capital Grant Assistance

	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	0	0	12	16	4
Murray Valley IA	0	0	30	36	6
Shepparton IA	0	0	0	0	0
Rochester IA - GB CMA	0	0	0	0	0
Rochester IA - NC CMA	0	0	4	7	3
SIR Total	**0**	**0**	**46**	**59**	**13**
Capital Grant Overlap (Does not result in additional pumps) [i]	0	0	11	11	0
Total Capital Grants for Upgrades	0	0	57	70	13

Table 10: Number of Existing Private Pumps Upgraded with Capital Grant Assistance in GB CMA and NC CMA

	1988	1990	2000	2005	2000 - 2005
GB CMA	0	0	42	52	10
NC CMA	0	0	4	7	3
Capital Grant Overlap (Does not result in additional pumps) [i]	0	0	11	11	0

The following comments refer to the notations in Table 9 and Table 10.

(i) SSDP Capital Grants overlap where existing SSDP Private pumps have also been upgraded with SSDP Capital Grant assistance. This overlap can be due to either, multiple upgrades to a single pump, or upgrades to pumps that were originally installed with SSDP Capital Grant assistance (Burkitt, J 2006, pers. comm., 17 October).

4.3.5 Area served by Upgraded SSDP Private Pasture pumps

The area served by upgraded SSDP Private Pasture pumps without considering overlap is presented in Table 11 and Table 12.

Table 11: Area Served by Upgraded SSDP Private Pasture pumps without considering Overlap

	Area Served (ha)				
	1988	**1990**	**2000**	**2005**	**2000 - 2005**
Central Goulburn IA	0	0	i	2,730	i
Murray Valley IA	0	0	i	5,250	i
Shepparton IA	0	0	i	10	i
Rochester IA – GB CMA	0	0	i	0	i
Rochester IA – NC CMA	0	0	i	473	i
SIR	0	0	6,597	8,462	1,864
Av. Area Served/Pump				143	

Table 12: Area Served by Upgraded SSDP Private Pasture pumps without considering Overlap in GB CMA and NC CMA

	Area Served (ha)				
	1988	**1990**	**2000**	**2005**	**2000 - 2005**
GB CMA	0	0	i	7,989	i
NC CMA	0	0	i	473	i

The area served by new SSDP Private Pasture pumps allowing for overlap and superposition is presented in Table 13 and Table 14.

Table 13: Area Served by Upgraded SSDP Private Pasture pumps allowing for Overlap

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	0	0	i	2,594	i
Murray Valley IA	0	0	i	4,782	i
Shepparton IA	0	0	i	10	i
Rochester IA – GB CMA	0	0	i	0	i
Rochester IA – NC CMA	0	0	i	473	i
SIR	0	0	6,126	7,858	1,731
Av. Area Served/Pump				133	

Table 14: Area Served by Upgraded SSDP Private Pasture pumps allowing for Overlap in GB CMA and NC CMA

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
GB CMA	0	0	i	7,385	i
NC CMA	0	0	i	473	i

The following comments refer to the notations in **Table 11**, **Table 12**, **Table 13** and **Table 14**.

(i) This figure is unable to be determined.

4.4 SSDP Public pumps

SSDP Public pumps are publicly owned assets with the purpose of providing salinity control, by discharging off-site when downstream conditions are appropriate.

4.4.1 Assumptions

The area rated[2] and area served[3] by SSDP Public pumps is determined with a 60 day pump test. The area served has only been determined for SSDP Public pumps commissioned since June 2001. Where the area served is unknown, it has been determined by increasing the radius of the rated area polygon by 117.4 m[4].

4.4.2 Number of SSDP Public Pumps

The number of SSDP Public pumps installed and which will be used for reporting purposes in the SSDP 2000 – 2005 Review is presented in **Table 15** and **Table 16.**

Table 15: Number of SSDP Public Pumps

	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	0	0	14	33	19
Murray Valley IA	0	0	4	5	1
Shepparton IA	0	0	0	0	0
Rochester IA – GB CMA	0	0	1	1	0
Rochester IA – NC CMA	0	0	2	4	2
SIR	0	0	21	43	22

Table 16: Number of SSDP Public Pumps in GB CMA and NC CMA

	1988	1990	2000	2005	2000 - 2005
GB CMA	0	0	19	39	20
NC CMA	0	0	2	4	2

4.4.3 Area served by SSDP Public Pumps

The area served by SSDP Public pumps (excluding overlap) is presented in **Table 17** and **Table 18.**

[2] Rated area is the area of drawdown to the 0.1 m contour.

[3] The area served is considered to be the area over which there is some drawdown in groundwater pressures/water level in response to groundwater pump operation, or some watertable drawdown due to the operation of tile drains.

[4] The average increase from the rated polygon radius to the served polygon radius across the SIR was determined to be 117.4 m.

Table 17: Area Served by SSDP Public Pumps – Excluding Overlap

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	0	0	3,439	7,771	4,332
Murray Valley IA	0	0	739	914	175
Shepparton IA	0	0	0	0	0
Rochester IA – GB CMA	0	0	0	130	130
Rochester IA – NC CMA	0	0	309	434	125
SIR	0	0	4,487	9,249	4,762
Av. Area Served/Pump				215	

Table 18: Area Served by SSDP Public Pumps in GB CMA and NC CMA

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
GB CMA	0	0	4,179	8,815	4,636
NC CMA	0	0	309	434	125

4.5 SSDP Private Horticulture pumps (watertable control)

SSDP Private Horticulture pumps (i.e. watertable control pumps) are privately owned by landholders and operate with the purpose of providing watertable control to horticulture areas by discharging off-site as required (generally in wet conditions) and re-using on-site where possible. SSDP Private Horticulture pumps are new pumps that have been installed with SSDP Capital Grant assistance.

4.5.1 Assumptions

The area served by SSDP Horticulture pumps (watertable control) is based on the assumption that 2 ML of SSDP Capital Grant volume (detailed in DOCS #1268433) equals 1 ha served.

4.5.2 Number of SSDP Private Horticulture pumps (watertable control)

The main data sources used to determine the new number of SSDP Horticulture pumps installed with SSDP assistance:

(i) G-MW BICCS database, at 30 June 2006. The G-MW BICCS database captures the groundwater pumps that are licensed with G-MW at that point in time

(ii) G-MW SSDP Horticulture Program spreadsheets (DOCS #737921 & #1268433)

(iii) Sub-surface Drainage Program Review 1999/2000 (SKM, 2002).

The number of new SSDP Private Horticulture pumps recorded in G-MW horticulture pump spreadsheets (DOCS #737921 & 1268433) totalled 20. However, only 17 horticulture pumps were identified on the G-MW BICCS database, at 30 June 2005. BICCS is not considered to be a reliable database, therefore for the purpose of reporting the number of new SSDP Private Horticulture pumps in the SSDP 2000 – 2005 Review, G-MW decided to use the figures in the SSDP Horticulture program spreadsheets (DOCS #737921 & #1268433) (Dickinson, P 2006, pers. comm., 12 July).

The number of SSDP Private Horticulture pumps installed with Capital Grant assistance, which will be used for reporting purposes in the SSDP 2000 – 2005 Review is presented in **Table 19.**

Table 19: Number of SSDP Private Horticulture pumps

	1988	1990	2000	2005	2000 - 2005
Shepparton IA	0	0	19	20	1
SIR	0	0	19	20	1
GB CMA	0	0	19	20	1

The area served by SSDP Private Horticulture pumps without considering overlap is presented in **Table 20.**

Table 20: Area Served by SSDP Private Horticulture Pumps without considering Overlap

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Shepparton IA	0	0	385	398	14
SIR	0	0	385	398	14
GB CMA	0	0	385	398	14
Av. Area Served/Pump			20	20	

The area served by SSDP Private Horticulture pumps allowing for overlap is presented in Table 21.

Table 21: Area Served by SSDP Private Horticulture Pumps allowing for Overlap

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Shepparton IA	0	0	375	389	14
SIR	0	0	329	352	14
GB CMA	0	0	329	352	14
Av. Area Served/Pump			20	19	

4.5.3 Pre- Plan Salt Loads from Horticulture pumps

Estimates of SIR salt disposal impacts include an allowance for 0.030 EC impact due to horticulture protection works installed by landholders between 1988 and 1992. This impact is equivalent to an annual salt load of approximately 195 tonnes. However, this salt load should be considered to be pre-Plan and not included as a cost in the SSDP 2000 – 2005 Review Economic Assessment.

The list of sites that corresponds with this impact cannot be located. However, good information is available for sites that were completed during 1989, which accounts for a salt load of about 150 tonnes/yr. Other sites that were installed prior to 1992 could be identified if required. However, many of the sites installed at this time have never been fully equipped, and it would be difficult to develop an unambiguous register for pre-plan works.

4.6 Area of SSDP Tile Drains

SSDP tile drains are privately owned by landholders and operate with the purpose of providing watertable control to horticulture areas by discharging off-site as required (generally in wet conditions) and re-using on-site where possible. SSDP tile drains are new systems that have been installed with SSDP assistance.

4.6.1 Assumptions

The area served by SSDP tile drains is based on the assumption that 1 ha of tile drainage provides 1 ha served.

4.6.2 Area of SSDP Tile Drains

Peter Dickinson's (G-MW) SSDP Horticulture Program spreadsheet (DOCS #1268433) was used as the main data source to determine the area of tile drainage installed with SSDP assistance. The area of SSDP tile installed with SSDP assistance, which will be used for reporting purposes in the SSDP 2000 – 2005 Review is presented in **Table 22**.

Table 22: Area of SSDP Tile Drains

	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	0	0	6.6	6.6	0
Murray Valley IA	0	0	3.2	3.2	0
Shepparton IA	0	0	6.1	6.1	0
SIR	0	0	15.9	15.9	0
GB CMA	0	0	15.9	15.9	0

4.7 Phase A pumps (water table control)

Phase A pumps (watertable control) are publicly owned assets with the purpose of providing watertable control to horticulture areas by pumping groundwater to maintain an appropriate depth from the ground level to watertable. This depth is generally 2 m, with the aim of providing watertable protection to horticultural plantings. Phase-A pumps have been installed with Government assistance prior to the commencement of the SSDP. Phase-A pumps discharge off-site to drains and channels and still operate under the initial rules on which they were established.

4.7.1 Assumptions

Phase A pumps include both hired and non-hired pumps and have been assumed to provide watertable control if they met the following criteria. The complete list of Phase A pumps and their status for the reference years of 1988, 1990, 2000 and 2005 is listed in **Attachment 4.**

G-MW Phase A Pumps included were pumps that:

- (i) Operate at the reference time
- (ii) Don't operate at the reference time, but are located in areas that currently have low water tables, but will operate if water levels rise
- (iii) Currently have operational problems (e.g. broken header line) but would otherwise operate
- (iv) Are On Care and Maintenance.

G-MW Phase A Pumps not included are pumps that were originally installed as Phase A pumps, but:

- (i) Have been decommissioned
- (ii) Have been semi-decommissioned
- (iii) Do not operate and are not rated.

Hired Phase A Pumps included were pumps that are:

- (i) Hired under agreement and provide the service
- (ii) No longer under a formal agreement, however are still hired and providing the service.

Hired Phase A Pumps not included are pumps that:

- (i) Are no longer hired and do not provide a service.

The area rated[5] by Phase A pumps is determined with a 60 day pump test. The area served has been determined by increasing the radius of the rated area polygon by 117.4 m[6]. This was the

[5] Rated area is the area of drawdown to the either 0.07 m or 0.10 m contour depending on the annual pumping duration.

[6] The average increase from the rated polygon radius to the served polygon radius for SSDP Public Pumps across the SIR was determined to be 117.4 m. This increase in the rated polygon radius has been applied to Phase A pumps to estimate their area served.

same methodology used to determine the area served by SSDP Public pumps where only the rated area was known.

Whilst it is understood that Phase A pumps and SSDP Public pumps have different operating regimes, the same methodology and radius increase (117.4 m) has been used due to a lack of data (i.e. the served area has not been determined using a 60 day pump test for any Phase A pumps).

The licence entitlement has been used as a basis to determine the area served by Phase A pumps that have been included but have not been rated. For such pumps, it is assumed that the area served by Phase A pumps is based on the assumption that 2 ML of Licence Entitlement equals 1 ha served. This was only applied to the Phase A pumps located near Invergordon in Shepparton Irrigation Area, and specifically includes pump IDs: SH11, SH20, SH21, SH32, SH33, SH34, SH35, SH40 and SH43.

4.7.2 Number of Phase A pumps

The number of Phase A pumps installed prior to the inception of the SSDP that will be used for reporting purposes in the SSDP 2000 – 2005 Review is presented in **Table 23.**

Table 23: Number of Phase A pumps

	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	53	52	49	49	0
Murray Valley IA	18	18	15	15	0
Shepparton IA	15	15	11	10	-1[i]
SIR	86	85	75	74	-1[i]
GB CMA	86	85	75	74	-1[i]

4.7.3 Area Served by Phase A pumps

The area served by Phase A pumps has not been given on an Irrigation Area basis due to uncertainty associated with location of the Phase A pumps.

The area served by Phase A pumps is presented in **Table 24.**

Table 24: Area Served by Phase A Pumps

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	ii	ii	13,939	13,939	0
Murray Valley IA	ii	ii	4,181	4,181	0
Shepparton IA	ii	ii	285	272	-13[i]
SIR	ii	ii	18,405	18,392	-13[i]
GB CMA	ii	ii	18,405	18,392	-13[i]
Av. Area Served/Pump			242	242	

The following comments refer to the notations in **Table 23 Table 24**.

(i) One Phase A pump was decommissioned in the Shepparton Irrigation Area
(ii) Area served by Phase A pumps is unknown.

4.8 Girgarre Evaporation Basin System Pumps

Girgarre evaporation basin system pumps are publicly owned assets with the purpose of providing salinity control. The system comprises one evaporation basin and three groundwater pumps (pump IDs: T101, T102 and T103). One groundwater pump discharges to the evaporation basin, while the other two pumps discharge off-site is to drains with purpose of providing salinity control to properties adjacent to the evaporation basin.

4.8.1 Assumptions

The area served by Girgarre evaporation basin system pumps is determined with a 60 day pump test, which is used to determine the area rated[7]. The area served is determined by increasing the mean radius of the rated area polygon by 117.4 m[8].

4.8.2 Number of Girgarre Evaporation Basin System Pumps

The number of Girgarre evaporation basin system pumps installed prior to the inception of the SSDP that which will be used for reporting purposes in the SSDP 2000 – 2005 Review is presented in **Table 25**.

Table 25: Number of Girgarre Evaporation Basin System Pumps

	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	3	3	3	3	0
SIR	3	3	3	3	0
GB CMA	3	3	3	3	0

4.8.3 Area Served by Girgarre Evaporation Basin System Pumps

The area served by the Girgarre evaporation basin system pumps is presented in **Table 26**.

[7] Rated area is the area of drawdown to the 0.1 m contour.

[8] The average increase from the rated polygon radius to the served polygon radius across the SIR was determined to be 117.4 m.

Table 26: Area Served by Girgarre Evaporation Basin System Pumps

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	1,357	1,357	1,357	1,357	0
SIR	1,357	1,357	1,357	1,357	0
GB CMA	1,357	1,357	1,357	1,357	0

4.9 Non-SSDP Assisted Private pumps

Non-SSDP pumps extract groundwater for use in irrigation, and therefore reduce watertable levels and contribute to the desired outcome of protecting parts of the SIR from salinisation. Non-SSDP assisted Private pumps are privately owned by landholders, which have been installed without SSDP assistance. Non-SSDP assisted Private pumps include both pasture and horticulture pumps as there is insufficient data to differentiate between these two categories.

Some non-SSDP assisted Private pumps have become voluntary SPB pumps. Whilst voluntary SPB pumps are encouraged to operate within the to SPB pumping guidelines, the extent to which they adhere to the guidelines is unknown, and are therefore assumed to operate the same as other non-SSDP Private pumps.

4.9.1 Assumptions

Non-SSDP assisted Private pumps were assumed to provide salinity control if they met the following criteria:

- Intersect shallow aquifers (Upper Shepparton Formation, not Deep Lead)
- Licensed and metered
- Licence Entitlement of at least 20 ML
- Located within the defined area at risk of salinisation and waterlogging within the SIR (refer to **Figure 2** for the defined area at risk).

The served area attributed to non-SSDP assisted Private pumps is based on the assumption that 1 ML of Licence Entitlement equates to 0.6 ha served. This assumption was based on the average SIR private pump extraction compared to Licence Entitlement for the period 2000/01 – 04/05, which was approximately 60%. Refer to **Attachment 3** for further details.

4.9.2 Number of Non-SSDP Assisted Private Pumps

The number of Non-SSDP assisted Private pumps installed and which will be used for reporting purposes in the SSDP 2000 – 2005 Review is presented in **Table 27** and **Table 28.**

Table 27: Non-SSDP Private Pumps

	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	i	i	i	169	i
Murray Valley IA	i	i	i	222	i
Shepparton IA	i	i	i	2	i
Rochester IA – GB CMA	i	i	i	1	i
Rochester IA – NC CMA	i	i	i	48	i
Outside IAs	i	i	i	1	i
SIR	i	i	389[ii]	443	54

Table 28: Non-SSDP Private Pumps in GB CMA and NC CMA

	1988	1990	2000	2005	2000 - 2005
GB CMA	i	i	i	395	i
NC CMA	i	i	i	48	i

The following comments refer to the notations in Table 27 and Table 28.

(i) This figure is unable to be determined.

(ii) Number of non-SSDP pumps within area at risk has been estimated (Hunter, T 2006, pers.comm. 15 September).

4.9.3 Area served by Non-SSDP Private pumps

The area served by non-SSDP Private pumps without considering overlap is presented in Table 29 and Table 30.

Table 29: Area Served by Non-SSDP Private pumps without considering Overlap

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	[i]	[i]	[i]	17,013	[i]
Murray Valley IA	[i]	[i]	[i]	29,409	[i]
Shepparton IA	[i]	[i]	[i]	225	[i]
Rochester IA – GB CMA	[i]	[i]	[i]	99	[i]
Rochester IA – NC CMA	[i]	[i]	[i]	4,020	[i]
Outside IAs	[i]	[i]	[i]	118	[i]
SIR	[i]	[i]	44,681[ii]	50,884	6,203
Av. Area Served/Pump				115	

Table 30: Area Served by Non-SSDP Private pumps without considering Overlap in GB CMA and NC CMA

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
GB CMA	[i]	[i]	[i]	46,824	[i]
NC CMA	[i]	[i]	[i]	4,060	

The area served by new SSDP Private pumps allowing for overlap and superposition is presented in Table 31.

Table 31: Area Served by Non-SSDP Private pumps allowing for Overlap

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
Central Goulburn IA	[i]	[i]	[i]	15,163	[i]
Murray Valley IA	[i]	[i]	[i]	20,840	[i]
Shepparton IA	[i]	[i]	[i]	214	[i]
Rochester IA – GB CMA	[i]	[i]	[i]	99	[i]
Rochester IA – NC CMA	[i]	[i]	[i]	3,780	[i]
Outside IAs	[i]	[i]	[i]	117	[i]
SIR	[i]	[i]	35,311[ii]	40,213	4,902
Av. Area Served/Pump				91	

Table 32: Area Served by Non-SSDP Private pumps allowing for Overlap in GB CMA and NC CMA

	Area Served (ha)				
	1988	1990	2000	2005	2000 - 2005
GB CMA	i	i	i	36,393	i
NC CMA	i	i	i	3,820	

The following comments refer to the notations in and **Table 29**, **Table 30**, **Table 31** and **Table 32**.

(i) This figure is unable to be determined.

(ii) Area served has been estimated by multiplying the number of pumps by the average area served per pump in June 2005.

5 FUTURE SSDP IMPLEMENTATION SCHEDULE

The future SSDP implementation schedule is based on maintaining a near constant budget for the period 2005/06 – 2010/11, and then determining what works and equivalent budget necessary to achieve the SSDP target outcome of serving 185,000 ha by June 2030. Section 3 includes further details regarding the target area to be served by the SSDP.

5.1 Indicative Annual SSDP Implementation Budget for 2005/06 – 2010/11

As a starting point, the indicative annual budget for the SSDP for the period 2005/06 – 2010/11 is assumed to be approximately $3.56 million. This figure is based on the SSDP implementation budget for 2005/06 ($3.8 M), **plus** DPI extension ($110 K), **minus** non-SSDP projects that are also currently funded within this budget ($350 K). These projects include C806a (Nutrient Impacts on River Murray) - $150 K and G700 (Implementation of SIR Groundwater Management Plan) - $200 K.

Based on this budget, the works schedules to serve 185,000 ha by June 2030, as detailed in Table 36, Table 37, Table 38 and Table 40, were developed for use in the economic assessment component of the SSDP 2000 – 2005 Review.

5.2 SSDP Implementation Overview

Based on the outputs from the works schedules an overview of the area to be served by the SSDP and its components is presented in Table 33.

Table 33: Target Area to be served by each Component of the SSDP

Target Area served by SSDP Components (ha)			Area Served by SSDP (ha)
Public Pumps	Private Pumps	Horticulture	
85,000	98,640	1,300	**184,940**
		Target Area to be served by SSDP:	**185,000**

The indicative cost of implementing the SSDP as a whole and for each of the components is presented in Table 34 for the entire implementation period.

Table 34: Indicative Costs associated with SSDP Implementation

Year	SSDP COMPONENT COST ($)				SSDP Cost ($)
	Public Pumps	Private Pumps	Horticulture	Support	
1990/91	$220,000	$2,170,000	$248,300	$780,000	$3,418,300
1991/92	$440,000	$2,170,000	$248,300	$780,000	$3,638,300
1992/93	$440,000	$2,170,000	$256,600	$780,000	$3,646,600
1993/94	$440,000	$2,170,000	$256,600	$780,000	$3,646,600
1994/95	$440,000	$2,190,000	$256,600	$780,000	$3,666,600
1995/96	$440,000	$2,190,000	$376,600	$880,000	$3,886,600
1996/97	$440,000	$2,190,000	$256,600	$881,685	$3,768,285
1997/98	$440,000	$2,190,000	$256,600	$894,404	$3,781,004
1998/99	$440,000	$2,300,000	$255,770	$881,769	$3,877,539
1999/00	$880,000	$2,300,000	$0	$809,154	$3,989,154
2000/01	$1,100,000	$520,000	$0	$776,050	$2,396,050
2001/02	$1,320,000	$670,000	$0	$765,108	$2,755,108
2002/03	$1,100,000	$3,520,000	$120,000	$836,165	$5,576,165
2003/04	$660,000	$1,470,000	$0	$1,070,435	$3,200,435
2004/05	$660,000	$900,000	$0	$1,613,902	$3,173,902
2005/06	$660,000	$1,030,000	$0	$2,630,000	$4,320,000
2006/07	$660,000	$920,000	$0	$2,730,000	$4,310,000
2007/08	$660,000	$920,000	$120,000	$2,330,000	$4,030,000
2008/09	$660,000	$920,000	$240,000	$2,330,000	$4,150,000
2009/10	$660,000	$920,000	$240,000	$2,480,000	$4,300,000
2010/11	$660,000	$920,000	$240,000	$2,530,000	$4,350,000
2011/12	$2,680,000	$1,360,000	$339,600	$2,480,000	$6,859,600
2012/13	$3,160,000	$1,360,000	$339,600	$2,330,000	$7,189,600
2013/14	$3,380,000	$1,470,000	$356,200	$2,330,000	$7,536,200
2014/15	$3,600,000	$1,470,000	$356,200	$2,330,000	$7,756,200
2015/16	$4,040,000	$1,470,000	$364,500	$2,430,000	$8,304,500
2016/17	$4,480,000	$1,470,000	$364,500	$2,480,000	$8,794,500
2017/18	$4,920,000	$1,490,000	$372,800	$2,330,000	$9,112,800
2018/19	$5,840,000	$1,490,000	$389,400	$2,330,000	$10,049,400
2019/20	$5,840,000	$1,490,000	$406,000	$2,330,000	$10,066,000
2020/21	$5,840,000	$1,470,000	$406,000	$2,430,000	$10,146,000
2021/22	$6,320,000	$1,470,000	$286,000	$2,480,000	$10,556,000
2022/23	$6,320,000	$1,470,000	$286,000	$1,730,000	$9,806,000
2023/24	$6,320,000	$1,360,000	$269,400	$1,730,000	$9,679,400
2024/25	$6,320,000	$1,360,000	$132,800	$1,730,000	$9,542,800
2025/26	$5,840,000	$1,360,000	$116,200	$1,830,000	$9,146,200
2026/27	$5,840,000	$1,360,000	$99,600	$1,880,000	$9,179,600
2027/28	$4,920,000	$1,360,000	$83,000	$1,630,000	$7,993,000
2028/29	$4,260,000	$1,360,000	$83,000	$1,630,000	$7,333,000
2029/30	$3,160,000	$1,360,000	$67,230	$1,630,000	$6,217,230
Total	**$106,500,000**	**$61,750,000**	**$8,490,000**	**$68,408,672**	**$245,148,672**

A comparison of the annual budget and cost of implementing scheduled works for the period 2005/06 - 10/2011 is shown in **Table 35**. This comparison indicates that the cost of implementing scheduled works is approximately 20 % greater than the indicative annual budget. This variation is considered to be acceptable for planning purposes (Hunter, T 2006 pers. comm., September).

Table 35: Comparison of Indicative Annual Budget and Cost of implementing Scheduled Works

YEAR	Scheduled SSDP Cost ($)	Indicative Budget ($)	Scheduled v Indicative (%)
2005/06	$4,320,000	$3,560,000	121%
2006/07	$4,310,000	$3,560,000	121%
2007/08	$4,030,000	$3,560,000	113%
2008/09	$4,150,000	$3,560,000	117%
2009/10	$4,300,000	$3,560,000	121%
2010/11	$4,350,000	$3,560,000	122%

The increased costs in 2009/10 and 2010/11 are due to the revision of the SSDP. It is anticipated that additional funding will be provided to undertake this activity.

5.3 SSDP Private Pasture pumps

5.3.1 Assumptions

The Government contribution to the implementation cost for SSDP Private pasture pumps is based on the following assumptions:

New Pumps installed with SSDP assistance

- $20k per FEDS investigation (~50 investigations/year) (Burkitt, J 2006 pers. comm., 14 June)
- 25 % of FEDS investigations successful per year (Burkitt, J 2006 pers. comm., 14 June)
- Therefore, $80k ($20k/25 %) per successful FEDS investigation
- Average SSDP Capital Grant expenditure is $30k per SSDP Private Pasture pump ($15k Admin + $15k Grant) (Burkitt, J 2006 pers. comm., 14 June)
- Therefore, expenditure per Capital Grant Pump installed is **$110,000** ($80k + $30k)
- This implementation cost does not include the Private contribution.

Existing Pumps upgraded with SSDP assistance

- It is assumed that there will be no Capital Grant overlap in the future for pump and SSDP Capital Grants for pump upgrades will only be granted to non-SSDP Private pumps (i.e. pumps that were not originally installed with Capital Grant assistance or previously upgraded with Capital Grant assistance)
- Average capital cost to upgrade existing pump with SSDP Capital Grant assistance is **$20,000** ($10k admin + $10k grant) (Burkitt, J 2006 pers. comm., 14 June)
- This implementation cost does not include the Private contribution.

Non-SSDP Private pumps

- There is no direct expenditure associated with non-SSDP assisted Private pumps
- This implementation cost does not include the Private contribution.

Area served by Private Pasture pumps

- The underlying assumption is that the overall average area served by Private pumps (for the entire implementation period: 1990 – 2030) is 90 ha per Private pump, allowing for overlap with area served by SSDP Public pumps (Hunter, T 2006, pers. comm., September). This assumption is more conservative than the assumption reported in the last SSDP Review (SKM, 2002), which reported that SSDP Private pasture pumps serve an area of 125 ha in Murray Valley Irrigation Area and 100 ha in other areas within the SIR.
- The current (up to June 2005) area served by Private pasture pumps is approximately 85 ha per Private pump, when the overlap with area served by SSDP Public pumps has been taken into account. This can be deduced with the figures shown in **Table 2**, 65,830 ha served divided by 756 Private pumps multiplied by 97 % to account for overlap with SSDP Public pumps.
- In accordance with the above dot points, the future area served by Private pumps is therefore assumed to be approximately 102 ha per Private pump, allowing for overlap with area served by SSDP Public pumps, to achieve an overall average of 90 ha per Private pump. This is believed appears to be appropriate, given that the proportion of SSDP Private pasture pumps will increase, relative to the total private pasture pumps.

5.3.2 SSDP Private Pasture Pump Schedule

The SSDP Private Pasture pump implementation schedule and associated cost is presented in **Table 36**. The SSDP Private Pasture pump implementation schedule has been based on historical data where possible.

New and Upgraded SSDP Private Pumps

Historical data has been used for new and upgraded SSDP Private pumps for the period 1999/2000 – 2005/06. The number of pumps installed annually for the period prior to this (i.e. 1990/91 – 1998/99) has been determined by straight line interpolation.

For the period 2006/07 – 10/11, it has been assumed that only eight new SSDP Capital Grant Private Pasture pumps will be commissioned and two pumps will be upgraded with SSDP Capital Grants per year due to budget constraints. After this period, the number of new SSDP Capital Grant Private Pasture pumps installed will increase to 12 – 13 per year, to achieve the target area served by 2029/30.

Non-SSDP Private pumps

It has been estimated that 289 non-SSDP Private pumps that meet the requirements to provide salinity control, as defined in **Section 4.9**, were installed by June 1990. The number of pumps installed annually for the period 1990/91 – 1998/99 has been determined by straight line interpolation.

It has been assumed that there will not be any new non-SSDP Private pumps installed for the remainder of the SSDP implementation period (2005/06 – 29/30), that meet the requirements to provide salinity control, as defined in **Section 4.9**.

Table 36: SSDP Private Pasture Pump Implementation Schedule

YEAR	TARGETS				Cost ($)
	New SSDP Pumps	Existing Pumps Upgraded	Non-SSDP Private Pumps	Area Served (ha)	
1990/91	19	4	290	26,421	$2,170,000
1991/92	19	4	11	2,870	$2,170,000
1992/93	19	4	11	2,870	$2,170,000
1993/94	19	4	11	2,870	$2,170,000
1994/95	19	5	11	2,954	$2,190,000
1995/96	19	5	11	2,954	$2,190,000
1996/97	19	5	11	2,954	$2,190,000
1997/98	19	5	11	2,954	$2,190,000
1998/99	20	5	11	3,039	$2,300,000
1999/00	20	5	11	3,039	$2,300,000
2000/01	4	4	11	1,604	$520,000
2001/02	5	6	11	1,857	$670,000
2002/03	32	0	11	3,630	$3,520,000
2003/04	13	2	11	2,195	$1,470,000
2004/05	8	1	10	1,604	$900,000
2005/06	9	2	0	1,127	$1,030,000
2006/07	8	2	0	1,024	$920,000
2007/08	8	2	0	1,024	$920,000
2008/09	8	2	0	1,024	$920,000
2009/10	8	2	0	1,024	$920,000
2010/11	8	2	0	1,024	$920,000
2011/12	12	2	0	1,434	$1,360,000
2012/13	12	2	0	1,434	$1,360,000
2013/14	13	2	0	1,536	$1,470,000
2014/15	13	2	0	1,536	$1,470,000
2015/16	13	2	0	1,536	$1,470,000
2016/17	13	2	0	1,536	$1,470,000
2017/18	13	3	0	1,639	$1,490,000
2018/19	13	3	0	1,639	$1,490,000
2019/20	13	3	0	1,639	$1,490,000
2020/21	13	2	0	1,536	$1,470,000
2021/22	13	2	0	1,536	$1,470,000
2022/23	13	2	0	1,536	$1,470,000
2023/24	12	2	0	1,434	$1,360,000
2024/25	12	2	0	1,434	$1,360,000
2025/26	12	2	0	1,434	$1,360,000
2026/27	12	2	0	1,434	$1,360,000
2027/28	12	2	0	1,434	$1,360,000
2028/29	12	2	0	1,434	$1,360,000
2029/30	12	2	0	1,434	$1,360,000
Total	**541**	**112**	**443**	**98,640**	

Note: All costs are in June 2005 dollars.

5.4 SSDP Public pumps

5.4.1 Assumptions

The Government contribution to the implementation cost for SSDP Public pumps is based on the following assumptions:

SSDP Public Pumps

- $42,400 per successful investigation (Nolan ITU, 2006, p.17) (benchmark)
- Average Capital Cost is $160,000 (Nolan ITU, 2006, p.21) (average + $2,500 for ENR project management)
- Final rating analysis cost is $15,000 (Brownlee, M 2006 pers. comm., 14 June)
- Therefore, expenditure per SSDP Public Pump installed is approximately **$220,000.**

SSDP Evaporation Basins

- Basin cost in 99/00 was $225,000 (Kleindienst, H 2006 pers. comm., 15 June)
- Average CPI increase was 2.8% p.a. from 99/00 – 04/05
- Therefore, basin cost in 2004/05 is **$260,000**
- Each SSDP evaporation basin has one SSDP Public pump
- This implementation cost does not include the Private contribution.

Area served by SSDP Public Pumps

- The underlying assumption is that the overall average area served by SSDP Public pumps is 200 ha/pump (SKM, 2002).
- The current (June 2005) area served by SSDP Public pumps is approximately 208 ha per SSDP Public pump, when the overlap with area served by Private pumps has been taken into account. This can be deduced with the figures shown in **Table 2**, 9,249 ha served divided by 43 SSDP Public pumps multiplied by 97 % to account for overlap with Private pumps.
- In accordance with the above two dot points, the future area served by SSDP Public pumps is therefore assumed to be approximately 199 ha per SSDP Public pump, allowing for overlap with area served by Private pumps, to achieve an overall average of 200 ha per Private pump. This is believed to be a conservative approach given that the current average area served by SSDP Public pumps is 208 ha.

5.4.2 Schedule

The SSDP Public pump implementation schedule and associated cost is presented in **Table 37.**

The SSDP Public pump implementation schedule has been based on historical data where possible. Historical data has been used for SSDP Public pumps for the period 1999/2000 – 2005/06. The number of pumps installed annually for the period prior to this (i.e. 1990/91 – 1998/99) has been determined by straight line interpolation.

For the period 2006/07 – 10/11, it has been assumed that only three SSDP Public pumps will be commissioned per year due to budget constraints. After this period, the number of new SSDP Capital Grant Private Pasture installed will incrementally increase up to 19 per year, to achieve the target area served by 2029/30.

It has been assumed that evaporation basins will not begin to be installed until 2011/12.

Table 37: SSDP Public Pump Implementation Schedule

Year	TARGETS				Cost ($)
	Reuse - Pumps	Pumps discharging to Basins	Basins	Area Served (ha)	
1990/91	1	0	0	209	$220,000
1991/92	2	0	0	417	$440,000
1992/93	2	0	0	417	$440,000
1993/94	2	0	0	417	$440,000
1994/95	2	0	0	417	$440,000
1995/96	2	0	0	417	$440,000
1996/97	2	0	0	417	$440,000
1997/98	2	0	0	417	$440,000
1998/99	2	0	0	417	$440,000
1999/00	4	0	0	834	$880,000
2000/01	5	0	0	1,043	$1,100,000
2001/02	6	0	0	1,251	$1,320,000
2002/03	5	0	0	1,043	$1,100,000
2003/04	3	0	0	626	$660,000
2004/05	3	0	0	626	$660,000
2005/06	3	0	0	597	$660,000
2006/07	3	0	0	597	$660,000
2007/08	3	0	0	597	$660,000
2008/09	3	0	0	597	$660,000
2009/10	3	0	0	597	$660,000
2010/11	3	0	0	597	$660,000
2011/12	10	1	1	2,189	$2,680,000
2012/13	10	2	2	2,389	$3,160,000
2013/14	11	2	2	2,588	$3,380,000
2014/15	12	2	2	2,787	$3,600,000
2015/16	14	2	2	3,185	$4,040,000
2016/17	16	2	2	3,583	$4,480,000
2017/18	18	2	2	3,981	$4,920,000
2018/19	20	3	3	4,578	$5,840,000
2019/20	20	3	3	4,578	$5,840,000
2020/21	20	3	3	4,578	$5,840,000
2021/22	20	4	4	4,777	$6,320,000
2022/23	20	4	4	4,777	$6,320,000
2023/24	20	4	4	4,777	$6,320,000
2024/25	20	4	4	4,777	$6,320,000
2025/26	20	3	3	4,578	$5,840,000
2026/27	20	3	3	4,578	$5,840,000
2027/28	18	2	2	3,981	$4,920,000
2028/29	15	2	2	3,384	$4,260,000
2029/30	10	2	2	2,389	$3,160,000
Total	**375**	**50**	**50**	**85,000**	

Note: All costs are in June 2005 dollars.

5.5 SSDP Private Horticulture Pumps and Tile Drains (watertable control)

5.5.1 Assumptions

The Government contribution to the implementation cost for SSDP Private Horticulture pumps and tile drainage systems is based on the following assumptions:

New SSDP Horticulture Pumps

- $18,000 per FEDS investigation (Dickinson, P 2006 pers. comm., 14 June)
- 20 % of FEDS investigations successful (derived from G-MW DOCS #737921)
- Therefore, $90,000 ($18,000/20 %) per successful FEDS investigation
- Average SSDP Capital Grant expenditure is $30 K ($15 K Admin + $15 K Grant) (Dickinson, P 2006 pers. comm., 14 June)
- Therefore, expenditure per Capital Grant Pump installed is **$120,000** ($90k + $30k)
- This implementation cost does not include the Private contribution.

Tile Drainage

- SSDP Capital Grant assistance for Tile Drainage implementation is $1,400 per hectare (Dickinson, P 2006 pers. comm., 17 October)
- Tile Drainage cost in 1999/2000 was $7,200 per hectare (SKM, 2002)
- Average CPI increase was 2.8% p.a. from 1999/2000 – 2004/05, results in $8,300 per hectare of Tile Drainage implementation in 2004/05
- Assumed administration expense associated with Tile Drainage Capital Grants is $6,900 ($8,300 – $1,400) per hectare of tile drainage
- Therefore, expenditure per Capital Grant Tile Drainage installed is **$8,300** ($1,400 Grant+ $6,900 Admin)
- This implementation cost does not include the Private contribution.

Area served by SSDP Private Horticulture Pumps and Tile Drains

- The current average area served by SSDP Private Horticulture pumps is 17.6 ha/pump.
- It is assumed that the overall average area served by SSDP Private Horticulture pumps is 20 ha/pump.
- This results in the future average area served by SSDP Private Horticulture pumps to be 21.4 ha/pump.
- It has been assumed that 1 ha of tile drainage serves 1 ha.

5.5.2 Schedule

The SSDP Private Horticulture pump and tile drain implementation schedule and associated cost is presented in **Table 38.**

The SSDP Private Horticulture pump implementation schedule has been based on historical data where possible. Historical data has been used for new SSDP Private Horticulture pumps for the period 1999/2000 – 2005/06. The number of Private Horticulture pumps installed with SSDP

Capital Grant assistance annually for the period prior to this (i.e. 1990/91 – 1998/99) has been determined by straight line interpolation.

It has been assumed that there will be no new Private Horticulture pumps installed with SSDP Capital Grant assistance until 2007/08. After this time, it has been assumed that 1 – 3 new pumps will be installed with SSDP Capital Grant assistance until 2023/24, to achieve the target area to be served.

There have not been any SSDP tile drains installed during the period 1999/2000 – 2005/06. The area of tile drains installed annually for the period prior to this (i.e. 1990/91 – 1998/99) has been determined by straight line interpolation.

For the period 2006/07 – 10/11, it has been assumed that there will be no new tile drains installed with SSDP Capital Grant Assistance. After this period, it is assumed that the area of new SSDP tile drains will incrementally increase up to a peak 20 ha per year before dropping off, to achieve the target area served by 2029/30.

Table 38: SSDP Horticulture Pumps and Tile Drains Implementation Schedule

Year	TARGETS			Cost ($)
	New Pumps (no.)	Tile Drains (ha)	Area Served (ha)	
1990/91	2	1	40	$248,300
1991/92	2	1	40	$248,300
1992/93	2	2	41	$256,600
1993/94	2	2	41	$256,600
1994/95	2	2	41	$256,600
1995/96	3	2	60	$376,600
1996/97	2	2	41	$256,600
1997/98	2	2	41	$256,600
1998/99	2	2	41	$255,770
1999/00	0	0	0	$0
2000/01	0	0	0	$0
2001/02	0	0	0	$0
2002/03	1	0	19	$120,000
2003/04	0	0	0	$0
2004/05	0	0	0	$0
2005/06	0	0	0	$0
2006/07	0	0	0	$0
2007/08	1	0	20	$120,000
2008/09	2	0	41	$240,000
2009/10	2	0	41	$240,000
2010/11	2	0	41	$240,000
2011/12	2	12	53	$339,600
2012/13	2	12	53	$339,600
2013/14	2	14	55	$356,200
2014/15	2	14	55	$356,200
2015/16	2	15	56	$364,500
2016/17	2	15	56	$364,500
2017/18	2	16	57	$372,800
2018/19	2	18	59	$389,400
2019/20	2	20	61	$406,000
2020/21	2	20	61	$406,000
2021/22	1	20	40	$286,000
2022/23	1	20	40	$286,000
2023/24	1	18	38	$269,400
2024/25	0	16	16	$132,800
2025/26	0	14	14	$116,200
2026/27	0	12	12	$99,600
2027/28	0	10	10	$83,000
2028/29	0	10	10	$83,000
2029/30	0	8	8	$67,230
Total	**50**	**300**	**1,300**	

All Costs are in June 2005 dollars

Note: All costs are in June 2005 dollars.

5.6 SSDP Support Costs

The schedule of total SSDP Support costs is presented in Table 39.

The schedule of total SSDP Support costs has been based on historical data where possible. Historical data has also been used as a basis for estimating unknown historical costs. With the exception of Research and Investigation (R&I) component, the current costs of support based activities have generally been assumed to remain constant for the remaining implementation period of the SSDP.

R&I has been assumed to be around $800,000 - $1,000,000 until 2020/21. After this time, it is expected that a number of the critical unknowns will be determined, and expenditure to drop off significantly. The cost of undertaking a review of the SSDP on a five yearly basis has also been included in the R&I component.

A drop of $500,000 in the G-MW Management, Support & Extension cost and coinciding increase in Monitoring costs in 2006/07 is due to a transfer of funds to meet the Goulburn Broken Catchment Management Authority Monitoring, Evaluation and Reporting (MER) requirements.

Given that a number of support based activities would still be undertaken if the SSDP was not being implemented, it was agreed that only a proportion of the SSDP Support costs be considered for the purpose of the Economic Assessment component of the SSDP 2000 - 2005 Review. The proportions of SSDP support costs to be considered are:-

- 50 % of DPI Extension costs
- 50 % of G-MW Management, Support & Extension costs
- 50 % of R&I costs
- 25 % of Monitoring costs.

The schedule of SSDP Support costs to be considered in the Economic Assessment is presented in Table 40.

Table 39: Schedule of SSDP Support Costs - Total

Year	Support Expenditure			
	DPI Extension	G-MW Management, Support & Extension	Research & Investigation	Monitoring
1990/91	$110,000	$300,000	$50,000	$320,000
1991/92	$110,000	$300,000	$50,000	$320,000
1992/93	$110,000	$300,000	$50,000	$320,000
1993/94	$110,000	$300,000	$50,000	$320,000
1994/95	$110,000	$300,000	$50,000	$320,000
1995/96	$110,000	$400,000	$50,000	$320,000
1996/97	$110,000	$400,000	$50,000	$321,685
1997/98	$110,000	$400,000	$50,000	$334,404
1998/99	$110,000	$400,000	$50,000	$321,769
1999/00	$110,000	$400,000	$50,000	$249,154
2000/01	$110,000	$400,000	$50,000	$216,050
2001/02	$110,000	$400,000	$50,000	$205,108
2002/03	$110,000	$400,000	$100,000	$226,165
2003/04	$110,000	$398,391	$195,000	$367,044
2004/05	$110,000	$656,220	$524,000	$323,682
2005/06	$110,000	$1,100,000	$1,100,000	$320,000
2006/07	$110,000	$600,000	$1,200,000	$820,000
2007/08	$110,000	$600,000	$800,000	$820,000
2008/09	$110,000	$600,000	$800,000	$820,000
2009/10	$110,000	$600,000	$950,000	$820,000
2010/11	$110,000	$600,000	$1,000,000	$820,000
2011/12	$110,000	$600,000	$950,000	$820,000
2012/13	$110,000	$600,000	$800,000	$820,000
2013/14	$110,000	$600,000	$800,000	$820,000
2014/15	$110,000	$600,000	$800,000	$820,000
2015/16	$110,000	$600,000	$900,000	$820,000
2016/17	$110,000	$600,000	$950,000	$820,000
2017/18	$110,000	$600,000	$800,000	$820,000
2018/19	$110,000	$600,000	$800,000	$820,000
2019/20	$110,000	$600,000	$800,000	$820,000
2020/21	$110,000	$600,000	$900,000	$820,000
2021/22	$110,000	$600,000	$950,000	$820,000
2022/23	$110,000	$600,000	$200,000	$820,000
2023/24	$110,000	$600,000	$200,000	$820,000
2024/25	$110,000	$600,000	$200,000	$820,000
2025/26	$110,000	$600,000	$300,000	$820,000
2026/27	$110,000	$600,000	$350,000	$820,000
2027/28	$110,000	$600,000	$100,000	$820,000
2028/29	$110,000	$600,000	$100,000	$820,000
2029/30	$110,000	$600,000	$100,000	$820,000
Total	**$4,400,000**	**$21,254,611**	**$18,269,000**	**$24,485,061**

Assumptions:
- June 2005 Dollars
- Expenditure recorded for that year in Dollars values at that time

Notes:
$500,000 increase in monitoring costs in 2006/7 due to GBCMA MER requirements
$500,000 decrease in support costs in 2006/7 due to transfer of funds to monitoring
SSDP Revision cost of $250,000 is spread over 2009/10 - 2011/12
SSDP Review cost of $125,000 is spread over 2015/16 - 2016/17, 2020/21 - 2021/2022, 2025/26 - 2026/2027

Table 40: Schedule of SSDP Support Costs – for Economic Assessment

Year	Support Expenditure			
	DPI Extension*	G-MW Management, Support & Extension*	Research & Investigation*	Monitoring#
1990/91	$55,000	$150,000	$25,000	$80,000
1991/92	$55,000	$150,000	$25,000	$80,000
1992/93	$55,000	$150,000	$25,000	$80,000
1993/94	$55,000	$150,000	$25,000	$80,000
1994/95	$55,000	$150,000	$25,000	$80,000
1995/96	$55,000	$200,000	$25,000	$80,000
1996/97	$55,000	$200,000	$25,000	$80,421
1997/98	$55,000	$200,000	$25,000	$83,601
1998/99	$55,000	$200,000	$25,000	$80,442
1999/00	$55,000	$200,000	$25,000	$62,289
2000/01	$55,000	$200,000	$25,000	$54,012
2001/02	$55,000	$200,000	$25,000	$51,277
2002/03	$55,000	$200,000	$50,000	$56,541
2003/04	$55,000	$199,196	$97,500	$91,761
2004/05	$55,000	$328,110	$262,000	$80,921
2005/06	$55,000	$550,000	$550,000	$80,000
2006/07	$55,000	$300,000	$600,000	$330,000
2007/08	$55,000	$300,000	$400,000	$330,000
2008/09	$55,000	$300,000	$400,000	$330,000
2009/10	$55,000	$300,000	$475,000	$330,000
2010/11	$55,000	$300,000	$500,000	$330,000
2011/12	$55,000	$300,000	$475,000	$330,000
2012/13	$55,000	$300,000	$400,000	$330,000
2013/14	$55,000	$300,000	$400,000	$330,000
2014/15	$55,000	$300,000	$400,000	$330,000
2015/16	$55,000	$300,000	$450,000	$330,000
2016/17	$55,000	$300,000	$475,000	$330,000
2017/18	$55,000	$300,000	$400,000	$330,000
2018/19	$55,000	$300,000	$400,000	$330,000
2019/20	$55,000	$300,000	$400,000	$330,000
2020/21	$55,000	$300,000	$450,000	$330,000
2021/22	$55,000	$300,000	$475,000	$330,000
2022/23	$55,000	$300,000	$100,000	$330,000
2023/24	$55,000	$300,000	$100,000	$330,000
2024/25	$55,000	$300,000	$100,000	$330,000
2025/26	$55,000	$300,000	$150,000	$330,000
2026/27	$55,000	$300,000	$175,000	$330,000
2027/28	$55,000	$300,000	$50,000	$330,000
2028/29	$55,000	$300,000	$50,000	$330,000
2029/30	$55,000	$300,000	$50,000	$330,000
Total	**$2,200,000**	**$10,627,306**	**$9,134,500**	**$9,121,265**

Assumptions:
* Expenditure is based on 50% of total cost
# Expenditure is based on 25% of total cost
- June 2005 Dollars
- Expenditure recorded for that year in Dollars values at that time

6 RECOMMENDATIONS

It is recommend that:

(i) The SSDP statistics, such as target area to be served, area served at June 2005 and area to be served, presented in **Table 2** be adopted for future reference

(ii) The SSDP Implementation Schedule, as detailed in **Table 36**, **Table 37**, **Table 38** and **Table 40**, be used for the economic assessment component of the SSDP 2000 – 2005 Review

(iii) G-MW's existing SSDP related data management systems either be improved or new data management system be developed to ensure that SSDP related data (e.g. pump locations and licence volumes) are correctly recorded and kept up to date

(iv) BICCS not be updated with correct data where a discrepancy exists. It is understood that BICCS is not considered to be a reliable data base, and that this is unlikely to change in the near future. Therefore no recommendations have been made in relation to updating BICCS database with identified data discrepancies.

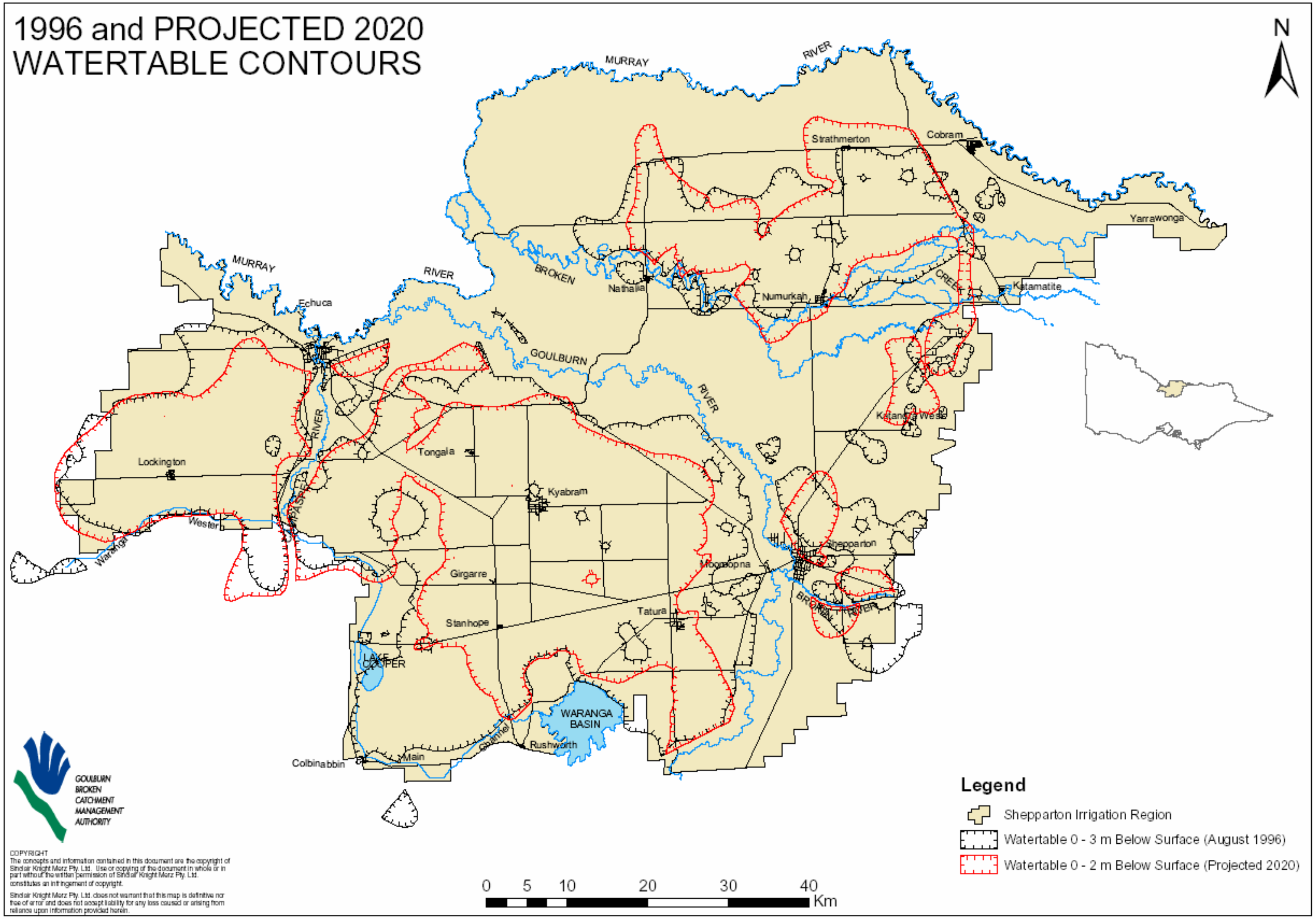
7 REFERENCES

Nolan ITU, 2006, Shepparton Irrigation Region Catchment Strategy Key Performance Indicators for the Public Salinity Control Pump Program FINAL.

Sinclair Knight Merz (SKM), 2002, Sub-surface Drainage Program Review 1999/2000.

(SIRLWSMP) Goulburn Broken Region Salinity Pilot Program Advisory Council, August 1989, Draft Shepparton Irrigation Region Land and Water Salinity Management Plan.

Attachment 1: 1996 and Projected 2020 Watertable Contours within the SIR



Attachment 2: Calculations to determine Revised SSDP Target Service Area

Item	Sub-item	No. of Pumps	Area (ha)	ID	Reference
Type B Management Area (high - medium yielding aquifers) within the projected 2020 0-2 m watertable contour within the SIR	Total	-	**177,337**	**(A)**	Current Mapping adapted from (SIRLWSMP, 1989)
Area of 1996 0-3 m watertable contour that extends beyond the projected 2020 0-2 m watertable contour	Total	-	**60,220**	**(B)**	Current Mapping adapted from (SIRLWSMP, 1989) & (SKM, 1996)
Assumed(i) relative proportion of B Type Management Area within the Total Area of 1996 0-3 m contour that extneds beyond the projected 2020 0-2 m watertable contour	Relative proportion	-	**30%**	**(C)**	Current Mapping adapted from (SIRLWSMP, 1989) & (SKM, 1996)
Phase A Area outside of the Composite Boundary (projected 2020 0-2m watertable contour plus 1996 0-3m watertable contour)	Total	-	**6,423**	**(D)**	Current Mapping adapted from (SIRLWSMP, 1989)
Area currently served by Phase A pumps and the Girgarre Evaporation Basin System (installed prior to SSDP)	Phase A Pumps	74	-18,392		Current Mapping (SKM, 2006)
	Girgarre	3	-1,357		
	Total	77	**-19,749**	**(E)**	
Area currently served by pumps that have been installed and upgraded with SSDP assistance (Capital Grants) outside of the Defined Area at Risk of Salinity and Waterlogging	Total	22	**2,901**	**(F)**	Current Mapping (SKM, 2006)
Area at Risk to be served by the SSDP			**184,979**	**(G)**	**= (A) + (B) x (C) + (D) - (E) + (F)**
Area at Risk to be served by the SSDP SAY			**185,000**		

(i) We have a sound understanding that the majority of the additional area outside the 2020 0-2 m boundary is C Type, and have assumed that only 30% of this area is B type.

Attachment 3: Licensed and Metered Private Pumps Servicing Pasture Areas

	2000/01	2001/02	2002/03	2003/04	2004/05	Total for Period
Licensed and Metered Pumps (#)	687	719	604	622	702	
Total Irrigation Entitlement (ML)	86,410	121,432	121,757	118,132	138,669	586,400
Total Volume Metered (ML)	71,750	63,295	101,823	64,288	64,820	365,976
Comparison of Metered and Licenced Volumes	83%	52%	84%	54%	47%	62%

Source: Shepparton Irrigation Region Water Service Protection Area Annual Reports (2000/01 - 04/05)

Attachment 4: Status of Phase A Pumps

G-MW Owned Phase A Pumps

Central Goulburn

Pump	Status			
	1988	1990	2000	2005
R1	O	O	O	O
R2	O	O	O	O
R4	O	O	O	O
R5	O	O	O	O
R6	O	O	O	O
R7	O	O	O	O
R8	O	O	O	O
R9	O	O	O	O
R10	O	O	O	O
R11	O	O	O	O
R12	O	O	O	O
R18	O	O	O	O
R20	O	O	O	O
R21	O	O	O	O
R22	O	O	O	O
R24	O	O	O	O
R25	O	O	O	O
R26	O	O	O	O
R28	O	O	O	O
R31	O	O	O	O
R32	O	O	O	O
R42	O	O	O	O
R44	O	O	O	O
R50	O	O	O	O
R51	O	O	O	O
R53	O	O	O	O
R54	O	O	O	O
R67	O	O	O	O
R69	O	O	A	A
R70	O	O	O	O
R72	O	O	O	O
R73	O	O	O	O
R74	O	O	O	O
R75	O	O	O	O
R76	O	O	O	O
R77	O	O	O	O
R81	O	O	O	O
R82	O	O	O	O
R83	O	O	O	O
R87	O	O	O	O
R88	O	O	N/O	N/O
T8	O	O	O	O
T11	O	O	O	O
T12	O	O	O	O
T13	O	O	O	O
T14	O	O	O	O
O	46	46	44	44
A	0	0	1	1
OCM	0	0	0	0
N/O	0	0	1	1
Include	46	46	44	44

Murray Valley

Pump	1988	1990	2000	2005
C1	O	O	O	O
C2	O	O	OCM	OCM
C3	O	O	A	A
C4	O	O	O	O
C5	O	O	O	O
C6	O	O	OCM	OCM
C7	O	O	OCM	OCM
C15	O	O	O	O
C32	O	O	O	O
C34	O	O	O	O
C35	O	O	O	O
C36	O	O	O	O
C40	O	O	O	O
C41	O	O	O	O
C42	O	O	O	O
C43	O	O	A	A
C44	O	O	O	O
C45	O	O	O	O
O	18	18	13	13
A	0	0	2	2
OCM	0	0	3	3
N/O	0	0	0	0
Include	18	18	16	16

Shepparton

Pump	1988	1990	2000	2005
SH11	O	O	O	O
SH12	O	O	O	SD
SH13	O	O	N/O	N/O
SH32	O	O	O	O
SH33	O	O	O	O
SH34	O	O	O	O
O	6	6	5	4
A	0	0	0	0
OCM	0	0	0	0
N/O	0	0	0	1
Include	6	6	5	4

Status Key

O = Operational
OCM = On Care & Maintenance
HD = Hire Discontinued
A = Abandoned
N/O = Not Operational
SD = Semi- decommissioned

Attachment 4: Status of Phase A Pumps cont.

Hired Phase A Pumps

Central Goulburn					Murray Valley					Shepparton				
Pump	Status				Pump					Pump				
	1988	1990	2000	2005		1988	1990	2000	2005		1988	1990	2000	2005
R29	O	HD	HD	HD	0	0	0	0	0	SH17	O	O	HD	HD
R30	O	O	O	O						SH20	O	O	O	O
R34	O	O	O	O						SH21	O	O	O	O
R39	O	O	HD	HD						SH35	O	O	O	O
R59	HD	HD	HD	HD						SH38	O	O	HD	HD
R60	O	O	O	O						SH39	O	O	HD	HD
R62	HD	HD	HD	HD						SH40	O	O	O	O
R63	O	O	O	O						SH41	O	O	HD	HD
R64	O	O	O	O						SH42	O	O	N/O	N/O
T9	O	O	O	O						SH43	O	O	O	O
O	8	7	6	6						O	10	10	5	5
HD	2	3	4	4						HD	0	0	4	4
Unknown	0	0	0	0						Unknown	0	0	0	0
Include	8	7	6	6						Include	10	10	5	5

Central Goulburn Total					Murray Valley Total					Shepparton Total				
	1988	1990	2000	2005		1988	1990	2000	2005		1988	1990	2000	2005
G-MW	46	46	44	44	**G-MW**	18	18	16	16	**G-MW**	6	6	5	4
Hired	8	7	6	6	**Hired**	0	0	0	0	**Hired**	10	10	5	5
Total	54	53	50	50	**Total**	18	18	16	16	**Total**	16	16	10	9

Status Key
- O = Operational
- OCM = On Care & Maintenance
- HD = Hire Discontinued
- A = Abandoned
- N/O = Not Operational
- SD = Semi- decommissioned

Section G - Consultation Strategy

Sub-Surface Drainage Program

Overview of Consultation Undertaken in the Preparation of the SSDP 5-Year Review

A series of formal and informal planning meetings have been undertaken as part of the SSDP 5-Year Review process. The following presents an overview of the consultation process undertaken.

1. PLANNING MEETINGS HELD (FORMAL):
Aspects of the SSDP 5-Year Review have been discussed in the forms detailed below.

i Sub-surface Drainage Working Group (SSDWG)

Meeting 2005 - 1 (March 2005)
- Paper on status of SSDP 2000 – 2005 Review.

Meeting 2005 - 2 (June 2005)
- Presentation of draft SSDP Vision, Mission and Objectives
- Paper on status of SSDP 2000 – 2005 Review.

Meeting 2005 - 3 (September 2005)
- Workshop as part of SSDP Social Assessment
- Paper on status of SSDP 2000 – 2005 Review and SSDP Vision, Mission and Objectives.

Meeting 2005 - 4 (December 2005)
- Presentation of SSDP Social Assessment Results
- Paper on status of SSDP 2000 – 2005 Review.

Meeting 2006 - 1 (March 2006)
- Paper on status of SSDP 2000 – 2005 Review.

ii Sub-surface Drainage Coordinating Group (SSDCG)

Meeting 10 (11 November 2004)
- Verbal update of status SSDP 2000 – 2005 Review.

Meeting 11 (17 February 2005)
- Presentation and Paper on proposed outline and draft Table of Contents (TOC) for SSDP 2000 – 2005 Review.

Meeting 12 (4 May 2005)
- Presentation of draft SSDP Vision, Mission and Objectives
- Verbal update of status SSDP 2000 – 2005 Review.

Meeting 13 (10 August 2005)
- Verbal update of status SSDP 2000 – 2005 Review.

Meeting 14 (10 November 2005)
- Presentation of SSDP Social Assessment Results
- Paper of status SSDP 2000 – 2005 Review.

Meeting 15 (2 February 2006)
- Verbal update of status SSDP 2000 – 2005 Review.

Meeting 16 (5 May 2006)
- Paper of status SSDP 2000 – 2005 Review including the completion of the Risk Assessment and Perspectives of Irrigation Futures.

iii. Surface Water Management Working Group (SWMWG)

Meeting 2005 - 3 (19 September 2005)

- Workshop as part of SSDP Social Assessment.

v. Farm and Environment Working Group

Meeting 2005 - 3 (3 August 2005)

- Workshop as part of SSDP Social Assessment.

v. Project Team Meeting

Meeting (November 2005)

- Proposed outline and draft Table of Contents (TOC) for SSDP 2000 – 2005 Review.

2. SOCIAL AND RISK ASSESSMENTS, AND IRRIGTION FUTURES

i. Social Assessment

Meeting 2006 – (3 August 2006)

- The Social Impact Assessment component of the SSDP 5-Year Review was presented to members of the Farm and Environment Working Group (F&EWG).

Meeting 2006 – (19September 2006)

- The Social Impact Assessment component of the SSDP 5-Year Review was presented to members of the Surface Water Management Working Group (SWMWG).

ii. Risk Assessment

Meeting 2006 – (1 February 2006)

- The Risk Assessment component of the SSDP 5-Year Review was developed during a workshop held at DPI between various stakeholders.

iii. Irrigation Futures

Meeting 2006 – (18 May 2006)

- DPI engaged members from each of the four SIRCS programs to explore the implications of one of four plausible irrigation future scenarios on their specific programs.

Meeting 2006 – (21 August 2006)

- DPI engaged members from each of the four SIRCS programs to present a summary of and discuss the implications of each of the four scenarios on their specific programs.

3. PLANNING MEETINGS HELD (INFORMAL)

Numerous informal meetings have been held as part of the preparation of the SSDP 2000-2005 Review, these include:

Meeting 1 2005 – (7 October 2005)

- Teleconference with Terry Hunter on the SSDP R&I Strategic Plan Review prioritisation.

Meeting 1 2006 - (10 January 2006)

- Teleconference update on status of the SIR composite Risk Matrix Layer.

Meeting 2 2006 - (1 February 2006)

- Workshop to present Baseline Data and Target Setting outputs (including SSDP Risk Assessment).

Meeting 3 2006 - (10 February 2006)

- Workshop as part of SSDWG Proposed Restructuring.

Meeting 4 2006 - (10 March 2006)

- Meeting regarding future funding for LWMP.

Meeting 5 2006 - (10 March 2006)

- Meeting with Rod McLennan and Ken Sampson detailing Resource Condition Targets (RCT) and how these should be included in the SSDP planning.

Meeting 6 2007 - (12 January 2007)

- Meeting with Terry Hunter to discuss preliminary comments on the SSDP 5-Year Review Report (First half of the report).

Meeting 7 2007 - (6 February 2007)

- Meeting with Terry Hunter to discuss preliminary comments on the SSDP 5-Year Review Report (Second half of the report).

Meeting 8 2007 - (30 May 2007)

- Meeting with Terry Batey, Ken Sampson, Terry Hunter and James Burkitt to finalise the SSDP 5-Year Review Report.

All other comments have been conveyed either verbally or by email.

4. APPROVAL PROCESS

The draft SSDP 5-Year Review was presented at the following meetings for endorsement:

i. SIRCS Review Planning Forum

Meeting 2007 - (21 March 2007)

- Workshop to present a verbal update on the status of the SSDP 5-Year Review.

ii. SIRTEC

Meeting 2007 - (2 April 2007)

- SSDP 5-Year Review verbal update presented.

iii. SIRIC

Meeting 2007 - (27 April 2007)

- SSDP 5-Year Review draft presented and endorsed by SIRIC. Comments from the Committee have been conveyed into the Review.

iv. GB CMA Board

Meeting 2007 - (11 May 2007)

- SSDP 5-Year Review draft presented and endorsed by the GB CMA Board.

v. G-MW Board

Meeting 2007 - (8 May 2007)

- SSDP 5-Year Review draft report accepted by G-MW Board Safety and Environment sub-committee.

Section H – Economic Assessment

Sub-surface Drainage Program
5 year review
Economic assessment

Final

March 2007

Final

March 2007

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Contents

SKM

1 Economic Evaluation

1.1 Introduction

The economic evaluation of the subsurface drainage program (SSDP) in the Shepparton Irrigation Region has been largely undertaken using the MDBC Drainage Evaluation Spreadsheet Model (DESM) Version 3.

In applying the DESM model, it was necessary to quantify a range of input parameters relating to the project. This short report details the assumptions that were made during the application of the model and the model outcome.

There are a number of modules in the DESM model, each of which represents a key element of the evaluation structure:

- Agricultural production – with project
- Agricultural production – without the project
- Agricultural production losses due to salinity
- Agricultural production losses due to waterlogging and flooding
- Drainage and on farm works – with project
- Drainage and on farm works – without project
- Effectiveness of drainage and on farm works
- Drainage Capital and O & M costs
- Reuse Benefits
- Downstream Impacts
- Road Benefits

The evaluation was undertaken using the time periods outlined in Figure 1 using a discount rate of 4% (real) and a sensitivity at 8% (real). A sensitivity test was also conducted showing the results when the gross margins were increased and decreased by 20%.

Separate evaluations were undertaken for separate components of the program. These include:

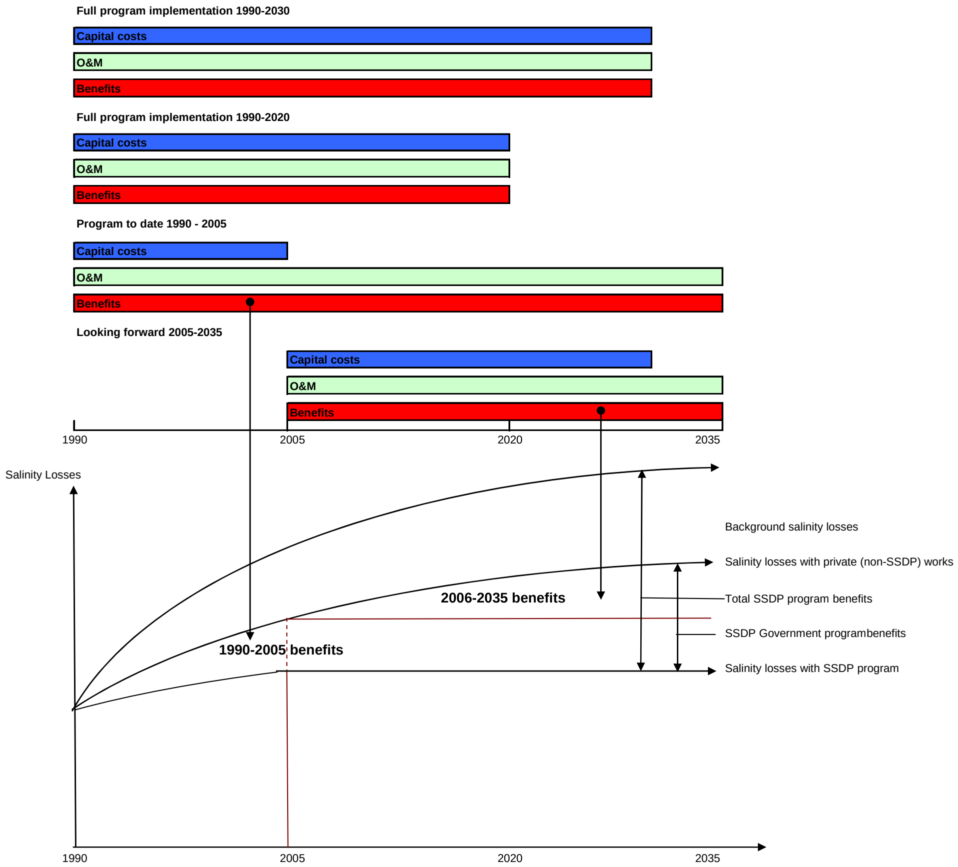
- Pump Upgrades (existing private pump upgraded with SSDP assistance)
- New Pumps (new private pumps installed with SSDP assistance)
- Reuse Pumps (public salinity control pumps)
- Evaporation Basin Pumps (public salinity control pumps)
- Horticulture Program (private horticulture pumps and tile drains installed with SSDP assistance).

Collectively the Pumps Upgrades and New Pumps make up the private pumping program, while Reuse and Evaporation Basin pumps make up the public program. For each of these programs a net present value (NPV) is calculated based on the net present benefits (NPB) minus the net present costs (NPC). A benefit-cost ratio (BCR) is also included, calculated as the NPB divided by the NPC.

Any economic evaluation based on cost-benefit analysis principles is undertaken looking at the situation in the absence of the program, (that is, what would have happened anyway) and the impact of the program.

Accordingly the benefits associated with the non-SSDP pumps are not considered as part of this assessment although it is acknowledged that the SSDP would assist in bringing attention to sub-surface drainage issues and thereby help increase the amount of non-SSDP pumps. In addition, assumptions have been made about the level of private investment in the absence of government funding. Figure 1 outlines a schematic of the benefits of the program. The graph shows the salinity losses over time. The top line is the losses that would occur over time without any groundwater pumping. These losses would be reduced by the introduction of privately owned pumps (shown by the middle line). The Government funded SSDP program will further reduce losses (shown by the bottom line). The benefits of the SSDP program (both Government and overall program) are the difference between these two lines as shown in the diagram. The diagram also shows how the benefits are split between the assessment periods. The full program benefits are the sum of the two periods.

Figure 1 Economic assessment evaluation periods



1.1.1 Changes from the previous assessment

The methodology used in this assessment has changed significantly since the last assessment. Most notably, the assessment period has changed from a 50 year assessment with a base year in 1990 using a discount rate of 5%. For this assessment, base years of 1990 and 2005 are used with assessment periods shorter than 50 years and using discount rates of 4% and 8% as requested by the Department of Sustainability and Environment.

Other changes to the model include:

- Changes to the timing of the capital works program (and therefore timing of operation and maintenance costs)
- Operation and maintenance costs have changed (see Table 7)
- The value of water has changed from $50/ML to $70/ML to reflect higher trading prices (see section 3.7)
- Gross margins for horticulture are substantially higher in this review (see section 3.1.2)

- The salinity loss functions for horticulture has changed, reducing the salinity benefit (see section 3.2)
- The value of 1 EC at Morgan has been increased to $230,000 per year (see section 3.8)
- It is not clear if support costs were included in the earlier review (see section 3.6)
- Effective area of perennial pasture factor reduced to 0.72 (see section 3.1.1).

SKM

2 Summary of results

The following tables provide a summary of the assessment.

Table 1 shows the assumed baseline level of drainage systems installed in the absence of government funding.

- **Table 1 Pumps installed in the absence of the SSDP program**

Program	Private Pumping		Public Pumping		Horticulture Program	
Component	New Pumps	Pump Upgrades	Reuse Pumps	Evaporation Basin Pumps	Tile Drainage	Pumps
% Installed without program	20%	0%	0%	0%	25%	15%

Table 2 and Table 3 outline the BCR associated with the total program from 1990 – 2020 and 2030. The base year is set to 1990 when the program began with the costs provided in 2005 dollars. Overall the analysis suggests that the program is viable economically.

- **Table 2 Economic assessment summary results 1990-2020: 2005 dollars, base year 1990 ($'000)**

	Private Pumping		Public Pumping			
Component	Pump Upgrades	New Pumps	Reuse Pumps	Evaporation Basin Pumps	Horticulture Program	Overall
1990-2020 (2005 dollars, base year 1990)						
4% NPV ($'000)	2,304	12,666	7,531	76	324	22,901
4% BCR	**1.5**	**1.4**	**1.4**	**1.1**	**1.1**	**1.4**
BCR sensitivities						
Discount rate: 8%	1.3	1.0	1.1	0.8	0.8	1.1
4% Gross Margin: +20%	1.8	1.6	1.7	1.3	1.3	1.6
4% Gross Margin: – 20%	1.2	1.1	1.1	0.9	0.9	1.1

- **Table 3 Economic assessment summary results 1990-2030: 2005 dollars, base year 1990 ($'000)**

	Private Pumping		Public Pumping			
Component	Pump Upgrades	New Pumps	Reuse Pumps	Evaporation Basin Pumps	Horticulture Program	Overall
1990-2030 (2005 dollars, base year 1990)						
4% NPV ($'000)	3,745	23,918	18,455	964	613	47,695
4% BCR	**1.7**	**1.6**	**1.5**	**1.2**	**1.2**	**1.5**
BCR sensitivities						
Discount rate: 8%	1.4	1.1	1.2	0.9	0.8	1.1
4% Gross Margin: +20%	2.0	1.9	1.8	1.5	1.4	1.8
4% Gross Margin: – 20%	1.3	1.3	1.2	1.0	0.9	1.2

Table 4 provides the costs and benefits of the program from inception in 1990 to 2005. Again the base year for the assessment is 1990, with 2005 dollars. No capital works have occurred for Evaporation Basin Pumps in this time period, and as such a BCR for the evaporation pumps is not applicable. The overall BCR for this time period indicates there has been a net benefit of the works installed to 2005.

- **Table 4 Economic assessment summary results 1990-2005: 2005 dollars, base year 1990 ($'000)**

	Private Pumping		Public Pumping			
Component	Pump Upgrades	New Pumps	Reuse Pumps	Evaporation Basin Pumps	Horticulture Program	Overall
1990-2005 (2005 dollars, base year 1990)						
4% NPV ($'000)	2,234	12,637	3,508	NA	672	19,052
4% BCR	**1.5**	**1.4**	**1.2**	**NA**	**1.3**	**1.3**
BCR sensitivities						
Discount rate: 8%	1.3	1.0	1.0	NA	0.9	1.0
4% Gross Margin: +20%	1.8	1.7	1.5	NA	1.5	1.6
4% Gross Margin: – 20%	1.2	1.1	1.0	NA	1.0	1.1

Table 5 provides the assessment of future works and is provided in 2005 dollars with a base year at 2005. As the base year is different to the other assessment periods, the NPVs are not directly comparable. Escalating the 1990-2020/2030 and 1990-2005 assessments to a base year of 2005 is not considered appropriate as costs incurred in the past should be considered sunk. The benefit cost ratios are comparable however. Overall the results are better for the assessment to 2035 as the analysis period extends past the end of the capital works in 2030. Benefits continue to accrue in the period 2030-2035 however these are not offset by any capital works.

The analysis shows the programs are justified going forward. However, it is important to consider the assumptions used in the analysis. In particular, the analysis assumes the pumps operate in areas of irrigated dairy or horticultural enterprises. However in the future, if the areas served by the pumps returned to dryland farming as a result of water trading or structural change the benefits would be reduced. The assessment also assumes a progressive salinity loss function in the no intervention case. However if dry conditions persist, the salinity losses the pumps are working to counter will be reduced as the water tables fall naturally (this is discussed further in section 3.2).

The horticulture program is generally less economically attractive than other programs primarily due to the small area that is covered by the program and the higher capital cost per hectare served relative to other programs. While the agricultural benefits per ha are larger than the pasture programs, these benefits do not outweigh the relatively high capital costs. Horticultural works are unlikely to be undertaken privately as the BCR is less than one at a discount rate of 8%, the likely hurdle rate for private investment. However private investment in drainage pumps in the absence of government funding may be expected to occur given the high BCR even at an 8% discount rate.

- **Table 5 Economic assessment summary results 2005-2030: 2005 dollars, base year 2005 ($'000)**

	Private Pumping		Public Pumping			
Component	Pump Upgrades	New Pumps	Reuse Pumps	Evaporation Basin Pumps	Horticulture Program	Overall
2005-2030 (2005 dollars, base year 2005)						
4% NPV ($'000)	3,867	29,556	37,900	2,825	203	74,352
4% BCR	**2.6**	**2.5**	**1.8**	**1.3**	**1.1**	**1.9**
BCR sensitivities						
Discount rate: 8%	2.1	1.7	1.4	0.9	0.7	1.4
4% Gross Margin: +20%	3.1	3.0	2.1	1.6	1.3	2.3
4% Gross Margin: – 20%	2.1	2.0	1.4	1.0	0.8	1.5

3 Model components

The following provides an outline of the key modelling components.

3.1 Agricultural Production

It was assumed that the agricultural profile and economic characteristics (excluding salinity, waterlogging, or flooding impacts) remained the same for the 'without project' and 'with project scenarios'.

3.1.1 Land Use Areas

Dairying was assumed to be the dominant agricultural enterprise for the private and public pasture pumping programs. Gross enterprise areas served are converted to an 'effective hectare' of perennial pasture using a factor of 0.72. This is based on an average mix of 60% perennial pasture, 20% of annual pasture and 20% of dryland within the gross areas served. Two ha of annual pasture or 10 ha of dryland is assumed to equivalent to 1 ha of perennial pasture. Analysis completed by CSIRO (2000, pg 6) suggests a factor between 0.55 and 0.85 using the average of several farm sizes.

For the private horticultural program, all of the areas served by low capacity pumps and tile drainage systems were assumed to be planted to perennial horticulture.

3.1.2 Achievable Gross Margins

For the public and private pump program, it has been assumed that upon sub-surface drainage implementation dairy enterprises benefit from reduced exposure to saline watertables. For other irrigated agriculture profiles, for example cropping and intensive sheep and beef grazing, the benefits to be achieved through sub-surface drainage are expected to be less than that achieved by a dairy enterprise.

Advice was provided by a local milk processing company, Tatura Milk, as to the gross margin that could be achieved by an enterprise in the absence of salinity and waterlogging. The estimate provided ($1600 - $1,700/ha) reflects data from the 2003/04 and 2004/05 financial years and assumes an income of approximately $4,500/ha, and production costs of $2,800/ha. As effective milk production area was separately collated for each year, and adjustment in relation to the level of irrigated allocations was not required.

A revised estimate of the achievable gross margin for horticultural enterprises has been calculated using more recent farm budget information relating to canning peaches and pears (RCMG, 2005) and fresh market products (DPI, 2005). The 2003 SPC census data has been used to calculate the areas under production.

Using the data presented in Table 6, the weighted average (by area) of achievable horticulture gross margin in the absence of salinity and waterlogging is estimated to be $8,900 per hectare per annum. This is a significant increase from the value used in the 2000 assessment of $3,578 per hectare per annum. However, it is important to note the significant variation in gross margins, from approximately $4,000 per hectare per annum through to $15,000 per hectare per annum.

- **Table 6 Calculation of Horticultural Gross Margin**

Variety	Area (ha) [a]	Proportional Allocation to Market (%)		Estimated Gross Margin ($/ha)	
		Fresh & Export [b]	Canning [c]	Fresh & Export [d]	Other [d]
Apples	2,097	81%	19%	13,980	3,747 [g]
Pears	3,228	44%	56%	11,420 [e]	4,200 [e]
Peaches	2,192	13%	87%	11,420	3,937 [e]
Apricots	593	27%	73%	15,101	8,477 [g]
Plums/Nectarines	1,076	92%	8%	11,132	7,054 [g]
Nashi	685	100%	0%	15,000 [e]	n/a
TOTAL	**9,853**			**8,900**	

Notes: [a] Area based on Goulburn Valley Orchard Census 2003. [b] Represents proportion of annual tonnage of produce to domestic fresh markets and export markets. [c] Represents proportion of annual tonnage of produce to canning and juice production. [d] Gross margin data reflects that for packed produce in DPI (2005) unless otherwise indicated. [e] Estimated by SKM. [f] Gross Margin data reflects that for canned fruit presented in RCMG (2005) [g] Pers Comm Olive Montecillo (DPI, Vic)

3.1.3 Gross Water Use Intensity

The gross water use intensity was assumed to be 8 ML/effective ha for dairying and 6 ML/ha for horticultural enterprises. This is important for the selection of the salinity loss function applied within each model.

3.2 Agricultural Production Losses Due to Salinity

In the earlier review the MDBC salinity loss function method was used for both pasture-based and horticultural enterprises. For the private pumping program, public reuse program, and horticultural works program, the low groundwater salinity (<10,000 EC) loss function assuming a required irrigation intensity of 5 ML/ha was applied.

For public pumps disposing to basins, the high groundwater salinity (>10,000 EC) loss function and an irrigation intensity of 5 ML/ha was adopted. The actual water intensity figures are higher than 5 ML/ha however the DESM only provides loss functions up to an intensity of 5 ML/ha.

While for pasture-based enterprises the same loss functions used in earlier reviews were adopted, SKM notes existing concerns regarding the potential for overestimating the benefits by applying this method (MDBC, 1994 pg 24). The method applies an inclining loss function beyond the onset of shallow water tables. The inclining loss function represents the gradual accumulation of salt in the soil profile due to sustained period of shallow water tables.

The applied loss function is considered a second best solution to estimate the agricultural losses associated with shallow water tables. Where possible, calculations should be based on the projected changes in proportions of area subject to specific soil salinity bands.

There is further argument to challenge the hypothesis that salt accumulation rates continually increase, particularly as the recent low rainfall sequence has resulted in reductions in the shallow water table levels from pre-existing levels. It is therefore possible, if not likely, that continued rainfall and irrigation will have reduced salt accumulation within the soil profile and thereby lowered soil salinity. The benefits to be achieved from surface drainage may also have reduced in the medium to long term.

For the purposes of consistency with the earlier analysis, the MDBC loss function has been applied as estimated in the earlier review. SKM Economics and Financial Advisory personnel consider this a second best solution given the limitations outlined in the discussion above.

The use of the MDBC loss functions not considered applicable to the horticultural program (assumed to be Shepparton East). It is the view of SKM that sufficient evidence exists that the loss functions would over-estimate the benefits in the earlier review. MDBC (1994, pg 68) state the following for the Shepparton East Subsurface Drainage assumptions:

> A combined figure was adopted for [salinity and waterlogging] losses, based on the results of a survey of the orchards in the area described in the salinity management report. The survey indicated the death of trees in 4% of the orchard area, and yield reductions estimated at 30% in a further 9% for the area. The losses were not attributed to either salinity or waterlogging, and for the purposes of this study, an overall weighted value of 7% of total production has been used.

Source: MDBC (1994, pg 68)

It is also noted that recent work undertaken by URS (2006, pg 5-2) that applied hypothetical events and recurrence intervals for shallow water table impacts also represented annual average losses in the order of 2% to 13% per annum.

Given that shallow water tables have gradually increased in the Shepparton region since the introduction of irrigation, it is broadly accepted that salt accumulation would have commenced some time before 1990.

The areas with shallow water tables are estimated back to 40 years before the start of the program. The model then requires the areas with shallow water tables in 10 year intervals from 40 years before the start of the program to the end of the assessment period. For this assessment it is assumed that the full area covered by the pumps has shallow water tables at the start of the program. 10 years prior to the start of the program, it is assumed that 75% of the area covered by the pumps has shallow water tables, 20 years prior it is 50% of the area, 30 years prior 25% of area and 40 years prior, a nominal area is impacted by shallow water tables.

The applied salinity loss functions are provided in Appendix B.

For the pasture programs, a correction factor of 0.8 is applied to the land areas to simulate the 20% of soils that would be in elevated locations and where the impact of rising water tables would be less pronounced.

The effectiveness of sub-surface drainage to mitigate salinity losses on pasture based enterprises was assumed to be 80%. This was derived by assuming 70% of the effective area served would be fully protected and one-third of the remaining area mitigated by 33% of the total losses currently experienced. This is consistent with the current assumptions used in the feasibility level investigations for new public pumps.

The effectiveness of sub-surface drainage to mitigate salinity losses on perennial horticulture was set to the default DESM value of 90%.

Only half of the agricultural benefits calculated in the DESM model for Upgraded Pumps is applied in the cost benefit analysis. The Upgraded Pumps costs represent only the cost to upgrade the pump, not the full cost of the pump. As such only a proportion of the benefits should be applied.

3.3 Waterlogging and Flooding

Agricultural production losses due to waterlogging and flooding were ignored in the earlier review by SKM and are not included in this review.

3.4 Drainage And Landforming

The benefits of surface drainage and landforming in areas also protected by subsurface drainage works were ignored with factors set to zero.

3.5 Capital and O&M Costs

Works establishment costs are detailed in Appendix C. The DESM was modified to accommodate works program of greater than 20 years and a varying annual costs.

It should be noted that the DESM calculates a residual asset value at the end of the evaluation period for inclusion in net present value calculations. The life of the assets assumed for this calculation is 50 years. This results in a slight reduction in the net present value of the works program establishment costs.

The capital costs are provided in 2005 dollars. O&M costs are also provided in constant dollars to simplify the evaluation. The following O&M costs have been included:

- **Table 7 O&M costs ($ / pump / pa)**

Pump Upgrades	New Pumps	Reuse Pumps	Evaporation Basin Pumps	Horticulture - Pumps	Horticulture – Tile drains
2,000 [a]	2,000 [a]	4,200 [b]	4,850 [c]	1,100 [d]	50 (per ha)

Notes: [a] Unit model estimated based on average costs operation ($973), maintenance ($510) and fees and charges ($525)per pump per year (assuming overall 80% of pumps will be electric and 20% diesel) [b] Pump O&M and channel outfall expense (DOCS#1738028) [c] $3,800 (Pump O&M (excluding channel outfall expense) (DOCS#1738028)) PLUS $1,050 for Basin O&M [d] Unit model estimated based on operation ($389), maintenance ($372) and fees and charges ($338) per pump per year (assuming overall 80% of pumps will be electric and 20% diesel)

3.6 Support costs

Support costs were included based on provided information for:

- DPI extension
- G-MW management, support and extension
- Research and investigation
- Monitoring

In the absence of the SSDP, support costs attributed to the program are assumed to fall to zero. Support costs are apportioned across the programs based on area served with a greater level of extension costs applied to the non-public programs.

Support costs are provided in Appendix D.

3.7 Reuse Benefits

The value of water is set to $70/ML. This value is based on an approximate value of permanent water trade of $1,200/ML. The annual cost is calculated at $70/ML assuming a 4% discount rate over a 30 year period. It was estimated that 1 ML/ha was able to be extracted and reused during the summer months for private pumps, and 0.23ML/ha for public pumps.

Any potential reuse benefits of drainage water reaching the River Murray have been excluded from this analysis.

3.8 Downstream Impacts

The assumptions relating to the estimation of salinity impacts are summarised in the following section.

The calculation is based on:

- The average salinity of shallow groundwater;
- The volumetric rate of groundwater extraction; and,
- The proportion of sub-surface drainage water discharged.

▪ **Table 8 Parameters for Determining Downstream Impact**

Ownership	Private			Public			Total
Management Area Type [a]	C	Low B3	High B3 Private	High B3 Public	B2	B1	
Total Area (ha) 2030	116,000	52,400	8,600	57,000	18,000	10,000	262,000
Area Drained (ha)	1,300	52,400	8,600	57,000	18,000	10,000	147,300
Winter Salt Load (t)	1,300	11,100	2,600	31,920	16,800	0	63,720
Summer Salt Load (t)	0	0	0	7,980	4,200	0	12,180
Total (t)	1,300	11,100	2,600	39,900	21,000	0	75,900
Approx EC Impact	**0.2**	**1.7**	**0.4**	**5.8**	**3.1**	**0.0**	**11.1**

[a] Management area type relate to the differing groundwater salinity areas.

The downstream financial impact of 1 EC at Morgan was set to $230,000 per year over the project period in line with the Shepparton Irrigation Region Salinity Audit (SKM, 2006 p14). The salt load without the plan was assumed to be zero however it is acknowledged that without the program there would be an increase in the diffuse salt load causing downstream impacts. Due to the difficulty in calculating this, it has not been included - leading to and over estimate of the total downstream impact. Based on this data the impact at Morgan of 1 tonne/day was set as per Table 9.

▪ **Table 9 Parameters for Determining Downstream Impact**

Program	Horticulture	Pump Upgrades	New Pumps	Reuse	Evaporation Basin
EC impact at Morgan of 1 tonne per day	0.0562	0.0536	0.0536	0.0533	NA

3.9 Road Benefits

Any potential benefits of the project to rural sealed and unsealed roads or farm tracks were ignored.

4 References

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Appendix A DESM model results

- **Table 10 DESM Evaluation Results 1990-2030 ($'000), 2005 dollars, base year 1990, 4% discount rate**

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	7,378	65,472	49,696	4,875	127,420	5,563	132,984
Reuse	1,883	16,661	3,567	-	22,112	-	22,112
Benefits without program							
Farm Productivity	-	13,094	-	-	13,094	1,029	14,124
Reuse	-	3,332	-	-	3,332	-	3,332
Net Benefits	**9,262**	**65,706**	**53,263**	**4,875**	**133,105**	**4,534**	**137,639**
Costs with program							
Establishment	1,614	30,304	16,689	3,071	51,677	3,696	55,374
Operations & Maint.	2,125	9,375	6,146	586	18,233	550	18,782
Downstream	311	3,202	8,082	-	11,595	331	11,927
Support	1,467	7,483	3,891	254	13,095	191	13,285
Costs without program							
Establishment	-	6,061	-	-	6,061	684	6,745
Operations & Maint.	-	1,875	-	-	1,875	102	1,977
Downstream	-	640	-	-	640	61	702
Support	-	-	-	-	-	-	-
Net Costs	**5,517**	**41,788**	**34,808**	**3,911**	**86,023**	**3,921**	**89,945**
NPV	**3,745**	**23,918**	**18,455**	**964**	**47,082**	**613**	**47,695**
Benefit Cost Ratio	1.7	1.6	1.5	1.2	1.5	1.2	1.5

Table 11 DESM Evaluation Results 1990-2030 ($'000), 2005 dollars, base year 1990, 8% discount rate

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	3,376	29,498	18,062	1,373	52,310	2,530	54,840
Reuse	889	7,752	1,328	-	9,969	-	9,969
Benefits without program							
Farm Productivity	-	5,900	-	-	5,900	468	6,368
Reuse	-	1,550	-	-	1,550	-	1,550
Net Benefits	**4,266**	**29,800**	**19,389**	**1,373**	**54,829**	2,062	**56,891**
	-	-	-	-	-	-	
Costs with program	-	-	-	-	-	-	
Establishment	1,216	22,511	9,574	1,360	34,662	2,573	37,234
Operations & Maint.	1,016	4,423	2,257	166	7,861	253	8,113
Downstream	147	1,489	2,985	-	4,620	148	4,768
Support	774	3,945	1,831	87	6,638	101	6,738
Costs without program							
Establishment	-	4,502	-	-	4,502	476	4,978
Operations & Maint.	-	885	-	-	885	47	931
Downstream	-	298	-	-	298	27	325
Support	-	-	-	-	-	-	-
Net Costs	**3,152**	**26,683**	**16,648**	**1,613**	**48,096**	2,524	**50,620**
NPV	**1,114**	**3,117**	**2,742**	**- 240**	**6,733**	**- 462**	**6,271**
Benefit Cost Ratio	1.4	1.1	1.2	0.9	1.1	0.8	1.1

▪ Table 12 DESM Evaluation Results 1990-2030 ($'000), 2005 dollars, base year 1990, 4% discount rate Gross Margin +20%

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	8,854	78,566	59,635	5,849	152,904	6,676	159,580
Reuse	2,260	19,993	4,281	-	26,534	-	26,534
Benefits without program							
Farm Productivity	-	15,713	-	-	15,713.26	1,235	16,948
Reuse	-	3,999	-	-	3,998.63	-	3,999
Net Benefits	**11,114**	**78,848**	**63,916**	**5,849**	**159,727**	**5,441**	**165,167**
Costs with program							
Establishment	1,614	30,304	16,689	3,071	51,677	3,696	55,374
Operations & Maint.	2,125	9,375	6,146	586	18,233	550	18,782
Downstream	311	3,202	8,082	-	11,595	331	11,927
Support	1,467	7,483	3,891	254	13,095	191	13,285
Costs without program							
Establishment	-	6,061	-	-	6,061	684	6,745
Operations & Maint.	-	1,875	-	-	1,875	102	1,977
Downstream	-	640	-	-	640	61	702
Support	-	-	-	-	-	-	-
Net Costs	**5,517**	**41,788**	**34,808**	**3,911**	**86,023**	**3,921**	**89,945**
NPV	**5,597**	**37,059**	**29,107**	**1,939**	**73,703**	**1,520**	**75,223**
Benefit Cost Ratio	2.0	1.9	1.8	1.5	1.9	1.4	1.8

▪ Table 13 DESM Evaluation Results 1990-2030 ($'000), 2005 dollars, base year 1990, 4% discount rate Gross Margin - 20%

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	5,903	52,378	39,756	3,900	101,936	4,451	106,387
Reuse	1,507	13,329	2,854	-	17,689	-	17,689
Benefits without program							
Farm Productivity	-	10,476	-	-	10,475.51	823	11,299
Reuse	-	2,666	-	-	2,665.75	-	2,666
Net Benefits	**7,409**	**52,565**	**42,610**	**3,900**	**106,484**	**3,627**	**110,112**
Costs with program							
Establishment	1,614	30,304	16,689	3,071	51,677	3,696	55,374
Operations & Maint.	2,125	9,375	6,146	586	18,233	550	18,782
Downstream	311	3,202	8,082	-	11,595	331	11,927
Support	1,467	7,483	3,891	254	13,095	191	13,285
Costs without program							
Establishment	-	6,061	-	-	6,061	684	6,745
Operations & Maint.	-	1,875	-	-	1,875	102	1,977
Downstream	-	640	-	-	640	61	702
Support	-	-			-	-	-
Net Costs	**5,517**	**41,788**	**34,808**	**3,911**	**86,023**	**3,921**	**89,945**
NPV	**1,893**	**10,777**	**7,802**	**- 11**	**20,461**	**- 294**	**20,167**
Benefit Cost Ratio	1.3	1.3	1.2	1.0	1.2	0.9	1.2

Table 14 DESM Evaluation Results 1990-2020 ($'000), 2005 dollars, base year 1990, 4% discount rate

Program Component	Regional Private Pumping – Upgraded	Regional Private Pumping – New	Regional Public Pumping – Reuse	Regional Public Pumping – Evaporation Basin	Total Pasture Program	Horticulture Program	Total SSDP program
Benefits with program							
Farm Productivity	5,367	46,346	25,157	1,122	77,992	3,910	81,902
Reuse	1,409	12,153	1,874	-	15,437	-	15,437
Benefits without program							
Farm Productivity	-	9,269	-	-	9,269	723	9,993
Reuse	-	2,431	-	-	2,431	-	2,431
Net Benefits	**6,777**	**46,799**	**27,031**	**1,122**	**81,729**	**3,187**	**84,915**
Costs with program							
Establishment	1,390	25,483	9,123	741	36,736	2,707	39,443
Operations & Maint.	1,613	6,961	3,065	139	11,778	384	12,162
Downstream	232	2,334	4,075	-	6,641	223	6,865
Support	1,238	6,312	3,237	167	10,953	161	11,114
Costs without program							
Establishment	-	5,097	-	-	5,097	501	5,597
Operations & Maint.	-	1,392	-	-	1,392	71	1,463
Downstream	-	467	-	-	467	41	508
Support	-	-	-	-	-	-	-
Net Costs	**4,473**	**34,134**	**19,500**	**1,046**	**59,153**	**2,862**	**62,015**
NPV	**2,304**	**12,666**	**7,531**	**76**	**22,576**	**324**	**22,901**
Benefit Cost Ratio	1.5	1.4	1.4	1.1	1.4	1.1	1.4

▪ Table 15 DESM Evaluation Results 1990-2020 ($'000), 2005 dollars, base year 1990, 8% discount rate

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	2,844	24,447	11,652	400	39,344	2,092	41,436
Reuse	764	6,560	885	-	8,209	-	8,209
Benefits without program							
Farm Productivity	-	4,889	-	-	4,889	387	5,277
Reuse	-	1,312	-	-	1,312	-	1,312
Net Benefits	**3,608**	**24,806**	**12,537**	**400**	**41,352**	**1,705**	**43,057**
	-	**-**	**-**	**-**		**-**	
Costs with program	-	-	-	-		-	
Establishment	1,121	20,487	6,433	399	28,441	2,157	30,598
Operations & Maint.	880	3,784	1,452	50	6,165	209	6,373
Downstream	126	1,259	1,937	-	3,322	119	3,442
Support	712	3,630	1,653	64	6,058	93	6,150
Costs without program							
Establishment	-	4,097	-	-	4,097	399	4,496
Operations & Maint.	-	757	-	-	757	39	795
Downstream	-	252	-	-	252	22	274
Support	-	-	-	-	-	-	-
Net Costs	**2,839**	**24,054**	**11,475**	**512**	**38,880**	**2,118**	**40,998**
NPV	**769**	**752**	**1,062**	**- 112**	**2,472**	**- 413**	**2,059**
Benefit Cost Ratio	1.3	1.0	1.1	0.8	1.1	0.8	1.1

▪ Table 16 DESM Evaluation Results 1990-2020 ($'000), 2005 dollars, base year 1990, 4% discount rate Gross Margin +20%

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	6,441	55,615	30,188	1,346	93,590	4,692	98,282
Reuse	1,691	14,584	2,249	-	18,524	-	18,524
Benefits without program							
Farm Productivity	-	11,123	-	-	11,123.05	868	11,991
Reuse	-	2,917	-	-	2,916.74	-	2,917
Net Benefits	**8,132**	**56,159**	**32,437**	**1,346**	**98,075**	**3,824**	**101,899**
Costs with program							
Establishment	1,390	25,483	9,123	741	36,736	2,707	39,443
Operations & Maint.	1,613	6,961	3,065	139	11,778	384	12,162
Downstream	232	2,334	4,075	-	6,641	223	6,865
Support	1,238	6,312	3,237	167	10,953	161	11,114
Costs without program							
Establishment	-	5,097	-	-	5,097	501	5,597
Operations & Maint.	-	1,392	-	-	1,392	71	1,463
Downstream	-	467	-	-	467	41	508
Support	-	-	-	-	-	-	-
Net Costs	**4,473**	**34,134**	**19,500**	**1,046**	**59,153**	**2,862**	**62,015**
NPV	**3,659**	**22,026**	**12,937**	**300**	**38,922**	**962**	**39,884**
Benefit Cost Ratio	1.8	1.6	1.7	1.3	1.7	1.3	1.6

■ **Table 17 DESM Evaluation Results 1990-2020 ($'000), 2005 dollars, base year 1990, 4% discount rate Gross Margin - 20%**

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	4,294	37,077	20,125	898	62,394	3,128	65,522
Reuse	1,127	9,722	1,500	-	12,349	-	12,349
Benefits without program							
Farm Productivity	-	7,415	-	-	7,415.36	579	7,994
Reuse	-	1,944	-	-	1,944.49	-	1,944
Net Benefits	**5,421**	**37,439**	**21,625**	**898**	**65,383**	**2,549**	**67,932**
Costs with program							
Establishment	1,390	25,483	9,123	741	36,736	2,707	39,443
Operations & Maint.	1,613	6,961	3,065	139	11,778	384	12,162
Downstream	232	2,334	4,075	-	6,641	223	6,865
Support	1,238	6,312	3,237	167	10,953	161	11,114
Costs without program							
Establishment	-	5,097	-	-	5,097	501	5,597
Operations & Maint.	-	1,392	-	-	1,392	71	1,463
Downstream	-	467	-	-	467	41	508
Support	-	-	-	-	-	-	-
Net Costs	**4,473**	**34,134**	**19,500**	**1,046**	**59,153**	**2,862**	**62,015**
NPV	**948**	**3,306**	**2,125**	**- 148**	**6,230**	**- 313**	**5,918**
Benefit Cost Ratio	1.2	1.1	1.1	0.9	1.1	0.9	1.1

Table 18 DESM Evaluation Results 1990-2005 ($'000), 2005 dollars, base year 1990, 4% discount rate

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	5,361	45,349	16,397	-	67,107	3,784	70,891
Reuse	1,457	12,323	1,296	-	15,075	-	15,075
Benefits without program							
Farm Productivity	-	9,069.81	-	-	9,069.81	699.95	9,770
Reuse	-	2,464.66	-	-	2,464.66	-	2,465
Net Benefits	**6,818**	**46,138**	**17,693**	**-**	**70,648**	**3,084**	**73,732**
Costs with program							
Establishment	1,312	23,798	6,260	-	31,370	2,183	33,553
Operations & Maint.	1,725	7,358	2,336	-	11,419	363	11,782
Downstream	243	2,403	3,161	-	5,807	204	6,011
Support	1,305	6,653	2,426	-	10,384	170	10,554
Costs without program							
Establishment	-	4,760	-	-	4,760	404	5,163
Operations & Maint.	-	1,472	-	-	1,472	67	1,539
Downstream	-	481	-	-	481	38	518
Support	-	-	-	-	-	-	-
Net Costs	**4,584**	**33,500**	**14,184**	**-**	**52,268**	**2,411**	**54,679**
NPV	**2,234**	**12,637**	**3,508**	**-**	**18,380**	**672**	**19,052**
Benefit Cost Ratio	1.5	1.4	1.2	#DIV/0!	1.4	1.3	1.3

Table 19 DESM Evaluation Results 1990-2005 ($'000), 2005 dollars, base year 1990, 8% discount rate

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	2,720	23,056	7,960	-	33,736	1,975	35,711
Reuse	750	6,364	637	-	7,751	-	7,751
Benefits without program							
Farm Productivity	-	4,611	-	-	4,611.29	365.35	4,977
Reuse	-	1,273	-	-	1,272.73	-	1,273
Net Benefits	**3,471**	**23,536**	**8,596**	**-**	**35,603**	**1,610**	**37,213**
	-	**-**	**-**	**-**			
Costs with program	-	-	-	-			
Establishment	1,060	19,218	4,723	-	25,001	1,847	26,848
Operations & Maint.	886	3,781	1,129	-	5,797	194	5,991
Downstream	125	1,235	1,528	-	2,888	109	2,996
Support	700	3,570	1,210	-	5,480	91	5,571
	-	**-**	**-**	**-**		**0**	
Costs without program	**-**	**-**	**-**	**-**		**0**	
Establishment	-	3,844	-	-	3,844	342	4,185
Operations & Maint.	-	756	-	-	756	36	792
Downstream	-	247	-	-	247	20	267
Support	-	-	-	-	-	-	-
Net Costs	**2,771**	**22,957**	**8,591**	**-**	**34,319**	**1,843**	**36,162**
NPV	**700**	**579**	**6**	**-**	**1,285**	**- 234**	**1,051**
Benefit Cost Ratio	1.3	1.0	1.0	#DIV/0!	1.0	0.9	1.0

▪ **Table 20 DESM Evaluation Results 1990-2005 ($’000), 2005 dollars, base year 1990, 4% discount rate Gross Margin +20%**

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	6,433	54,419	19,676	-	80,529	4,540	85,069
Reuse	1,748	14,788	1,555	-	18,090	-	18,090
Benefits without program							
Farm Productivity	-	10,884	-	-	10,883.77	840	11,724
Reuse	-	2,958	-	-	2,957.59	-	2,958
Net Benefits	**8,181**	**55,365**	**21,231**	**-**	**84,778**	**3,700**	**88,478**
Costs with program							
Establishment	1,312	23,798	6,260	-	31,370	2,183	33,553
Operations & Maint.	1,725	7,358	2,336	-	11,419	363	11,782
Downstream	243	2,403	3,161	-	5,807	204	6,011
Support	1,305	6,653	2,426	-	10,384	170	10,554
Costs without program							
Establishment	-	4,760	-	-	4,760	404	5,163
Operations & Maint.	-	1,472	-	-	1,472	67	1,539
Downstream	-	481	-	-	481	38	518
Support	-	-	-	-	-	-	-
Net Costs	**4,584**	**33,500**	**14,184**	**-**	**52,268**	**2,411**	**54,679**
NPV	**3,597**	**21,865**	**7,047**	**-**	**32,509**	**1,289**	**33,799**
Benefit Cost Ratio	1.8	1.7	1.5	NA	1.6	1.5	1.6

Table 21 DESM Evaluation Results 1990-2005 ($'000), 2005 dollars, base year 1990, 4% discount rate Gross Margin - 20%

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	4,289	36,279	13,118	-	53,686	3,027	56,713
Reuse	1,165	9,859	1,036	-	12,060	-	12,060
Benefits without program							
Farm Productivity	-	7,256	-	-	7,255.85	560	7,816
Reuse	-	1,972	-	-	1,971.73	-	1,972
Net Benefits	**5,454**	**36,910**	**14,154**	**-**	**56,518**	**2,467**	**58,985**
Costs with program							
Establishment	1,312	23,798	6,260	-	31,370	2,183	33,553
Operations & Maint.	1,725	7,358	2,336	-	11,419	363	11,782
Downstream	243	2,403	3,161	-	5,807	204	6,011
Support	1,305	6,653	2,426	-	10,384	170	10,554
Costs without program							
Establishment	-	4,760	-	-	4,760	404	5,163
Operations & Maint.	-	1,472	-	-	1,472	67	1,539
Downstream	-	481	-	-	481	38	518
Support	-	-	-	-	-	-	-
Net Costs	**4,584**	**33,500**	**14,184**	**-**	**52,268**	**2,411**	**54,679**
NPV	**870**	**3,410**	**- 30**	**-**	**4,250**	**56**	**4,306**
Benefit Cost Ratio	1.2	1.1	1.0	NA	1.1	1.0	1.1

▪ Table 22 DESM Evaluation Results 2005-2030 ($'000), 2005 dollars, base year 2005, 4% discount rate

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	5,144	51,006	81,767	12,241	150,157	4,420	154,578
Reuse	1,119	11,235	5,572	-	17,926	-	17,926
Benefits without program							
Farm Productivity	-	10,201	-	-	10,201	818	11,019
Reuse	-	2,247	-	-	2,247	-	2,247
Net Benefits	**6,263**	**49,792**	**87,339**	12,241	**155,635**	**3,603**	**159,238**
Costs with program							
Establishment	689	15,010	24,709	7,454	47,863	3,344	51,207
Operations & Maint.	1,095	5,440	9,491	1,460	17,487	453	17,939
Downstream	181	2,096	12,278	-	14,555	306	14,861
Support	431	2,199	2,961	500	6,091	56	6,147
Costs without program							
Establishment	-	3,002	-	-	3,002	619	3,621
Operations & Maint.	-	1,088	-	-	1,088	84	1,172
Downstream	-	419	-	-	419	57	476
Support	-	-	-	-	-	-	-
Net Costs	**2,396**	**20,236**	**49,439**	**9,415**	**81,486**	**3,400**	**84,886**
NPV	**3,867**	**29,556**	**37,900**	**2,825**	**74,149**	**203**	**74,352**
Benefit Cost Ratio	2.6	2.5	1.8	1.3	1.9	1.1	1.9

Table 23 DESM Evaluation Results 2005-2030 ($'000), 2005 dollars, base year 2005, 8% discount rate

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	2,609	25,589	39,654	5,565	73,418	2,187	75,604
Reuse	563	5,599	2,708	-	8,870	-	8,870
Benefits without program							
Farm Productivity	-	5,118	-	-	5,117.87	404.53	5,522
Reuse	-	1,120	-	-	1,119.80	-	1,120
Net Benefits	**3,173**	**24,951**	**42,362**	**5,565**	**76,050**	**1,782**	**77,832**
Costs with program							
Establishment	577	12,326	18,772	5,414	37,089	2,655	39,744
Operations & Maint.	541	2,665	4,495	667	8,369	225	8,594
Downstream	90	1,035	5,813	-	6,939	152	7,090
Support	282	1,437	2,084	292	4,095	37	4,132
Costs without program							
Establishment	-	2,465	-	-	2,465	491	2,956
Operations & Maint.	-	533	-	-	533	42	575
Downstream	-	207	-	-	207	28	235
Support	-	-	-	-	-	-	-
Net Costs	**1,491**	**14,258**	**31,164**	**6,373**	**53,286**	**2,508**	**55,794**
NPV	**1,682**	**10,692**	**11,198**	**- 808**	**22,764**	**- 726**	**22,038**
Benefit Cost Ratio	2.1	1.7	1.4	0.9	1.4	0.7	1.4

Table 24 DESM Evaluation Results 2005-2030 ($'000), 2005 dollars, base year 2005, 4% discount rate Gross Margin +20%

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	New	Reuse	Evaporation Basin			
Benefits with program							
Farm Productivity	6,173	61,207	98,120	14,689	180,189	5,305	185,493
Reuse	1,343	13,482	6,686	-	21,511	-	21,511
Benefits without program							
Farm Productivity	-	12,241	-	-	12,241.36	981	13,223
Reuse	-	2,696	-	-	2,696.36	-	2,696
Net Benefits	**7,516**	**59,751**	**104,807**	**14,689**	**186,762**	**4,323**	**191,085**
Costs with program							
Establishment	689	15,010	24,709	7,454	47,863	3,344	51,207
Operations & Maint.	1,095	5,440	9,491	1,460	17,487	453	17,939
Downstream	181	2,096	12,278	-	14,555	306	14,861
Support	431	2,199	2,961	500	6,091	56	6,147
Costs without program							
Establishment	-	3,002	-	-	3,002	619	3,621
Operations & Maint.	-	1,088	-	-	1,088	84	1,172
Downstream	-	419	-	-	419	57	476
Support	-	-	-	-	-	-	-
Net Costs	**2,396**	**20,236**	**49,439**	**9,415**	**81,486**	**3,400**	**84,886**
NPV	**5,120**	**39,515**	**55,368**	**5,274**	**105,276**	**924**	**106,199**
Benefit Cost Ratio	3.1	3.0	2.1	1.6	2.3	1.3	2.3

■ Table 25 DESM Evaluation Results 2005-2030 ($’000), 2005 dollars, base year 2005, 4% discount rate Gross Margin -20%

Program Component	Regional Private Pumping		Regional Public Pumping		Total Pasture Program	Horticulture Program	Total SSDP program
	Upgraded	**New**	**Reuse**	**Evaporation Basin**			
Benefits with program							
Farm Productivity	4,115	40,805	65,413	9,793	120,126	3,536	123,662
Reuse	895	8,988	4,458	-	14,341	-	14,341
Benefits without program							
Farm Productivity	-	8,161	-	-	8,160.90	654	8,815
Reuse	-	1,798	-	-	1,797.58	-	1,798
Net Benefits	**5,011**	**39,834**	**69,871**	**9,793**	**124,508**	**2,882**	**127,390**
Costs with program							
Establishment	689	15,010	24,709	7,454	47,863	3,344	51,207
Operations & Maint.	1,095	5,440	9,491	1,460	17,487	453	17,939
Downstream	181	2,096	12,278	-	14,555	306	14,861
Support	431	2,199	2,961	500	6,091	56	6,147
Costs without program							
Establishment	-	3,002	-	-	3,002	619	3,621
Operations & Maint.	-	1,088	-	-	1,088	84	1,172
Downstream	-	419	-	-	419	57	476
Support	-	-	-	-	-	-	-
Net Costs	**2,396**	**20,236**	**49,439**	**9,415**	**81,486**	**3,400**	**84,886**
NPV	**2,614**	**19,598**	**20,432**	**377**	**43,022**	**- 518**	**42,504**
Benefit Cost Ratio	2.1	2.0	1.4	1.0	1.5	0.8	1.5

Appendix B Salinity loss functions

- ## Table 26 Salinity loss functions: Evaporation basins

Year	Area of shallow water tables	Age	Salinity loss function
-40	1.0	0	0%
-30	1,400	10	20%
-20	2,900	20	26%
-10	4,300	30	29%
0	5,700	40	32%
10	5,700	50	34%
20	5,700	60	34%
30	5,700	70	35%
40	5,700	80	35%
50	5,700	90	35%

- ## Table 27 Salinity loss functions: Reuse

Year	Area of shallow water tables	Age	Salinity loss function
-40	1.0	0	0%
-30	10,800	10	16%
-20	21,600	20	22%
-10	32,400	30	25%
0	43,200	40	27%
10	43,200	50	28%
20	43,200	60	29%
30	43,200	70	29%
40	43,200	80	29%
50	43,200	90	30%

- ## Table 28 Salinity loss functions: Upgraded pumps

Year	Area of shallow water tables	Age	Salinity loss function
-40	1.0	0	0%
-30	1,500	10	16%
-20	3,000	20	22%
-10	4,500	30	25%
0	6,000	40	27%

Year	Area of shallow water tables	Age	Salinity loss function
10	6,000	50	28%
20	6,000	60	29%
30	6,000	70	29%
40	6,000	80	29%
50	6,000	90	30%

- **Table 29 Salinity loss functions: New pumps**

Year	Area of shallow water tables	Age	Salinity loss function
-40	1.0	0	0%
-30	7,300	10	16%
-20	14,600	20	22%
-10	22,000	30	25%
0	29,300	40	27%
10	29,300	50	28%
20	29,300	60	29%
30	29,300	70	29%
40	29,300	80	29%
50	29,300	90	30%

- **Table 30 Salinity loss functions: Horticultural pumps**

Year	Area of shallow water tables	Age	Salinity loss function
-40	1.0	0	0%
-30	325	10	7%
-20	650	20	7%
-10	975	30	7%
0	1,300	40	7%
10	1,300	50	7%
20	1,300	60	7%
30	1,300	70	7%
40	1,300	80	7%
50	1,300	90	7%

Appendix C Program Capital and Operating costs

Table 31 Public Pumps

Year	TARGETS				Cost ($)	Reuse Public						Basins Public					
	Reuse - Pumps	Pumps discharging to Basins	Basins	Area Served (ha)		Reuse Capital Cost($) (Gov)	O&M ($) (Private)	Cum Cost($)	Reuse Area	Cum Area	% of Total	Basins Cost ($) (Gov)	O&M ($) (Private)	Cum Cost ($)	Basins Area	Cum Area	% of total
1990/91	1	0	0	209	$220,000	$220,000	$4,200	$220,000	209	209	0%	$0	$0	$0	0	0	0%
1991/92	2	0	0	417	$440,000	$440,000	$12,600	$660,000	417	626	1%	$0	$0	$0	0	0	0%
1992/93	2	0	0	417	$440,000	$440,000	$21,000	$1,100,000	417	1,043	1%	$0	$0	$0	0	0	0%
1993/94	2	0	0	417	$440,000	$440,000	$29,400	$1,540,000	417	1,460	2%	$0	$0	$0	0	0	0%
1994/95	2	0	0	417	$440,000	$440,000	$37,800	$1,980,000	417	1,877	3%	$0	$0	$0	0	0	0%
1995/96	2	0	0	417	$440,000	$440,000	$46,200	$2,420,000	417	2,294	3%	$0	$0	$0	0	0	0%
1996/97	2	0	0	417	$440,000	$440,000	$54,600	$2,860,000	417	2,711	4%	$0	$0	$0	0	0	0%
1997/98	2	0	0	417	$440,000	$440,000	$63,000	$3,300,000	417	3,128	4%	$0	$0	$0	0	0	0%
1998/99	2	0	0	417	$440,000	$440,000	$71,400	$3,740,000	417	3,545	5%	$0	$0	$0	0	0	0%
1999/00	4	0	0	834	$880,000	$880,000	$88,200	$4,620,000	834	4,379	6%	$0	$0	$0	0	0	0%
2000/01	5	0	0	1,043	$1,100,000	$1,100,000	$109,200	$5,720,000	1,043	5,421	7%	$0	$0	$0	0	0	0%
2001/02	6	0	0	1,251	$1,320,000	$1,320,000	$134,400	$7,040,000	1,251	6,672	9%	$0	$0	$0	0	0	0%
2002/03	5	0	0	1,043	$1,100,000	$1,100,000	$155,400	$8,140,000	1,043	7,715	10%	$0	$0	$0	0	0	0%
2003/04	3	0	0	626	$660,000	$660,000	$168,000	$8,800,000	626	8,340	11%	$0	$0	$0	0	0	0%
2004/05	3	0	0	626	$660,000	$660,000	$180,600	$9,460,000	626	8,966	12%	$0	$0	$0	0	0	0%
2005/06	3	0	0	597	$660,000	$660,000	$193,200	$10,120,000	597	9,563	13%	$0	$0	$0	0	0	0%
2006/07	3	0	0	597	$660,000	$660,000	$205,800	$10,780,000	597	10,160	14%	$0	$0	$0	0	0	0%
2007/08	3	0	0	597	$660,000	$660,000	$218,400	$11,440,000	597	10,757	14%	$0	$0	$0	0	0	0%
2008/09	3	0	0	597	$660,000	$660,000	$231,000	$12,100,000	597	11,354	15%	$0	$0	$0	0	0	0%
2009/10	3	0	0	597	$660,000	$660,000	$243,600	$12,760,000	597	11,951	16%	$0	$0	$0	0	0	0%
2010/11	3	0	0	597	$660,000	$660,000	$256,200	$13,420,000	597	12,549	17%	$0	$0	$0	0	0	0%
2011/12	10	1	1	2,189	$2,680,000	$2,200,000	$298,200	$15,620,000	1,990	14,539	19%	$480,000	$4,850	$480,000	199	199	2%
2012/13	10	2	2	2,389	$3,160,000	$2,200,000	$340,200	$17,820,000	1,990	16,529	22%	$960,000	$14,550	$1,440,000	398	597	6%
2013/14	11	2	2	2,588	$3,380,000	$2,420,000	$386,400	$20,240,000	2,189	18,719	25%	$960,000	$24,250	$2,400,000	398	995	10%
2014/15	12	2	2	2,787	$3,600,000	$2,640,000	$436,800	$22,880,000	2,389	21,107	28%	$960,000	$33,950	$3,360,000	398	1,393	14%
2015/16	14	2	2	3,185	$4,040,000	$3,080,000	$495,600	$25,960,000	2,787	23,894	32%	$960,000	$43,650	$4,320,000	398	1,791	18%
2016/17	16	2	2	3,583	$4,480,000	$3,520,000	$562,800	$29,480,000	3,185	27,079	36%	$960,000	$53,350	$5,280,000	398	2,189	22%
2017/18	18	2	2	3,981	$4,920,000	$3,960,000	$638,400	$33,440,000	3,583	30,661	41%	$960,000	$63,050	$6,240,000	398	2,588	26%
2018/19	20	3	3	4,578	$5,840,000	$4,400,000	$722,400	$37,840,000	3,981	34,642	46%	$1,440,000	$77,600	$7,680,000	597	3,185	32%
2019/20	20	3	3	4,578	$5,840,000	$4,400,000	$806,400	$42,240,000	3,981	38,623	51%	$1,440,000	$92,150	$9,120,000	597	3,782	38%
2020/21	20	3	3	4,578	$5,840,000	$4,400,000	$890,400	$46,640,000	3,981	42,604	57%	$1,440,000	$106,700	$10,560,000	597	4,379	44%
2021/22	20	4	4	4,777	$6,320,000	$4,400,000	$974,400	$51,040,000	3,981	46,585	62%	$1,920,000	$126,100	$12,480,000	796	5,175	52%
2022/23	20	4	4	4,777	$6,320,000	$4,400,000	$1,058,400	$55,440,000	3,981	50,566	67%	$1,920,000	$145,500	$14,400,000	796	5,971	60%
2023/24	20	4	4	4,777	$6,320,000	$4,400,000	$1,142,400	$59,840,000	3,981	54,547	73%	$1,920,000	$164,900	$16,320,000	796	6,767	68%
2024/25	20	4	4	4,777	$6,320,000	$4,400,000	$1,226,400	$64,240,000	3,981	58,527	78%	$1,920,000	$184,300	$18,240,000	796	7,564	76%
2025/26	20	3	3	4,578	$5,840,000	$4,400,000	$1,310,400	$68,640,000	3,981	62,508	83%	$1,440,000	$198,850	$19,680,000	597	8,161	82%
2026/27	20	3	3	4,578	$5,840,000	$4,400,000	$1,394,400	$73,040,000	3,981	66,489	89%	$1,440,000	$213,400	$21,120,000	597	8,758	88%
2027/28	18	2	2	3,981	$4,920,000	$3,960,000	$1,470,000	$77,000,000	3,583	70,072	93%	$960,000	$223,100	$22,080,000	398	9,156	92%
2028/29	15	2	2	3,384	$4,260,000	$3,300,000	$1,533,000	$80,300,000	2,986	73,057	97%	$960,000	$232,800	$23,040,000	398	9,554	96%
2029/30	10	2	2	2,389	$3,160,000	$2,200,000	$1,575,000	$82,500,000	1,990	75,048	100%	$960,000	$242,500	$24,000,000	398	9,952	100%
Total	**375**	**50**	**50**	**85,000**	**$106,500,000**	**$82,500,000**			**75,048**			**$24,000,000**			**9,952**		

Table 32 Private Pumps

		TARGETS				New Private								Upgraded Private							
YEAR	YEAR	New SSDP Pumps	Existing Pumps Upgraded	Non-SSDP Private Pumps	Area Served (ha)	Total Capital Cost($)	Capital cost ($) (Private)	Capital Cost ($) (Govt)	O&M ($) (Private)	Cum Cost($)	New Area	Cum Area	% of Total	Upgraded Capital Cost ($)	Capital cost ($) (Private)	Total Capital Cost ($) (Govt)	O&M ($) (Private)	Cum Cost ($)	Upgraded Area	Cum Area	% of total
1	1990/91	19	4	290	26,421	2,441,500	351,500	2,090,000	38,000	2,441,500	1,604	1,604	3%	121,000	41,000	80,000	8,000	121,000	338	338	3%
2	1991/92	19	4	11	2,870	2,441,500	351,500	2,090,000	76,000	4,883,000	1,604	3,208	6%	121,000	41,000	80,000	16,000	242,000	338	675	6%
3	1992/93	19	4	11	2,870	2,441,500	351,500	2,090,000	114,000	7,324,500	1,604	4,811	9%	121,000	41,000	80,000	24,000	363,000	338	1,013	10%
4	1993/94	19	4	11	2,870	2,441,500	351,500	2,090,000	152,000	9,766,000	1,604	6,415	13%	121,000	41,000	80,000	32,000	484,000	338	1,351	13%
5	1994/95	19	5	11	2,954	2,441,500	351,500	2,090,000	190,000	12,207,500	1,604	8,019	16%	151,250	51,250	100,000	42,000	635,250	422	1,773	17%
6	1995/96	19	5	11	2,954	2,441,500	351,500	2,090,000	228,000	14,649,000	1,604	9,623	19%	151,250	51,250	100,000	52,000	786,500	422	2,195	21%
7	1996/97	19	5	11	2,954	2,441,500	351,500	2,090,000	266,000	17,090,500	1,604	11,227	22%	151,250	51,250	100,000	62,000	937,750	422	2,617	25%
8	1997/98	19	5	11	2,954	2,441,500	351,500	2,090,000	304,000	19,532,000	1,604	12,831	25%	151,250	51,250	100,000	72,000	1,089,000	422	3,039	29%
9	1998/99	20	5	11	3,039	2,570,000	370,000	2,200,000	344,000	22,102,000	1,688	14,519	29%	151,250	51,250	100,000	82,000	1,240,250	422	3,461	33%
10	1999/00	20	5	11	3,039	2,570,000	370,000	2,200,000	384,000	24,672,000	1,688	16,207	32%	151,250	51,250	100,000	92,000	1,391,500	422	3,883	37%
11	2000/01	4	4	11	1,604	514,000	74,000	440,000	392,000	25,186,000	338	16,545	33%	121,000	41,000	80,000	100,000	1,512,500	338	4,221	41%
12	2001/02	5	6	11	1,857	642,500	92,500	550,000	402,000	25,828,500	422	16,967	33%	181,500	61,500	120,000	112,000	1,694,000	506	4,727	45%
13	2002/03	32	0	11	3,630	4,112,000	592,000	3,520,000	466,000	29,940,500	2,701	19,668	39%	0	0	0	112,000	1,694,000	0	4,727	45%
14	2003/04	13	2	11	2,195	1,670,500	240,500	1,430,000	492,000	31,611,000	1,097	20,765	41%	60,500	20,500	40,000	116,000	1,754,500	169	4,896	47%
15	2004/05	8	1	10	1,604	1,028,000	148,000	880,000	508,000	32,639,000	675	21,441	42%	30,250	10,250	20,000	118,000	1,784,750	84	4,980	48%
16	2005/06	9	2	0	1,127	1,156,500	166,500	990,000	526,000	33,795,500	922	22,362	44%	60,500	20,500	40,000	122,000	1,845,250	205	5,185	50%
17	2006/07	8	2	0	1,024	1,028,000	148,000	880,000	542,000	34,823,500	819	23,182	46%	60,500	20,500	40,000	126,000	1,905,750	205	5,390	52%
18	2007/08	8	2	0	1,024	1,028,000	148,000	880,000	558,000	35,851,500	819	24,001	47%	60,500	20,500	40,000	130,000	1,966,250	205	5,595	54%
19	2008/09	8	2	0	1,024	1,028,000	148,000	880,000	574,000	36,879,500	819	24,821	49%	60,500	20,500	40,000	134,000	2,026,750	205	5,800	56%
20	2009/10	8	2	0	1,024	1,028,000	148,000	880,000	590,000	37,907,500	819	25,640	50%	60,500	20,500	40,000	138,000	2,087,250	205	6,005	58%
21	2010/11	8	2	0	1,024	1,028,000	148,000	880,000	606,000	38,935,500	819	26,459	52%	60,500	20,500	40,000	142,000	2,147,750	205	6,209	60%
22	2011/12	12	2	0	1,434	1,542,000	222,000	1,320,000	630,000	40,477,500	1,229	27,689	54%	60,500	20,500	40,000	146,000	2,208,250	205	6,414	62%
23	2012/13	12	2	0	1,434	1,542,000	222,000	1,320,000	654,000	42,019,500	1,229	28,918	57%	60,500	20,500	40,000	150,000	2,268,750	205	6,619	64%
24	2013/14	13	2	0	1,536	1,670,500	240,500	1,430,000	680,000	43,690,000	1,332	30,249	60%	60,500	20,500	40,000	154,000	2,329,250	205	6,824	66%
25	2014/15	13	2	0	1,536	1,670,500	240,500	1,430,000	706,000	45,360,500	1,332	31,581	62%	60,500	20,500	40,000	158,000	2,389,750	205	7,029	68%
26	2015/16	13	2	0	1,536	1,670,500	240,500	1,430,000	732,000	47,031,000	1,332	32,912	65%	60,500	20,500	40,000	162,000	2,450,250	205	7,234	69%
27	2016/17	13	2	0	1,536	1,670,500	240,500	1,430,000	758,000	48,701,500	1,332	34,244	67%	60,500	20,500	40,000	166,000	2,510,750	205	7,439	71%
28	2017/18	13	3	0	1,639	1,670,500	240,500	1,430,000	784,000	50,372,000	1,332	35,575	70%	90,750	30,750	60,000	172,000	2,601,500	307	7,746	74%
29	2018/19	13	3	0	1,639	1,670,500	240,500	1,430,000	810,000	52,042,500	1,332	36,907	73%	90,750	30,750	60,000	178,000	2,692,250	307	8,053	77%
30	2019/20	13	3	0	1,639	1,670,500	240,500	1,430,000	836,000	53,713,000	1,332	38,238	75%	90,750	30,750	60,000	184,000	2,783,000	307	8,360	80%
31	2020/21	13	2	0	1,536	1,670,500	240,500	1,430,000	862,000	55,383,500	1,332	39,570	78%	60,500	20,500	40,000	188,000	2,843,500	205	8,565	82%
32	2021/22	13	2	0	1,536	1,670,500	240,500	1,430,000	888,000	57,054,000	1,332	40,902	80%	60,500	20,500	40,000	192,000	2,904,000	205	8,770	84%
33	2022/23	13	2	0	1,536	1,670,500	240,500	1,430,000	914,000	58,724,500	1,332	42,233	83%	60,500	20,500	40,000	196,000	2,964,500	205	8,975	86%
34	2023/24	12	2	0	1,434	1,542,000	222,000	1,320,000	938,000	60,266,500	1,229	43,462	85%	60,500	20,500	40,000	200,000	3,025,000	205	9,180	88%
35	2024/25	12	2	0	1,434	1,542,000	222,000	1,320,000	962,000	61,808,500	1,229	44,691	88%	60,500	20,500	40,000	204,000	3,085,500	205	9,385	90%
36	2025/26	12	2	0	1,434	1,542,000	222,000	1,320,000	986,000	63,350,500	1,229	45,920	90%	60,500	20,500	40,000	208,000	3,146,000	205	9,589	92%
37	2026/27	12	2	0	1,434	1,542,000	222,000	1,320,000	1,010,000	64,892,500	1,229	47,150	93%	60,500	20,500	40,000	212,000	3,206,500	205	9,794	94%
38	2027/28	12	2	0	1,434	1,542,000	222,000	1,320,000	1,034,000	66,434,500	1,229	48,379	95%	60,500	20,500	40,000	216,000	3,267,000	205	9,999	96%
39	2028/29	12	2	0	1,434	1,542,000	222,000	1,320,000	1,058,000	67,976,500	1,229	49,608	98%	60,500	20,500	40,000	220,000	3,327,500	205	10,204	98%
40	2029/30	12	2	0	1,434	1,542,000	222,000	1,320,000	1,082,000	69,518,500	1,229	50,837	100%	60,500	20,500	40,000	224,000	3,388,000	205	10,409	100%
	Total	**541**	**112**	**443**	**98,640**	**69,518,500**	**10,008,500**	**59,510,000**			**50,837**			**3,388,000**					**10,409**		

Table 33 Horticulture Pumps

	TARGETS				NEW PUMPS		TILE DRAINS			NEW PUMPS	TILE DRAINS		
Year	New Pumps (no.)	Tile Drains (ha)	Area Served (ha)	Total Capital	Capital cost ($) (Private)	Total Capital Cost ($) (Govt)	Capital cost ($) (Private)	Total Capital Cost ($) (Govt)	Total Operating	O&M ($) (Private)	O&M ($) (Private)	Cum Area	% of total
1990/91	2	1	40	266,500	11,200	240,000	7,000	8,300	2,250	2,200	50	40	3%
1991/92	2	1	40	266,500	11,200	240,000	7,000	8,300	4,500	4,400	100	80	6%
1992/93	2	2	41	281,800	11,200	240,000	14,000	16,600	6,800	6,600	200	121	9%
1993/94	2	2	41	281,800	11,200	240,000	14,000	16,600	9,100	8,800	300	162	12%
1994/95	2	2	41	281,800	11,200	240,000	14,000	16,600	11,400	11,000	400	203	16%
1995/96	3	2	60	407,400	16,800	360,000	14,000	16,600	14,800	14,300	500	263	20%
1996/97	2	2	41	281,800	11,200	240,000	14,000	16,600	17,100	16,500	600	304	23%
1997/98	2	2	41	281,800	11,200	240,000	14,000	16,600	19,400	18,700	700	345	27%
1998/99	2	2	41	280,270	11,200	240,000	13,300	15,770	21,695	20,900	795	385	30%
1999/00	0	0	0	-	-	-	-	-	21,695	20,900	795	385	30%
2000/01	0	0	0	-	-	-	-	-	21,695	20,900	795	385	30%
2001/02	0	0	0	-	-	-	-	-	21,695	20,900	795	385	30%
2002/03	1	0	19	125,600	5,600	120,000	-	-	22,795	22,000	795	405	31%
2003/04	0	0	0	-	-	-	-	-	22,795	22,000	795	405	31%
2004/05	0	0	0	-	-	-	-	-	22,795	22,000	795	405	31%
2005/06	0	0	0	-	-	-	-	-	22,795	22,000	795	405	31%
2006/07	0	0	0	-	-	-	-	-	22,795	22,000	795	405	31%
2007/08	1	0	20	125,600	5,600	120,000	-	-	23,895	23,100	795	425	33%
2008/09	2	0	41	251,200	11,200	240,000	-	-	26,095	25,300	795	466	36%
2009/10	2	0	41	251,200	11,200	240,000	-	-	28,295	27,500	795	507	39%
2010/11	2	0	41	251,200	11,200	240,000	-	-	30,495	29,700	795	547	42%
2011/12	2	12	53	434,800	11,200	240,000	84,000	99,600	33,295	31,900	1,395	600	46%
2012/13	2	12	53	434,800	11,200	240,000	84,000	99,600	36,095	34,100	1,995	653	50%
2013/14	2	14	55	465,400	11,200	240,000	98,000	116,200	38,995	36,300	2,695	708	54%
2014/15	2	14	55	465,400	11,200	240,000	98,000	116,200	41,895	38,500	3,395	762	59%
2015/16	2	15	56	480,700	11,200	240,000	105,000	124,500	44,845	40,700	4,145	818	63%
2016/17	2	15	56	480,700	11,200	240,000	105,000	124,500	47,795	42,900	4,895	874	67%
2017/18	2	16	57	496,000	11,200	240,000	112,000	132,800	50,795	45,100	5,695	931	72%
2018/19	2	18	59	526,600	11,200	240,000	126,000	149,400	53,895	47,300	6,595	989	76%
2019/20	2	20	61	557,200	11,200	240,000	140,000	166,000	57,095	49,500	7,595	1,050	81%
2020/21	2	20	61	557,200	11,200	240,000	140,000	166,000	60,295	51,700	8,595	1,111	85%
2021/22	1	20	40	431,600	5,600	120,000	140,000	166,000	62,395	52,800	9,595	1,151	89%
2022/23	1	20	40	431,600	5,600	120,000	140,000	166,000	64,495	53,900	10,595	1,192	92%
2023/24	1	18	38	401,000	5,600	120,000	126,000	149,400	66,495	55,000	11,495	1,230	95%
2024/25	0	16	16	244,800	-	-	112,000	132,800	67,295	55,000	12,295	1,246	96%
2025/26	0	14	14	214,200	-	-	98,000	116,200	67,995	55,000	12,995	1,260	97%
2026/27	0	12	12	183,600	-	-	84,000	99,600	68,595	55,000	13,595	1,272	98%
2027/28	0	10	10	153,000	-	-	70,000	83,000	69,095	55,000	14,095	1,282	99%
2028/29	0	10	10	153,000	-	-	70,000	83,000	69,595	55,000	14,595	1,292	99%
2029/30	0	8	8	123,930	-	-	56,700	67,230	70,000	55,000	15,000	1,300	100%
Total	**50**	**300**	**1,300**	**$10,870,000**									

Appendix D Support Costs

▪ **Table 34 Support costs**

Year	Support Expenditure			
	DPI Extension*	G-MW Management, Support & Extension*	Research & Investigation*	Monitoring#
1990/91	$55,000	$150,000	$25,000	$80,000
1991/92	$55,000	$150,000	$25,000	$80,000
1992/93	$55,000	$150,000	$25,000	$80,000
1993/94	$55,000	$150,000	$25,000	$80,000
1994/95	$55,000	$150,000	$25,000	$80,000
1995/96	$55,000	$200,000	$25,000	$80,000
1996/97	$55,000	$200,000	$25,000	$80,421
1997/98	$55,000	$200,000	$25,000	$83,601
1998/99	$55,000	$200,000	$25,000	$80,442
1999/00	$55,000	$200,000	$25,000	$62,289
2000/01	$55,000	$200,000	$25,000	$54,012
2001/02	$55,000	$200,000	$25,000	$51,277
2002/03	$55,000	$200,000	$50,000	$56,541
2003/04	$55,000	$199,196	$97,500	$91,761
2004/05	$55,000	$328,110	$262,000	$80,921
2005/06	$55,000	$550,000	$550,000	$80,000
2006/07	$55,000	$300,000	$600,000	$330,000
2007/08	$55,000	$300,000	$400,000	$330,000
2008/09	$55,000	$300,000	$400,000	$330,000
2009/10	$55,000	$300,000	$475,000	$330,000
2010/11	$55,000	$300,000	$500,000	$330,000
2011/12	$55,000	$300,000	$475,000	$330,000
2012/13	$55,000	$300,000	$400,000	$330,000
2013/14	$55,000	$300,000	$400,000	$330,000
2014/15	$55,000	$300,000	$400,000	$330,000
2015/16	$55,000	$300,000	$450,000	$330,000
2016/17	$55,000	$300,000	$475,000	$330,000
2017/18	$55,000	$300,000	$400,000	$330,000
2018/19	$55,000	$300,000	$400,000	$330,000
2019/20	$55,000	$300,000	$400,000	$330,000
2020/21	$55,000	$300,000	$450,000	$330,000
2021/22	$55,000	$300,000	$475,000	$330,000
2022/23	$55,000	$300,000	$100,000	$330,000
2023/24	$55,000	$300,000	$100,000	$330,000
2024/25	$55,000	$300,000	$100,000	$330,000
2025/26	$55,000	$300,000	$150,000	$330,000
2026/27	$55,000	$300,000	$175,000	$330,000
2027/28	$55,000	$300,000	$50,000	$330,000
2028/29	$55,000	$300,000	$50,000	$330,000
2029/30	$55,000	$300,000	$50,000	$330,000
Total	**$2,200,000**	**$10,627,306**	**$9,134,500**	**$9,121,265**

Section I – Environmental Impact Assessment

DEPARTMENT OF
PRIMARY INDUSTRIES

Environmental Impact Assessment of the Sub Surface Drainage Program - Shepparton Irrigation Region (SIR)

Department of Sustainability and Environment
Department of Primary Industries

Funded by the Sub Surface Drainage Program (Goulburn Murray Water), the Shepparton Irrigation Region Implementation Committee and the Goulburn Broken Catchment Management Authority through the Shepparton Irrigation Region Catchment Strategy.

The Sustainable Irrigated Landscapes - Goulburn Broken, Environmental Management Program staff compiled this Environmental Impact Assessment based on research and communication with stakeholders, landowners, government departments and consultants where necessary.

The Environmental Management Program staff provides coordination and facilitation services throughout the Shepparton Irrigation Region in accordance with the Goulburn Broken Regional Catchment Strategy. The main focus of the Environmental Management Program is to help protect and enhance bio-diversity consistent with catchment priorities on private land.

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Photos. Main – Numurkah Rifle Range. Trio – *Dillwynia cinerascens* – Grey Parrot Pea, *Burhinus grallarius* - Bush-stone Curlew, *Acacia acinacea* – Gold-dust Wattle.

Australian Government

ACKNOWLEDGEMENTS

Thanks and appreciation are extended to the EMP staff, SIL-GB, for assistance with mapping, report development, guidance and patience during the development of this environmental assessment. Further acknowledgment is also extended to Charlie Bird (Hydro Environmental, Victoria) for reviewing the document and continued direction and support throughout the report writing process. Economic analysis was carried out by Olive Montecillo, DPI Echuca. Spatial data required to conduct this assessment was also contributed by Sinclair, Knight and Merz (SKM).

ABBREVIATIONS

CAS	Catchment and Agriculture Services
CM	Choice Modelling
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment
EC	Electrical Conductivity (salinity measure)
EPA	Environmental Protection Authority
EVC	Ecological Vegetation Classification
GBCMA	Goulburn Broken Catchment Management Authority
GIS	Geographic Information Systems (mapping program)
GMW	Goulburn Murray Water
ML	Mega Litre (1,000,000Litres)
SDA	Salt Disposal Allocation
SDE	Salt Disposal Entitlement
SIL-GB	Sustainable Irrigated Landscapes - Goulburn Broken
SIR	Shepparton Irrigation Region
SIRCS	Shepparton Irrigation Region Catchment Strategy
SIRIC	Shepparton Irrigation Region Implementation Committee
SKM	Sinclair Knight Merz (Consultants)
SPAC	Salinity Program Advisory Council
SSDP	Sub-Surface Drainage Program
VROT	Victorian Rare or Threatened Species

FOREWORD

This environmental impact assessment report is the result of combined efforts from a number of dedicated staff from the Sustainable Irrigated Landscapes – Goulburn Broken portfolio. The report incorporates both spatial technology (GIS) and economic modelling to feed environmental benefits into the Sub-surface drainage program five year review.

Protection of our environmental features within the Shepparton Irrigation Region is a key focus of the Shepparton Irrigation Region Catchment Strategy (SIRCS).

This report identifies, quantitatively, the amount of environmental features protected through the Sub-surface drainage program, in conjunction with key stakeholders including Goulburn-Murray Water (GMW), Department of Primary Industries and Hydro Environmental Pty Ltd.

Ken Sampson
Executive Officer
Shepparton Irrigation Region Implementation Committee
Goulburn Broken Catchment Management Authority

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PURPOSE OF THE PAPER

The purpose of this paper is to present the environmental assessment of the Shepparton Irrigation Region Catchment Strategy (SIRCS) Sub-surface Drainage Program (SSDP). The environmental assessment is being undertaken as part of the 'triple bottom line' assessment for the SSDP 2000-2005 Review.

A key component of the Environmental Impact Assessment is the application of the ''Choice Modelling (CM) Technique' to assign dollar values ($) to the environmental benefits of the SSDP. This technique applies environmental values estimated in one area (study site), to environmental assets in another area (policy site) **-** in this case the Shepparton Irrigation Region (SIR). A complete copy of the report prepared by Olive Montecillo on 'Valuing the Environmental Benefits of the Sub-surface Drainage Program in the Shepparton Irrigation Region' is presented in **Appendix A**.

This paper should be read in conjunction with the 'GI03036 *High Value Environmental Features – December 2005' report* (McLeod, 2005).

In summary this paper broadly identifies the following:

Stage – 1 (1990)

- Area of key environmental features that were served by Public sub-surface drainage works prior to the SSDP in 1990.
- Area of key environmental features that were at risk from salinisation and waterlogging in 1990.

Stage – 2 (2005)

- Area of key environmental features that were served by the SSDP in 2005.
- Area of key environmental features that were at risk from salinisation and waterlogging in 2005.

Stage – 3 (2030)

- Area of key environmental features that could be served by the SSDP in 2030.

INTRODUCTION

Sub-surface drainage plays an integral role in the protection of environmental features from the impacts of a rising watertable. A key objective of the SSDP is to protect and enhance key environmental features within the Shepparton Irrigation Region (SIR), where economically, socially and environmentally feasible.

Approximately two-thirds of the Goulburn Broken catchment has been cleared for agriculture, mainly on the flatter, more fertile lands of the mid and lower catchments (Bennett *et al* 1998). This has resulted in the near elimination of some native vegetation types including Plains Grassy Woodland and Plains Woodland vegetation communities. Much of what remains of these vegetation types is declining in quality and is not protected in managed reserves. Existing environmental features within the SIR are under constant threat from clearing, waterlogging, rising watertables, agricultural practices (grazing) and soil degradation.

A key aim of the Goulburn Broken Native Vegetation Management Plan is to 'maintain the extent of all existing native vegetation types at 1999 levels in keeping with the goal of 'net gain' listed in Victoria's Biodiversity Strategy 1997' (GBCMA, 2000).

The native vegetation of the SIR forests and woodlands are dominated by River Red Gum (*Eucalyptus camaldulensis*) along the natural watercourses and the lower flood prone areas including Barmah Forest and the Murray, Goulburn, Campaspe and Broken River systems. On the margins of these riverine forests in more well drained, drier soil conditions, are stands of Grey Box (*Eucalyptus microcarpa*), Yellow Box (*Eucalyptus melliodora*), Buloke (*Allocasuariana leuhmanii*) and Black Box (*Eucalyptus largiflorens*) woodlands.

In the more open woodlands, White Cypress (Murray) Pine (*Callitris glaucophylla*), along with scattered Grey Box and Yellow Box occur on sandy rises which once supported a diverse range of understorey species now uncommon across the region due to human interference. The understorey in most existing remnants has been severely degraded by stock and pest animals (Lunt, 1998).

Understorey species once present in high numbers include:

- Gold Dust Wattle *(Acacia acinacea)*
- Golden Wattle *(Acacia pycnantha)*
- Sweet Bursaria *(Bursaria spinosa)*
- Wedge Leaf Hop-bush *(Dodonea viscosa)*
- Weeping Pittosporum *(Pittosporum phylliraeoides).*

The endangered Vegetation Community 'Plains Woodland' constitutes the majority of 'remaining indigenous' vegetation within the SIR. However, this vegetation type now only occupies 1% of its former range being depleted mostly by land clearance for agricultural purposes (Glanznig, 1995). **Figure 1 (p.8)** shows the ecological vegetation cover prior to European settlement in the SIR (where pink shading reflects a predominately 'plains woodland' landscape). **Figure 2 (p.8)** shows the current extent (2005) of vegetation cover (where white equals no vegetation, no tree cover).

This extensive loss has had a devastating impact on indigenous flora and fauna communities and populations (Burgman and Lindenmayer, 1998). Many taxa are now rare, vulnerable or threatened, such as the Superb Parrot (*Polytelis swainsonii*) and the Bush Stone Curlew (*Burhinus grallarius*) (Pizzey and Knight 1997) and some extinctions such as the Eastern Hare Wallaby (*Lagorchestes leporides*) (Bennet *et al,* 1998 and Strahan, 1995), have occurred.

Despite vast areas of northern Victoria being totally cleared, scattered pockets of indigenous vegetation still remain on private land. This remnant occupation on private land totals approximately 60% of remaining indigenous vegetation within the SIR. These remnants, fragmented as they are, contribute to an ecologically important patchwork of indigenous vegetation across the SIR, and are the primary focus for continued protection under the SSDP.

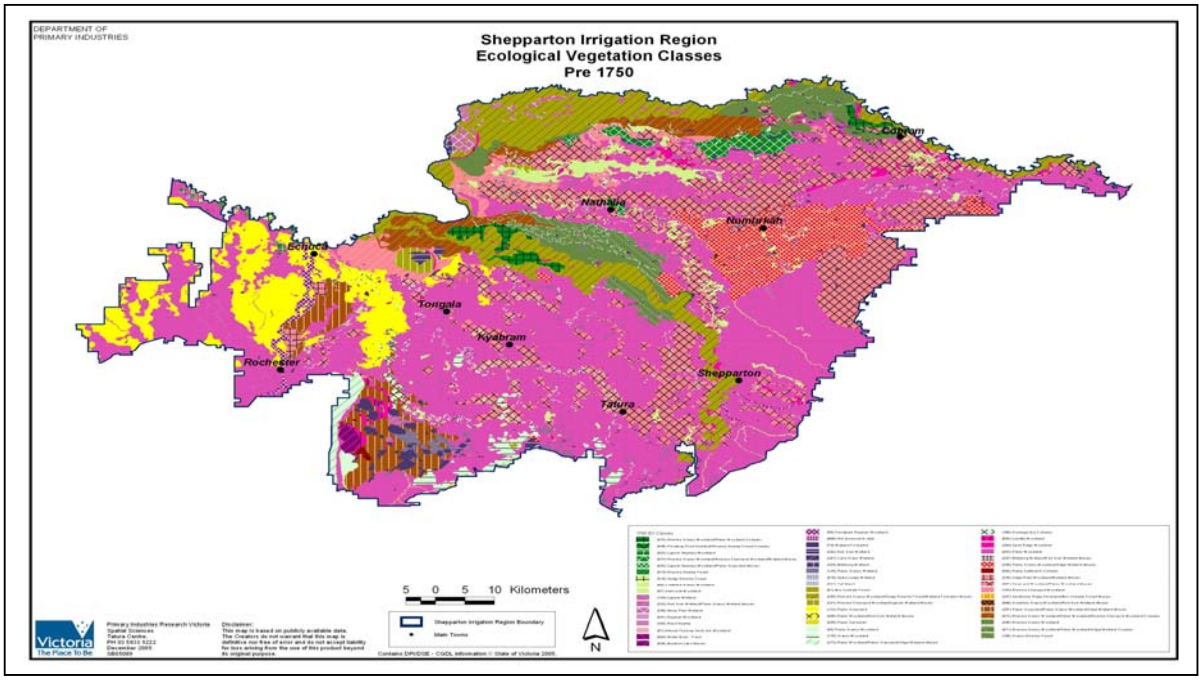


Figure 1 – SIR Ecological Vegetation Classification Pre 1750

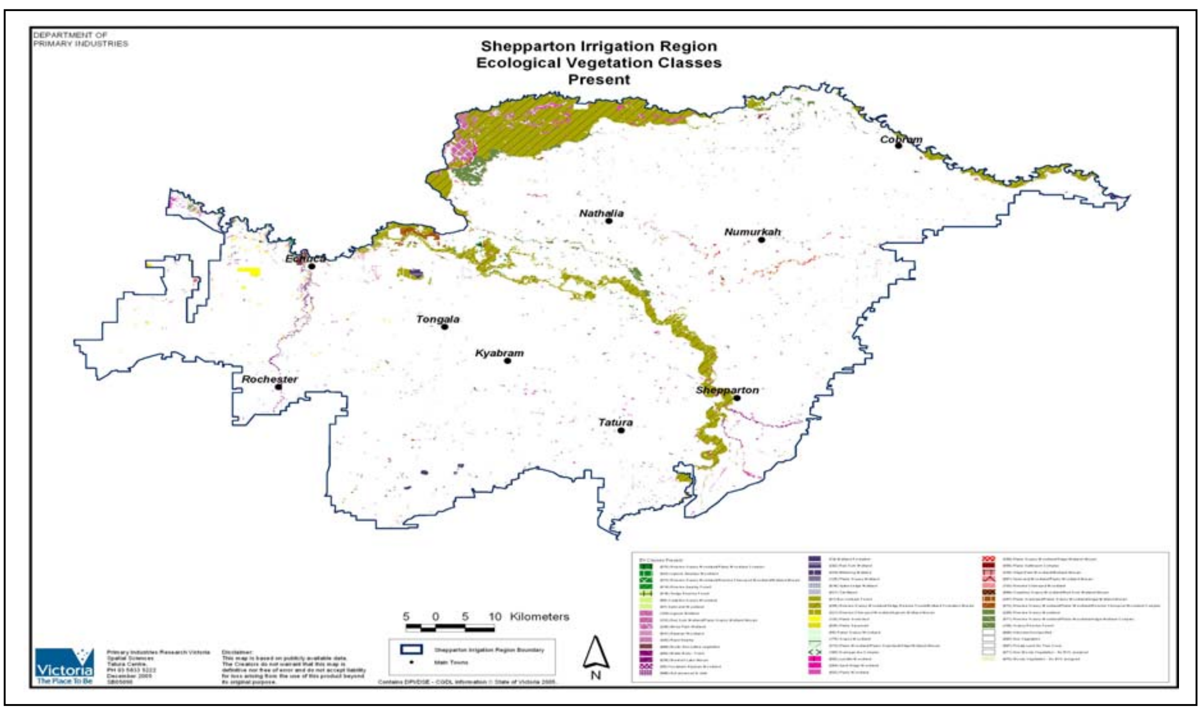


Figure 2 – SIR Ecological Vegetation Classification Current

SALT DISPOSAL ENTITLEMENTS IN THE SIR

The SIR is a key component of the Murray Darling Basin, and the Murray River is the main available mechanism for removing salt from the region, however activities like salt harvesting occur in parts of the region (DPI 2005). The Murray-Darling Basin Salinity and Drainage Strategy ensures that communities do not undertake activities that worsen the salinity problem in other areas. The challenge is to manage salt disposal to achieve an acceptable balance between the objectives of minimising water quality impacts in the Murray River and getting salinity management outcomes for productivity and the environment in the SIR.

Most of the activities in the SIRCS either have an EC (Electrical Conductivity) saving or require an EC Credit, also known as a Salt Disposal Allocation (SDA). The continued delivery and provision of activities through this strategy is dependent on availability and sharing of EC Credits with other irrigation regions across the state that also have an impact on salinity levels in the River Murray.

The uptake of Salt Disposal Entitlement (SDE) for private pasture groundwater pumps is 1.44EC, 0.16EC for private horticulture groundwater pumps and 1.54EC for public groundwater pumps. Uptake of SDE for the Sub-Surface Drainage Program is 3.14EC of the SIR's total allocation to date of 4.9EC (Hydro Environmental 2006).

The cost of salt disposal to the River Murray has not been included in the financial component of the Environmental Assessment as it is considered in the Economic Assessment of the SSDP.

METHODOLOGY

1.1 Desktop Assessment

A desktop environmental assessment has been undertaken to identify the area of environmental features that have been served by the implementation of the SSDP and are expected to be served in the future. The desktop environmental assessment involved:

- Conducting a literature search and resource examination.
- Collating existing data from environmental assessments previously undertaken for Public Salinity Control Pump sites (by DPI staff).
- Determining the environmental assessment area boundary, using Geographic Information Systems (GIS) to determine the area served (area of influence) by groundwater pumps. For the purpose of this report, the area served is considered to be the area over which there is some drawdown in groundwater pressures/water level in response to groundwater pump operation, which has been assumed to result in a positive impact on identified key environmental features.
- Examination of environmental features using ArcGIS. **Figure 3 (p.10)**.
  - Aerial photography.
  - Ecological Vegetation Classifications – pre 1750 (EVCs).
  - Remnant vegetation.
  - Watertable information.
  - Wetlands.
  - Soil types.
  - Threatened flora and fauna.

1.2 Field Assessment

On site assessments of Public Salinity Control Pump sites undertaken by DPI staff to identify:

- Existing environmental features (native and exotic)
- Presence of pest plants and animals
- Health of remnant native vegetation
- Conservation value of the site (Low to Very High)
- Presence of Victorian Rare or Threatened Species (Victorian Rare or Threatened Species - VROTS).

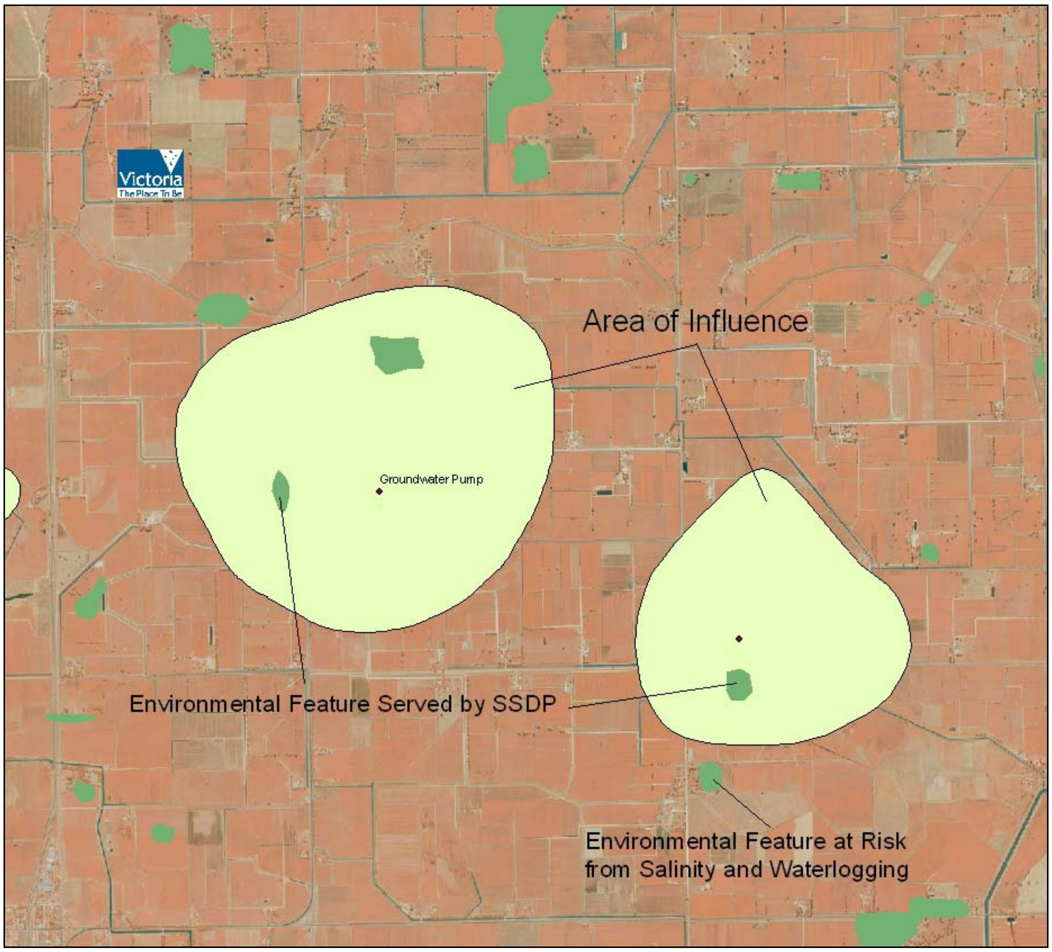


Figure 3 – Determining Environmental Features Protected by SSDP and at Risk from Salinisation and Waterlogging

PROJECT DEVELOPMENT AND ASSESSMENT

1.3 Stage 1 (1990)

Objective 1.1 – Identify area of key environmental features that were served by Public sub-surface drainage works prior to the SSDP in 1990.

<u>Task Methodology</u> - Data were analysed using GIS to determine the area of key environmental features that were served by Public sub-surface drainage works prior to the SSDP in 1990, which include:

- Pre-SSDP: Phase A pumps (refer to **Section 2.1 p.14).**
- Pre-SSDP: Girgarre Evaporation Basin system pumps (refer to **Section 2.2 p.14).**

Due to a lack of data, it has been assumed that:

- The area of key environmental features located within the SIR is the same as the area identified in June 30 2005.
- There are no key environmental features located within areas served by non-SSDP Private pasture pumps in 1990.

Objective 1.2 – Identify the area of key environmental features located in the area at risk of salinisation and waterlogging which were not served by Public sub-surface drainage works prior to the SSDP in 1990.

<u>Task Methodology</u> – Data were analysed using GIS to determine the area of environmental features located within the defined <u>area at risk of salinisation and waterlogging</u> (refer to **Figure 4 p.13**) which were not served by Public sub-surface drainage works prior to the SSDP in 1990.

Key environmental features at risk from salinisation and waterlogging were identified based on an assessment of the depth to watertable that would be required to protect natural features (woodlands, grasslands etc). The information is based on knowledge of root systems of native, perennial vegetation, and experience with how some species and Ecological Vegetation Classification's (EVCs) perform in a high watertable environment.

Based on this knowledge of native vegetation, areas of environmental features that were within the targeted area were deemed to be 'at risk' of salinisation and waterlogging. **Appendix B (p.39)** details the tolerance of different vegetation types to different watertable depths and salinities.

1.4 Stage 2 (2005)

Objective 2.1 – Identify key environmental features that were served by the SSDP in 2005.

<u>Task Methodology</u> – A data set with sub-surface drainage works implemented up to 30 June 2005 was collated using GIS to determine the area of environmental features served by sub-surface drainage works. The area of key environmental features served by the SSDP in 30 June 2005 was determined by subtracting area of environmental features served by Public sub-surface drainage works prior to SSDP in 1990 (Objective 1.1 above) from this figure.

SSDP related Works include:

- SSDP Private pasture pumps (refer to **Section 2.3 p.14**)
- SSDP Public pumps (refer to **Section 2.4 p.14**)
- SSDP Private horticultural pumps (watertable control) (refer to **Section 2.5 p.14**)
- Non-SSDP assisted private pumps (refer to **Section 2.6**)

Environmental assessments have also been conducted by Department of Primary Industries (DPI) staff as part of feasibility studies for many of the proposed public salinity control pump sites. Field assessments identified vegetation types (both native and exotic); determining the health of remnant vegetation (dieback etc); conservation value of the site (low to very high); and the presence of pest plants and animals. The information obtained from these assessments was used to prior valuable information on VROT located within or nearby groundwater pumps.

Objective 2.2 – Identify the area of key environmental features located in the area at risk of salinisation and waterlogging which were not served by sub-surface drainage works in 30 June 2005.

Task Methodology – This task was undertaken by subtracting the area of key environmental features served by the SSDP in 30 June 2005 (Objective 2.1 p.11) from the area of key environmental features at risk of salinisation and waterlogging, which were not served by Public sub-surface drainage works prior to the SSDP in 1990 (Objective 1.2 p.11).

1.5 Stage 3 (2030)

Objective 3.1 – Identify the area of key environmental features that could be served by the SSDP by the SSDP by 30 June 2030.

Task Methodology – It is understood that sub-surface drainage related works will only serve approximately 60% of the defined area at risk of salinisation and waterlogging. In accordance with this, it has been assumed that only 60% of the total area of key environmental features located within the defined area of risk can be served by the SSDP.

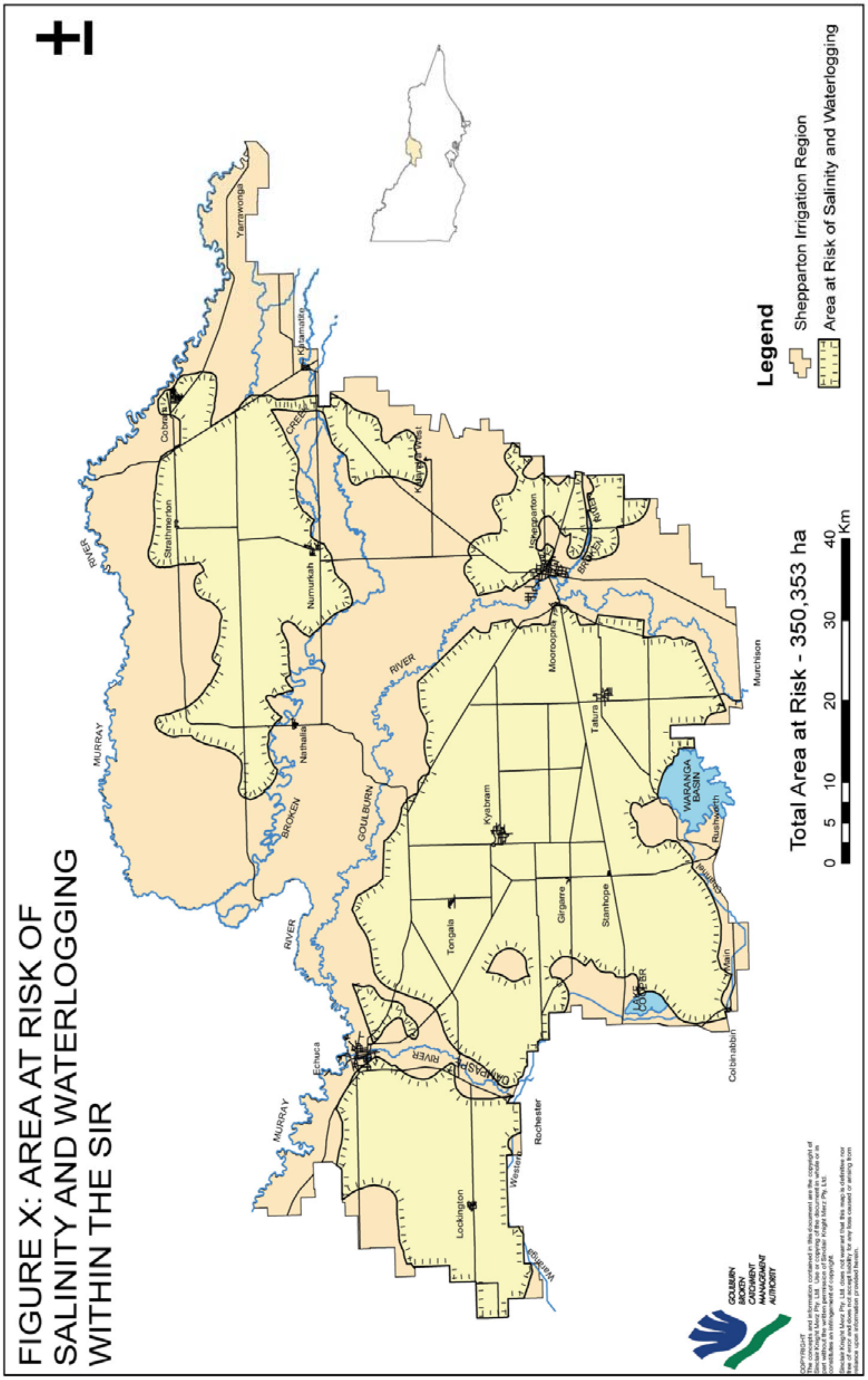


Figure 4 – Defined Area at Risk of Salinisation and Waterlogging

2. Sub-surface Drainage Works

2.1 Pre SSDP: Phase A pumps (watertable control)

Phase A pumps (watertable control) are publicly owned assets with the purpose of providing watertable control to horticulture areas by pumping groundwater to maintain an appropriate depth from ground level to watertable. This depth is generally 2m, with the aim of providing watertable protection to horticultural plantings. These pumps discharge off-site to drains and channels.

The area rated by Phase A pumps is determined with a 60 day pump test. The area served has been determined by increasing the radius of the rated area polygon by 117.4m. This was the same methodology used to determine the area served by SSDP Public pumps where only the rated area was known. Whilst it is understood that Phase A pumps have different operating regimes, the same methodology has been applied due to a lack of data.

2.2 Pre SSDP: Girgarre Evaporation Basin System pumps

Girgarre evaporation basin system pumps are publicly owned assets with the purpose of providing salinity control. The area served by Girgarre evaporation basin system pumps is determined with a 60 day pump test, which is used to determine the area rated. The area served has been determined by increasing the mean radius of the rated area polygon by 117.4m.

2.3 SSDP Private pasture pumps

SSDP Private pasture pumps are privately owned by landholders and operate with the purpose of providing local salinity control. The area served by these pumps is based on the assumption that 1ML of Licence Entitlement equates to 0.6 ha of area served. This assumption was based on the average SIR private pump extraction compared to Licence Entitlement for the period 2000/01 to 04/05, which was approximately 60%.

2.4 SSDP Public pumps

SSDP Public pumps are publicly owned assets with the purpose of providing salinity control, by discharging off-site when downstream conditions are suitable. The area rated (area of drawdown to 0.1m) and area served (area of drawdown to 0.0m) are determined through a 60 day pump test. Where the area served is unknown, it has been determined by increasing the radius of the rated area polygon by 117.4m.

2.5 SSDP Private horticultural pumps (watertable control)

SSDP Private horticultural pumps (watertable control pumps) are privately owned and operate with the purpose of providing watertable control to horticulture areas by discharging off-site as required (through drainage networks during wet periods) and re-using on-site where possible. The area served by SSDP horticulture pumps is based on the assumption that 2ML of SSDP Capital Grant volume equals 1 ha served.

2.6 Non-SSDP assisted private pumps

Non-SSDP Private pumps extract groundwater for use in irrigation, and therefore reduce watertable levels and contribute to the desired outcome of protecting parts of the SIR from salinisation. These pumps are privately owned by landholders, which have been installed without SSDP assistance and include both pasture and horticultural pumps. The served area attributed to non-SSDP assisted private pumps is based on the assumption that 1ML of Licence Entitlement equates to 0.6ha served. This assumption was based on the average SIR private pump extraction compared to Licence Entitlement for the period 2000/01 – 04/05, which was approximately 60% (G-MW, 2006).

RESULTS

2.7 Overview

The results included herein are a combination of area (hectare) data derived from desktop and field studies undertaken by the Environmental Management Program (EMP) at DPI Tatura and economic ($) data obtained from Olive Montecillo, Farm Management Economist at DPI Echuca. Total area protected and total area at risk data were applied to the Choice Modelling Technique in order to obtain a 'monetary' value for environmental features.

Table 2 (Below) summarises the 'area protected' and 'area at risk' for each stage of this project. The results presented in Table 1 (Below) are further discussed in the following sections.

Table 1 – Summary of baseline statistics used throughout data analysis

	Hectares
Total Area at Risk of Salinisation and Waterlogging	350,350
Total Area of key Environmental Features within 'Area at Risk'	15,300

Table 2 – Summary of Results

	Area of key Env. Features served by SSD Works	Area of key Env. Features served by SSDP	Area of key Env. Features not served by SSD Works within the 'Area at Risk'	Area Served by SSD Works within the SIR
	(Ha)	(Ha)	(Ha)	(Ha)
Stage 1 - 1990	210	0	15,090	19,390
Stage 2 - 2005	2,280	2,070	13,020	88,290
Stage 3 - 2030	9,210	9,000	6,090	~200,000

2.8 Stage 1 (1990)

Objective 1.1 – Identify area of key environmental features that were served by Public sub-surface drainage works prior to the SSDP in 1990.

A total serviced area of approximately 19,000 hectares had relieved valuable and highly productive agricultural land, including significant environmental features on both public and private land, from waterlogging and rising watertables through the construction and implementation of groundwater pumps (refer to **Figure 5 p.18)**.

Objective 1.2 – Identify the area of key environmental features located in the area at risk of salinisation and waterlogging which were not served by Public sub-surface drainage works prior to the SSDP in 1990.

A further 15,090 hectares of key environmental features were identified as being at risk of salinisation and waterlogging.

2.9 Stage 2 (2005)

Objective 2.1 – Identify key environmental features that were served by the SSDP in 2005.

The results of the assessment show that the works and measures being implemented under the SSDP are currently serving approximately 2,280 hectares of environmental features (refer to **Figure 6 p.19**). Eight (8) threatened flora species were identified in areas currently serviced by the SSDP. **Table 3** (Below) presents a list of the threatened flora species identified in areas currently serviced by the SSDP. Two (2) of these species are considered rare in the Goulburn Broken Catchment.

Table 3 – Threatened flora present (2005)

Common Name	Scientific Name	Status
Buloke	*Allocasuarine luehmannii*	Vulnerable in region
White Cypress-pine	*Callitris glaucophylla*	Depleted
Hooked needlewood	*Hakea tephrosperma*	Rare in region
Silky umbrella grass	*Digitaria ammophila*	Vulnerable in region
Yarran wattle	*Acacia omalophylla*	Endangered in region
Waterbush	*Myoporum montanum*	Rare in region
Bottle bluebush	*Maireana excavata*	Depleted
Mallee Golden wattle	*Acacia notabilis*	Vulnerable in region

Nine (9) threatened fauna species were identified in areas currently served by the SSDP, including the Superb Parrot (*Polytelis swainsonii)* which is considered rare in the region. **Table 4** (Below) presents a list of the threatened fauna species identified in areas currently served by the SSDP.

Table 4 – Threatened fauna present (2005)

Common Name	Scientific Name (names should be in italics or underlined)	Status
Squirrel glider	Petaurus norfolcensis	Widespread uncommon
Bush Stone curlew	Burhinus grallarius	Widespread uncommon
Hardhead	Aytha australis	Widespread uncommon
Whiskered Tern	Chlidonias hybridus	Widespread uncommon
Musk Duck	Biziura lobata	Widespread uncommon
Superb Parrot	Polytelis swainsonii	Rare in region
Royal Spoonbill	Plataea regia	Widespread uncommon
Tree Goanna	Varanus varius	Widespread uncommon
Brolga	Grus rubicunda	Localised uncommon

For the purpose of this assessment it has been assumed that the SSDP contributes toward the protection of both flora and fauna species.

Objective 2.2 – Identify the area of key environmental features located in the area at risk of salinisation and waterlogging which were not served by sub-surface drainage works in 30 June 2005.

Approximately 13,020 ha of environmental features were identified as being within the targeted area at risk of salinisation and waterlogging.

2.10 Stage 3 (2030)

Objective 3.1 – Identify the area of key environmental features that could be served by the SSDP by 30 June 2030.

It is forecasted that if the SSDP remains active in the region that a total of over 9,210 ha of environmental features will be receiving protection through groundwater pumping (assuming that approximately 60% of the area of key environmental features identified as being at risk is served by groundwater pumps) (refer to **Figure 6**).

2.11 Area of Wetlands served by the SSDP

Approximately 2,220 ha of Priority listed wetlands have been identified within the defined area at risk of salinity and waterlogging within the SIR. Prior to the inception of the SSDP in 1990 there were no areas of wetlands served by the sub-surface drainage works, and SSDP related activities currently (June 30 2005) serve approximately 10ha of identified wetland areas. It is forecast that the area of wetlands served by the SSDP will increase by the completion of the SSDP IN 2029/30. However, it is difficult to estimate this area.

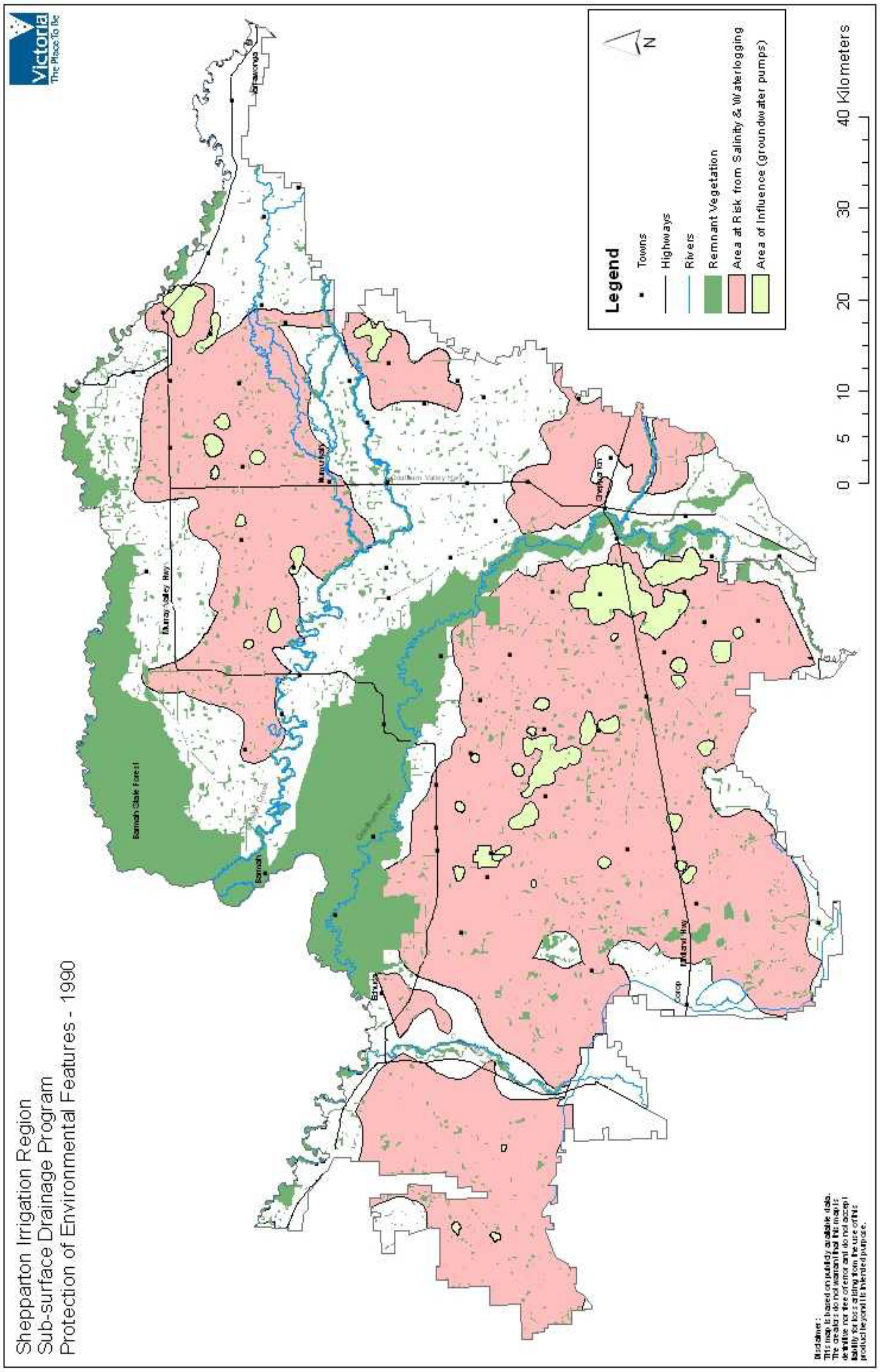


Figure 5 – Extent of Sub-surface drainage to 1990

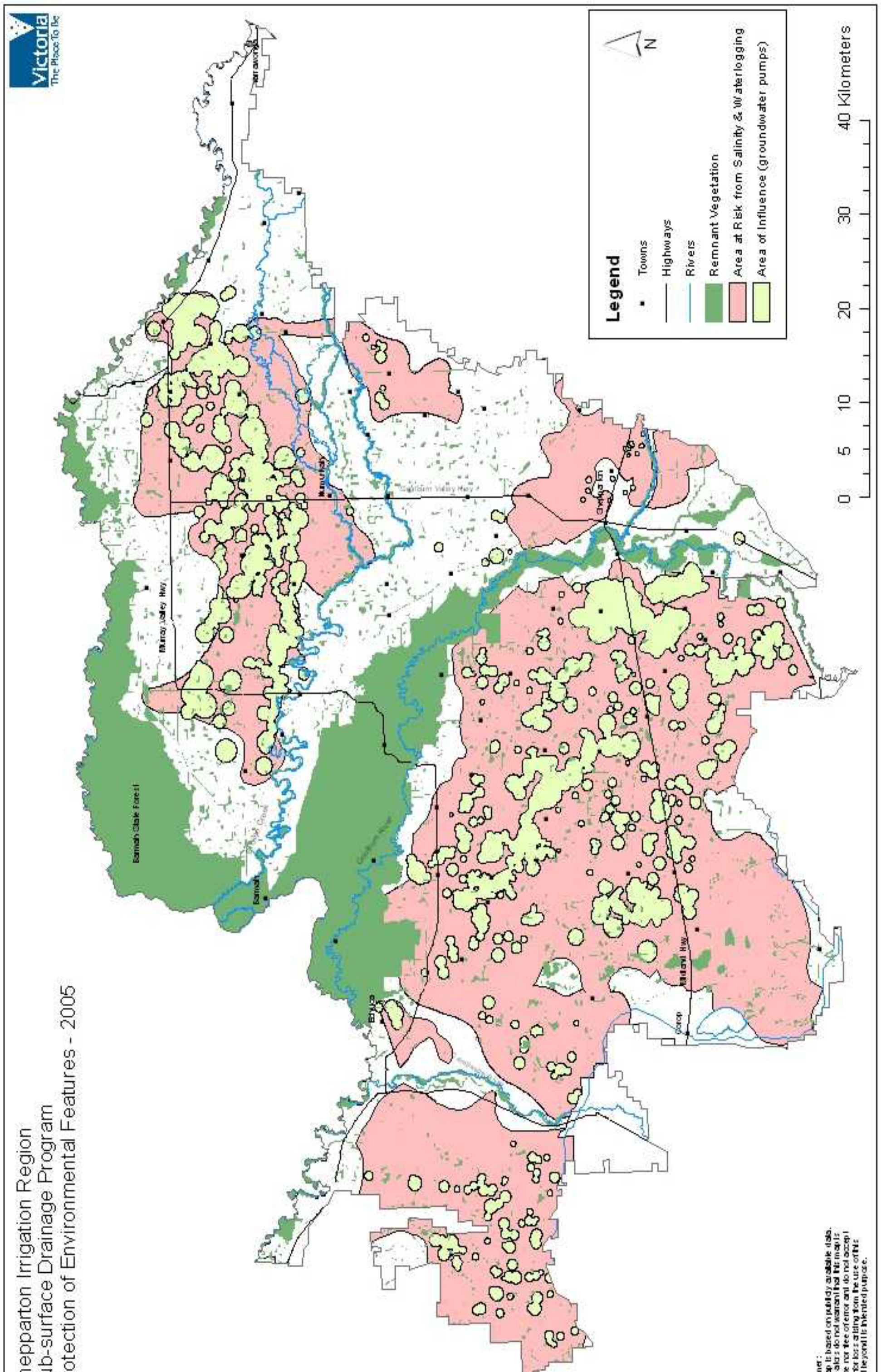


Figure 6 - Extent of Sub-surface drainage to 2005

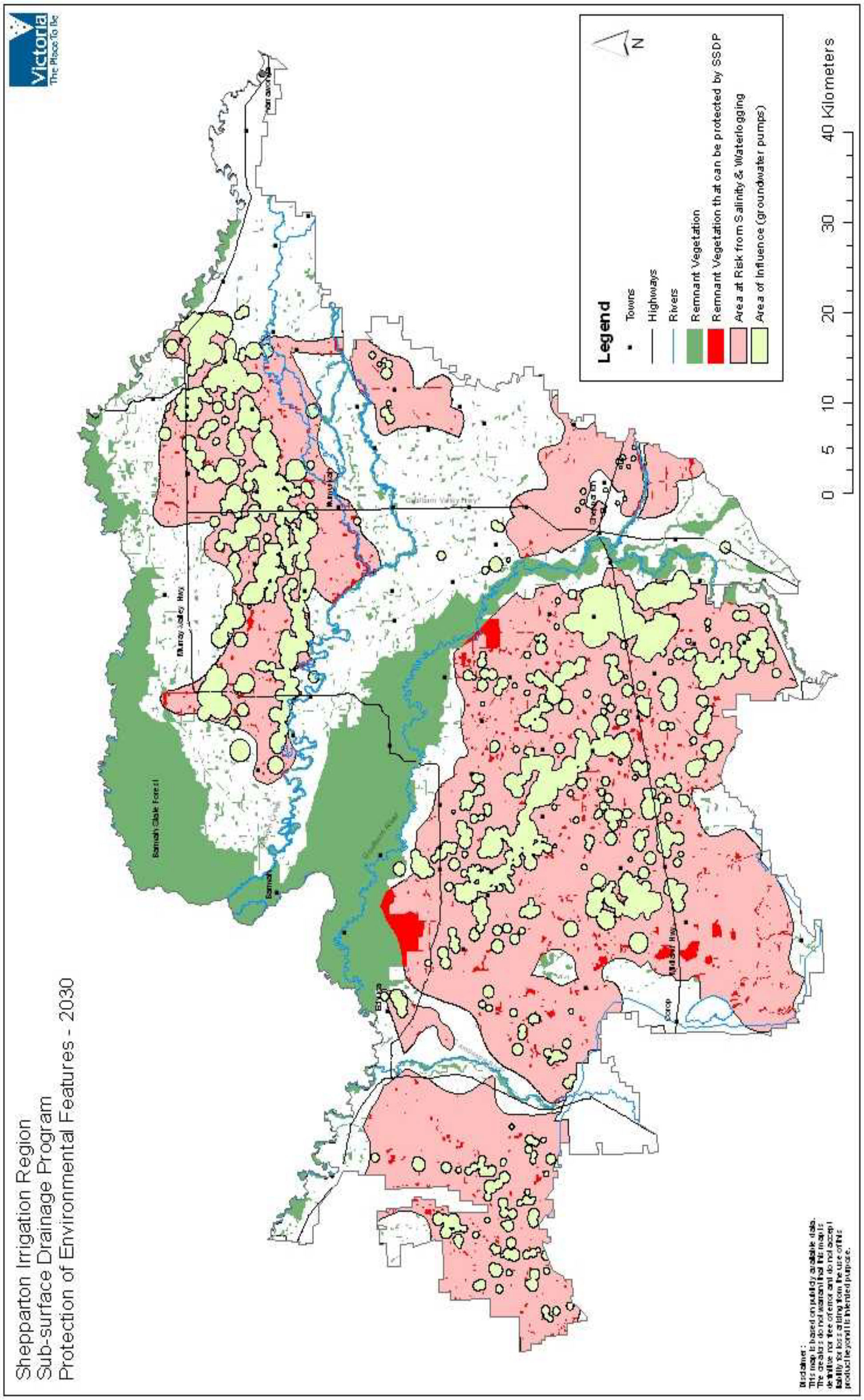


Figure 7- Extent of Sub-surface drainage to 2030

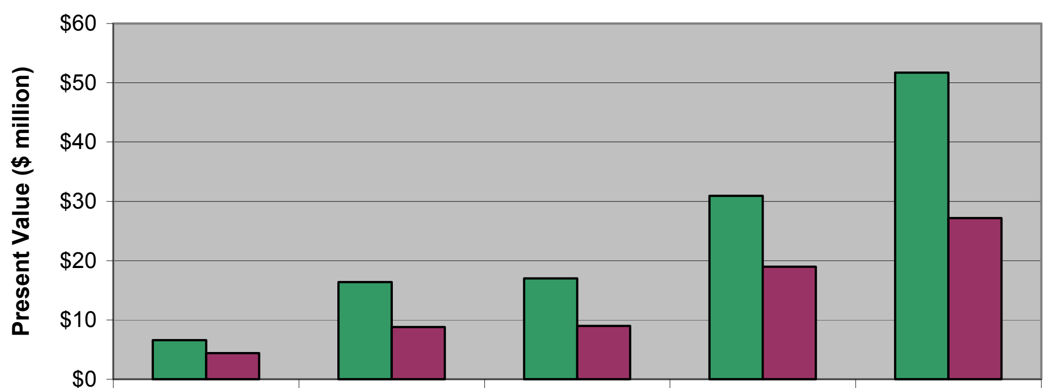
2.12 Valuing the environmental benefits of the SSDP in the SIR

Choice Modelling (CM) is a method of valuing non-market goods such as the environment. The results of a CM study from one area (study site) can be used to value the environmental attributes in another area (policy site). This is referred to as Benefit transfer method.

The implicit prices for the 'LOOK ' and 'SPECIES' attributes were applied to the SIR to calculate the value that the households will pay for these environmental attributes (Montecillo, 2006). The water and social attributes are not applicable to this program (refer to Appendix A p.25 for full report).

Present Value (PV) of Environmental Features 1990-2005-2030

The net present values (PV) of environmental features protected by the SSDP between 1990 and 2005 are $6.6 million at 4% and $4.4 million at 8% (Montecillo 2007) (refer to **Figure 8** Below). The PV for the 30 year period (1990 – 2020) are $16.4 million at 4% and $8.8 million at 8% discount rate (Montecillo 2007).



	1990 to 2005	1990 to 2020	1990 to 2030	2005 to 2025	2005 to 2035
4%	$6.6	$16.4	$17.0	$30.9	$51.7
8%	$4.4	$8.8	$9.0	$19.0	$27.2

Figure 8 Net Value of Environmental Features Protected by SSDP

The projected PV of the benefits of the proposed SSD works for the 20-year period (2005/6 to 2024/25) are $31 million and $19 million at 4% and 8% discount rates, respectively (Montecillo 2007). For the projected 30-year period between 2005 and 2035, it is estimated that a total of 9,000 ha of environmental features will be protected via sub-surface drainage (Montecillo 2007). The present value associated with these benefits equates to $52 million at 4% and $27 million at 8% (Montecillo 2007). The present value at 4% of ten (10) hectares of wetlands protected (1990 to 2030) are $36,000 and $69,000 at 8% in 30 years (1990 to 2020) (Montecillo 2007).

LIMITATIONS

A range of limitations has been identified in developing this Environmental Impact Assessment. These limitations are as follows:

- Total figures of environmental features protected or at risk require further ground truthing to confirm accuracy of these values.
- Information is based on available GIS data at the time of preparation of the paper. This specifically relates to the:
  - Aerial photography used based on 1999/2000 surveys conducted. Aerial photography is 'static' hence we assume minor changes between the photos taken in 1999 and June 30 2005.
  - Ecological Vegetation Classification's (EVC) are 'arbitrary' changes in the landscape, in relation to vegetation communities, and are not defined by specific boundaries.
- Due to the intensive agricultural characteristics of the SIR, grasslands and the majority of wetlands have not been included as it is assumed that these sites have been highly modified and not of a true representation of their feature type.
- The data used in this report may have some errors due to the majority of data being collected by means of desktop assessment. DPI has made every effort to provide the highest standard of data possible taking into account time and resource limitations as determined by the limited parameters of this project brief. Desktop discrepancies can be inherent when:
  - Using aerial photography limiting the ability to differentiate between native and exotic species.
  - Estimates of areas are only based on remnant vegetation GIS layer.
- The implicit price used in determining the monetary value of the environmental features ('Look' and 'Species') was derived from a study in Western Australia and may or may not represent the value that Victorians place on these features.

CONCLUSION / RECOMMENDATIONS

The Environmental Management Program, DPI - Tatura is confident that the results detailed in this report are as accurate 'as possible' given the desktop nature of this study and the limitations imposed therein.

Sub-surface drainage plays a pivotal role in protecting our environmental features from the damaging effects of rising watertables. By June 2005, over 6,000ha of key environmental features were receiving relief from shallow watertables through groundwater pumping in the SIR. It is imperative that the SSDP continues to target areas, particularly those identified in the '*High Value Environmental Features*' report (McLeod, 2005).

DPI makes the following recommendations for consideration in relation to the protection of environmental features in the SIR:

- Future groundwater pumps should be located in close proximity to areas currently serviced by the SSDP. This will provide further protection to significant environmental features from high watertables.
- Investigations should be made into the establishment of bores within sites identified in the HVEF report classified as having High and Very High Priority.
    - Cantwells Bushland Reserve – Echuca South
    - Gaynors Swamp – Stanhope
    - Yielma Bushland Reserve – Yielma
    - Daunts Bend (Goulburn River) – Toolamba
    - Rumbalara Common – Mooroopna
    - Kempsters Bridge (Broken Creek) – Nathalia
    - Gemmills Swamp – Mooroopna
    - Ferguson Road (Goulburn River) – Mooroopna South
    - Nathalia Reserves – Nathalia
    - Brays Swamp – Merrigum
    - Cussen Park Wetland – Tatura
- Monitoring of environmental features within areas serviced by groundwater pumps is recommended to identify any notable changes in vegetation health. Monitoring should include:
    - Salt tolerance levels of individual species.
    - Associated remnant vegetation conditions.
    - Effectiveness of remnant vegetation management on existing remnant vegetation stands and associated fauna habitat (eg fencing = regeneration).
    - Undertake a photo point project to monitor visual changes in vegetation health such as the evidence of dieback in Grey Box (*Eucalyptus microcarpa*).
    - Regular checks of native and exotic fauna populations.
    - Changes in impacts of weed invasion (salinity indicator species).
- Sites containing threatened flora and fauna should be actively managed (fencing) to ensure protection from other threatening processes (grazing).

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APPENDICES

APPENDIX A

Valuing the Environmental Benefits of Sub-surface Drainage Program in the Shepparton Irrigation Region – Final Report

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27 March 2007

1. Introduction

Sub-surface Drainage Program (SSDP) is one of the key features of the Shepparton Irrigation Region Land and Water Salinity Management Plan (SIRLWSMP). The program aims to, where possible and justified, protect and reclaim the Region's land and water resources from salinisation through management of its groundwater (SIRLWSMP, 1989). The activities included in the program are installing public and private groundwater pumps and tile drains.

It is estimated that about 15,300 ha of environmental features could be protected by the sub-surface drainage system (McLeod, McCallum and Morrison, 2007). Prior to the implementation of the SIRLWSMP in 1990, some 210 hectares were receiving protection from groundwater pumping. From 1990 to 2005, an additional 2,070 hectares were being protected and the remaining 13,020 hectares are considered at risk from further degradation through salinisation and waterlogging.

Projection done by Hydro Environmental and Goulburn Murray Water (GMW) estimated that by 2030, an additional 6,930 hectares could be protected from salinisation and waterlogging (McLeod, McCallum and Morrison, 2007).

In line with the policy of quantifying the triple bottom line (economic, environmental and social) impacts of government programs, the SIRCS Implementation Committee commissioned a study to determine the value of the environmental benefits of SSDP.

This study used the Benefit Transfer Technique[1] and applied the results from the Choice Modelling (CM) studies undertaken in Western Australia (WA) and New South Wales (NSW). CM is a method of valuing non-market goods where respondents evaluate a number of options or scenarios.

2 Methodology

The value of the 'Look' environmental feature was estimated using the implicit price based on the study by Bennett and van Bueren in the Great Southern Region of WA in 2000. The implicit price is the price that each household pays to protect 10,000 ha of bush for 20 years.

[1] Under Benefit transfer technique, the value estimates that have been developed for other cases ("source" estimates) are used to make inform decisions where an environmental exercise is not warranted given the scale of the proposed changes or cannot be afforded in terms of either time or money (the "target/policy" case). [Bennett and Morrison, 2001, p7]

The study by Whitten and Bennett in the Murrumbidgee River Floodplain in NSW was used in estimating the value of 'Wetlands'. The implicit price is a one-off price that each household pays to protect 1,000 ha of wetlands.

An overview of CM is discussed in Section 4.

The implicit price was adjusted to account for the socio-economic differences between the population and income of the "study site" and the "policy site"[2]. The URS review states that:

The income adjustment for both national and international benefit transfers to estimate the mean Willingness to Pay at the policy site (WTP_p) is:

$$WTP_p = WTP_s * [Y_p / Y_s]$$

Where :

WTP_p = the original benefit estimates from the study site;

WTP_s = the original benefit estimate from the policy site;

Y_p = the income levels at the policy site;

Y_s = the income levels at the study site

Policy site = Victoria
Study site = Western Australia ('Look' and 'Species') and NSW ('Wetlands')

'Look' attribute:
The WTP in this context is $/10,000 ha of protected/repaired farmland and native bush. Y_s and Y_p are the average yearly total incomes in 1999-2000[3] for Western Australia and Victoria, respectively.

'Species' attribute:
The WTP in this context is $/threatened or endangered protected. Y_s and Y_p are the average yearly total incomes in 1999-2000[4] for Western Australia and Victoria, respectively.

For the 'Wetlands' study, the WTP is $/1,000 ha of protected/ repaired wetlands. Y_s and Y_p are the average yearly total incomes in 1999-2000[5] for Canberra, Melbourne, Greater Shepparton and Benalla.

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2 The "study sites" for the 'Look' attribute is the GSR and Perth in Western Australia and the "study sites" for the 'Wetlands' attribute are Adelaide, Canberra and Wagga-Wagga and Griffith in New South Wales. The "policy sites" are the GBC and Melbourne and Melbourne, Canberra, Greater Shepparton and Benalla, respectively.

3 The average annual total incomes for Western Australia (Perth and GSR), Victoria (Melbourne and GBC) and Canberra were taken from the National Regional Profile published by the Australian Bureau of Statistics, ABS cat. no. 1379.0.55.001

4 The average annual total incomes for Western Australia (Perth and GSR), Victoria (Melbourne and GBC) and Canberra were taken from the National Regional Profile published by the Australian Bureau of Statistics, ABS cat. no. 1379.0.55.001

5 The average annual total incomes for Melbourne, Benalla, Greater Shepparton and Canberra were taken from the National Regional Profile published by the Australian Bureau of Statistics, ABS cat. no. 1379.0.55.001

The present value (PV) of the environmental benefits was calculated using a 4% and 8% discount rate. PV is the total amount that a series of future payments is worth now. The formula to calculate PV is

$$PV = S_t * [1/(1+i)^t]$$

Where :
S = sum of money (benefits or costs);
t = year;
i = discount rate

Discount rate is the rate of exchange between value today and value in the future.

2. Assumptions and basic data

Table 1 is a summary of the data used in the analysis. The details of areas protected that are given values are in Appendix A.

The benefits are valued one year after installing sub-surface drainage system (one-year lag before benefits accrue).

Between 1975 and 1981, groundwater pumps were installed to manage the rising water table (SPPAC 1989 page 14, Lavis personal communication). It was estimated that these pumps protected 210 ha of areas with significant environmental features.

The 'without the program' scenario assumes there are neither bushland nor species nor wetlands protected and/or restored.

Table 1 Environmental area protected and to be protected by the SSDP, 1990 to 2030

			Area (ha)
A	Total area at risk of salinisation and waterlogging		15,300
B	Area protected as of 1990		210
C	Remaining area at risk of salinisation and waterlogging, as of 1990	*C = A - B*	15,090
D	Area protected as of 2005		2,280
E	Area protected by the SSDP between 1990 and 2005	*E = D - B*	2,070
F	Remaining area at risk of salinisation and waterlogging as of 2005	*F = A – D*	13,020
	Area protected, 2030		9,210
J	Total area that can be protected by SSDP between 2006 and 2030	*J = F –I*	6,930
	Area of wetland protected, 2005		10

Four species were protected from 1990 to 2005 and 13 species will be protected from 2005 to 2030.

1 Choice Modelling

Choice modelling (CM) is a technique that can be used to estimate the value of non-market goods. Bennett (2005) describes CM as

> "A 'stated preference' technique that involves a sample of people who are expected to experience the benefits/costs, being asked a series of questions about their preferences for alternative future resource management strategies. Each question, called a 'choice set', presents to respondents the outcome of usually three or four alternative strategies. The alternatives are described in terms of a common set of attributes.
>
> The alternatives are differentiated one from the other by the attributes taking on different levels. One of the alternatives – that relating to the 'business as usual' (BAU) option – is held constant and is included in all the choice sets."

In the CM studies conducted by van Bueren Bennett (2000, 2004) and by Whitten and Bennett (2001), respondents were presented with a number of policy options that affect a number of financial, social and environmental attributes. The respondents were then asked to choose the options that they like most by looking at the levy amount and the effects that the projects are expected to have on the environment and country communities (van Bueren and Bennett, 2004 and 2000 page 61, Whitten and Bennett, 2001). In the WA study, the levy per household is paid annually for 20 years whilst in the NSW study, the levy per household is a one-off payment.

1.1 Natural Resource Attributes

The studies (van Bueren and Bennett, 2000 and 2004, Whitten and Bennett, 2001) started with a survey of policy makers and their advisers to establish a list of possible generic attributes to describe land and water degradation impacts and the environmental goods to be assessed and compared. This was followed by focus groups to gain an appreciation of the general public's understanding of these issues. In the WA study, surveys were then conducted in Perth and Albany and other selected metropolitan and non-metropolitan areas nationally. In the NSW study, the surveys were conducted in Griffith and Wagga Wagga in NSW, Canberra and Adelaide.

The following attributes were chosen:

Table 2 Attributes selected for Choice Modelling Technique

Attribute	Variable	Attribute Description
Endangered native species	Species	Species Protection, measured by the number endangered species protected from extinction
Countryside aesthetics	Look	Landscape Aesthetics, measured by the area of farmland repaired and bush protected (hectares)
Waterway health	Water	Measured by the length of waterways restored for recreational purposes (fishing or swimming) – km
Country communities	Social	Social impact, viability of country communities measured by the net loss of population from country towns each year

Source: van Bueren and Bennett, Nov 2000 pages 16 and 38

Table 3 Attributes selected for Choice Modelling Technique, Murrumbidgee River Floodplain (MRF) New South Wales

Attribute	Attribute Description
Cost	Size of levy
Wetlands	Area of healthy wetlands (ha)
Birds	Population of native water and woodland birds
Fish	Population of native fish
Farmers leaving	Number of farmers leaving

Source: Whitten and Bennett February 2001 pages 8 and 22

1.2 Strengths of CM technique

- Specifically targets environmental attributes that can not be estimated in related markets.
- Can be used in a regional context.
- Socio-economic differences between the target population and the survey population can be accounted for.
- Forces respondents to consider natural resource trade-offs rather than a single issue. This generates more realistic values.
- Can be used in conjunction with other environmental valuation techniques
- The result of a CM study can be used as a "source" estimate in a Benefit Transfer technique.

1.3 Limitations of this study

Care should be taken when using the results of this desktop valuation of the environmental impacts of the SSDP. The implicit price was derived from the West Australian (WA) study, which may or may not reflect the choices to be made by Victorians.

The respondents in the WA study were asked to choose the options that they like by looking at the levy amount and the effects of the projects (funded by the levy) are expected to have on the environment and the country communities over the next 20 years. As the evaluation of the SSDP has time frames of 30 and 40 years, it can't be assumed that the households would pay the same amount for any period longer than 20 years.

The impacts of other natural resource management programs on the environmental features were not included in the analysis, which may or may not overvalue the benefits of SSDP.

1.4 Implicit Prices

There are two models that can be used in valuing environmental features – using national or regional model.

van Bueren and Bennett (2004) stated that:

1. For environmental policies that have an Australia-wide impact, the national model value estimates should be used.
2. In situations where the impacts of a policy is limited to a particular region within a single State (or possibly spanning two adjoining States), the national value estimates should be scaled up. The scaling adjustment is required to reflect the higher values attached to attributes in regional frame.

3. The national estimates serve as a base source of value estimates, which can be adjusted to fit different policy frames. Value estimates for assessing regional case study models would be a better source of estimates for assessing policies that were specifically targeted at those regions.

The regional model is best suited in valuing the impacts of the sub-surface drainage in the Shepparton Irrigation Region.

Table 4 shows the implicit price that a household is willing to pay annually for the attribute for 20 years. Table 5 lists the one-off implicit price that a household is willing to pay for the attribute.

Table 4 Implicit prices, Western Australian study (actual prices in 2000)

Attribute		Perth	Albany
Species	per species	$1.27	$1.55
Look (aesthetics)	per 10,000 ha	$1.40	$1.84
Water	per 10 km	$0.91	$1.56
Social	per person	-$0.71	-$0.55

Source: van Bueren and Bennett, 2000, pages 16 and 38

Table 5 Implicit prices, Murrumbidgee River Floodplain study (actual prices in 2000)

Attribute		Mean implicit price
Wetland area	per 1,000 ha	$11.39
Number of native birds	per 1% change	$0.55
Number of native fish	per 1% change	$0.34
Farmers leaving	per farmer	-$5.73

The '*Look*', *'Species'* and *'Wetlands'* attributes are included in the analysis. The implicit prices for the '*Look* ' and *'Species'* attributes were applied to the Shepparton Irrigation Region to calculate the levy that the households would pay for this environmental attribute for 20 years.

The implicit price for the *'Wetlands'* attribute was applied to calculate the one-off levy that the household would pay for this environmental attribute.

Whilst the SSDP may have protected or improved the natural habitat of the river system in the SIR thus improving amenity, the '*Water'* attribute was excluded from the analysis. The Program doesn't have a direct impact on the quality of the river system for recreational use of the river system.

The '*Social'* or the *'Farmers leaving'* attributes have a negative implicit price, implying that respondents in the Western Australian and NSW projects perceive the loss of population as a cost and are willing to trade-off income to prevent a loss in community viability (van Bueren and Bennett 2000 p41).

The other attributes in the NSW study were not included because the Program didn't have a direct impact on them.

The social impact of the SSDP is covered in another report.

2 Results and discussion

2.1 Adjusted implicit price

The values of landscape aesthetics and species attributes were calculated using the implicit price extrapolated to 17%[6] of households in the Goulburn Broken Catchment (GBC) and Melbourne. The 2006 estimated number of households in GBC is 82,000 and 1.4 million in Melbourne (Dept of Sustainability and Environment 2004).

The WA implicit prices (shown in Table 4) were adjusted for the Victorian situation using the income level in Victoria. The income level in Victoria was taken from ABS "National Regional Profile". The 2000 prices were adjusted using the Consumer Price Index.

The calculated values are shown in Table 6. At 2006 prices, a household in Melbourne is willing to pay $1.63 per threatened or endangered species and $1.80 per 10,000 ha of bushland protected per year for 20 years. In the Goulburn Broken Catchment, each household is willing to pay $2.08 and $2.47 per year for 20 years, respectively. For the 'wetlands' attribute, the implicit price is $14.09 per 1,000 ha of wetlands restored or protected.

The list of annual values of the attributes is in Appendix B.

Table 6 Adjusted implicit value of 'Species' and 'Look' environmental attributes

Environmental Attribute	at 2000 prices		at 2006 prices	
	Melbourne	GBC	Melbourne	GBC
Species (per species)	$1.36	$1.74	$1.63	$2.08
Look (per 10,000 ha)	$1.50	$2.06	$1.80	$2.47
Wetlands (per 1,000 ha)	$11.77		$14.09	

2.2 Present values

The analysis covers the **difference** between the 'with' and 'without' the Program scenarios.

The net present values (PV) of environmental features protected by the SSDP for the 30-year period (1990 to 2020) are $16.4 million at 4% and $8.9 million at 8% discount rate (Table 7 and Figure 1)

The PV at 4% of ten ha wetlands protected (1990 to 2030) are $36,900 and $69,000 at 8% in 30 years (1990 to 2020).

6 The implicit prices are expressed as per household values. They should only be aggregated to 17 per cent of the target population, which corresponds to the proportion of the population upon which the value estimates are based. Aggregation beyond this level is speculative.

Table 7 Net financial values of the environmental benefits attributed to the SSDP (at 2006 prices)

	1990-91 to 2019-20 (30 years)	1990-91 to 2029-30 (40 years)	2005-6 to 2034-35 (30 years)
Look			
Discount rate 4%	$860,971	$907,690	$2,381,169
Discount rate 8%	$451,171	$464,319	$1,326,080
Species			
Discount rate 4% ($M)	$15.5	$16.1	$49.4
Discount rate 8% ($M)	$8.4	$8.5	$25.9
Wetlands			
Discount rate 4%	$36,868	$47,771	
Discount rate 8%	$69,071	$84,791	
TOTAL			
Discount rate 4% ($M)	$16.4	$17.1	$51.7
Discount rate 8% ($M)	$8.9	$9.0	$27.2

The value of the environmental benefits due to the implementation SSDP Plan (2005-6 to 2029-30) at the end of 30 years is $52 million at 4% and $27 million at 8% discount rate.

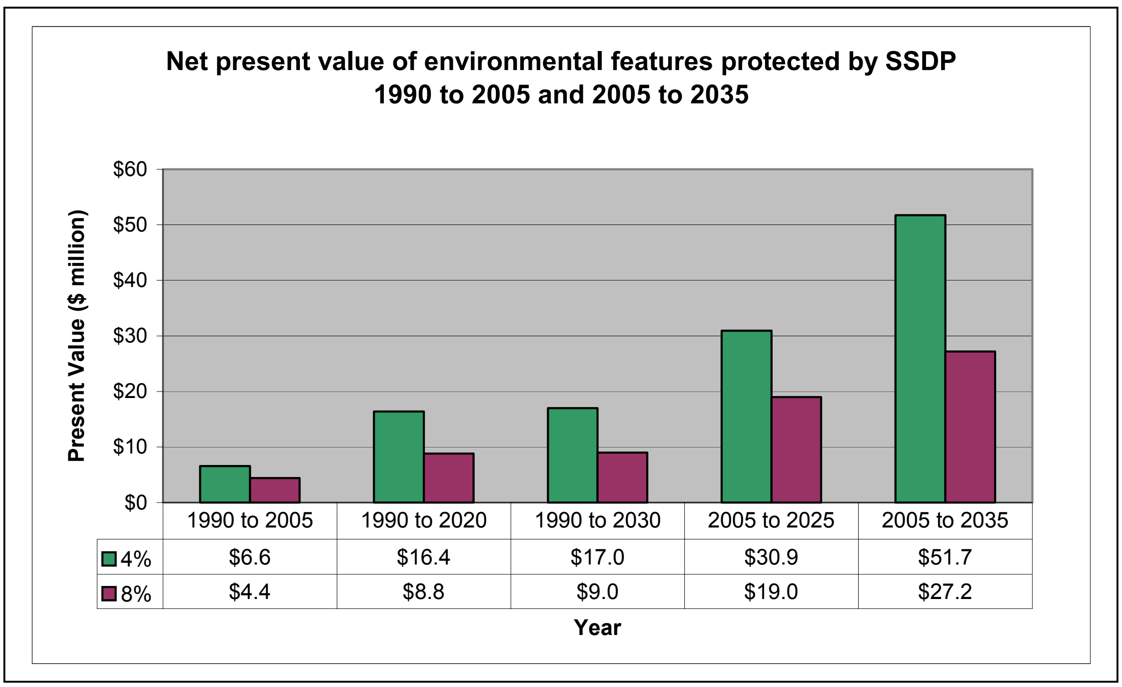

Figure 3 Net present value of environmental features protected by SSDP

3 Sensitivity analysis

If households are willing to pay for the 'Look' and 'Species' environmental attributes for 15 years, the present value of the of the benefits of SSDP is $13.3 million (1990 to 2020 and 1990 to 2030) at 4% and $7.6 million at 8% (Table 8).

The present values of the benefits from the planned implementation of SSDP (2005 to 2030) are $40 million and $23 million at 4% and 8% discount rates, respectively.

Table 8 Sensitivity analysis – Net present value of 'Look' and 'Species' at 15-year levy payment periods (at 2006 prices)

	1990-91 to 2019-20 (30 years)	1990-91 to 2029-30 (40 years)	2005-6 to 2034-35 (30 years)
Look			
Discount rate 4%	$710,678	$713,007	$2,575,839
Discount rate 8%	$391,383	$392,106	$1,370,662
Species			
Discount rate 4% ($M)	$12.6	$12.6	$37.6
Discount rate 8% ($M)	$7.2	$7.2	$21.3
TOTAL			
Discount rate 4% ($M)	$13.3	$13.3	$40.2
Discount rate 8% ($M)	$7.6	$7.6	$22.7

If households are willing to pay for the 'Look' and 'Species' environmental attributes for 25 years, the present value of the of the net benefits of SSDP (1990 to 2020) is $18 million at 4% and $9.4 million at 8%. At 40-year implementation period (1990 to 2030), the present values are $20.2 million and $10.1 million at 4% and 8%, respectively.

The present values of the benefits from the planned implementation of SSDP (2005 to 2035) are $56 million at 4% and $29 million at 8% discount rate for 30 years.

Table 9 Sensitivity analysis – Net present value of 'Look' and 'Species' at 25-year levy payment periods (at 2006 prices)

	1990-91 to 2019-20 (30 years)	1990-91 to 2029-30 (40 years)	2005-6 to 2034-35 (30 years)
Look			
Discount rate 4%	$937,950	$1,076,415	$3,188,312
Discount rate 8%	$478,792	$517,268	$1,611,396
Species			
Discount rate 4% ($M)	$17.0	$19.2	$53.2
Discount rate 8% ($M)	$8,9	$9.5	$27.3
TOTAL			
Discount rate 4% ($M)	$18.0	$20.2	$56.4
Discount rate 8% ($M)	$9.4	$10.1	$28.9

3. Conclusion

The results of the desktop valuation of the environmental impacts of the Sub-Surface Drainage Program show significant environmental benefits.

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4. APPENDICES

A. Area

SSDP protected a total of 2,070 ha from 1990-91 to 2004-5 and will protect a total of 6,930 ha from 2005-6 to 2039-40. The annual increase in area protected is 138 ha from 1990-91 to 2004-5 and 277 ha from 2005-6 to 2029-30 (Tables 11 and 12).

Note that the implicit price is the payment/levy that each household would pay annually for 20 years. The cumulative area protected increases, but the area subject to valuation will decrease overtime. Whilst the values of some assets can last, the value of the land protected and species protected can only be estimated for 20 years. This is because the original work (WA study) specified "how much each household would pay as a yearly environmental levy for 20 years".

The valuation is similar to the principle of depreciation where the book value of an asset becomes zero when it reached its estimated life span, although that asset still has "productive value".

It was assumed that there is a lag of one year before benefits accrue, that is the area protected in 1990-91 will have a value in 1991-92.

Table 10 Cumulative area of bush and number of species protected by SSDP that are subject to valuation, 1990 to 2005 implementation period

Year	Area of bush (ha)	Number of species	Wetlands (ha)
1990	-		
1991	-		-
1992	138		1
1993	276	1	1
1994	414	1	2
1995	552	1	3
1996	690	1	3
1997	828	2	4
1998	966	2	5
1999	1,104	2	5
2000	1,242	2	6
2001	1,380	3	7
2002	1,518	3	7
2003	1,656	3	8
2004	1,794	3	9
2005	1,932	4	9
2006	2,070	4	10
2007	2,070	4	10
2008	2,070	4	10
2009	2,070	4	10
2010	2,070	4	10

Year	Area of bush (ha)	Number of species	Wetlands (ha)
2011	2,070	4	10
2012	1,932	4	10
2013	1,794	3	10
2014	1,656	3	10
2015	1,518	3	10
2016	1,380	3	10
2017	1,242	2	10
2018	1,104	2	10
2019	966	2	10
2020	828	2	10
2021	690	1	10
2022	552	1	10
2023	414	1	10
2024	276	1	10
2025	138		10
2026			10
2027			10
2028			10
2029			10
2030			10

Note: The number of species protected is in proportion to the area of bush protected.

Note that the implicit price is the payment/levy that each household would pay annually for 20 years. The cumulative area protected increases, but the area subject to valuation will decrease overtime. Whilst the values of some assets can last, the value of the land protected and species protected can only be estimated for 20 years. This is because the original work (WA study) specified "how much each household would pay as a yearly environmental levy for 20 years".

The valuation is similar to the principle of depreciation where the book value of an asset becomes zero when it reached its estimated life span, although that asset still has "productive value".

It was assumed that there is a lag of one year before benefits accrue, that is the area protected in 1990-91 will have a value in 1991-92.

Table 11 Cumulative areas protected by SSDP that are subject to valuation, 2005 to 2030 implementation period

Year	Area of bush (ha)	Number of species
2006	-	-
2007	277	1
2008	554	1
2009	831	2
2010	1,108	2
2011	1,385	3
2012	1,662	3
2013	1,939	4
2014	2,216	4
2015	2,493	5
2016	2,770	5
2017	3,047	6
2018	3,324	6
2019	3,601	7
2020	3,878	7

Year	Area of bush (ha)	Number of species
2021	4,155	8
2022	4,432	8
2023	4,709	9
2024	4,986	9
2025	5,263	10
2027	5,540	10
2028	5,540	10
2029	5,540	10
2030	5,540	10
2031	5,540	10
2032	5,540	10
2033	5,540	10
2034	5,540	9
2035	5,540	9

B. Prices

Table 12 Implicit price per ha of environmental attributes at 2006 prices

Year	'Look' $/ha	'Species' $/species	Wetlands ($/ha)	Year	'Look' $/ha	'Species' $/species	Wetlands ($/ha)
1991	$25.94	$233,835	$242	2014	$51.81	$468,459	$381
1992	$27.04	$244,252	$247	2015	$52.56	$475,170	$387
1993	$27.45	$249,942	$250	2016	$53.29	$481,827	$392
1994	$28.49	$257,997	$254	2017	$54.03	$488,500	$397
1995	$29.89	$269,454	$259	2018	$54.76	$495,095	$402
1996	$31.66	$286,302	$264	2019	$55.49	$501,648	$408
1997	$32.52	$294,512	$268	2020	$56.21	$508,206	$413
1998	$33.01	$298,888	$272	2021	$56.93	$514,630	$418
1999	$33.78	$306,008	$276	2022	$57.59	$520,592	$422
2000	$35.32	$318,674	$307	2023	$58.23	$526,426	$427
2001	$38.18	$343,951	$312	2024	$58.86	$532,116	$431
2002	$40.02	$361,694	$318	2025	$59.48	$537,735	$436
2003	$41.90	$377,506	$322	2026	$60.09	$543,161	$440
2004	$43.38	$393,780	$328	2027	$60.67	$548,433	$444
2005	$45.12	$407,977	$333	2028	$61.24	$553,551	$448
2006	$45.87	$414,728	$339	2029	$61.78	$558,469	$452
2007	$46.61	$421,468	$344	2030	$62.31	$563,249	$456
2008	$47.35	$428,151	$349	2031	$62.82	$567,842	
2009	$48.10	$434,887	$355	2032	$63.44	$573,432	
2010	$48.84	$441,601	$360	2033	$64.06	$579,078	
2011	$49.59	$448,346	$365	2034	$64.69	$584,780	
2012	$50.33	$455,076	$371	2035	$65.33	$590,537	
2013	$51.07	$461,754	$376				

The implicit price of wetlands was annualised at 4% for 40 years.

APPENDIX B

Estimate of environmental features tolerance to watertable depth

Environmental Features	Approx. depth to watertable tolerance*	Comments
Woodland (Grey box)	>3m for low-moderate salinity levels up to 6,000 EC	Grey box is a floodplain species that will tolerate some inundation but occurs at the higher elevations on the floodplain so its tolerance to waterlogging is medium.
Riparian (River Red Gum)	>2m for low-moderate salinity levels up to 6,000 EC	River Red Gum is a floodplain species that will tolerate extensive inundation and occurs at lower levels in the floodplain so its tolerance to waterlogging is high.
Riparian (Grey Box)	>3m for low-moderate salinity levels up to 6,000 EC	Grey box is a floodplain species that will tolerate some inundation but occurs at the higher elevations on the floodplain so its tolerance to waterlogging is medium.
Grassland	>1m for low-moderate salinity levels up to 6,000 EC	Grasslands generally occur near or slightly above the floodplain woodlands in the landscape, hence are not particularly tolerant of waterlogging. However, the species present have shallower root systems than the larger, woody perennials in woodlands, hence they should be able to tolerate a higher watertable.
Wetlands (ephemeral)	>3m for low moderate salinity levels up to 6,000 EC	Trees in and around an ephemeral wetland system will have adapted to wetting and drying periods and hence will be less tolerant of waterlogging than those in a permanent wetland. Species could be Grey Box, Black Box and River Red Gum.
Wetlands (permanent)	>2m for low-moderate salinity levels up to 6,000 EC	Trees around permanent wetland systems will have good tolerance to waterlogging and hence will be tolerant of higher watertables. Species are likely to be restricted to River Red Gum.

Estimates derived from *Assessment of High Value Environmental Features within the SIR 2005*. Information compiled by Alex Sislov and Neil McLeod 2005.

* Tolerance to these watertable levels and salinities implies that the species can survive, but are not necessarily functioning at full capacity or are very healthy.

Note:
- *Higher salinity levels would require more depth to watertable.*
- *The 6,000EC figure tends to be the 'tipping point' for these species.*

Seasonal fluctuations will most likely have an impact on these figures.

Section J – Social Assessment

Hydro Environmental

Shepparton Irrigation Region
Catchment Implementation Strategy

Shepparton Irrigation Region
Sub-surface Drainage Program
2000 – 2005 Review

SOCIAL IMPACT ASSESSMENT

GOULBURN
BROKEN
CATCHMENT
MANAGEMENT
AUTHORITY

DRAFT
13 December 2005

CONTENTS

Acronyms

CMA	Catchment Management Authority
F&EP	Farm and Environment Program
F&EWG	Farm and Environment Working Group
GBCMA	Goulburn Broken Catchment Management Authority
G-MW	Goulburn Murray Water
RCS	Regional Catchment Strategy
SIA	Social Impact Assessment
SIR	Shepparton Irrigation Region
SIRCS	Shepparton Irrigation Region Catchment Strategy
SSDP	Sub-surface Drainage Program
SSDWG	Sub-surface Drainage Working Group
SWMP	Surface Water Management Program
SWMWG	Surface Water Management Working Group
TBL	Triple Bottom Line

1 Purpose of this Paper

The purpose of this document is to present the 'Social Impact Assessment' component of the Shepparton Irrigation Region Sub-surface Drainage Program 2000 – 2005 Review (SIR SSDP Review). The assessment is based on the outcomes of three social assessment workshops conducted in the Shepparton Irrigation Region during August and September in 2005.

This document is one of three technical background papers that support the Triple Bottom Line (TBL) Assessment in the SIR SSDP Review.

2 Background

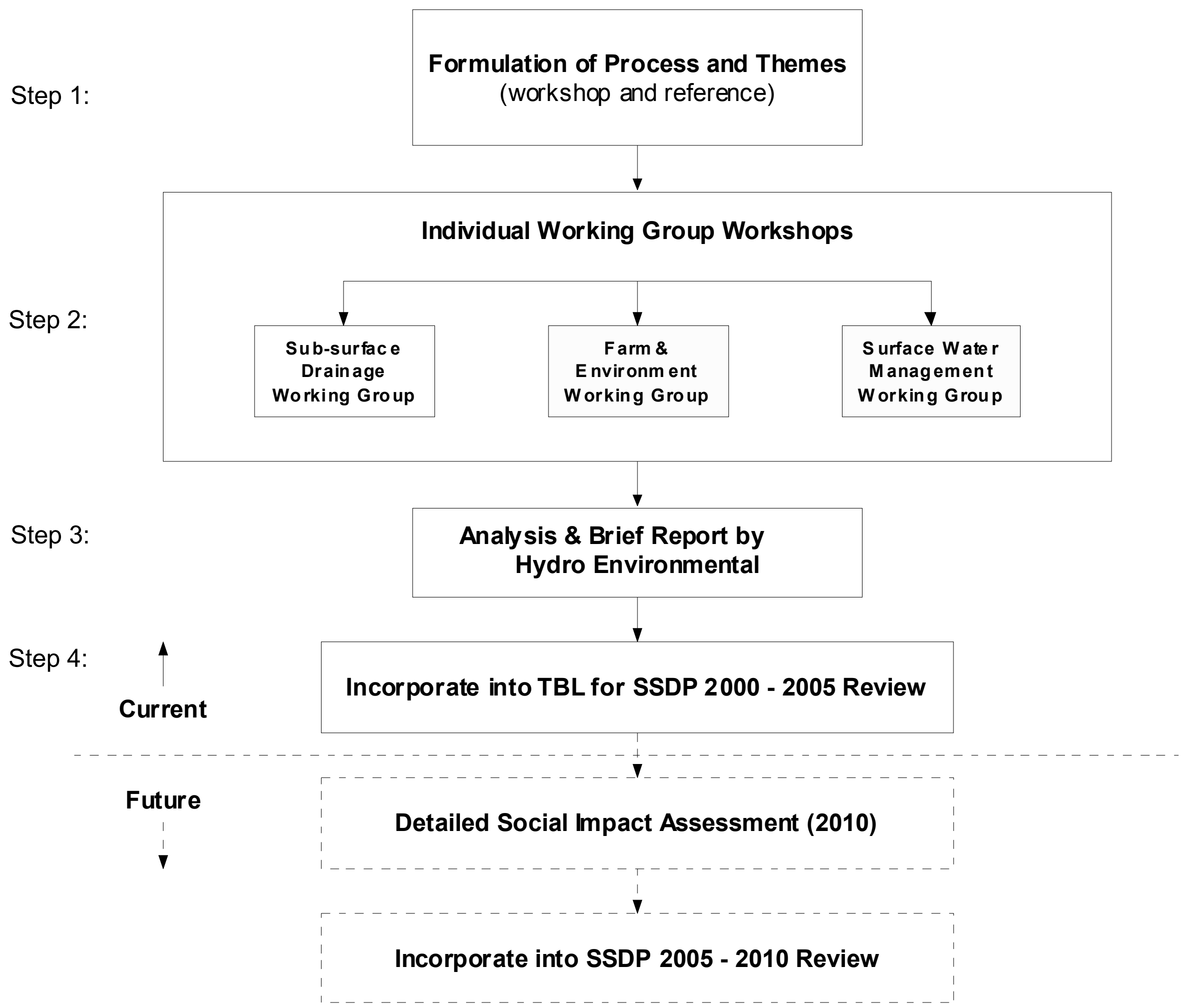
Assessment of the social impact of the Sub-surface Drainage Program (SSDP) in the Shepparton Irrigation Region (SIR) is an important aspect of the overall assessment process for the SIR SSDP Review. In endorsing the SIR SSDP Review, the State Government needs to be assured that it will deliver an overall benefit, from a combined social, financial and environmental perspective.

To determine the social implications of the existing and proposed sub-surface drainage management works and measures at the SIR SSDP Review level, three individual workshops were conducted with a cross section of landowners and agency staff located in the SIR. The workshops were conducted with three existing Shepparton Irrigation Region Catchment Strategy (SIRCS) working groups, which included the Sub-surface Drainage Working Group, Farm and Environment Working Group and the Surface Water Management Working Group. This document outlines the key findings from those workshops.

3 Social Impact Assessment Workshop

Based on discussions with Goulburn Broken Catchment Management Authority (GBCMA), Goulburn – Murray Water (G-MW) and Department of Primary Industries (DPI) officers, a decision was made to undertake the Social Impact Assessment based on four key steps. These steps are summarised in Table 1. Further details regarding each step are presented in the following section. The outcomes from this Social Assessment will be used as a basis to undertake a more thorough and detailed social assessment in five years time, as part of the 2010 revision of the SSDP.

Table 1: Social Impact Assessment Process



3.1 Step 1: Foundation of Themes

Step 1 involved an internal workshop held by water resource management consultant, Hydro Environmental. The key outcome from the workshop was the identification of eight social themes that were used to assist in quantifying the social implications of the SSDP in the SIR. These social themes included:

i. Community Wellbeing – population stability and community health
ii. Sense of Community – cohesion
iii. Natural Resources Knowledge Base – understanding of issues and processes
iv. Improved Business Confidence – reduced business risk and greater preparedness to invest in the SIR
v. Security of Water Supply – SSDP impact
vi. Changes in Landscape – aesthetics/environment
vii. Confidence in the Sub-surface Drainage Program – likelihood of objectives being achieved
viii. Protection of Significant Cultural and Historical Sites.

A brief description of each of the above social themes is detailed in **Attachment B.**

3.2 Step 2: Individual Working Group Social Impact Assessments

Three individual workshops were conducted to address the social implications of the SSDP in the SIR. The workshops endeavoured to access a cross section of irrigation farm landowners and agency staff located in the SIR. It was therefore decided to use the SIRCS working group meetings as workshop forums.

The workshops were attended by local landowner representatives, and representatives from GBCMA, DPI and G-MW. **Table 2** outlines the timing and size of each working group workshop, and a full list of the workshop attendees is detailed **Attachment A**.

Table 2: Summary of Workshops

Working Group	Date	No. of Participants
Farm and Environment Working Group (F&EWG)	3 August 2005	12
Sub-surface Drainage Working Group (SSDWG)	12 September 2005	8
Surface Water Management Working Group (SWMWG)	19 September 2005	12

The workshops, which were facilitated by Hydro Environmental, were broadly structured into three sections, namely:

i. Presenting and confirming the eight social themes relevant to the implementation of the existing and proposed sub-surface drainage management works and measures, and recording documenting additional suggested themes

ii. Undertaking an assessment of each of the defined social themes in the SIR for the period from 1990 - 2005

iii. Undertaking an assessment of each of the defined social themes in the SIR for the period from 2006 – 2030.

The eight social themes are described in **Attachment B**.

3.2.1 Social Themes to be Assessed

The initial part of the workshop focused on confirming whether the above issues were representative of all of the possible social implications associated with the implementation of existing and proposed sub-surface drainage management works and measures. All working groups agreed on the eight presented issues, and the Sub-surface Drainage Working Group identified one additional social theme. The additional social theme “Community ownership of the program” has been documented (refer to **Attachment C**) and will be considered in the 2010 social assessment of the SSDP. However, it has not been scored by all working groups, and has therefore not included in the overall social assessment for this review.

The complete list of the themes considered as part of the social assessment is as included in Section 3.1. Following agreement on some of the detail concerning boundaries of each social theme, workshop attendees assessed each of the themes across the SIR.

3.2.2 Assessment of Social Themes

Each Working Group was divided into sub-groups of four people to measure the eight social themes, and hence gauge the social impact of the SSDP across the SIR. Social themes were scored using the criteria presented in **Table 3** for each of the following periods:

- 1990 – 2005
- 2006 – 2030.

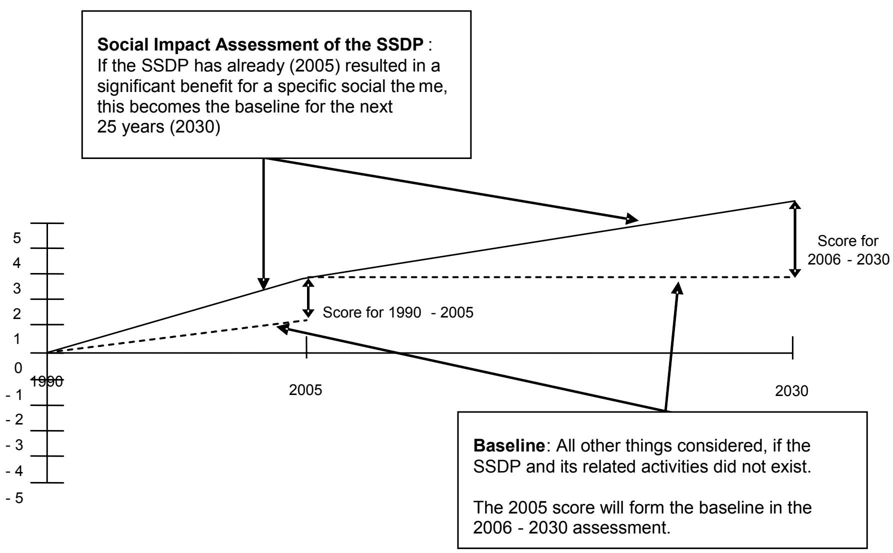
Table 3: Criteria for Scoring each Social Theme

Score	Description
+ 5	strongly positive outcome
+ 3	definitely positive outcome
+ 1	marginally positive outcome
0	neutral, neither positive or negative social outcome
- 1	marginally negative outcome
- 3	definitely negative outcome
- 5	strongly negative outcome

All scoring was undertaken relative to the baseline at 2005 and 2030, as shown in **Figure 1**. It is important to recognise that other factors such as commodity prices and farm technology also play a part in social change over time, which formed the baseline. Many of these factors would have occurred independent of whether the SSDP was ever developed and implemented.

The ultimate social change will therefore be measured by the difference between the Working Group's social impact rating for each social theme and baseline in 2005 and 2030. **Figure 1** provides a diagrammatic representation of determining the ultimate social impact of the SSDP.

Figure 1: Determining the Ultimate Social Impact of the SSDP



The agreed sub-group results for each Working Group were then presented to the particular Working Group. As part of these presentations all attendees were given the opportunity to discuss the sub-group assessments and reach agreement on the final assessment (consensus) score for their particular Working Group. The social assessment results for each Working Group, including supporting comments, are presented in **Attachment E**. A summary of the social assessment results is presented in **Table 4**.

3.3 Step 3: SSDP Social Assessment Analysis

A summary of the social assessment results for the SSDP in the SIR are presented in **Table 4**. The table also includes the average score for each social issue for each time period (1990 – 2005 and 2006 – 2030), and the overall average score for each time periods.

No attempt has been made to quantify the expected benefits in dollar terms. This is due to the approach adopted to determine the social benefits. To accurately estimate the social benefits in dollar terms would involve undertaking detailed and costly surveys.

The results presented in **Table 4** indicate that there is some variation between scores given to social themes between, and within some, Working Groups for both time periods. This is expected due to the subjective nature of the assessment undertaken. The key outcome of the assessment is the overwhelming belief that the SSDP has had a positive social outcome over the past 15 years, and is expected to continue to do so over the next 25 years. The overall score of + 2 (i.e. 7 out of 10) is a very positive result. **Table 5** presents some of the key comments that were recorded during the social assessment workshops and support scoring of each theme.

Table 4: Summary of the Outcomes of the SSDP Social Impact Assessment Workshops

No.	Social Theme	F&EWG	SSDWG	SWMWG	Average	F&EWG	SSDWG	SWMWG	Average
		1990 – 2005 Period				2006 – 2030 Period			
1	Community Wellbeing	+2.5	+3	+3	**+3**	+1.5	+2	+3	**+2**
2	Sense of Community	+3	+2.5	+2	**+2.5**	+2.5	+1	+2	**+2**
3	Natural Resources Knowledge Base	+2	+4	+2	**+2.5**	+3	+3	+2	**+2.5**
4	Improved Business Confidence	+1.5	+2	+3	**+2**	+2.5	+1-3	+2	**+2**
5	Security of Water Supply	+1.5	+3	+2	**+2**	+1	+1-3	+3	**+2**
6	Changes in Landscape (including environmental)	+1	+2	+1	**+1.5**	+3	+1.5	+2	**+2**
7	Confidence in the Sub-surface Drainage Program	+1.5	+3	+2	**+2**	+2.5	+2	+3	**+2.5**
8	Protection of Significant Cultural and Historical Sites	0	0	0	**0**	+1	+1	+1	**+1**
	Average overall social impact	**+2**				**+2**			

Note: Refer to **Table 3** for criteria used for scoring each social theme.

Some interesting observations from the results presented in **Table 4 are:**

i. Overall the expectations looking forward are the same as those achieved by the program to 2005

ii. The community related social themes were judged to be marginally less positive for the future SSDP activities than they have been in the past

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

iv. Overall the Sub-surface Drainage Working Group (SSDWG) was the most positive about past achievements of the SSDP, and Farm and Environmental Working Group (F&EWG) members were the most pessimistic. In contrast, looking forward, the F&EWG was the most positive and the SSDWG provided the least positive result.

v. The Surface Water Management Working Group (SWMWG) saw positive outcomes looking backwards and forwards. Overall its score was between those from the other Working Groups. The SWMWG saw the future providing slightly more positive social outcomes than the past.

3.4 Step 4: Incorporation into Triple Bottom Line Assessment

The results presented in **Table 4** will form the basis of the 'Social Assessment' component of the SIR SSDP, which will feed into the Triple Bottom Line assessment for the SSDP 2000 – 2005 Review.

Table 5: Key Comments from SSDP Social Impact Assessment Workshops – Detailed in Attachment E

Social Theme	Key Comments	
	1990 – 2005 Period	**2006 – 2030 Period**
1. Community Wellbeing	• SSDP has improved productivity • Where groundwater pumping has occurred, community wellbeing has been very positively improved • If hadn't had groundwater pumping would have had to sell out	• Program being in place should give big confidence and stability
2. Sense of Community	• SSDWG, Pumper's Trumpet, Landcare undertaking bore monitoring • Require community involvement for groups and public pumps	• As water quality decreases, more discussion will be necessary to aid the community • Communities will not be so cohesive – evaporation basins – winners and losers – reconfiguration problems
3. Natural Resources Knowledge Base	• Water table maps, Saltwatch, awareness programs, DPI extension • Since commencing, knowledge and awareness are improving • Salinity of water is perhaps still not understood, especially in farm soil management • Positive only for people directly involved in program	• Knowledge will increase with SSDP being a part of this but not necessarily a major part • Improved knowledge over time & as more people involved
4. Improved Business Confidence	• In horticultural areas, i.e. Shepparton East • Positive change, however, SSDP not a big consideration • Dairying more secure, bought investments in region	• Vital part of security • Safety net developed • Horticulture – only get investment if watertables controlled
5. Security of Water Supply	• Groundwater is seen as valuable resources, not always for groundwater control • Been a vital support for people during the drought • Opportunity to access water possibly main driver rather than salinity control	• Metering, lowering expectations of groundwater use for future. Less secure but better managed • Will be a vital support for people during the drought • Given increasing value of water, GW pumps should be seen as an increasingly valuable farm asset, especially for security of water supply • More likely to relieve individual concerns than wider community
6. Changes in Landscape (including environmental)	• Difficult to quantify. Has reduced impacts on landscape such as dead trees and improved pasture, etc. • Minimal impact on landscape, some mature trees probably saved and reduced salt scalding • Both salinity & groundwater supply pumping would benefit natural features by drawdown in water table	• More focus on quality • More education, especially horticulture
7. Confidence in the Sub-surface Drainage Program	• Overall positive attitude by community in SSD program • SSDP is achieving objectives • Strong demand for FEDS program	• If some wet years return, groundwater pumpers will have confidence to manage their land better • Absolute (strategically important)
8. Protection of Significant Cultural and Historical Sites	• Not aware of any	• There is potential

4 Conclusion

As shown in **Table 4**, the SSDP has had a measurable positive social outcome over the past 15 years, and is expected to continue to do so over the next 25 years as a result of the implementation of existing and proposed sub-surface drainage management works and measures across the SIR.

Overall the Program scored 7 out of a possible 10 from a social perspective, with confidence in the program and its impacts on the social aspects of the landscape and cultural heritage features increasing, compared to the achievements over the past 15 years.

xxxxXXXXxxxx

ATTACHMENTS

ATTACHMENT A – Workshop Attendees

No.	Name	Organisation	Working Group
1.	Alex Sislov	Department of Primary Industries	Farm and Environment Working Group
2.	Chelsea Nicholson	Department of Primary Industries	Farm and Environment Working Group
3.	Libby Reynolds	Department of Primary Industries	Farm and Environment Working Group
4.	Rachel Spokes	Department of Primary Industries	Farm and Environment Working Group
5.	Chris Nicholson	Department of Primary Industries	Farm and Environment Working Group
6.	David Robertson	Department of Primary Industries	Farm and Environment Working Group
7.	Alison McCallum	Department of Primary Industries	Farm and Environment Working Group
8.	Ann Roberts	Community Representative	Farm and Environment Working Group
9.	Les Langley	Community Representative	Farm and Environment Working Group
10.	George Trew	Community Representative	Farm and Environment Working Group
11.	John Laing	Community Representative	Farm and Environment Working Group
12.	Rein Silverstein	Community Representative	Farm and Environment Working Group
13.	Terry Hunter	Goulburn-Murray Water	Sub-surface Drainage Working Group
14.	Martin Brownlee	Goulburn-Murray Water (SKM)	Sub-surface Drainage Working Group
15.	Bruce Gill	Department of Primary Industries	Sub-surface Drainage Working Group
16.	Peter Gibson	Community Representative	Sub-surface Drainage Working Group
17.	Ian Whatley	Community Representative	Sub-surface Drainage Working Group
18.	George Trew	Community Representative	Sub-surface Drainage Working Group
19.	Gordon Weller	Community Representative	Sub-surface Drainage Working Group
20.	Kevin Chapman	Community Representative	Sub-surface Drainage Working Group
21.	Neil McLeod	Department of Primary Industries	Surface Water Management Working Group
22.	Sandra Schroen	Department of Primary Industries	Surface Water Management Working Group
23.	Georgie Fraser	Department of Primary Industries	Surface Water Management Working Group
24.	Mark Paganini	Department of Primary Industries	Surface Water Management Working Group
25.	Colin James	Goulburn Broken CMA	Surface Water Management Working Group
26.	Carl Walters	Goulburn-Murray Water	Surface Water Management Working Group
27.	Greg Smith	Goulburn-Murray Water	Surface Water Management Working Group
28.	Sam Green	Goulburn-Murray Water	Surface Water Management Working Group
29.	Allen Canobie	Community Representative	Surface Water Management Working Group
30.	Steve Farrell	Community Representative	Surface Water Management Working Group
31.	George Trew	Community Representative	Surface Water Management Working Group
32.	Hank Sanders	Community Representative	Surface Water Management Working Group

ATTACHMENT B – Description of the Social Themes

A brief description of the eight social themes assessed is presented below:

1. **Community Wellbeing** – population stability and community health

   Has the SSDP helped maintain the community population in the Shepparton Irrigation Region by maintaining or improving the productivity of the region, which leads to better community well being?

2. **Sense of Community** – cohesion

   Have SSDP activities, such as group FEDS (Farm Exploratory Drilling Service) and public pumps, brought the community together in a more cooperative fashion to socialise and/or overcome such things as regional salinity issues?

3. **Natural Resources Knowledge Base** – understanding of issues and processes

   Has the SSDP improved the community's knowledge of natural resource issues, and if so, has this understanding of cause, effects and sustainable strategies impacted the community in a positive or negative way?

4. **Improved Business Confidence** – reduced business risk and greater preparedness to invest in the Shepparton Irrigation Region

   Has the SSDP improved the community's confidence to invest in the Shepparton Irrigation Region, and consequently does the community feel more/less confident about their current or potential investment in the region?

5. **Security of Water Supply –** SSDP Impact

   Have SSDP activities, such as establishment of new private groundwater pumps, led to a more secure water supply resource for farmers, that is of sufficient quality and quantity to relieve community concerns during times of channel water restrictions or more water in the channel or drainage system through groundwater extraction or groundwater control.

6. **Changes in Landscape** – aesthetics/environment

   Have SSDP activities changed the aesthetics of the landscape (including vegetation and other environmental features) such that it has affected the community in a positive or negative manner?

7. **Confidence in the Sub-surface Drainage Program** – likelihood of program objectives being achieved

   *Does the community believe that the SSDP is achieving its objectives? (Objectives are included in **Attachment D** for your reference)*

8. **Protection of Significant Cultural and Historical Sites**

   Have SSDP activities resulted in the protection of Aboriginal cultural sites or European heritage sites?

ATTACHMENT C – Additional Social Themes

One additional social theme was identified at the workshop undertaken at the Sub-surface Drainage Working Group meeting, and is detailed below:

9. **Community Ownership of the Program** –

   Does the community have a sense of ownership over the program and has this level of ownership affected the community in a positive or negative manner?

   Ownership maybe endangered through:

   - Input to the development or revision of the Plan
   - Involvement in the implementation process
   - Being affected by activities undertaken under the auspices of the SSDP.

ATTACHMENT D – Sub-surface Drainage Program Vision, Mission and Objectives

SSDP Vision:

Secure, efficient, productive agriculture and enhanced environmental assets within the Shepparton Irrigation Region.

SSDP Mission:

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.

SSDP Objectives:

Within the Shepparton Irrigation Region, where economically, socially and environmentally feasible, to:

i. reduce the risk caused by soil and water salinisation by encouraging the conjunctive use of shallow groundwater in irrigated agriculture

ii. foster opportunities to improve financial returns on investment in agriculture and improve community stability by increasing productivity and reducing risk

iii. encourage innovation and continuous improvement in salt and groundwater management

iv. minimise the mobilisation of salt and its impact on downstream users by being strategic and promoting solutions such as evaporation basins

v. encourage high levels of community awareness, capacity and involvement in implementation of the Shepparton Irrigation Region Sub-surface Drainage Program and its associated Catchment Programs and Strategies by all appropriate means

vi. protect key land and water resources by providing effective salt management for XXX,XXX ha of agricultural land, by 2025

vii. protect and enhance XXX ha of high value environmental assets, by 2025.

ATTACHMENT E – Detailed Scores and Comments provided by Workshop Attendees

Table E1 – Farm and Environment Working Group Social Assessment Score and Comments Relating to the SSDP for the period 1990 - 2005

Social Theme	Sub-Group Number	Sub-Group Score (1990 - 2005)	Working Group Consensus Score (1990 - 2005)	Sub-Group Comments
1. Community Wellbeing	1	0	**2.5**	Marginal in either direction or neutral. Phase A pumps have given confidence.
	2	3		More than maintained (improved) productivity.
	3	3		Population has decreased in some communities due to other issues – e.g. drought and commodity prices.
2. Sense of Community	1	0	**3**	Leaseholders engaged initially. No ongoing discussion. Continual engagement.
	2	3		SSDWG, Pumper's Trumpet, Landcare undertaking bore monitoring.
	3	4		SSDP activities were tools used by Landcare groups (watertable watch). Programs demanded by community (i.e. Landcare group). Landcare groups drove community activity.
3. Natural Resources Knowledge Base	1	2	**2**	Number of layers, increase in awareness of salinity across the community, cause and effect. Has it progressed in 15 years? In Landcare groups, FEDs investigations.
	2	4		Water table maps, Saltwatch, awareness programs, DPI extension.
	3	1		Since starting, knowledge and awareness are improving.
4. Improved Business Confidence	1	2	**1.5**	In horticultural areas, i.e. Shepparton East it has. Cannot solely improve business confidence.
	2	2		Landholders prepared to invest in sustainable projects, local processors invest in their businesses.
	3	0		Other issues have a greater impact – e.g. white paper, commodity prices.
5. Security of Water Supply	1	1	**1.5**	Perception that it does by those who don't have it. It saw a lot of people through a low water allocation. Cost of installation and what they get out of it in dry years is minimal.
	2	3		Groundwater is seen as valuable resources, not always for groundwater control.
	3	0		Potential to access water possibly main driver rather than salinity control.
6. Changes in Landscape (including environmental)	1	0	**1**	Whole Farm Plans, community drains and salinity pumps have, but not a pump on its own.
	2	1		From public perspective most probably not much but their maintenance of many remnants due to groundwater pumping.
	3	2		Difficult to quantify. Has reduced impacts on landscape such as dead trees and improved pasture, etc.
7. Confidence in the Sub-surface Drainage Program	1	0	**1.5**	Cannot say it has achieved or hasn't achieved. 7 dry yrs had to contribute +ve/-ve effects.
	2	2		Quiet achiever, benign neglect, may be ignored not but reflects confidence now, not as a bigger issue as in the past.
	3	2		Horticultural showing less confidence due to lack of education.
8. Protection of Significant Cultural and Historical Sites	1	0	**0**	No specific sites that we are aware of.
	2	0		Low recognition by public.
	3	0		Not aware of any.

Table E2 – Farm and Environment Working Group Social Assessment Score and Comments Relating to the SSDP for the period 2006 - 2030

Social Theme	Sub-Group Number	Sub-Group Score (2006 - 2030)	Working Group Consensus Score (2006 - 2030)	Sub-Group Comments
1. Community Wellbeing	1	0	**1.5**	Same as going backwards as going forwards. No influence.
	2	0		Drier climate, reduced groundwater, therefore loss of salinity issue but water quality will be reduced.
	3	4		Community well-being will be dependent on many other issues. i.e. returns, droughts.
2. Sense of Community	1	0	**2.5**	Neutral.
	2	2		As water quality decreases, more discussion will be necessary to aid the community.
	3	4		
3. Natural Resources Knowledge Base	1	2	**3**	Yes, more awareness over time. If they cut funding out for FEDs.
	2	4		Appropriate groundwater use, e.g. safe use. Move from quality to quantity.
	3	3		Knowledge will increase with SSDP being a part of this but not necessarily a major part.
4. Improved Business Confidence	1	2	**2.5**	Same, benefit few, specific areas / hotspots / localised.
	2	2		Lowered water tables mean groundwater has less threat, but quality issue rises.
	3	3		Vital part of security.
5. Security of Water Supply	1	1	**1**	Marginal.
	2	1		Metering, lowering expectations of g/w use for future. Less secure but better managed.
	3	0		SSDP only a part of overall strategy.
6. Changes in Landscape (including environmental)	1	1	**3**	Can see this being higher in future.
	2	3		High value environmental features project will raise people's awareness of groundwater & biodiversity.
	3	4		Trees matured.
7. Confidence in the Sub-surface Drainage Program	1	1	**2.5**	In wet cycle it will be more positive, less perched water tables.
	2	3		More focus on quality.
	3	3		More education, especially horticulture.
8. Protection of Significant Cultural and Historical Sites	1	1	**1**	Neutral.
	2	1		Needs more awareness.
	3	0		Not aware of any.

Table E3 – Sub-surface Drainage Working Group Social Assessment Score and Comments Relating to the SSDP for the period 1990 - 2005

Social Theme	Sub-Group Number	Sub-Group Score (1990 - 2005)	Working Group Consensus Score (1990 - 2005)	Sub-Group Comments
1. Community Wellbeing	1	2	**3**	Program encouraged the use of the resource. The impact has been a positive control of water table & the community sees that some action was being taken and are supportive.
	2	4		Where groundwater pumping has occurred, community wellbeing has been very positively improved, i.e. L/M's would not be there without them. Also raised awareness of community.
2. Sense of Community	1	2	**2.5**	Require community involvement for groups and public pumps.
	2	3		Has been part of what brought some groups together, especially where positive results (in groundwater success) were found, e.g. Group FEDs.
3. Natural Resources Knowledge Base	1	4	**4**	People's knowledge has expanded and they seek understanding.
	2	4		WT maps, WT watch bores have been very beneficial (in raising awareness) but hasn't raised all NRM issues much, e.g. Biodiversity drainage. Salinity of water is perhaps still not understood, especially in farm soil management.
4. Improved Business Confidence	1	1	**2**	Slight
	2	2		Positive change, not a big consideration.
5. Security of Water Supply	1	2	**3**	
	2	4		Been a vital support for people during the drought.
6. Changes in Landscape (including environmental)	1	3	**2**	
	2	1		Not been a big factor.
7. Confidence in the Sub-surface Drainage Program	1	4	**3**	
	2	2		Would vary in different areas.
8. Protection of Significant Cultural and Historical Sites	1	0	**0**	
	2	0		Not seen as significant.
9. Community Ownership of the Program	1	1	**1.5**	A small part of public understands – not a football club.
	2	2		Plan wouldn't have gone anywhere without initial community ownership.

Table E4 – Sub-surface Drainage Working Group Social Assessment Score and Comments relating to the SSDP for the period 2006 - 2030

Social Theme	Sub-Group Number	Sub-Group Score (2006 - 2030)	Working Group Consensus Score (2006 - 2030)	Sub-Group Comments
1. Community Wellbeing	1	1	**2**	To maintain regional salt disposal and monitor salinity for productivity.
	2	3		The crisis that started the SSD's program (Phase A, 1995 WT) is not likely to be as large a driver of community action. Wellbeing will still be supported by the program.
2. Sense of Community	1	1	**1**	As competition for resource & protection. Communities will not be so cohesive – evaporation basins – winners and losers – reconfiguration problems.
	2	2		
3. Natural Resources Knowledge Base	1	3	**3**	Working from high base which limits the rate of future improvement.
	2	4		
4. Improved Business Confidence	1	0	**1-3**	Just maintaining.
	2	4		Given increasing value of water, GW pumps should be seen as an increasingly valuable on farm asset, especially for security of water supply.
5. Security of Water Supply	1	0	**1-3**	Increase in salinity.
	2	4		
6. Changes in Landscape (including environmental)	1	1	**1.5**	
	2	2		Should be seen as an essential component of sustainability of irrigation systems.
7. Confidence in the Sub-surface Drainage Program	1	1	**2**	Coming from high base which is likely to limit the change in confidence for the future.
	2	3		Especially if some wet years return, g/w pumpers will have confidence to manage their land better.
8. Protection of Significant Cultural and Historical Sites	1	1	**1**	Potential
	2	0		
9. Community Ownership of the Program	1	1	**1**	Forward not likely to change.
	2	?		Can it be maintained?

Table E5 – Surface Water Management Working Group Social Assessment Score and Comments relating to the SSDP for the period 1990 - 2005

Social Theme	Sub-Group Number	Sub-Group Score (1990 - 2005)	Working Group Consensus Score (1990 - 2005)	Sub-Group Comments
1. Community Wellbeing	1	2	**3**	Positive reaction. Landcare groups grown from this – e.g. Wyuna (public) Additional water & salinity control. i.e. catalyst If hadn't had groundwater pumping would have had to sell out
	2	3		Not only has it kept land production, but SSDP has helped some get through low surface water availability in drought.
	3	5		Last 7-8 yrs dry indicative of importance of SSD for community well being. Initially salinity control = water supply IFF supplement which lead to economic stability & productivity – continuity.
2. Sense of Community	1	1	**2**	Ex-Wyuna – not as significant – i.e. benefit & less number of people Management of discharge of salt done well
	2	1		Groundwater pumps tend to be individually developed, not worked on as a community group so cohesion in community.
	3	4		Sense of unity through group forming. Community focus team for ethnic education. Encourage ethnic awareness of catchment issues. Reporting progress – strengthened.
3. Natural Resources Knowledge Base	1	1	**2**	This program is not isolated – needs to be tied in with other program
	2	3		Positive only for people directly involved in program. Big poster of water table maps over time has helped understanding as did Watertable Watch Flags, Saltwatch, etc.
	3	2		More aware of natural resource base (soil = NV) Commercial landholders active – protection of natural resource base Not all at same level but increased level of SSD & effects Marginal to considerable
4. Improved Business Confidence	1	3	**3**	Dairying more secure, bought investments in region.
	2	3		Bigger issue for horticulture than pasture? Investment by SPC Ardmona shows confidence.
	3	3		SSD – General overall trend to improve land with confidence that land will remain viable & productive. Targeting need for groundwater pump has allowed more productivity & need. Most pump for water since 2002.

Social Theme	Sub-Group Number	Sub-Group Score (1990 - 2005)	Working Group Consensus Score (1990 - 2005)	Sub-Group Comments
4. Improved Business Confidence	1	3	**3**	Dairying more secure, bought investments in region.
	2	3		Bigger issue for horticulture than pasture? Investment by SPC Ardmona shows confidence.
	3	3		SSD – General overall trend to improve land with confidence that land will remain viable & productive. Targeting need for groundwater pump has allowed more productivity & need. Most pump for water since 2002.
5. Security of Water Supply	1	3	**2**	Not the case prior to 2000 - important
	2	1		More likely to relieve individual concerns than wider community.
	3	1		Selectively positive – where successful Establishment of precent pumps for water supply Initial pumps for sub surface control Allowed retention of enterprise.
6. Changes in Landscape (including environmental)	1	2	**1**	Ex Girgarre Evap Basin – pre 2000 significant impact – i.e. large environmental impact
	2	1		Minimal impact on landscape, some mature trees probably saved and reduced salt scalding. Saving horticulture trees more obvious.
	3	1		It is assumed Haven't seen death Both salinity & groundwater supply pumping would benefit natural features by drawdown in water table Stabilised landscape condition Hold deterioration leading to an increase in productive area Encouraged revegetation = landscape and change
7. Confidence in the Sub-surface Drainage Program	1	2	**2**	Mistrust by users as originally was paid to use g/w – now charged for it – still used though
	2	3		Incentive provides a necessary "carrot" to sign up to program. Do people just sign up for the extra water?
	3	2		Overall positive attitude by community in SSD program SSDP is achieving objectives Strong demand for FEDS program
8. Protection of Significant Cultural and Historical Sites	1	1	**0**	Benefits as a consequence to other benefits
	2	0		Not aware of any cases where SSD has protect such sites.
	3	0		Protection through individual site avoidance during construction
9. Other Positive & Negative Impacts of the SSDP	1			
	2			Salt disposal can be negative, although resulting wetlands (e.g. Girgarre) can be positive.
	3			

Table E6 – Surface Water Management Working Group Social Assessment Score and Comments relating to the SSDP for the period 2006 - 2030

Social Theme	Sub-Group Number	Sub-Group Score (2006 - 2030)	Working Group Consensus Score (2006 - 2030)	Sub-Group Comments
1. Community Wellbeing	1	3	**3**	
	2	4		Program being in place should give big confidence in stability But, a series of wet years & impacts of high watertables could change this
	3	2		Numerous factors contribute to community wellbeing High priority sites done = strategic pump placement Focus on maintenance Streamlining Continue to be strong theme for multiple outcomes
2. Sense of Community	1	2	**2**	
	2	2		Given increase in number of pumps can expect more cohesion
	3	2		Maintain sense of community Maintain benchmark – continuity No record breaking – steady as she goes Utilised good work done to surge forward. e.g. image
3. Natural Resources Knowledge Base	1	1	**2**	Positive impact – on its own not significant program but would be a 4 if whole strategy Depends on weather and increase in enterprises
	2	4		Improved knowledge over time & as more people involved. Also, larger farms & fewer owners who are move driven, therefore knowledgeable.
	3	2		More emphasis – through knowledge & awareness High Value Environmental Feature project Sites associated with correctly maintained groundwater pumps will improve environmental features
4. Improved Business Confidence	1	2	**2**	Makes region sustainable – i.e. will not get more water so this helps security i.e. “insurance policy” – may be cheaper source of water compared with gravity Cost of fuel to be considered
	2	4		Horticulture – only get investment if watertables controlled.
	3	1		Past & ongoing work for future stability & viability for SIR (has in good stead for future) Safety net developed Asset for individual farms & SIR

Social Theme	Sub-Group Number	Sub-Group Score (2006 - 2030)	Working Group Consensus Score (2006 - 2030)	Sub-Group Comments
5. Security of Water Supply	1	4	**3**	Pending on unbundling impact & climate
	2	1		Will people weigh up cost of buying gravity water versus investing in groundwater pump more so than they do now? More opportunities to trade unused gravity water and use pump.
	3	3		Continue demand for FEDS Huge help for future for those with water
6. Changes in Landscape (including environmental)	1	1	**2**	
	2	2		Hard to show “improvement” to community when SSDP may only arrest decline. But, influx of new residents showing interest in rural lifestyle.
	3	3		Change will compound. E.g. revegetation start to road benefits.
7. Confidence in the Sub-surface Drainage Program	1	3	**3**	Rising costs of fuel Depends on weather – should be maintained.
	2	3		
	3	5		Absolute
8. Protection of Significant Cultural and Historical Sites	1	2	**1**	More awareness – i.e. put in g/w system for cultural purposes – limited potential
	2	1		May become more prominent with time as an issue.
	3	0		As before
9. Other Positive & Negative Impacts of the SSDP	1			Future Protection of Environmental Features with SSDP - Increased awareness of treating a problem on a catchment basis. Impact from dryland and irrigation areas. Ecotourism potential in future?
	2			Salt disposal will be a bigger issue and have impacts on diverters, but there are also opportunities for aquaculture, salt harvesting, evap basin wetlands.
	3			

Table E7 – Other Comments recorded during the Social Assessment Workshops

Social Theme	1990 – 2005 Period	2006 – 2030 Period
1. Community Wellbeing	With the future application of the SSDP the benefits to the community will become apparent	The areas of the greatest need have been targeted in the early part of the program. It could be anticipated that the present rate of new application might be maintained With the involvement of more landholders community involvement is anticipated to increase
2. Sense of Community	How does the application of the program benefiting individual landholders, translate to impacting the community as a whole?	In comparison to the Surface Water Management Program, the SSDP requires less Requires less community cooperation
3. Natural Resources Knowledge Base		If the number of farmers decreases, but are more driven and have more knowledge about farm management practices, it still can result in an increased knowledge base
4. Improved Business Confidence	Improved business confidence can be measured by the community's investment in the SSDP	The SSDP's impact on where future investment might take place (favour land with entitlement/pump)
5. Security of Water Supply	Security only assured for those individuals with good water supply from pumps. This is not necessarily a large proportion of the program	It is anticipated that Water Security will become a bigger issue in the future, with unbundling etc. Is shandied water still a valuable resource – will it be more relied upon in the future
	Shandied water is still considered a valuable resource	Ground water systems are complicated, it will be based on business decisions weather to buy in water or secure other supplies Big demand for FEDS program anticipated to continue
6. Changes in Landscape (including environmental)	SSDP saves isolated trees, Farm and Environment programs have more impact on landscape with revegetation Difficult to prove improved condition compared with condition now if there were no program	
7. Confidence in the Sub-surface Drainage Program	Evidence with FEDS uptake Initially (around 1990) farmers informed that they will never pay for ground water. Now groundwater extraction is being limited. This has created a sense of mistrust The community believes the program is presently meeting its objectives	
8. Protection of Significant Cultural and Historical Sites		

Section K – Risk Assessment

SSDP Risk Assessment and Works Program for the SSDP 2000 - 2005 Review

DOCUMENTATION OF WORKSHOP OUTCOMES

- 1 February 2006 -

prepared for

GOULBURN - MURRAY WATER

February 2006

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TABLE OF CONTENTS

1. PURPOSE OF THE PAPER

The purpose of this paper is to present the findings of the Risk Assessment and Program Implementation Targets workshop, which will form part of the Sub-surface Drainage Program (SSDP) 2000-2005 5-Year Review.

The workshop was divided into two sessions:-

- Session 1 - Risk Assessment
- Session 2 - Program Implementation Target Setting.

2. WORKSHOP OBJECTIVES

The primary objective of the workshop was to:

"generate source data relating to stakeholder risks and program implementation targets".

A copy of the workshop agenda paper is presented in **Attachment A**.

3. WORKSHOP OUTCOMES AND TIMING

On the 1 February 2006, a workshop was held at the DPI in Tatura as part of the preparation of the SSDP 2000 – 2005 review. The workshop was attended by 13 people, which included representatives from the following organisations:-

- Goulburn Broken Catchment Management Authority (GB CMA)
- Goulburn – Murray Water (G-MW)
- Murray Darling Basin Committee (MDBC)
- Department of Primary Industries (DPI)
- Sinclair Knight Merz Pty Ltd
- Bill Trewhella Consulting Pty Ltd
- Hydro Environmental Pty Ltd.

Representatives from the each of the above organisations were present at both Session 1 and Session 2 of the workshop. A complete list of all the workshop attendees is presented in **Attachment B**.

Both Session 1 and Session 2 of the workshop were facilitated by Mr Peter Alexander from Hydro Environmental. The key outcomes from each of the sessions are presented in the following sections.

4. SESSION 1 – RISK ASSESSMENT

4.1 What is Risk?

Risk is the chance or possibility of loss, injury or damage. It is generally measured from the perspective of the parties that could suffer the loss, injury or damage.

A measure of risk is defined as being = Consequence x Likelihood.

4.2 Risk Ranking Matrix

Consequences

- What are the **consequences of the incident occurring**?

  Consider what could reasonably have happened as well as what actually happened. The consequence of the incident occurring is categorised as follows:

  – Catastrophic: Disastrous economic or environmental loss = (Cat)

  – Major: Significant economic or environmental loss = (Maj)

  – Moderate: Some economic or environmental loss = (Mod)

  – Minor: Slight economic or environmental loss = (Min)

  – Insignificant: Little to no economic or environmental loss = (Ins).

Likelihood

- What is the **likelihood of each of the consequence identified** occurring?

  The likelihood of the consequence occurring is categorised as follows.

  – Almost certain: - The event is expected to occur in most circumstances

  – Likely: - The event will probably occur in most circumstances

  – Possible: - The event might occur at some time

  – Unlikely: - The event could occur at some time

  – Rare : - The event may occur, only in exceptional circumstances.

Given the consequence of the risk occurring and the likelihood of the consequence, a risk matrix is used to define the overall level of risk. The risk ranking matrix is presented in **Figure 1**.

In addition to defining the level of risk for each specific risk area, an overall level of risk was determined for each participating stakeholder relating to the implications of implementing the SSDP.

■ **Figure 1: Risk Ranking Matrix**

		Consequences				
		Ins	Min	Mod	Maj	Cat
Likelihood	Rare	L	L	M	H	H
	Unlikely	L	L	M	H	E
	Possible	L	M	H	E	E
	Likely	M	H	H	E	E
	Almost certain	H	H	E	E	E

E = extreme risk- mitigation strategy and close management required

H = high risk

M = moderate risk

L = low risk- little impact, address through routine management.

4.3 Risk Assessment Process

4.3.1 Overview

The following activities were undertaken as part of the Risk Assessment:-

1. Identifying the key stakeholders
2. Identifying the areas of potential risk to those stakeholders as a result of the implementation of SSDP
3. Assessing the consequence and likelihood of each area of risk
4. Determining an overall level of risk for the organisations.

The risk assessment was based on the 'Risk Ranking Matrix' approach. It was felt that this was the most appropriate approach tool given the stakeholders involved, the time constraints, budget available and the accuracy of the qualitative nature of the data available.

The risk assessment was based on the assumption that the SSDP will continue to be implemented. The assessment was to focus on the risk specifically posed over the next 5 years of implementation.

4.3.2 Risk Assessment Stakeholders

The nine key stakeholders considered to be most impacted by the SSDP and for which the risk of implementing the SSDP was considered by the workshop were as follows:-

- Catchment Management Authorities
- Goulburn-Murray Water
- Murray Darling Basin Commission
- Municipal Councils
- Department of Sustainability and Environment
- Local Department of Primary Industries (Vic)
- Local Consultants
- Landowners requiring SSD protection
- Broader Community.

4.3.3 Areas of Risk

A number of areas at risk were raised during the risk assessment process that would be affected if the SSDP continues. Many of these areas are common to more that one stakeholder and are defined below:-

- **Staffing** – Staffing for some organisations would be affected by the implementation SSDP. The level of risk would be driven by the level of involvement and the number of staff involved over the entire organisation in the implementation of the Program. G-MW and local consultants are the stakeholders the most risk adverse due to the number of personnel directly involved in the implementation of the SSDP and the potential variations in the year to year financing of the SSDP.
- **Perception of Customers** – The potential for negative feedback from customers (with respect to G-MW) and clients (with respect to Local DPI and Consultants), resulting from poor outcomes with the implementation of the SSDP is an important business risk.
- **Management of assets** – Depending on the agency's level of involvement in the program, the extent of asset responsibility and their business focus, their risk may vary. G-MW is likely to be affected the most should the with the continued implementation of the SSDP because of its level of asset management responsibility.
- **Management of Salt Disposal on a local scale** – Likely to affect stakeholders who manage the area on a local scale such as G-MW and CMAs.
- **Management of Salt Disposal out of the region** – Of particular concern for those organisations that are responsible for the regional management of salt, but also likely to affect those organisations that are concerned with the salt management at a State level (DSE) and across the Murray Darling Basin (e.g. MDBC).
- **Financial uncertainties** – Likely to impact on those organisations that are heavily reliant on the financial injection that the SSDP provides. The level of financial risk is likely to correlate well with the level of risk to staffing.
- **Level of service committed** – Particularly relevant to G-MW which is committed to providing and maintaining a particular level of service.
- **Change of Disposal rules** – This would affect those stakeholders that are responsible for the management of salt at both a local and regional level.
- **Salinity accounting** – The effectiveness and transparency of salinity accounting is a major influence of the MDBC and salt disposal is a key impact of the SSDP. The effectiveness of salinity accounting is therefore paramount and a risk to MDBC.
- **Stewardship (catchment condition)** – How an organisation is perceived to be managing and protecting the environment, and likely implications of the implementation of the SSDP on the catchment condition.
- **Social impacts** – The social risks associated with the implementation of the SSDP. Similarly, to Stewardship this risk area is particularly relevant to those organisations that are responsible the management of the catchment and the well-being of its community.

4.3.4 Risk Assessment Outcomes

The outcomes were based on the on the risks associated with the implementation of the SSDP for the 2005-2010 period.

In determining the level of risk considerable debate was held amongst workshop participants relating to each risk area. The level of attention currently given to areas of high risk was used as a check to the assessment outcomes.

The risk assessment outcomes relating to each stakeholder are presented in **Attachment C**.

It should be noted that the risk to the organisation if the SSDP is not implemented was not assessed and would lead to totally different scores. For example, the continued implementation of the SSDP would result in a 'low level of risk' to landowners with high watertables, however if the Program was to cease the level of risk would be considerably higher and in some instances extreme.

4.4 Summary of Risk Assessment Outcomes

The key outcomes and conclusions with respect to the risk assessment, as agreed by workshop attendees, are:-

- There is a far higher risk to each of the stakeholders by the SSDP not being implemented than is posed by its implementation
- The Goulburn-Broken CMA, MDBC and local Consultants are the stakeholders most at risk as a result of the implementation of the SSDP. Salt management is the key factor for this high level of risk from a CMA and MDBC perspective, with financial and staffing implications the most significant issue for local Consultants
- Strategies have been developed or are being developed by most organisations to address areas of high risk
- Each stakeholder has at least one area of 'High risk' associated with the implementation of the SSDP for the 2005-2010 period.

Table 1 provides a summary of the overall level of risk faced by each organisation as a result of the implementation of the SSDP over the next 5 years, and the areas where it is believed that the risks are the highest.

Table 1: Overall Risk Assessment for each Stakeholder

Stakeholder	Assessed overall level of risk posed by SSDP implementation	Areas of Highest risk (i.e. Extreme or High Risk)
Goulburn-Broken Catchment Management Authority	High	• Financial uncertainty • Management of regional salt disposal • Uncertainty and lack of control with the changing salt disposal rules • Land stewardship

Table 1: Overall Risk Assessment for each Stakeholder (Cont.)

Stakeholder	Assessed overall level of risk posed by SSDP implementation	Areas of Highest risk
Murray Darling Basin Commission	High	• Salt disposal accounting • Perception of customers (States)
Local Consultants	High	• Staffing • Financial uncertainty • Perception of Clients
Goulburn-Murray Water	Moderate	• Customer perception • Local salt disposal • Level of service obligations • Lack of control and uncertainty with the out of region salt disposal rules
Local Department of Primary Industries (Vic)	Moderate	• Land stewardship
Municipal Councils	Low	• Financial uncertainty
Department of Sustainability and Environment	Low	• Custody of landscape assets
Landowners requiring SSD protection	Low	• Management of local salt disposal
Broader Community	Low	• Management of local salt disposal

5. SESSION 2 – PROGRAM IMPLEMENTATION TARGET SETTING

5.1 Overview

This session was focused on the achievements to date assisted and the future implementation targets of the SSDP.

Workshop attendees discussed whether the current objectives of the SSDP relating to implementation of works can be achieved by the Program completion date of 2025. Achievements to date were presented and a range of different completion dates were provided based on the current rate of implementation and potential future budget constraints.

5.2 Background

It is estimated that the SSDP has to date provided sub-surface drainage protection to approximately 116,000 hectares with the installation and operation of 1,176 groundwater pumps. However, this is below the rate required to achieve the target level of protection by 2025.

Based on the current area protected, it is estimated that approximately 74,000 ha of land remains to be protected under the SSDP. If this area was to be protected by the year 2025, at least 40 pumps would need to be installed each year for the next 20 years. On average only 20 pumps / year have been installed for the past 5 years. On this basis various SSDP completion date options were presented.

5.3 Target Setting Outcomes

5.3.1 Overview

It was initially noted by the workshop attendees that there seems to be significant gaps of knowledge in the acquired data. This fact was acknowledged by Hydro Environmental and it was stated that the data presented were rough estimates only, and a more detailed analysis was required to refine these figures.

Given the lack of accurate data the following actions were agreed the by workshop attendees:-

- **2005 SSDP Review:** As a matter of urgency the base line number of pumps in each category and the area requiring protection and being protected should be determined and agreed for 1990 and 2005.
- **2005 SSDP Review:** For the purposes of the 2005 SSDP review the historic planning assumptions in terms of area to be protected, number of pumps required in each year and the area protected for each megalitre of water pumped should be assumed.
- **2010 SSDP Review:** The base assumption associated with the SSDP should be reviewed to coincide with the year 2010 revision of the SSDP. The assumptions to be reviewed would include but not be limited to:-
  - » the area now requiring protection in each sub-catchment
  - » the volume of water to be removed for each pump type to protect each hectare of land in each catchment
  - » the average area protected by each pump.

5.3.2 Key Findings and Suggestions

Over the course of the Session the following findings and suggestions were made by the workshop attendees:-

1. Limited by information	It was discussed that available information was limited and in some cases confusing when considering annual data however the overall totals were accepted as reasonable for the purposes of the workshop
2. Change to Table	The heading "Overall (plan pumps and non-plan pumps including overlap)" should be changed to "Overall (plan pumps and non-plan pumps corrected for overlap)" at the bottom of Table 2.
3. Area Protected per pump	The overall estimate of 89 ha per pump is considered to be the worst possible case scenario due to improved irrigation practices and change in weather conditions. Volumes of water to be proposed to protect each hectare of land may be needed. This would increase the area protected per pump.
4. Non - plan pumps	To avoid confusion and instead of trying to distinguish whether non-plan pumps were installed/registered prior to or during the program it was decided that only the cumulative number of non - plan pumps and area served would be recorded up to the year 2005. Pre-plan pumps will only comprise Girgarre, Tongala and Phase A public pumps. Confusion also arises as to whether metered or non-metered (or both) pumps were entered into the database.
5. Public Pumps	It was acknowledged that gaps existed in data as there was a period of approximately 12 months where no public pumps were recorded due to lag from previous years still being entered in the database.
6. Variations in available water	It was suggested and acknowledged that permanent TWE changes and increased allocations to the environment through conversion of the sales allocation would have an affect on the results (likely reduction of 12.5%).
7. Use of Water Entitlement	Using Licensing Water Entitlements as estimates of use was considered inaccurate, as it is predicted that only 120,000 ML (700 pumps) of a possible 180,000 ML are metered. Of the 120,000 ML only 60,000 ML of entitlement was utilised in 2003/2004. Furthermore, water entitlements less than 20 ML and non-operational pumps were not recorded which partly offsets the above inaccuracies.
8. Funding Limitations	It is predicted that funding will be at the lower end of the scale for the next five years.

5.4 Summary of SSDP Implementation Outcomes

The key outcomes and conclusions with respect to the SSDP Implementation Targets, as agreed by workshop attendees, are:-

- Installations will remain at around 20 pumps per year
- Target completion date of 2025 is still considered appropriate
- A report is to be prepared presenting an agreed set of baseline data for 1990 and 2005. This data will be based on current knowledge and be based on service available for public pumps and entitlement for private pumps include:-
  - » Number of plan private pumps, public pumps, tile drains and non plan pumps
  - » The area protected by each pump type and tile drain in each subregion
  - » The total area protected in each subcategory taking into account overlap.
- The base assumptions relating to the implementation of the SSDP should be reviewed as part of the 2010 SSDP review. The assumptions to be reviewed would include but not be limited to:-
  - » the area now requiring protection in each sub-catchment
  - » the volume of water to be removed for each pump type to protect each hectare of land in each catchment
  - » the average area protected by each pump.

xxxXXXxxx

ATTACHMENT A – Workshop Program

SSDP Risk Assessment and Works Program for the SSDP Review – Workshop

Purpose of Meeting	Workshop - SSDP risk assessment and SSDP work target setting		
Project:	Data Gathering Assistance for the SSDP 2001 – 2005 Review	**Project No:**	GMW 519
Prepared by:	Hydro Environmental	**Meeting No:**	Workshop 1
Place of Meeting:	Eutaxia Conference Room DPI - Tatura	**Date of Meeting:** **Time of Meeting:**	1 February 2006 WS 9.30 am to 2.00pm Disc 2pm to 3.30pm

Attendees:	**Organisation:**	
Claire Haines	DPI	Workshop only
Bruce Gill	DPI	Workshop only
Alex Sislov	DPI	Workshop only
Matthew Bethune	DPI	Workshop only
Neil McLeod	DPI	Workshop only
Heinz Kleindienst	SKM	Workshop only
Mike Cuthbert	MDBC	Workshop only
Bill Trewhella	Bill Trewhella Consulting	Workshop & Discuss
Ken Sampson	DPI	Workshop & Discuss
Terry Hunter	GMW	Workshop & Discuss
Peter Alexander	Hydro Environmental	Workshop & Discuss
Charlie Bird	Hydro Environmental	Workshop & Discuss
Matthew Potter	Hydro Environmental	Workshop & Discuss
Trevor March	Hydro Environmental	Workshop only

DRAFT AGENDA

1. Welcome

(*Hydro Environmental)*

2. Workshop Program

The workshop program comprises three parts:-
- A risk assessment workshop (PART A)
- A target setting workshop (PART B)
- A discussion concerning the content of the SSDP review (PART C)

PART A - Risk Assessment Workshop

A.1 Purpose of Workshop

To provide source data for the preparation of the 2001 - 2005 SSDP review by;

- Informing stakeholders of the proposed Risk Assessment process
- Seeking the views of stakeholders to the proposed process
- Workshopping the SSDP Risk Assessment.

The proposed process by which the Risk Assessment will be undertaken is detailed in **Appendix A.**

Appendix B describes the tools that can be used in undertaking a Risk Assessment.

PART B - Target Setting Workshop

B.1 Purpose of Target Setting Workshop

To provide source data for the preparation of the 2001 - 2005 SSDP Review by;

- Considering progress with the program relative to the planned progress to date
- Considering whether the 2001 planned 5 year program and program completion targets are achievable
- Considering whether the program can be completed by the year 2025.

The proposed process to be used in setting targets is detailed in **Appendix C**.

PART C - General Discussion

C.1 Purpose of Post Workshop Discussion on SSDP Review

To provide guidance relating to the contents of a number of sections in the 2005 SSDP review. These sections include:-

(i) Achievements of the Plan to date
(ii) Influences on the Plan since 2000
(iii) Changes in the Plan since 2000
(iv) Adaptive management initiative within the Plan
(v) Triple Bottom Line Assessment
(vi) Other considerations.

ATTACHMENT B – Workshop Attendees

Table A1 presents a list of people who attended the SSDP Risk Assessment and Works Program for the SSDP Review Workshop held at Tatura on the 1 February 2006.

Table A1: List of workshop attendees

No.	Name	Organisation
1	Ken Sampson	GBCMA
2	Terry Hunter	G-MW
3	Peter Dickinson	G-MW
4	Mike Cuthbert	MDBC
5	Bruce Gill	DPI
6	Alex Sislov	DPI
7	Neil McLeod	DPI
8	Matthew Bethune	DPI
9	Martin Brownlee	SKM
10	Bill Trewhella	Bill Trewhella Consulting
11	Peter Alexander	Hydro Environmental
12	Matthew Potter	Hydro Environmental
13	Trevor March	Hydro Environmental

ATTACHMENT C – Detailed Risk Assessment Outcome

Outcomes focused on views expressed for the life of the SSDP. To reach the desired outcomes considerable debate amongst workshop participants determined the consequences and likelihood for each action. The level of attention currently given to areas of high risk was used as a check. Outcomes for each stakeholder are presented below along with an overall risk assessment.

C.1 Goulburn Broken Catchment Management Authority

- Overall risk resulting from the SSDP implementation is **High**
- Areas of high and extreme risk that require stakeholder focus:-
  - Financial uncertainty (Extreme risk)
  - Change in salt disposal rules (Extreme risk) because the CMA's have little control over this
  - Management of salt disposal out of the region
  - Stewardship – Catchment condition

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Perception of Customers (catchment community)	Moderate	Unlikely	Moderate
2. Management of Disposal - Local	Moderate	Unlikely	Moderate
- Out of Region	Moderate	Possible	High
3. Financial uncertainty	Major	Possible	Extreme
4. Change in Disposal Rules - Cost / Salt Volumes	Major	Likely	Extreme
5. Stewardship - Catchment Condition	Major	Unlikely	High
Overall Risk			**High**

C.2 Goulburn-Murray Water

- Overall risk resulting from the SSDP implementation is **Moderate**
- Areas of high risk that require stakeholder focus:-
  - Customer perception
  - Management of disposal on a local scale
  - Level of service provided
  - Possible changes in disposal rules

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Staffing uncertainty	Minor	Possible	Moderate
2. Perception of Customers (irrigators)	Minor	Likely	High
3. Management (custody) of assets	Minor	Unlikely	Low
4. Management of Disposal - Local	Major	Unlikely	High
- Out of Region	Minor	Rare	Low
5. Financial uncertainty	Minor	Rare	Low
6. Level Service Commitment	Moderate	Possible	High
7. Change in Disposal Rules - Cost / Salt Volumes	Moderate	Likely	High
Overall Risk			**Moderate**

C.3 Murray Darling Basin Commission

- Overall risk resulting from the SIR SSDP implementation is **High**
- Areas of high risk that require stakeholder focus:-
  - Salinity Accounting – Management and Review (Extreme risk)
  - Customer (States) perception

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Perception of Customers (States)	Moderate	Likely	High
2. Management of Disposal - Out of Region	Minor	Unlikely	Low
3. Salinity Accounting - Management and Review	Major	Unlikely	Extreme
Overall Risk			**High**

C.4 Municipal Councils

- Overall risk resulting from the SSDP implementation is **Low**
- Areas of high risk that require stakeholder focus:-
  - Financial uncertainties due to their commitment to fund part of the operating costs of the SSDP works

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Perception of Customers (local community)	Minor	Unlikely	Low
2. Management (custody) of assets	Insignificant	Possible	Low
3. Financial uncertainties	Insignificant	Almost Certain	High
Overall Risk			**Low**

C.5 Department of Sustainability and Environment

- Overall risk resulting from the SSDP implementation is **Low**
- Financial risk is the main driver when determining overall risk
- Area of high risk that require stakeholder focus:-
  - Management (custody) of assets- namely landscape and catchment assets

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Perception of Customers (Government, other States)	Moderate	Unlikely	Moderate
2. Management (custody) of assets	Moderate - Major	Unlikely	Moderate - High
3. Management of Disposal - Local (evap. basins)	Minor	Unlikely	Low
- Out of Region	Moderate	Unlikely	Moderate
4. Financial uncertainties	Insignificant	Possible	Low
Overall Risk			**Low**

C.6 Department of Primary Industries (Victoria) - Local

- Overall risk resulting from the SSDP implementation is **Moderate**
- Areas of high risk that require stakeholder focus:-
  - Stewardship credibility – Catchment condition

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Staffing uncertainty	Minor	Possible	Moderate
2. Perception of Customers / Clients	Moderate	Unlikely	Moderate
3. Financial uncertainty	Minor	Possible	Moderate
4. Stewardship - Catchment Condition	Major	Unlikely	High
Overall Risk			**Moderate**

C.7 Local Consultants

- Overall risk resulting from the SSDP implementation is **High**
- Areas of high risk that require stakeholder focus:-
  - Staffing uncertainties
  - Customer perception
  - Financial uncertainties

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Staffing issues	Major	Possible	Extreme
2. Perception of Clients	Major	Unlikely	High
3. Financial uncertainties	Major	Possible	Extreme
Overall Risk			**High**

C.8 Local Community (At risk due to high water tables)

- Overall risk resulting from the SSDP implementation is **Low**
- Areas of high risk that require stakeholder focus:-
  - Management of disposal on a local scale

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Social impacts	Minor	Unlikely	Low
2. Management (custody of assets)	Minor	Unlikely	Low
3. Management of Disposal - Local	Moderate	Possible	High
4. Financial uncertainties	Insignificant	Unlikely	Low
5. Land Stewardship	Minor	Unlikely	Low
Overall Risk			**Low**

C.9 Broader Community (Land owners and Urban Communities - Not at risk due to high water tables)

- Overall risk resulting from the SSDP implementation is **Low**
- Areas of high risk that require stakeholder focus:-
  - Management of disposal on a local scale

Action / Area	Consequence Catastrophic, Major, Moderate, Minor, Insignificant	Likelihood Almost Certain, Likely, Possible, Unlikely, Rare	Risk Extreme, High, Moderate, Low
1. Social impacts	Insignificant	Rare	Low
2. Management (custody) of assets	Insignificant	Rare	Low
3. Management of Disposal - Local	Moderate	Possible	High
4. Financial uncertainties	Insignificant	Unlikely	Low
5. Land Stewardship	Insignificant	Rare	Low
Overall Risk			**Low**

Section L – Future Irrigation Scenarios

GOULBURN-MURRAY WATER

Shepparton Irrigation Region Catchment Strategy

Implications of Future Irrigation Scenarios on the Shepparton Irrigation Region

Sub-surface Drainage Program

July 2006

Table of Contents

Implications of the Irrigation Future Scenarios on the Sub-surface Drainage Program

1.0 Purpose

Hydro Environmental was engaged Goulburn-Murray Water to analyse and provide strategic advice on the implications of the Department of Primary Industries developed irrigation scenarios related to the future of irrigation in the Shepparton Irrigation Region (SIR). The purpose of this document is to present the assessment of the implications of those four Department of Primary Industry's "Perspectives of Future Irrigation" Scenarios for the SIR Sub-surface Drainage Program.

2.0 Background

It is imperative that irrigation infrastructure planning and the implementation of the Shepparton Irrigation Region Catchment Strategy (SIRCS) Sub-surface Drainage Program (SSDP) considers the future needs of irrigated agriculture. These needs are, however, extremely difficult to predict. The Department of Primary Industry (DPI), as part of Shepparton Irrigation Region Catchment Strategy, has developed four irrigation future scenarios that will assist future irrigation infrastructure planning in the Goulburn-Broken catchment. These four scenarios which are detailed in **Attachment 4** were developed to help decision makers gauge the uncertainties of irrigated agriculture in the Shepparton Region in the future. This will assist in planning irrigation infrastructure and support so it can service the future needs of the SIR community. The four scenarios titled, Moving On, New Frontiers, Pendulum and Drying Up are designed to incorporate a range of opportunities and challenges that the Shepparton Irrigation Region may come across in the next 30 years.

These scenarios are briefly described as:-

(i) <u>Scenario 1</u> "Moving On" presents drier than average climatic conditions during the first period (2005-2020) that persists into the second period (2020-2035).

(ii) <u>Scenario 2</u> "New Frontiers" indicates drier than average climatic conditions in the first period (2005-2020) with even drier climatic conditions predicted in the second period (2020-2035).

(iii) <u>Scenario 3</u> "Pendulum" provides slightly drier than average climatic conditions during the first period (2005-2020). Wetter than average climatic conditions are predicted in the second period (2020-2035) with several seasons of above average rainfall and floods.

(iv) <u>Scenario 4</u> "Drying Up" initially presents wetter than average climatic conditions in the initial stages of the first period with drier than average climatic conditions in the later stages of the first period (2005-2020). Climatic conditions in the second period (2020-2035) are slightly wetter than average.

A simplified summary of the aspects of each scenario that may impact on the SSDP is included in **Attachment 1**. A more detailed analysis of the implications of each scenario and the requirement for SSDP assets is included in **Attachment 2**.

The DPI's Goulburn Broken Irrigation Futures Team has facilitated five workshops engaging both the regional community and key stakeholders to develop these scenarios. The latest workshop was on the 18 May 2006, where members from each of the five programs (Waterways, Farms and Environment, Communication, Sub-surface Drainage and Surface Drainage) gathered to explore the implications of one of the scenarios (New Frontiers) on their specific program.

The Sub-surface Drainage Program (SSDP) engaged Hydro Environmental to provide strategic input and advice into this process. Following this workshop, Managers from each SIRCS program were required to conduct its own workshops to explore the implications of the remaining three scenarios on their program and provide an integrated outlook for the program across all scenarios.

Hydro Environmental has since worked with the SSDP Management Team and collated data from the DPI for all four scenarios. The descriptive implications for each of the four scenarios for the SSDP are presented in **Attachment 3**.

3.0 Discussion

The following sections summarise the detailed implications for each of the four scenarios for the SSDP.

3.1 Vision for the Catchment

The Sub-surface Drainage Program vision for the Region is to *"secure efficient, productive agriculture and enhanced environmental assets within the Shepparton Irrigation Region"*. Based on the output from the workshop on the 18 May, the SSDP has expanded its Vision for the Catchment and this is detailed in **Attachment 3**. In summary, the SSDP team's vision for the SSDP is that it should:

(i) be strategic, innovative and forward looking

(ii) be community driven and have a science based approach

(iii) endeavour to protect agricultural and natural assets from salinisation and the affects of salt

(iv) ensure effective management of salt within and external to the region

(v) ensure that the community is well informed

(vi) use up-to-date, cost effective technology and management systems

(vii) ensure the protection and enhancement of native biodiversity

(viii) have access to a well informed SSDP advisory community.

3.2 The Scenarios

As indicated in **Attachment 3** each of the Scenarios was addressed under the following headings which were provided at the 18 May workshop.

(i) What does this scenario mean to the vision for catchment outcomes in terms of:

a. challenges and;

b. opportunities

(ii) How do we manage our catchment in light of these challenges and opportunities?

a. Immediately and;

b. Short to mid-term (emerging issues 3-5 year period)

A general summary of the implications for the SSDP under each of the scenarios is as follows:

3.2.1 Scenario 1: Moving On

Under Scenario 1 "Moving On" there would be a slight reduction in the need for sub-surface drainage works (~100 less pumps than the current target) during the first period (2005-2020). The need for sub-surface drainage works would increase slightly in the second period (2020-2035) with approximately 200 more pumps required than the current target.

3.2.2 Scenario 2: New Frontiers

Under Scenario 2 "New Frontiers" there would be a slight reduction in the need for sub-surface drainage works (~100 less pumps than the current target) during the first period (2005-2020). The need for sub-surface drainage works would reduce significantly in the second period (2020-2035) with around 500 pumps that were installed in the first period, needing to be decommissioned.

3.2.3 Scenario 3: Pendulum

Under Scenario 3 "Pendulum" the need for sub-surface drainage works in the first period (2005-2020) would again be reduced with just 450 pumps likely to be required based on the current target. The need for sub-surface drainage works in the second period (2020-2035) however would be enhance when approximately 600 pumps would be required.

3.2.4 Scenario 4: Drying Up

Under Scenario 4 "Drying Up" the need for sub-surface drainage works in the first period (2005-2020) would be reduced with approximately 400 pumps needing to be decommissioned. The need for sub-surface drainage works in the second period (2020-2035), however, is likely to be significantly in need when around 1100 pumps would be required to serve the area under threat.

3.3 Looking across the Scenarios

Looking across the scenarios, the SSDP:

(i) must be community driven with a science based approach

(ii) needs to have a long-term integrated, strategic planning process with irrigation infrastructure and knowledge base that is flexible and adaptable to changing land use regimes

(iii) needs to maintain knowledge through good documentation, especially when resources may be allocated elsewhere during periods of dry weather, so that this expertise can be called upon once sub-surface drainage works and measures are required once again

(iv) needs to focus on succession planning

(v) needs to protect and enhance native biodiversity in the region.

4.0 Conclusion

Based on the lessons learnt from the analysis of the four possible scenarios for the future of irrigation in the SIR over the next 30 years, the following key conclusions were drawn for the SSDP:

(i) adaptive management through monitoring, analysis and strategic planning to enable the Plan implementation and asset operation to respond to change

(ii) the construction of high value assets and evaporation basins should be delayed as long as possible

(iii) decommissioning and mothballing of works has to be accepted as reality

(iv) an appropriate level of influence on G-MW reconfiguration processes should be applied to ensure sub-surface drainage aspects are considered (needs and requirements)

(v) processes, procedures and decisions related to the SSDP planning and implementation should be well documented to facilitate knowledge transfer

(vi) succession planning at agency and community level is a high priority

(vii) input from an astute and knowledgeable community is essential if the program is to be effectively and efficiently community driven.

ATTACHMENT 1 - Key Sub-surface Drainage Program Scenario Indicators

Hydro Environmental

ATTACHMENT 1

1. Scenario Summary

Scenario	Period	SSDP Related Drivers												Market Buoyancy	
		White Paper	Environmental Flows	Rainfall	Runoff	Temperature	High Reliability Water	Medium Reliability Water	Water Traded out of Region	Water Traded into the Region	Water Use	Irrigated Area	Privatisation	IMPACTS	IMPLICATIONS
1. Moving On	2005-2020	-	-	↓2	▼4	↑2	-	▼5	↑2	-	↓1	↓1	-	(i) Genetically Modified (GM) organisms introduced (ii) Free Trade Agreements with USA and ASEAN (iii) Conflict between lifestyle and agricultural owners	(i) Improvement in efficiency and productivity (ii) Decline in small town populations (iii) Enlargement of farms
	2020-2035	-	-	↓2	↓2	↑3	-	▼4	↑1	-	↑2	↑2	▲5	(i) Increase in water tariff towards "bottom" end of system (ii) G-MW becomes privatised (iii) China and India grow as a market	(i) Increase in technology, systems and management (ii) Privatisation provides greater flexibility for farmers (iii) Climate remains dry
2. New Frontiers	2005-2020	-	↑3	↓2	↓3	↑2	↑1	▼5	↑2	-	↓3	↓3	-	(i) Free Trade Agreements with USA and ASEAN (ii) GM organisms prohibited (iii) Community concern for environment increases (iv) Conflict between lifestyle and agricultural owners	(i) Lifestyle development increases (ii) Water for the Environment
	2020-2035	-	↑3	↓3	↓2	↑3	-	-	▲5	-	▼4	▼4	-	(i) International Free Trade introduced (ii) Synthetic food production introduced (iii) GM organisms allowed	(i) Significant decline in agricultural economic activity (ii) Niche systems increase (iii) Water & Land for the environment
3. Pendulum	2005-2020	-	▲5	↓2	↓2	↑2	- ▼4	▼5	-	↑2	▼4	▼4	-	(i) Free Trade Agreements with USA and ASEAN (ii) GM organisms prohibited (iii) Tension between City and Country	(i) Niche systems increase (ii) Water for the Environment (iii) Less Production
	2020-2035	-	↓2	↑3	↑2	-	-	-	↑2	↑2	▲5	▲5	-	(i) China and India grow as a market (ii) Conservative Government (iii) Water Auctioned (iv) Irrigated agriculture expands	(i) Rebuild Infrastructure (ii) GM prohibited foods a market advantage (iii) Groundwater and Salinity Issues
4. Drying Up	2005-2020	-	-	↑2 ▼5	↓2	▲5	▼4	▼5	-	-	▼5	▼5	-	(i) Free Trade Agreements with USA and ASEAN (ii) International Market Collapse (iii) Drought (5 years), Driest Period (iv) Fractured Community	(i) Less Production (ii) Higher frequency of bushfires (iii) Recession, Selling of Assets
	2020-2035	-	-	↑1	↓2	↓1	-	▼4	↑2	-	↑1	↓3	-	(i) Full recovery from drought & recession (ii) Water availability increases (iii) Labour in short supply	(i) Government assistance to rural communities (ii) GM ban a market advantage (iii) Strong focus on environment & health food

Legend

Negative	Change	Positive
-	No change impact	-
↓	1 Low change impact	↑
↓	2-3 Medium change impact	↑
▼	4-5 High change impact	▲

ATTACHMENT 2 - SSDP Asset Implications of each Scenario

Hydro Environmental

ATTACHMENT 2

2. SSDP asset implications of each Scenario

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Scenario	Period	Water Use Total (ML)	Area Irrigated (ha)	Irrigated Area (%)	Gross Value of Production ($ 000,000)	Water Use (ML/ha)	Ratio Water Use relative to 2005	Ratio Area Irrigated relative to 2005	Area to be Protected (ha) Based on Average of Area Watered and Water Application change 2005 (ha)	Area Protected June 2005 (ha)	Remaining Area to be Protected (ha)	Assumed Area to be Protected per pump (ha)	Total Pumps Required	Total Pumps Installed	Further Pumps Required
2	Base	1997**	1,505,800	316,900	71	1000	4.75	1.38	1.28							
3		2005*	1,090,100	247,400	58	1500	4.41	-	-	200,116	88,289	111,827	149	1,649	897	**752**
4	Moving On	2005 - 2020	998,500	233,300	55	1700	4.28	0.92	0.94	186,000	88,289	97,711	142	1,583	897	**686**
5		2020 - 2035	1,137,900	277,900	65	2400	4.09	1.04	1.12	216,800	88,289	128,511	149	1,761	897	**864**
6	New Frontiers	2005 - 2020	995,600	225,500	54	1200	4.42	0.91	0.91	182,600	88,289	94,311	141	1,567	897	**670**
7		2020 - 2035	544,600	154,600	42	800	3.52	0.50	0.62	112,500	88,289	24,211	109	1,118	897	**221**
8	Pendulum	2005 - 2020	827,200	167,500	39	1100	4.94	0.76	0.68	143,700	88,289	55,411	123	1,346	897	**449**
9		2020 - 2035	1,422,500	286,200	67	2800	4.97	1.30	1.16	246,300	88,289	158,011	149	1,960	897	**1,063**
10	Drying Up	2005 - 2020	290,100	54,700	13	600	5.30	0.27	0.22	48,800	88,289	-39,489	-98	1,298	897	**401 (decommissioned)**
11		2020 - 2035	1,134,300	196,400	47	2100	5.78	1.04	0.79	183,500	88,289	95,211	141	1,571	897	**674**

* Percentages and climate change quoted in draft are based on 2005 data as the base year.
** If we were to base the draft on the 1997 data we would get vastly different percentages
Area Requiring Protection by 2030 = 200,116ha
***Assuming each pump on average protects 98 - 149ha of land from salinisation (Refer to below comment)
**** Baseline Statistics include Phase A and Girgarre in overall calculations (allowing for overlap)

ATTACHMENT 3 - Perspectives of Future Irrigation (SIR SSDP Perspective)

Hydro Environmental

ATTACHMENT 3

Shepparton Irrigation Region Catchment Strategy

Perspectives of Future Irrigation

SIR SSDP Perspective

This paper presents the output from the Sub-surface Drainage Program Team's considerations of the four Department of Primary Industry's Irrigation Futures Scenarios.

This paper comprises the following information:

1.0 Vision for the Catchment

2.0 Assessment of the Impact of each Scenario

- 2.1 Scenario 1: Moving On
- 2.2 Scenario 2: New Frontiers
- 2.3 Scenario 3: Pendulum
- 2.4 Scenario 4: Drying Up

3.0 Looking across the Scenarios

Each of the Scenarios was addressed in Section 2 by assessing the following questions:

1.0 What does this scenario mean to the vision for catchment outcomes in terms of

- 1.1 challenges and;
- 1.2 opportunities?

2.0 How do we manage our catchment in light of these challenges and opportunities?

- 2.1 immediately and;
- 2.2 short to mid-term (emerging issues 3-5 year period)

1.0 Vision for the Catchment

1.1 Sub-surface Drainage Program - Vision

(i)	The SSDP is strategic, innovative and forward looking
(ii)	Community driven and science based approach
(iii)	Well informed SSDP advisory community
(iv)	Protection of agricultural and natural assets from salinisation and the affects of salt
(v)	Effective management of salt within and external to the region
(vi)	An informed community
(vii)	Up to date, cost effective technology and management systems
(viii)	Protection and enhancement of native biodiversity

1.2 General

(i)	"Smart kids farm the farm"
(ii)	Agreed balance between irrigation and environmental assets
(iii)	River health – maintaining the functions and resilience of the river

1.3 How does the SSDP plan to manage its role in the catchment?

(i)	It is important that SIRCS has a long-term integrated strategic planning process
(ii)	Ensure alignment of land capability and water supply asset location in the long-term
(iii)	Improve awareness of salt management issues and strategies at community level by for example, developing enhanced community awareness/education of sustainable management within the region
(iv)	Ensuring adaptability to a changing environment by recognising the need for an adaptive management approach (planning cycle – evaluation, planning, monitoring and implementation)
(v)	Improve the alignment/integration between the regulatory, statutory and catchment planning frameworks and the catchment strategy
(vi)	Greater acceptance that we don't have all the answers, hence the need to take risks and the need for an adaptive management approach (i.e. up-to-date statutory, regulatory and catchment planning frameworks)
(vii)	Decommissioning and mothballing of works has to be accepted as reality
(viii)	Need to develop cost share arrangements to deal with non-mainstream land use (e.g. lifestyle, urban, industrial)
(ix)	Use older generation community members to interface between the community and SSDP managers
(x)	Appropriate influence on G-MW reconfiguration processes to ensure SSD aspects are considered (needs and requirements)
(xi)	Further strategic guidance of where water is transferred within and into the region
(xii)	Enhance monitoring and analysis to ensure timely response to factors that influence SSDP assets and their operation (e.g. water transfers, climate, hydrology)
(xiii)	Invest in new technology processes, that will provide financial, environmental and social benefits and assist the agricultural industry to compete with overseas imports

Continue..

(xiv)	Enhance relations and awareness of stakeholders regarding the SSDP and the likely impact of future scenarios
(xv)	Secure funding to match SSDP needs which may be variable
(xvi)	Minimise the commitment to long-term high value assets (e.g. evaporation basins) in the short-term
(xvii)	Focus on maintaining the knowledge base, enhancing capacity building and improving succession planning (e.g. for senior management and SSDP advisory community) through good documentation and easy access to documentation so it can be used again when required

2.0 Assessment of the Impact of each of each Scenario

2.1 Scenario 1: Moving On

2.1.1 What does this scenario mean to the vision for catchment outcomes in terms of challenges and opportunities?

2.1.1.1 Challenges

(i)	**Irrigators to sub-divide land for profit from lifestyle properties. Challenge to influence land use change and avoid stranded SSDP assets**
(ii)	**Cheap imports may place substantial pressure on irrigators to find new ways to compete (reduced ability to pay for services due to reduced agricultural viability)**
(iii)	**Privatisation of infrastructure could impact on irrigators, effects could be felt economically due to higher costs**
(iv)	**Establishment of commercial arrangements between CMA and the private sector for SSDP asset operation and maintenance and use of supply assets for salt conveyance**
(v)	**Reconfiguration of SSD works may need to adapt to areas of demand (e.g. irrigators moving towards the river and upper reaches of the irrigation system – cheaper water)**
(vi)	**Develop an understanding of the implications of a changing environment (e.g. maintaining knowledge and funding when the need for SSDP works are reduced)**
(vii)	*Ensure alignment of the SSDP with regulatory, statutory and planning frameworks*
(viii)	*Influence the irrigation infrastructure rationalisation (reconfiguration) outcomes*
(ix)	*Attempt to establish preferred development zones which have surface and sub-surface drainage and a high standard of water supply*
(x)	*Confine the SSDP asset establishment to areas where water entitlement volumes are stable or increasing*
(xi)	*Adaptive management balanced with consistent approach across the region and over time to maintain community support*
(xii)	*Provide fully serviced/cost effective salt management services for agricultural land and environmental assets to support future generations*
(xiii)	*Need to further develop and refine models and predictive tools (Management Systems)*
(xiv)	*Regulatory framework may need to adapt to changes (e.g. increased pressure on groundwater use)*
(xv)	*Align program needs with funding that is available*

Continue..

(xvi)	*Managing soil sodicity in cropping region as agricultural intensity and groundwater use increases*
(xvii)	*Understanding salt tolerance characteristics of crops and adjust SSD asset needs and operation accordingly*
(xviii)	*Minimise G-MW's risk associated with salt conveyance (within and external to the region)*
(xix)	*Monitoring of appropriate drivers to support decision support and modelling*
(xx)	*Develop an understanding of the implications of a changing environment*
(xxi)	*Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility so it can be used again when required*
(xxii)	*Develop new communication processes to ensure those working remotely are well informed*

2.1.1.2 Opportunities

(i)	**Drier climate will result in a reduction in the need for sub-surface drainage works (~200 less pumps than the current target between 2005-2020)**
(ii)	**Landowners finding it more feasible to meet costs due to the demand for more niche market farms that compete with imports (driven by markets)**
(iii)	**Reduce the need for, and impact of, out of region salt disposal**
(iv)	**Reduce requirement for SSDP assets and funding (e.g. pumps, redundancy)**
(v)	*Need to support statutory planning changes across the region to encourage development in areas where salt mitigation and drainage works can be provided*
(vi)	*To support irrigation in the area by maintaining the relatively low downstream salt impacts of the region*
(vii)	*Influence confidence to invest in the SIR by removing risk of salinisation*
(viii)	*Increased ability to dispose of salt externally to the region*
(ix)	*Better tailored cost recovery regime for works in view of commercial environment*
(x)	*Increased irrigation efficiency, reducing water use and requirement for SSDP works*
(xi)	*Create the opportunity to encourage more efficient farming units*
(xii)	*Use older generation community members to interface between the community and SSDP*

2.1.2 How do we manage our catchment in light of these challenges and opportunities?

2.1.2.1 Immediate

(i)	*Need to achieve the best balance between internal and contracted resources to sustain implementation of the SSDP*
(ii)	*Continue to provide input to and effectively influence the catchment strategy and its other programs*
(iii)	*Maintain and enhance communication with key stakeholders*
(iv)	*Enhance integration with other SIRCS programs at both the planning and the implementation level*
(v)	*Identify gaps in existing tools that influence landowner adoption of SSDP works and measures and identify new tools as appropriate*
(vi)	*Delay construction of evaporation basins*

Continue..

(vii)	*Maintain, develop and enhance adaptive management approach to SSDP implementation*
(viii)	*Need for more critical appraisal of where plan-assisted works will be located (e.g. drainage catchment scale planning)*
(ix)	*Support and influence G-MW reconfiguration planning processes and other planning processes*
(x)	*Review the appropriateness of monitoring and adapt as necessary*
(xi)	*Become more vigilant and adaptive to a changing environment that may impact on the program*
(xii)	*Renewed focus in community awareness of salt management within and outside the region*
(xiii)	*Improve access to enhanced GIS tools and improve capacity for its use by stakeholders*
(xiv)	*Output from the use of tools (e.g. GIS) to aid better analysis understanding of how changing land use regimes feeds into adaptive management*
(xv)	*Continue to implement planned works and measures and monitoring programs*
(xvi)	*Enhanced succession plan and capacity of the SSDP at a community and agency level (e.g. SIRCS, SSDP etc.)*
(xvii)	*Continue to maintain and enhance awareness to major stakeholders (e.g. local government) regarding planning (e.g. reconfiguration)*
(xviii)	*Develop new technology to improve water use efficiency and investigate the best low cost systems available*
(xix)	*Change in MBM's, regulations and extensions to influence behaviour when asset operation or uptake of works is less than required*
(xx)	*Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility so it can be used again when required*
(xxi)	*Undertake operations, monitoring and decision making to match the program needs to funding available*
(xxii)	*Ensure flexibility and that the community shares in the decision making process*
(xxiii)	*Focus on private works, minimise public works in the short-term*
(xxiv)	*Public works should only be installed after the long-term water supply and drainage infrastructure needs are known and adopted as part of G-MW reconfiguration plans*

2.1.2.2 Emerging Issues (3 - 5 year period)

(i)	**Need to plan for lifestyle properties. Changing standard of service required (e.g. absentee farmers using land for retreats)**
(ii)	*Enhanced succession planning for the SSDP at a community and agency level*
(iii)	*Developing mothballing/decommissioning rules for works or measures*
(iv)	*Research on crop salt tolerance and soil sodicity impacts on crops needs to be enhanced, disseminated and implemented for current and potential crops in the region*
(v)	*Re-evaluate the needs of the community – dynamics and enterprise may be changing*
(vi)	*Promote the SIR and specific areas in the SIR for sustainable agriculture*
(vii)	*Promote the virtues of SIR for irrigation development (within and external to the region)*
(viii)	*Work with community to develop a better understanding of environmental assets (i.e. high/low value assets – need to discriminate)*
(ix)	*Design SSD works for resource use as well as salinity control in areas that match long term requirements*

2.2 Scenario 2: New Frontiers

2.2.1 What does this scenario mean to the vision for catchment outcomes in terms of challenges and opportunities?

2.2.1.1 Challenges

(i)	**Develop an understanding of the implications of a changing environment (e.g. maintaining knowledge and funding when the need for SSDP works are reduced)**
(ii)	**Challenge to influence land use change and minimise agricultural land loss. Irrigators to sub-divide land for profit from lifestyle properties.**
(iii)	**Synthetic food production may place substantial pressure on irrigators for new ways to compete, hence possible lifestyle opportunities**
(iv)	**Water traded out of the region to southern NSW (55%) will reduce the need for sub-surface drainage works and measures in the second period (2020-2035). Challenge to influence where water transfers in and out of the region occur. Possible regulatory framework changes**
(v)	**Managing soil sodicity in cropping region as agricultural intensity and groundwater use increases**
(vi)	**Understanding salt tolerance characteristics of crops and the influence that will have on the SSDP asset need and operation**
(vii)	*Ensure alignment of the SSDP with regulatory, statutory and planning frameworks*
(viii)	*Influence the irrigation infrastructure rationalisation (reconfiguration) outcomes*
(ix)	*Attempt to establish preferred development zones which have surface and sub-surface drainage and a high standard of water supply*
(x)	*Confine the program asset establishment to areas where water entitlement volumes are stable or increasing*
(xi)	*Adaptive management balance with consistent approach across the region and over time to maintain community support*
(xii)	*Provide fully serviced/cost effective salt management services for agricultural land and environmental assets to support future generations*
(xiii)	*Need to further develop and refine models and predictive tools (Management Systems)*
(xiv)	*Regulatory framework may need to adapt to changes (e.g. increased pressure on groundwater use)*
(xv)	*Minimise G-MW's risk associated with salt conveyance (within and external to the region)*
(xvi)	*Align program needs with funding that is available*
(xvii)	*Monitoring of appropriate drivers to support decision support and modelling*
(xviii)	*Develop an understanding of the implications of a changing environment*
(xix)	*Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility so it can be used again when required*
(xx)	*Develop new communication processes to ensure those working remotely are well informed*

2.2.1.2 Opportunities

(i)	**Drier climate will result in a reduction in the need for sub-surface drainage works (~200 less pumps than currently planned in first period (2005-2020), and ~500 less pumps than had been installed would be decommissioned in the second period (2020-2035) (as a result of a drier climate, increase in environmental flows)**
(ii)	**Reduce the need for, and impact of, out of region salt disposal**
(iii)	**Reduce requirement for SSDP assets and funding (e.g. pumps, redundancy)**
(iv)	*Need to support statutory planning changes across the region to encourage development in areas where salt mitigation and drainage works can be provided*
(v)	*To support irrigation in the area by retaining the relatively low downstream salt impacts of the region*
(vi)	*Influence confidence to invest in the SIR by removing risk of salinisation*
(vii)	*Increased ability to dispose of salt externally to the region*
(viii)	*Better tailored cost recovery regime for works in view of commercial environment*
(ix)	*Increased irrigation efficiency, reducing water use and requirement for SSDP works*
(x)	*Create the opportunity to encourage more efficient farming units*
(xi)	*Use older generation community members to interface between the community and SSDP*

2.2.2 How do we manage our catchment in light of these challenges and opportunities?

2.2.2.1 Immediate

(i)	**Become more vigilant and adaptive to a changing environment that may impact on the program (e.g. mothballing and decommissioning of pumps)**
(ii)	**Renewed focus in community awareness of salt management within and outside the region, particularly as community concern increases**
(iii)	*Need to achieve the best balance between internal and contracted resources to sustain implementation of the SSDP*
(iv)	*Continue to provide input to and effectively influence the catchment strategy and its other programs*
(v)	*Enhance integration with other SIRCS programs at both the planning and the implementation level*
(vi)	*Maintain and enhance communication with key stakeholders*
(vii)	*Identify gaps in existing tools that influence landowner adoption of SSDP works and measures and identify new tools as appropriate*
(viii)	*Maintain, develop and enhance adaptive management approach to plan implementation*
(ix)	*Delay construction of evaporation basins*
(x)	*Need for more critical appraisal of where plan-assisted works will be located (e.g. drainage catchment scale planning)*
(xi)	*Support and influence G-MW reconfiguration planning processes and other planning processes*
(xii)	*Review the appropriateness of monitoring and adapt as necessary*
(xiii)	*Become more vigilant and adaptive to a changing environment that may impact on the program*
(xiv)	*Improve access to enhanced GIS tools and improve capacity for its use by stakeholders*
(xv)	*Renewed focus in community awareness of salt management within and outside the region*
(xxv)	*Ensure flexibility and that the community shares in the decision making process*

Continue..

(xxvi)	*Focus on private works, minimise public works in the short-term*
(xvi)	*Public works should only be installed after the long-term water supply and drainage infrastructure needs are known and adopted as part of G-MW reconfiguration plans*

2.2.2.2 Emerging Issues (3 - 5 year period)

(i)	**Develop and apply a flexible system and process for locating and designing SSDP Works**
(ii)	**Need to plan for lifestyle properties and tailor the standard of service required (e.g. absentee farmers using land for retreats) to suit**
(iii)	**Design SSD works as well as salinity control in areas that match long term requirements**
(iv)	*Enhanced succession planning for the SSDP at a community and agency level*
(v)	*Developing mothballing/decommissioning rules for works or processes*
(vi)	*Research on crop salt tolerance and soil sodicity impacts on crops needs to be enhanced, disseminated and implemented for current and potential crops in the region*
(vii)	*Re-evaluate the needs of the community – dynamics and enterprise may be changing*
(viii)	*Promote the SIR and specific areas in the SIR for sustainable agriculture*
(ix)	*Promote the virtues of SIR for irrigation development (within and external to the region)*
(x)	*Work with community to develop a better understanding of environmental assets (i.e. high/low value assets – need to discriminate)*
(xi)	*Design SSD works for resource use as well as salinity control in areas that match long term requirements*

2.3 Scenario 3: Pendulum

2.3.1 What does this scenario mean to the vision for catchment outcomes in terms of challenges and opportunities?

2.3.1.1 Challenges

First Period

(i)	**Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility through period of low demand so it can be used again when required**
(ii)	**Develop an understanding of the implications of a changing environment (e.g. maintaining knowledge so it can be used again for the second period)**
(iii)	**Confine the program to prime development areas to guide 5% trade from NSW to the region**
(iv)	**Adaptive regulatory framework to ensure that groundwater as a resource is appropriately managed following drier climate**
(v)	**Environmental flows to the Murray resulting in farmers losing a substantial amount of their water entitlement. Farmers obliged to use water more efficiently. Less need for SSDP works and measures**
(vi)	**Convince the community to meet the cost of SSDP Works to protect environmental assets**

Continue..

(vii)	**Determining which pumps should be decommissioned and which should be mothballed**
(viii)	**Challenge to influence land use change. Irrigators to sub-divide land for profit from lifestyle properties**
(ix)	*Ensure alignment of the SSDP with regulatory, statutory and planning frameworks*
(x)	*Influence the irrigation infrastructure rationalisation (reconfiguration) outcomes*
(xi)	*Attempt to establish preferred development zones which have surface and sub-surface drainage and a high standard of water supply*
(xii)	*Confine the program asset establishment to areas where water entitlement volumes are stable or increasing*
(xiii)	*Adaptive management balance with consistent approach across the region and over time to maintain community support*
(xiv)	*Provide fully serviced/cost effective salt management services for agricultural land and environmental assets to support future generations*
(xv)	*Need to further develop and refine models and predictive tools (Management Systems)*
(xvi)	*Regulatory framework may need to adapt to changes (e.g. increased pressure on groundwater use)*
(xvii)	*Managing soil sodicity in cropping region as agricultural intensity and groundwater use increases*
(xviii)	*Understanding salt tolerance characteristics of crops and adjust SSD asset needs and operation accordingly*
(xix)	*Minimise G-MW's risk associated with salt conveyance (within and external to the region)*
(xx)	*Align program needs with funding that is available*
(xxi)	*Monitoring of appropriate drivers to support decision support and modelling*
(xxii)	*Develop an understanding of the implications of a changing environment*
(xxiii)	*Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility so it can be used again when required*
(xxiv)	*Develop new communication processes to ensure those working remotely are well informed*

Second Period

(i)	**Refocus program needs and tools support in response to large increase in volume of water pumped, resulting in a large demand for SSDP works and measures (challenge to influence behaviour)**
(ii)	**Water reallocated from environmental flows back to landowners, increasing demand on SSD works and measures**
(iii)	**Influence in were development occurs once environmental flows are reallocated back to the landowner**
(iv)	**To try to minimise the out of region impacts of increased salt disposal**
(v)	**Pumps decommissioned in first period are required once again. Flexible planning, funding, salt disposal and operation of works required**
(vi)	**Rising water tables cause salinity levels to rise. Greater need for SSD works to protect both agriculture and environment**
(vii)	**Managing soil sodicity in cropping region as agricultural intensity and groundwater use increases**
(viii)	**Understanding salt tolerance characteristics of crops and adjust SSD asset needs and operation accordingly**

Continue..

(ix)	**Ensure that stakeholders are aware of the need to enhance operation and implementation of SSD and other works and measures to reduce the impact of rising water tables**
(x)	*Ensure alignment of the SSDP with regulatory, statutory and planning frameworks*
(xi)	*Influence the irrigation infrastructure rationalisation (reconfiguration) outcomes*
(xii)	*Minimise G-MW's risk associated with salt conveyance (within and external to the region)*
(xiii)	*Develop an understanding of the implications of a changing environment*
(xiv)	*Attempt to establish preferred development zones which have surface and sub-surface drainage and a high standard of water supply*
(xv)	*Confine the program asset establishment to areas where water entitlement volumes are stable or increasing*
(xvi)	*Adaptive management balance with consistent approach across the region and over time to maintain community support*
(xvii)	*Provide fully serviced/cost effective salt management services for agricultural land and environmental assets to support future generations*
(xviii)	*Need to further develop and refine models and predictive tools (Management Systems)*
(xix)	*Align program needs with funding that is available*
(xx)	*Regulatory framework may need to adapt to changes (e.g. increased pressure on groundwater use)*
(xxi)	*Monitoring of appropriate drivers to support decision support and modelling*
(xxii)	*Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility so it can be used again when required*
(xxiii)	*Develop new communication processes to ensure those working remotely are well informed*

2.3.1.2 Opportunities

First Period

(i)	**Overall impact of Victoria's contribution to Environmental Flows, a reduction in rainfall, and a reduction in water table levels, has resulted in less need for SSDP works and measures (~600 less pumps than the current target)**
(ii)	**Increased ability to dispose of salt externally to the region**
(iii)	**Reduce the out of region impact of salt disposal due to increased dilution effect**
(iv)	**Reduce requirement for SSDP assets and funding (e.g. pumps, redundancy)**
(v)	*Need to support statutory planning changes across the region to encourage development in areas where salt mitigation and drainage works can be provided*
(vi)	*To support irrigation in the area by retaining the relatively low downstream salt impacts of the region*
(vii)	*Influence confidence to invest in the SIR by removing risk of salinisation*
(viii)	*Increased ability to dispose of salt externally to the region*
(ix)	*Better tailored cost recovery regime for works in view of commercial environment*
(x)	*Increased irrigation efficiency, reducing water use and requirement for SSDP works*
(xi)	*Create the opportunity to encourage more efficient farming units*
(xii)	*Use older generation community members to interface between the community and SSDP*

Continue..

Second Period

(i)	**Wetter climate will result in an increase in the need for SSDP works (~400 more pumps than the current target)**
(ii)	**Increase opportunity for salt conveyance and distribution within the region**
(iii)	**Water reallocation from Environmental Flows to economic use provides regional benefits and allows the irrigation area to prosper**
(iv)	**Confidence in the industry to invest within and external to the region**
(v)	**Need to support statutory planning changes to support "Primary Development" zones**
(vi)	**SSD Works that were once decommissioned or mothballed, will be resurrected**
(vii)	**Enhance flexible and efficient/effective irrigation infrastructure (increased opportunity for salt conveyance within and external to the region)**
(viii)	*Need to support statutory planning changes across the region to encourage development in areas where salt mitigation and drainage works can be provided*
(ix)	*To support irrigation in the area by retaining the relatively low downstream salt impacts of the region*
(x)	*Influence confidence to invest in the SIR by removing risk of salinisation*
(xi)	*Increased ability to dispose of salt externally to the region*
(xii)	*Better tailored cost recovery regime for works in view of commercial environment*
(xiii)	*Increased irrigation efficiency, reducing water use and requirement for SSDP works*
(xiv)	*Create the opportunity to encourage more efficient farming units*
(xv)	*Use older generation community members to interface between the community and SSDP*

2.3.2 How do we manage our catchment in light of these challenges and opportunities?

2.3.2.1 Immediate

(i)	**Delay construction of SSD Works (including evaporation basins) for the short-term**
(ii)	**Delay construction of evaporation basins until later in the second phase of this scenario**
(iii)	**Develop new technology to improve water use efficiency and investigate the best low cost systems available, this is especially the case during the first period when the climate is drier**
(iv)	**Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility so it can be used again when required**
(v)	**Focus on private works, do not progress public works**
(vi)	*Need to achieve the best balance between internal and contracted resources to sustain implementation of the SSDP*
(vii)	*Maintain and enhance communication with key stakeholders*
(viii)	*Continue to provide input to and effectively influence the catchment strategy and its other programs*
(ix)	*Enhance integration with other SIRCS programs at both the planning and the implementation level*
(x)	*Maintain, develop and enhance adaptive management approach to plan implementation*
(xi)	*Identify gaps in existing tools that influence landowner adoption of SSDP works and measures and identify new tools as appropriate*

Continue..

(xii)	*Delay construction of evaporation basins*
(xiii)	*Need for more critical appraisal of where plan-assisted works will be located (e.g. drainage catchment scale planning)*
(xiv)	*Review the appropriateness of monitoring and adapt as necessary*
(xv)	*Support and influence G-MW reconfiguration planning processes and other planning processes*
(xvi)	*Improve access to enhanced GIS tools and improve capacity for its use by stakeholders*
(xvii)	*Become more vigilant and adaptive to a changing environment that may impact on the program*
(xviii)	*Renewed focus in community awareness of salt management within and outside the region*
(xxvii)	*Ensure flexibility and that the community shares in the decision making process*
(xxviii)	*Focus on private works, minimise public works in the short-term*
(xix)	*Public works should only be installed after the long-term water supply and drainage infrastructure needs are known and adopted as part of G-MW reconfiguration plans*

2.3.2.2 Emerging Issues (3 - 5 year period)

(i)	**Develop flexible SSD Works and technical specification and operation (e.g. mothballing of works)**
(ii)	**Promote SSDP changes and benefits to others within and external to the irrigation area to ensure water is allocated to target areas**
(iii)	*Enhanced succession planning for the SSDP at a community and agency level*
(iv)	*Developing mothballing/decommissioning rules for works or processes*
(v)	*Research on crop salt tolerance and soil sodicity impacts on crops needs to be enhanced, disseminated and implemented for current and potential crops in the region*
(vi)	*Re-evaluate the needs of the community – dynamics and enterprise may be changing*
(vii)	*Promote the SIR and specific areas in the SIR for sustainable agriculture*
(viii)	*Promote the virtues of SIR for irrigation development (within and external to the region)*
(ix)	*Work with community to develop a better understanding of environmental assets (i.e. high/low value assets – need to discriminate)*
(x)	*Design SSD works for resource use as well as salinity control in areas that match long term requirements*

2.4 Scenario 4: Drying Up

2.4.1 What does this scenario mean to the vision for catchment outcomes in terms of challenges and opportunities?

2.4.1.1 Challenges

(i)	**Develop an understanding of the implications of a changing environment (e.g. maintaining knowledge and funding when the need for SSDP works are reduced)**
(ii)	**Ensure alignment of the SSDP with regulatory, statutory and planning frameworks following the Government's land restructuring program**
(iii)	**Adaptive regulatory framework to ensure that groundwater as a resource is appropriately managed following drier climate**

Continue..

(iv)	**Determining which SSDP pumps should be decommissioned and which should be "mothballed"**
(v)	**Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility through period of low demand so it can be used again when required**
(vi)	**Convince the community to meet the cost of SSDP Works to protect environmental assets**
(vii)	**Monitor the level of service associated with degraded assets**
(viii)	*Ensure alignment of the SSDP with regulatory, statutory and planning frameworks*
(ix)	*Influence the irrigation infrastructure rationalisation (reconfiguration) outcomes*
(x)	*Attempt to establish preferred development zones which have surface and sub-surface drainage and a high standard of water supply*
(xi)	*Develop an understanding of the implications of a changing environment*
(xii)	*Confine the program asset establishment to areas where water entitlement volumes are stable or increasing*
(xiii)	*Adaptive management balance with consistent approach across the region and over time to maintain community support*
(xiv)	*Provide fully serviced/cost effective salt management services for agricultural land and environmental assets to support future generations*
(xv)	*Need to further develop and refine models and predictive tools (Management Systems)*
(xvi)	*Regulatory framework may need to adapt to changes (e.g. increased pressure on groundwater use)*
(xvii)	*Managing soil sodicity in cropping region as agricultural intensity and groundwater use increases*
(xviii)	*Understanding salt tolerance characteristics of crops and adjust SSD asset needs and operation accordingly*
(xix)	*Minimise G-MW's risk associated with salt conveyance (within and external to the region)*
(xx)	*Align program needs with funding that is available*
(xxi)	*Monitoring of appropriate drivers to support decision support and modelling*
(xxii)	*Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility so it can be used again when required*
(xxiii)	*Develop new communication processes to ensure those working remotely are well informed*

2.4.1.2 Opportunities

(i)	**Drier climate will result in a reduction in the need for sub-surface drainage works. Some 300 existing pumps will need to be decommissioned/mothballed based on current targets in the first phase. These pumps will need to be "re-activated" as ~850 pumps will be required to meet the current target in the second phase (i.e. 550 new pumps to be installed)**
(ii)	**Reduce the need for, and impact of, out of region salt disposal**
(iii)	**Reduce requirement for SSDP assets and funding (e.g. pumps, redundancy)**
(iv)	*Need to support statutory planning changes across the region to encourage development in areas where salt mitigation and drainage works can be provided*
(v)	*To support irrigation in the area by retaining the relatively low downstream salt impacts of the region*
(vi)	*Influence confidence to invest in the SIR by removing risk of salinisation*

Continue..

(vii)	*Increased ability to dispose of salt externally to the region*
(viii)	*Better tailored cost recovery regime for works in view of commercial environment*
(ix)	*Increased irrigation efficiency, reducing water use and requirement for SSDP works*
(x)	*Create the opportunity to encourage more efficient farming units*
(xi)	*Use older generation community members to interface between the community and SSDP*

2.4.2 How do we manage our catchment in light of these challenges and opportunities?

2.4.2.1 Immediate

(i)	**Slow pump installations to a minimum across the region**
(ii)	**Maintain knowledge base, develop capacity building and succession planning through good documentation and accessibility so it can be used again when required**
(iii)	**Reduce the number of sub-surface drainage pumps used by SSDP**
(iv)	**Develop new technology to improve water use efficiency and investigate the best low cost systems available, this is especially the case during the first period when the climate is drier**
(v)	**Become more vigilant and adaptive to a changing environment that may impact on the program (e.g. mothballing and decommissioning of pumps)**
(vi)	**Stop any planned construction of evaporation basins for the first phase, and delay for as long as possible in second phase**
(vii)	*Need to achieve the best balance between internal and contracted resources to sustain implementation of the SSDP*
(viii)	*Continue to provide input to and effectively influence the catchment strategy and its other programs*
(ix)	*Enhance integration with other SIRCS programs at both the planning and the implementation level*
(x)	*Maintain and enhance communication with key stakeholders*
(xi)	*Identify gaps in existing tools that influence landowner adoption of SSDP works and measures and identify new tools as appropriate*
(xii)	*Maintain, develop and enhance adaptive management approach to plan implementation*
(xiii)	*Delay construction of evaporation basins*
(xiv)	*Need for more critical appraisal of where plan-assisted works will be located (e.g. drainage catchment scale planning)*
(xv)	*Support and influence G-MW reconfiguration planning processes and other planning processes*
(xvi)	*Review the appropriateness of monitoring and adapt as necessary*
(xvii)	*Become more vigilant and adaptive to a changing environment that may impact on the program*
(xviii)	*Renewed focus in community awareness of salt management within and outside the region*
(xix)	*Improve access to enhanced GIS tools and improve capacity for its use by stakeholders*
(xxix)	*Ensure flexibility and that the community shares in the decision making process*
(xxx)	*Focus on private works, minimise public works in the short-term*
(xx)	*Public works should only be installed after the long-term water supply and drainage infrastructure needs are known and adopted as part of G-MW reconfiguration plans*

2.4.2.2 Emerging Issues (3 - 5 year period)

(i)	**Develop and apply a flexible system and process for locating and designing SSDP Works**
(ii)	**Process an procedures for decommissioning and mothballing of bores (selection process and proceedings to be developed)**
(iii)	**The need for a stringent regulatory framework for the use of groundwater during drought**
(iv)	*Enhanced succession planning for the SSDP at a community and agency level*
(v)	*Developing mothballing/decommissioning rules for works or processes*
(vi)	*Research on crop salt tolerance and soil sodicity impacts on crops needs to be enhanced, disseminated and implemented for current and potential crops in the region*
(vii)	*Re-evaluate the needs of the community – dynamics and enterprise may be changing*
(viii)	*Promote the SIR and specific areas in the SIR for sustainable agriculture*
(ix)	*Promote the virtues of SIR for irrigation development (within and external to the region)*
(x)	*Work with community to develop a better understanding of environmental assets (i.e. high/low value assets – need to discriminate)*
(xi)	*Design SSD works for resource use as well as salinity control in areas that make long term requirements*

3.0 Looking across all scenarios

3.1 How do we manage these challenges and realise the opportunities?
(i.e. develop strategies which will be robust in dealing with all four scenarios)

(i)	Ensure that SIRCS has a long-term integrated strategic planning process which enhances adaptive management
(ii)	Ensure alignment of land capability, efficient supply infrastructure and SSDP assets location in the long-term
(iii)	Appropriate influence on G-MW reconfiguration processes to ensure SSD aspects are considered (needs and requirements)
(iv)	Strategic planning of new irrigation infrastructure and irrigation infrastructure which is to remain operational
(v)	Further strategic guidance of where water is transferred within and into the region
(vi)	Ensure SSDP and its assets remain adaptable to change by providing flexible works and measures (to allow for increase and reduction in demand)
(vii)	Improve the alignment/integration between the regulatory, statutory and catchment planning frameworks and the catchment strategy
(viii)	Decommissioning and mothballing of works has to be accepted as reality and procedures and guidelines need to be developed accordingly
(ix)	Need to develop cost share arrangements to deal with non-mainstream land use (e.g. lifestyle, urban, industrial)
(x)	Secure funding to match SSDP needs which may be variable
(xi)	Use older generation community members to interface between the community and SSDP managers

Continue..

(xii)	Greater public awareness of the issues affecting the agricultural industry in the region that could encounter in the future
(xiii)	Greater acceptance that we don't have all the answers, hence the need to take risks and the need for an adaptive management approach (i.e. up-to-date statutory, regulatory and catchment planning frameworks)
(xiv)	Enhance monitoring and analysis to ensure timely response to factors that influence SSDP assets and their operation (e.g. water transfers, climate, hydrology)
(xv)	Develop a flexible system and process, keep in touch with community needs and adjust SSDP infrastructure accordingly
(xvi)	Invest in new technology processes, this will provide financial, environmental and social benefits and assist the agricultural industry to compete with overseas imports
(xvii)	Enhance relations and awareness of stakeholders regarding the SSDP and the likely impact of future scenarios
(xviii)	Minimise the commitment to inflexible long-term high value assets (e.g. evaporation basins)
(xix)	Focus on maintaining knowledge base and develop capacity building and succession planning (e.g. for senior management and SSDP advisory community) through preparing good documentation and providing document accessibility so it can be used again when required

3.2 What are the implications for your program?

(i)	Ensure the SSDP is community driven with a science based approach
(ii)	Ensure the SSDP is strategic, innovative and forward looking
(iii)	Ensure protection and enhancement of native biodiversity in the region
(iv)	Any rationalisation of irrigation and SSDP infrastructure needs to be flexible and adaptable to changing land use regimes
(v)	SSDP may need to be adaptable as the need for works and measures may vary (increase or decrease) with time
(vi)	Temporary and permanent decommissioning of works will occur
(vii)	The introduction of lifestyle properties may reduce the perceived need for, and expenditure of, SSD Works and monitoring
(viii)	Ensure appropriate monitoring and analysis processes are in place to ensure timely knowledge of changes in SSDP drivers
(ix)	Increase investment in capacity building, knowledge transfer, succession planning and management systems
(x)	Construction of evaporation basins and public works should be deferred as long as possible
(xi)	Salt conveyance and disposal systems should be designed to be flexible and adaptive to changes in supply system and irrigation water demand and River Murray flows (including environmental flows)
(xii)	Ensure adequate and appropriate monitoring is in place to support sustainable salt management, salt conveyance and salt export from the region
(xiii)	Need to develop processes for assessing which pumps should be decommissioned or mothballed and when
(xiv)	Need to develop standard decommissioning and mothballing processes
(xv)	Increase investment in capacity building, succession planning, knowledge transfer and management systems

Continue..

(xvi)	Ensure the protection of agricultural land and natural assets from salinisation and the affects of salt
(xvii)	Focus on private works and delay public works
(xviii)	Design pumps such that they are suitable for “resource extraction” as well as “salinity control”

ATTACHMENT 4 - Department of Primary Industries (DPI) "Perspectives of Future Irrigation"

Perspectives of Future Irrigation

Prepared by

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on behalf of

Goulburn Broken Irrigation Futures Project

Contents

State Government Victoria
Departments of
Sustainability and Environment
Primary Industries

National Program for Sustainable Irrigation

Cooperative Research Centre for Irrigation Futures

Goulburn-Murray Water

Goulburn Broken Catchment Management Authority

action Salinity & Water Australia

Australian Governments and local communities working together to prevent, repair and manage rising salinity and declining water quality across Australia.

Introduction

It is critical that irrigation infrastructure planning considers the needs of future irrigated agriculture. However, it is difficult to predict the future for irrigated agriculture as it will be influenced by many uncertain factors. Scenario planning is an approach to deal with the uncertainty by considering a plausible range of futures, so that the planned irrigation infrastructure will be able to service the needs of the future.

This section contains four scenarios, describing alternative plausible futures for irrigated agriculture in the Goulburn Broken catchment, and their implications for irrigation water supply. Although the scenarios have been developed for the Goulburn Broken catchment, they are also relevant to other irrigation regions in northern Victoria.

The four scenarios, Moving On, New Frontiers, Pendulum, and Drying Up, summarise the external driving forces, the region's response to those driving forces and the regional impacts that follow. The impacts focus on those factors relevant to irrigation infrastructure planning.

The four scenarios are not predictions of the future. They are intended to represent a range of possible opportunities and challenges that the Goulburn Broken catchment may face over the next 30 years. Many elements of the scenarios can be interpreted as metaphors or examples of possible events that may occur. For example, the outbreak of fire blight described in Scenario 2 has been used to depict a bio-security threat. Alternative bio-security threats such as foot and mouth disease or avian influenza could have been used. Similarly, government policies described in the scenarios should be considered as plausible, but should not be interpreted as a statement of future government policy or intent.

The four scenarios have been developed by the Goulburn Broken Irrigation Futures project. The project is a community initiative aiming to develop a shared vision for irrigated agriculture in the region. The project engaged the regional community and other key stakeholders through a series of 4 workshops held at 6 locations throughout the catchment. These workshops looked at the community's aspirations, the possible evolution of external driving forces in the future, and strategies to achieve the aspirations. The outputs of the workshops were developed further by a Technical Working Group to assess implications of the external driving forces and regional strategies.

Each scenario is presented in two forms: a summary and a more detailed description. The scenario summary provides a snapshot of the driving forces, regional impacts and implications for the distribution of water, along with illustrative graphs of land use, irrigated area, water use and farm gate gross value of production for the Shepparton Irrigation Region. The detailed scenario description contains additional information about the driving forces and impacts on different irrigation-dependent industry groups.

The scenarios are intended to stimulate discussions on strategic approaches to irrigation infrastructure planning including reconfiguration by considering what the future may hold and how the region can ensure it is robust under a range of possible futures. Further work looking at the implications of the scenarios for environmental management and the community will be reported in subsequent publications.

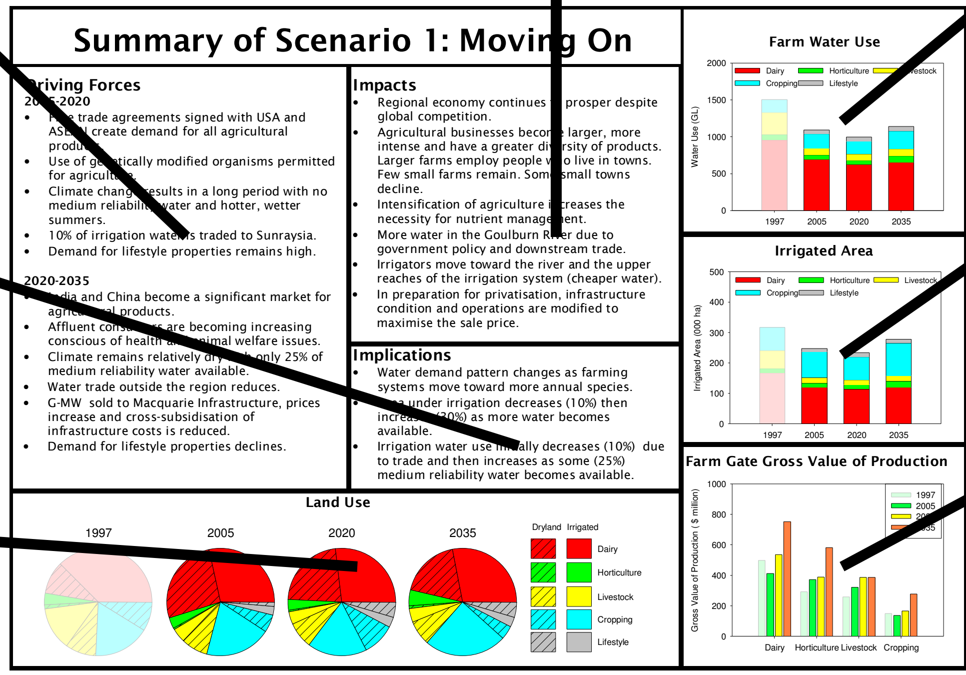
Scenario Presentation

Scenario Summary

Impacts
Describes a summary of regional scale consequences of the scenario including some economic, environmental and social impacts

Driving Forces
Describes a summary of the main factors influencing the region during the scenario.

Farm Water Use
Illustrates the changes in farm water use by industry for the Shepparton Irrigation Region over the period of the scenario.



Implications
Describes the implications of the scenario for the distribution of irrigation water.

Irrigated Area
Illustrates the changes in the area of land which is irrigated in a particular year by industry for the Shepparton Irrigation Region over the period of the scenario.

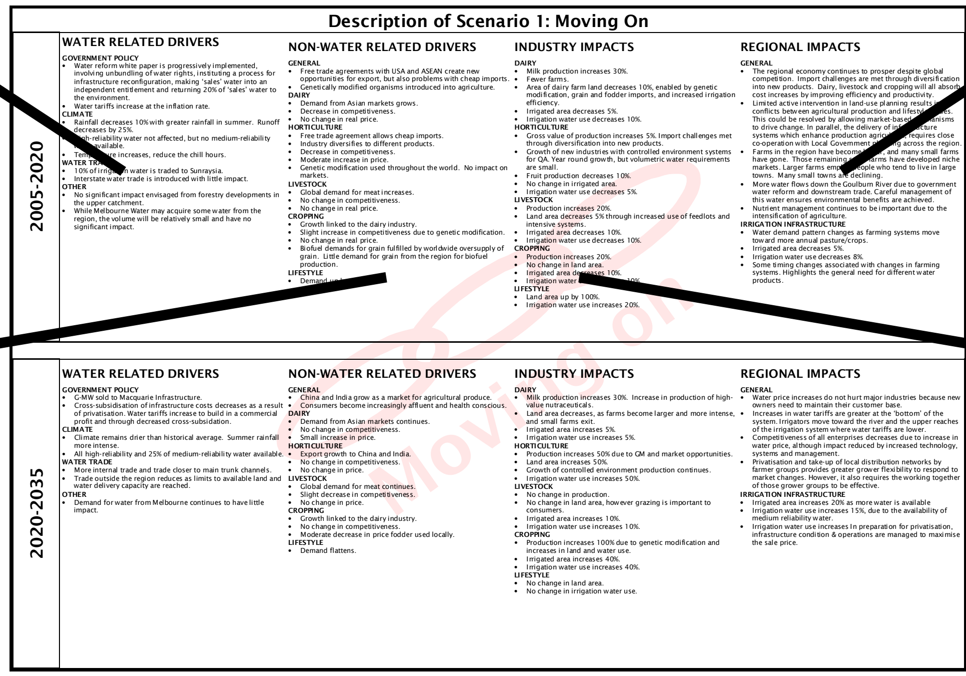
Land Use
Illustrates the changes in land use within irrigated properties by industry for the Shepparton Irrigation Region over the period of the scenario.

Farm Gate Gross Value of Production
Illustrates the changes in the farm gate gross value of production for the Shepparton Irrigation Region by industry over the period of the scenario in 2005 dollars.

Scenario Description

Water Related Drivers
Describes the driving forces related to the availability of water, including forces related to government policy, climate and water trade.

Regional Impacts
Describes some of the regional scale consequences of the scenario, in terms of some social, economic and environmental impacts. Specific impacts for irrigation infrastructure are also described .



Non-Water Related Drivers
Describes the non-water related driving forces and how they influence each of the major industries within the region.
Price changes are real changes in price and do not include the effect of inflation.

Industry Impacts
Describes the impacts of the combination of water and non-water related driving forces on the major industries within the region. Impacts are described for each industry as a whole and do not necessarily reflect the impact on individuals within each industry.

Learning from the Scenarios

The four scenarios presented in this section describe alternative plausible futures for irrigated agriculture in the region and their implications on future irrigation water supply. Some of the drivers are common to all scenarios. For example, the emergence of new economic powers such as China and India providing both threats and opportunities for our industries. Other drivers diverge markedly, resulting in very different scenarios.

Scenario 1 "Moving on" depicts a steadily changing operating environment for the region. The industries in the region evolve successfully in response to international business conditions and moderate climate variability. In Scenario 2 "New Frontiers", agricultural production in the region declines over time because of a number of unfavourable conditions, most notably, the rise in synthetic food production. However, there is a sharp increase in the number of people who live in rural areas and work remotely, bringing a new and significant income stream to the region. Scenario 3 "Pendulum" describes how large shifts in water policy can dramatically change the face of the region. Scenario 4 "Drying up" highlights the vulnerability of the region to global economic recession and natural disasters such as drought.

The four scenarios represent four very different futures, as highlighted by the graphs below. Even though they are not predictions of the future, they provide useful test beds for examining the effectiveness of management strategies under a range of conditions. In the context of irrigation infrastructure planning, the four scenarios highlight a number of important issues.

Flexibility of irrigation infrastructure
There is great uncertainty in the size of the irrigated area and the amount of water use in the future. There may be periods of rapid contraction and expansion of irrigation. Thus there is a need to build flexibility into irrigation infrastructure, so that it is adaptable to future demands. Flexibility may be achieved through innovative system configurations, flexible distribution technologies, a mix of infrastructure ownership, and improved management systems.

Irrigation service level requirements
One of themes that emerged strongly from the scenarios is that the competitiveness of the agricultural industries in the region will depend on generating and marketing differentiated products. The industries are thus likely to demand greater levels of service in water supply than today. On the other hand, service requirements for water use on lifestyle properties are likely to be quite varied. Water supply to lifestyle properties may become more significant in the future as indicated by Scenario 2 "New Frontiers".

Integration with land use and environmental planning
The scenarios describe significant changes in land use over the next 30 years, within and between agricultural, lifestyle and environmental uses. These land use changes can radically alter the viability and requirements of irrigation infrastructure. Irrigation infrastructure planning needs to be closely linked with land use and environmental planning. This calls for a collaborative approach to planning by agencies, industry groups and the community.

Social and economic responsibility
The scenarios highlight the complexity of issues surrounding irrigation and the importance of involving stakeholders, including the community, in decision making. Changes to irrigation infrastructure and irrigation business viability can potentially have wide social consequences. Equity and social adjustment need to be carefully managed during periods of infrastructure change. Likewise, financial planning for infrastructure needs to make provision for industry down turns.

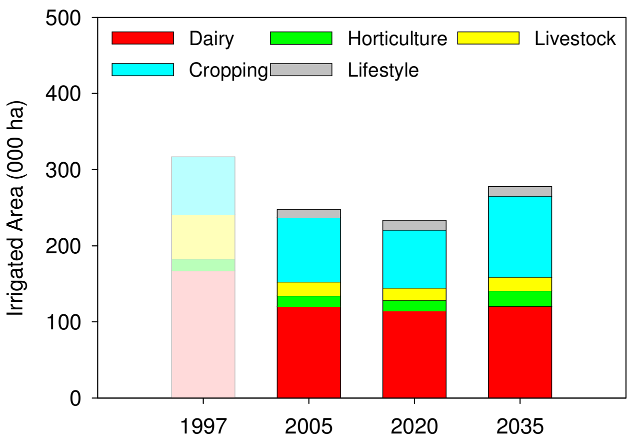
Large shifts in government policy on water can dramatically change the face of the region, as indicated by Scenario 3 "Pendulum". It is critical that the region actively influences all levels of government so that regional concerns and issues are addressed in policy development.

Planning for changes
The scenarios also point to some of the potential weaknesses of the region. For example, the relatively small size of irrigated land parcels makes the region uncompetitive when the market demands large-scale production systems, as indicated in Scenario 2 "New Frontiers". Significant restructuring will be required to overcome some of these weaknesses, but it should be done under the right conditions so that changes can be made smoothly. The scenarios suggest that there are only a limited number of windows of opportunity for large-scale restructuring. In Scenario 3 "Pendulum" for example, government may be lobbied to assist in land amalgamation during periods of major water policy shifts. To seize these opportunities, there is a need for having plans and options prepared in anticipation of future conditions.

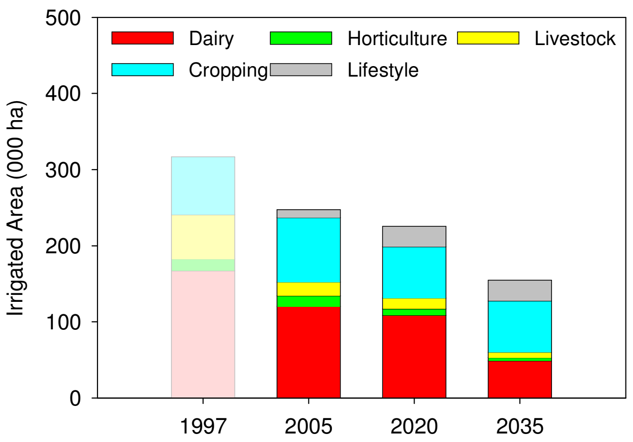
The issues highlighted above represent the learnings from the scenarios by the Goulburn Broken Irrigation Futures Project. The scenarios are intended to stimulate discussions on strategic approaches to irrigation infrastructure planning including reconfiguration. Therefore, readers are encouraged to use the scenarios to develop their own thoughts and ideas.

Comparing the Scenarios - Irrigated Area

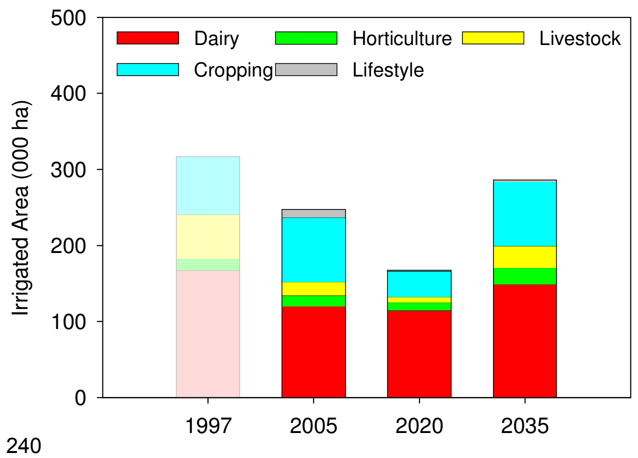
Scenario 1: Moving On



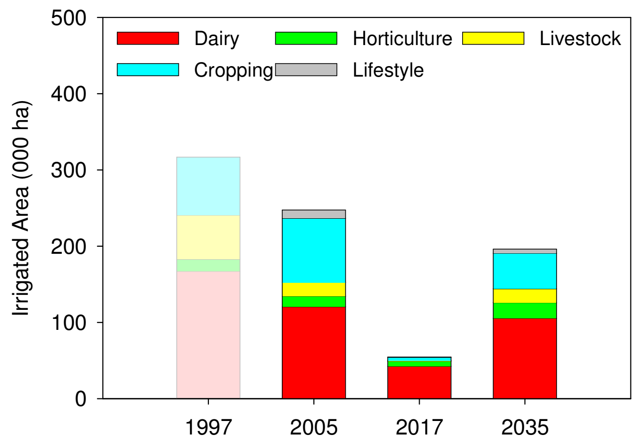
Scenario 2: New Frontiers



Scenario 3: Pendulum



Scenario 4: Drying Up



Summary of Scenario 1: Moving On

Driving Forces

2005-2020

- Free trade agreements signed with USA and ASEAN create demand for all agricultural products.
- Use of genetically modified organisms permitted for agriculture.
- Climate change results in a long period with no medium reliability water and hotter, wetter summers.
- 10% of irrigation water is traded to Sunraysia.
- Demand for lifestyle properties remains high.

2020-2035

- India and China become a significant market for agricultural products.
- Affluent consumers are becoming increasing conscious of health and animal welfare issues.
- Climate remains relatively dry with only 25% of medium reliability water available.
- Water trade outside the region reduces.
- G-MW sold to Macquarie Infrastructure, prices increase and cross-subsidisation of infrastructure costs is reduced.
- Demand for lifestyle properties declines.

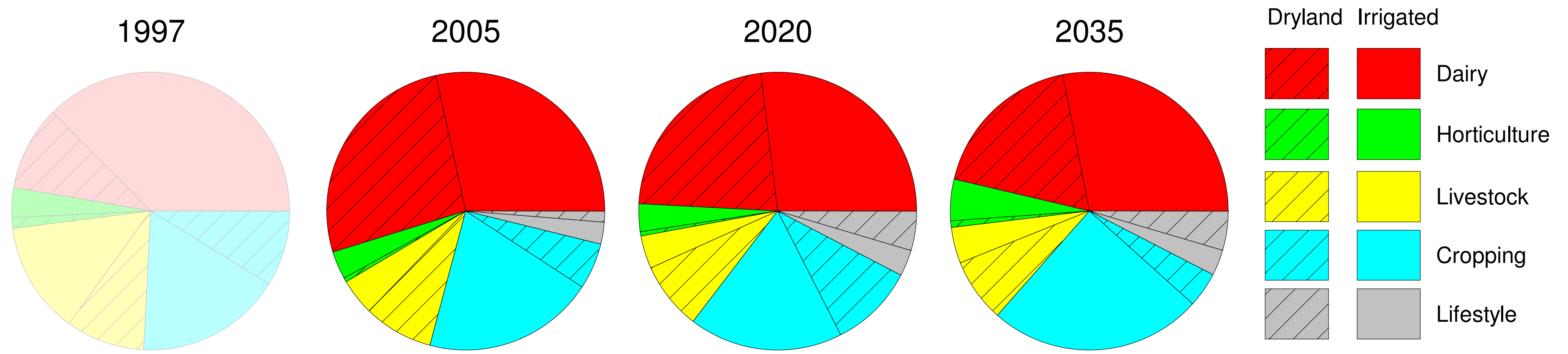
Impacts

- Regional economy continues to prosper despite global competition.
- Agricultural businesses become larger, more intense and have a greater diversity of products. Larger farms employ people who live in towns. Few small farms remain. Some small towns decline.
- Intensification of agriculture increases the necessity for nutrient management.
- More water in the Goulburn River due to government policy and downstream trade.
- Irrigators move toward the river and the upper reaches of the irrigation system (cheaper water).
- In preparation for privatisation, infrastructure condition and operations are modified to maximise the sale price.

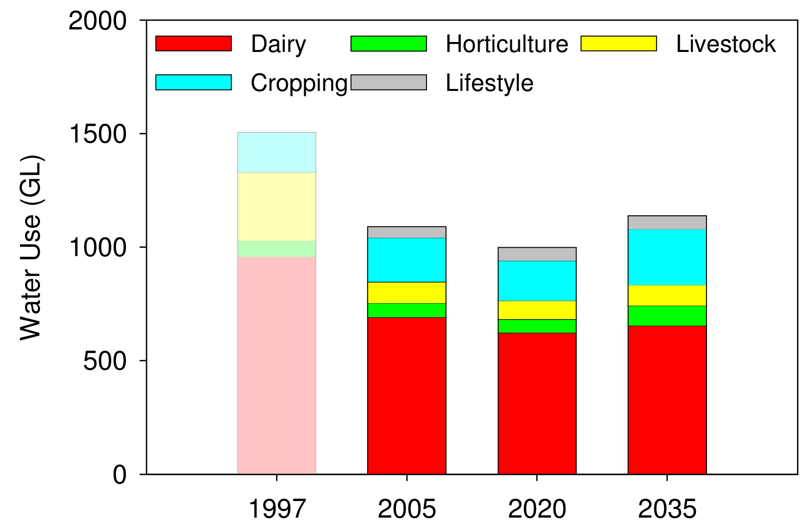
Implications

- Water demand pattern changes as farming systems move toward more annual species.
- Area under irrigation decreases (10%) then increases (30%) as more water becomes available.
- Irrigation water use initially decreases (10%) due to trade and then increases as some (25%) medium reliability water becomes available.

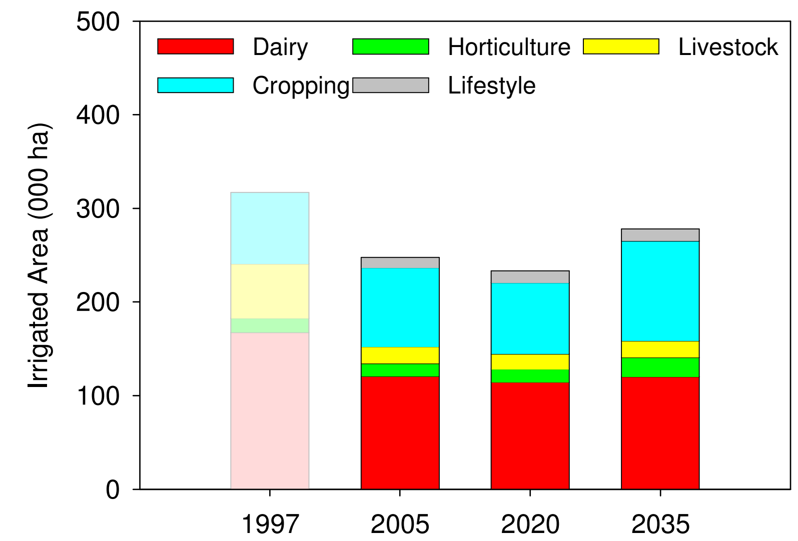
Land Use



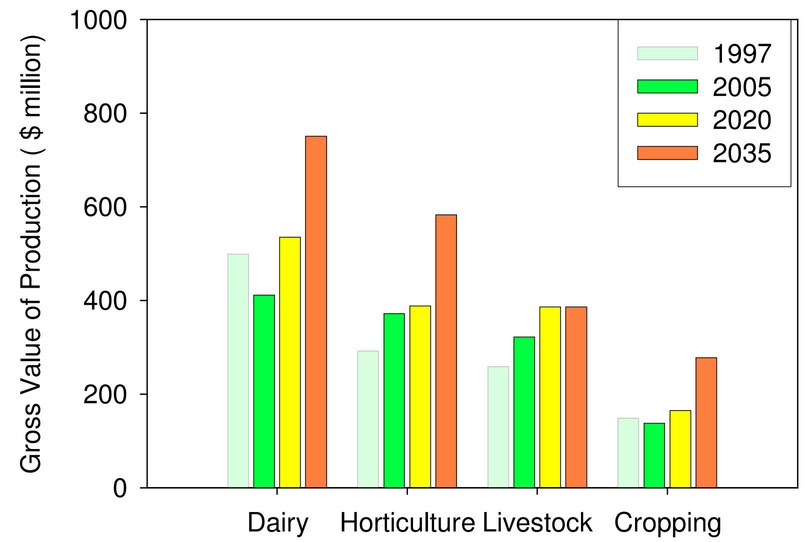
Farm Water Use



Irrigated Area



Farm Gate Gross Value of Production



Description of Scenario 1: Moving On

2005-2020

WATER RELATED DRIVERS

GOVERNMENT POLICY
- Water reform white paper is progressively implemented, involving unbundling of water rights, instituting a process for infrastructure reconfiguration, making 'sales' water into an independent entitlement and returning 20% of 'sales' water to the environment.
- Water tariffs increase at the inflation rate.

CLIMATE
- Rainfall decreases 10% with greater rainfall in summer. Runoff decreases by 25%.
- High-reliability water not affected, but no medium-reliability water available.
- Temperature increases, reduce the chill hours.

WATER TRADE
- 10% of irrigation water is traded to Sunraysia.
- Interstate water trade is introduced with little impact.

OTHER
- No significant impact envisaged from forestry developments in the upper catchment.
- While Melbourne Water may acquire some water from the region, the volume will be relatively small and have no significant impact.

NON-WATER RELATED DRIVERS

GENERAL
- Free trade agreements with USA and ASEAN create new opportunities for export, but also problems with cheap imports.
- Genetically modified organisms introduced into agriculture.

DAIRY
- Demand from Asian markets grows.
- Decrease in competitiveness.
- No change in real price.

HORTICULTURE
- Free trade agreement allows cheap imports.
- Industry diversifies to different products.
- Decrease in competitiveness.
- Moderate increase in price.
- Genetic modification used throughout the world. No impact on markets.

LIVESTOCK
- Global demand for meat increases.
- No change in competitiveness.
- No change in real price.

CROPPING
- Growth linked to the dairy industry.
- Slight increase in competitiveness due to genetic modification.
- No change in real price.
- Biofuel demands for grain fulfilled by worldwide oversupply of grain. Little demand for grain from the region for biofuel production.

LIFESTYLE
- Demand up by 100%.

INDUSTRY IMPACTS

DAIRY
- Milk production increases 30%.
- Fewer farms.
- Area of dairy farm land decreases 10%, enabled by genetic modification, grain and fodder imports, and increased irrigation efficiency.
- Irrigated area decreases 5%.
- Irrigation water use decreases 10%.

HORTICULTURE
- Gross value of production increases 5%. Import challenges met through diversification into new products.
- Growth of new industries with controlled environment systems for QA. Year round growth, but volumetric water requirements are small.
- Fruit production decreases 10%.
- No change in irrigated area.
- Irrigation water use decreases 5%.

LIVESTOCK
- Production increases 20%.
- Land area decreases 5% through increased use of feedlots and intensive systems.
- Irrigated area decreases 10%.
- Irrigation water use decreases 10%.

CROPPING
- Production increases 20%.
- No change in land area.
- Irrigated area decreases 10%.
- Irrigation water use decreases 10%.

LIFESTYLE
- Land area up by 100%.
- Irrigation water use increases 20%.

REGIONAL IMPACTS

GENERAL
- The regional economy continues to prosper despite global competition. Import challenges are met through diversification into new products. Dairy, livestock and cropping will all absorb cost increases by improving efficiency and productivity.
- Limited active intervention in land-use planning results in conflicts between agricultural production and lifestyle values. This could be resolved by allowing market-based mechanisms to drive change. In parallel, the delivery of infrastructure systems which enhance production agriculture, requires close co-operation with Local Government planning across the region.
- Farms in the region have become larger, and many small farms have gone. Those remaining small farms have developed niche markets. Larger farms employ people who tend to live in large towns. Many small towns are declining.
- More water flows down the Goulburn River due to government water reform and downstream trade. Careful management of this water ensures environmental benefits are achieved.
- Nutrient management continues to be important due to the intensification of agriculture.

IRRIGATION INFRASTRUCTURE
- Water demand pattern changes as farming systems move toward more annual pasture/crops.
- Irrigated area decreases 5%.
- Irrigation water use decreases 8%.
- Some timing changes associated with changes in farming systems. Highlights the general need for different water products.

2020-2035

WATER RELATED DRIVERS

GOVERNMENT POLICY
- G-MW sold to Macquarie Infrastructure.
- Cross-subsidisation of infrastructure costs decreases as a result of privatisation. Water tariffs increase to build in a commercial profit and through decreased cross-subsidation.

CLIMATE
- Climate remains drier than historical average. Summer rainfall more intense.
- All high-reliability and 25% of medium-reliability water available.

WATER TRADE
- More internal trade and trade closer to main trunk channels.
- Trade outside the region reduces as limits to available land and water delivery capacity are reached.

OTHER
- Demand for water from Melbourne continues to have little impact.

NON-WATER RELATED DRIVERS

GENERAL
- China and India grow as a market for agricultural produce.
- Consumers become increasingly affluent and health conscious.

DAIRY
- Demand from Asian markets continues.
- No change in competitiveness.
- Small increase in price.

HORTICULTURE
- Export growth to China and India.
- No change in competitiveness.
- No change in price.

LIVESTOCK
- Global demand for meat continues.
- Slight decrease in competitiveness.
- No change in price.

CROPPING
- Growth linked to the dairy industry.
- No change in competitiveness.
- Moderate decrease in price fodder used locally.

LIFESTYLE
- Demand flattens.

INDUSTRY IMPACTS

DAIRY
- Milk production increases 30%. Increase in production of high-value nutraceuticals.
- Land area decreases, as farms become larger and more intense, and small farms exit.
- Irrigated area increases 5%.
- Irrigation water use increases 5%.

HORTICULTURE
- Production increases 50% due to GM and market opportunities.
- Land area increases 50%.
- Growth of controlled environment production continues.
- Irrigation water use increases 50%.

LIVESTOCK
- No change in production.
- No change in land area, however grazing is important to consumers.
- Irrigated area increases 10%.
- Irrigation water use increases 10%.

CROPPING
- Production increases 100% due to genetic modification and increases in land and water use.
- Irrigated area increases 40%.
- Irrigation water use increases 40%.

LIFESTYLE
- No change in land area.
- No change in irrigation water use.

REGIONAL IMPACTS

GENERAL
- Water price increases do not hurt major industries because new owners need to maintain their customer base.
- Increases in water tariffs are greater at the 'bottom' of the system. Irrigators move toward the river and the upper reaches of the irrigation system where water tariffs are lower.
- Competitiveness of all enterprises decreases due to increase in water price, although impact reduced by increased technology, systems and management.
- Privatisation and take-up of local distribution networks by farmer groups provides greater grower flexibility to respond to market changes. However, it also requires the working together of those grower groups to be effective.

IRRIGATION INFRASTRUCTURE
- Irrigated area increases 20% as more water is available
- Irrigation water use increases 15%, due to the availability of medium reliability water.
- Irrigation water use increases In preparation for privatisation, infrastructure condition & operations are managed to maximise the sale price.

Moving on

Summary of Scenario 2: New Frontiers

Driving Forces

2005-2020

- Free trade agreements signed with USA and ASEAN create demand for all agricultural products. Middle East trading partners lost due to our alliance with United States.
- Large increase in lifestyle developments.
- Genetically modified organisms prohibited.
- Community concern for the environment increases.
- Environmental flow entitlement increased through deal with medium reliability entitlement.
- Climate change results in long period with high reliability allocation of less than 100%.
- 15% of irrigation water is traded out of the region to Sunraysia and Northeast Victoria.

2020-2035

- International free trade is introduced.
- Fireblight and regulation cause a major decline in agricultural production across all industries.
- Synthetic food production significantly reduces the demand for naturally produced foods including dairy, horticultural and meat products, but substantially increases demand for grain.
- Demand for lifestyle properties plateaus.
- Genetically modified organisms allowed.

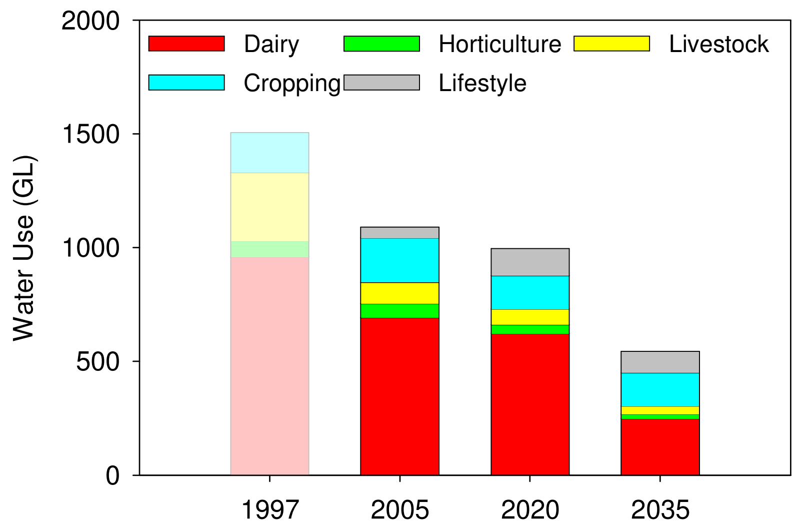
Impacts

- Initially, a small decline in agricultural activity occurs due to the loss of markets. Followed by a substantial decline due to synthetic food production. Niche agricultural industries on some small properties cater for the health food market.
- Demand for grain causes increase in annual cropping. Large quantities of water trades to New South Wales where grain production is more efficient due to larger land parcel sizes. Water trade increases infrastructure costs for remaining irrigators.
- Regional economy is maintained by new lifestyle development. Lifestyle development is unplanned causing conflicts between agricultural production and lifestyle values.
- Land is reserved for environmental purposes.

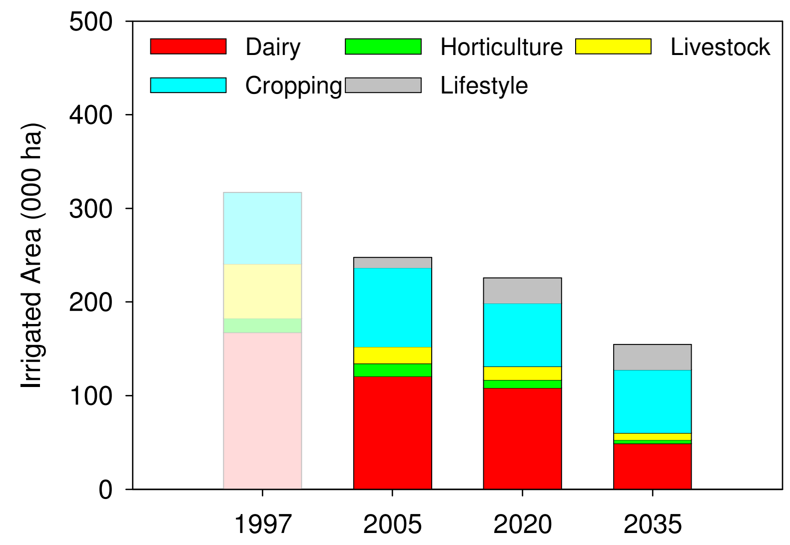
Implications

- Major contraction in most irrigated agricultural industries.
- Area under irrigation and irrigation water use decreases substantially (45%) due to water trade.
- Best areas for irrigation may change according to market demand for products and land availability.

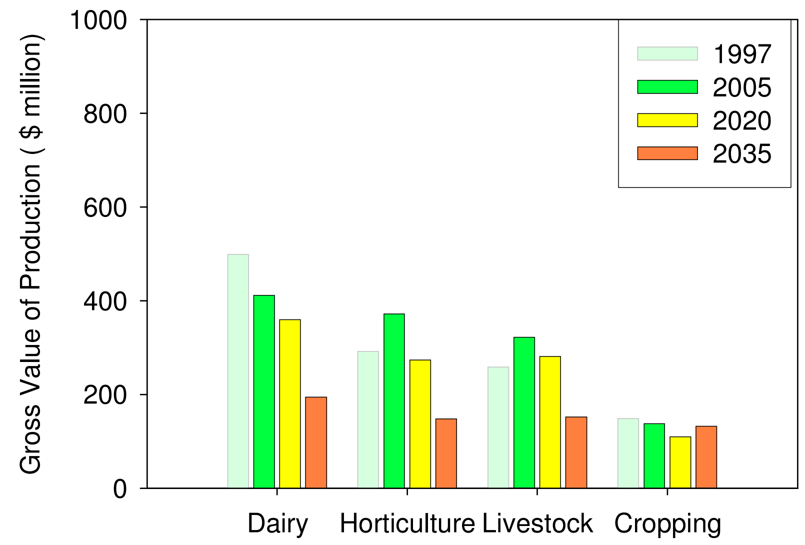
Farm Water Use



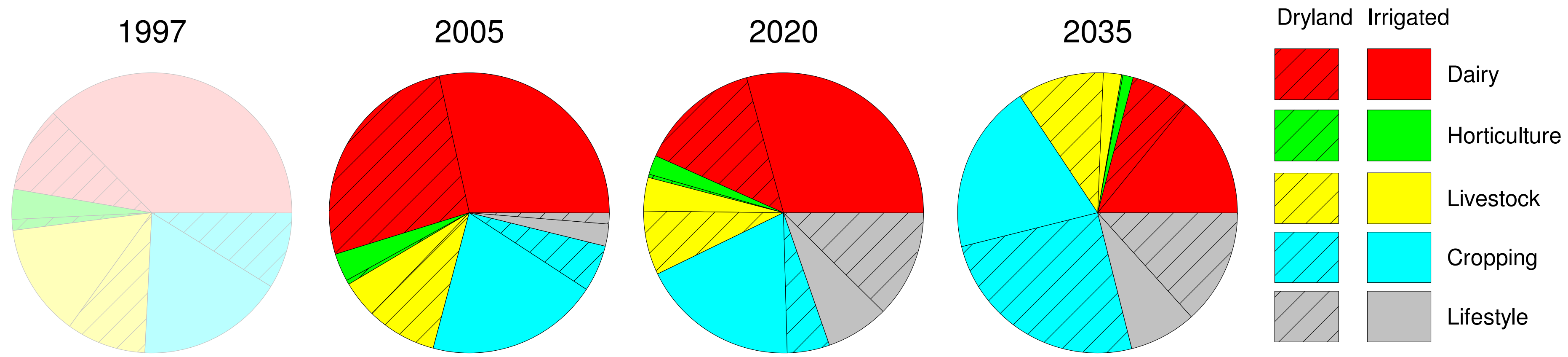
Irrigated Area



Farm Gate Gross Value of Production



Land Use



Description of Scenario 2: New Frontiers

2005-2020

WATER RELATED DRIVERS

GOVERNMENT POLICY
- Water reform white paper is progressively implemented, involving unbundling of water rights, instituting a process for infrastructure reconfiguration, making 'sales' water into an independent entitlement and returning 20% of 'sales' water to the environment.
- Water tariffs increase at the inflation rate.
- Environmental flow entitlement increased through deal exchanging medium-reliability for high-reliability irrigation water entitlement. Volume of high-reliability water entitlement increases by 10% as medium reliability water entitlement is eliminated.
- Interstate water trade enabled but has no impact due to economic recession.

CLIMATE
- Climate remains drier than average.
- Bushfire causes a decline in runoff.
- Water allocation of 95% of high-reliability water.

WATER TRADE
- 5% of irrigation water is traded to north east Victoria, and 10% to Sunraysia.

NON-WATER RELATED DRIVERS

GENERAL
- Free trade agreements with USA and ASEAN create new opportunities for export, but also problems with cheap imports.
- Middle East trading partners lost through alliance with USA.
- Health and food safety important considerations in consumer purchases.
- Community concern for the environment increases.
- Increase in lifestyle developments and tourism.
- Cost of oil doubles causing a brief international recession.
- Use of genetic modification prohibited.

DAIRY
- Demand decreases.
- Small decrease in price.
- Small decrease in competitiveness.

HORTICULTURE
- Free trade agreement allows cheap imports.
- Fireblight outbreak cripples pome fruit industry.
- Large price decrease as import restrictions on pome fruit lifted.
- Competitiveness of other industries increases though marketing of clean and green image.
- Small increase in price for other fruit and vegetables.

LIVESTOCK
- International demand for meat reduces.
- No change in competitiveness.
- Small decrease in price.

CROPPING
- Demand reduces slightly due to less dairy.
- Competitiveness decreases.
- Moderate price decrease.

LIFESTYLE
- Communication technology enables significant increase in rural living.
- Demand for land substantially up.
- Demand for low cost rural housing up.

INDUSTRY IMPACTS

DAIRY
- Milk production decreases 5%.
- Fewer farms and irrigated area decreases 10%.
- Water use decreases 10%.

HORTICULTURE
- Pome fruit production decreases 75%.
- Other fruit and vegetable production increases 20%.
- Irrigated area decreases 40%.
- Irrigation water use decreases 40%.

LIVESTOCK
- Production decreases 5%.
- Irrigated area decreases 20%.
- Irrigation water use decreases 25%.

CROPPING
- Production decreases 5%.
- Irrigated area decreases 20%.
- Irrigation water use decreases 25%.

LIFESTYLE
- Land area increases 350%.
- Irrigation water use increases 150%.

REGIONAL IMPACTS

GENERAL
- Lifestyle development increasingly underpins the economic base of the region, creating increased demand for service industries.
- Unplanned lifestyle developments cause conflicts between agricultural production and lifestyle values.

IRRIGATION INFRASTRUCTURE
- Contraction in most industries especially export focused industries.
- Problems with meeting cost of water.
- Irrigated area decreases 10%.
- Irrigation water use decreases 10%.

New Frontiers

2020-2035

WATER RELATED DRIVERS

GOVERNMENT POLICY
- Barrages at mouth of Murray River removed giving large water savings.
- Regional salt discharge entitlement increased by 100%.
- Agricultural land purchased to produce wildlife and tourism corridors and wetlands across the region. Some prior stream areas retired.

CLIMATE
- Climate dries further.

WATER AVAILABILITY
- Water allocation constant due to water saved at barrages.

WATER TRADE
- Large volume of water (55%) traded to grain growers in southern NSW as they have larger land parcels.

NON-WATER RELATED DRIVERS

GENERAL
- Disease and regulation causes major production reduction across all industries.
- International free trade.
- Genetically modified organisms permitted to decrease food prices and increase exports.
- Synthetic food production of milk, meat and fruit.
- Oil substitution occurs (electricity, fuel cells etc). Small increase in energy cost.

DAIRY
- Substantial decrease in demand due to synthetic food production.
- Small niche for high price real milk.
- Small increase in price.
- Large decrease in competitiveness.

HORTICULTURE & LIVESTOCK
- Similar to dairy although hit later.
- Small increase in price due to demand for real food.

CROPPING
- Demand for grain increases greatly as raw feedstock for synthetic food production.
- Substantial increase in competitiveness.
- Large increase in price.

LIFESTYLE
- Demand for land plateaus.

INDUSTRY IMPACTS

DAIRY
- Milk production decreases 50%.
- Irrigated area decreases 55%.
- Irrigation water use decreases 60%.

HORTICULTURE
- Fruit and vegetable decreases 50%.
- Irrigated area decreases 50%.
- Irrigation water use decreases 50%.

LIVESTOCK
- Production decreases 50%.
- Irrigated area decreases 50%.
- Irrigation water use decreases 50%.

CROPPING
- No change in production.
- No change in irrigated area.
- No change in irrigation water use.

LIFESTYLE
- No change in irrigated area.
- Irrigation water use decreases 20%.

REGIONAL IMPACTS

GENERAL
- Significant decline in agricultural economic activity due to loss of markets and technological advance. This results in a large and unplanned movement of water out of the region and creates pressure on remaining irrigators to pay for infrastructure costs.
- Small land parcels limit the ability of the region to respond to changes in markets and remain competitive.
- Niche production systems increase on small properties.
- Large areas of land are reserved for environmental purposes, including flood management and biodiversity conservation.

IRRIGATION INFRASTRUCTURE
- Major contraction in most industries. Cropping maintained.
- Irrigated area decreases 30%.
- Irrigation water use decreases 45%.
- All year demand for niche industries.
- Best areas (soils, parcel size etc) for current land use may be different in the future land uses.
- Annual cropping highly responsive to water availability.

Summary of Scenario 3: Pendulum

Driving Forces

2005-2020

- Free trade agreements signed with USA and ASEAN create demand for all agricultural products.
- Multinationals take over food processing plants.
- Genetically modified organisms prohibited.
- High energy costs create demand for biofuels.
- Government returns 3500 GL of environmental water to Murray River. Victoria contributes 1500 GL through buy back of all medium reliability and 30% of high reliability water, at premium prices. Some water trades into Goulburn Valley from NSW.
- Water buy back coupled with government purchase, amalgamation and auction of land.

2020-2035

- Chinese Yuan floated and China grows as a market for agricultural products.
- Genetically modified free status becomes a marketing advantage.
- Government reverses policy and returns water to agriculture by auction. Proceeds of auction fund development of distribution infrastructure which is transferred to irrigator cooperatives.
- Wet climate sequence causes floods.

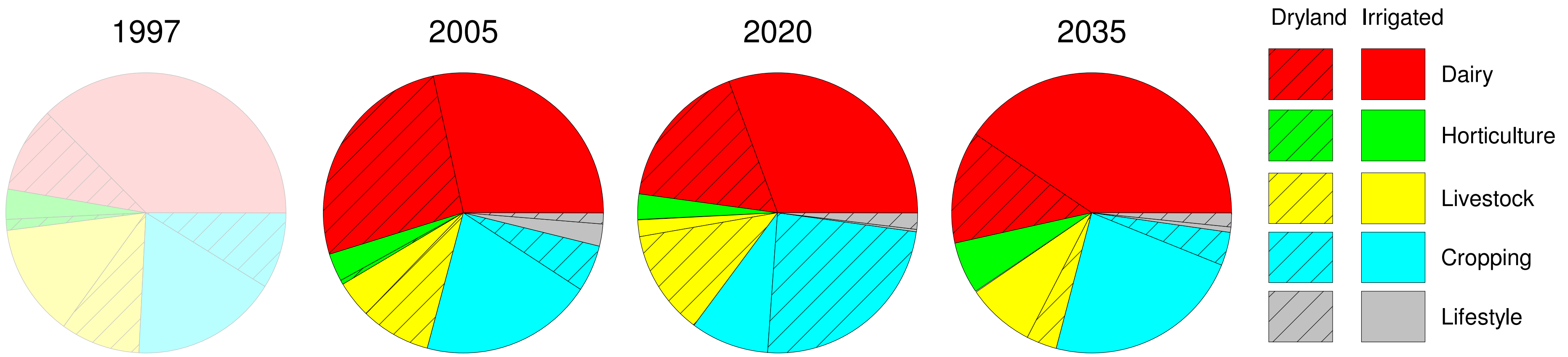
Impacts

- Initially the regional economy declines as water is returned to the environment. Unemployment rises considerably as demand for service industries decreases.
- Perception of little additional benefit resulting from water being returned to the environment.
- Subsequently, the economy booms as international market conditions improve and policy reversal means more water is available for agriculture.
- Labour shortages occur.
- Planned adjustment of land and water resources allows infrastructure costs to be managed and leads to an improved match between land capability and use.
- Increased rainfall and floods lead to a re-emergence of water logging and salinity problems.

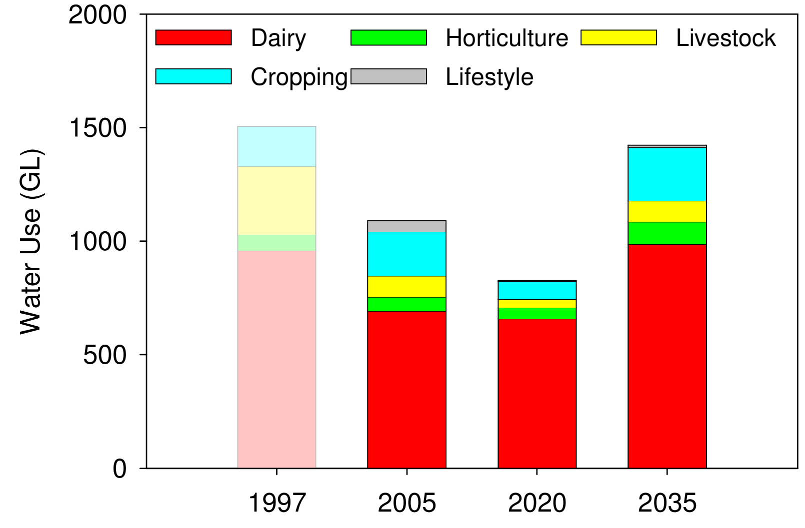
Implications

- Changes in government policy enable large changes in irrigated area and water use to be planned.

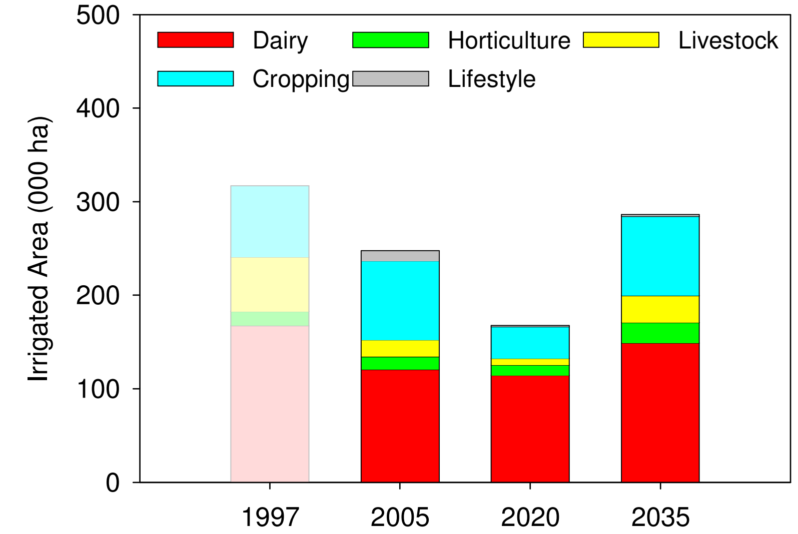
Land Use



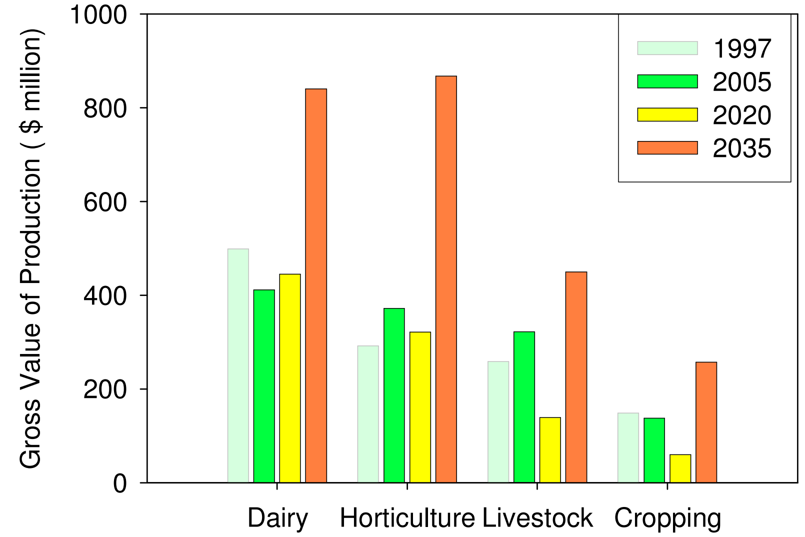
Farm Water Use



Irrigated Area



Farm Gate Gross Value of Production



Description of Scenario 3: Pendulum

2005-2020

WATER RELATED DRIVERS

GOVERNMENT POLICY

- Water reform white paper is progressively implemented, involving unbundling of water rights, instituting a process for infrastructure reconfiguration, making 'sales' water into an independent entitlement and returning 20% of 'sales' water to the environment.
- New government policy introduced to return and additional 3000 GL returned to Murray River, of which Victoria contributes 1250 GL (50% of G-MW entitlement).
- Interstate water trade enabled.
- Government buys back all medium reliability water entitlement and 30% of the high reliability water entitlement at premium prices.
- Government initiates land restructuring program, resuming land, restructuring land boundaries and auctioning dryland properties.
- Irrigation system is restructured in conjunction with land restructuring, resulting in some water savings and no change in water tariffs.

CLIMATE

- Rainfall remains slightly drier than 'normal'.

WATER TRADE

- Sunraysia purchases NSW water.
- Interstate water trade result in water flowing from NSW to the region (5%).

NON-WATER RELATED DRIVERS

GENERAL

- Free trade agreements with USA and ASEAN create new opportunities for export, but also problems with cheap imports.
- Multi-nationals corporations take over processing facilities in the region.
- Use of genetically modified organisms prohibited.
- Large increase in energy costs and interest rates.
- Biofuels industry grows.

DAIRY

- Opportunity for export to Asian markets grows.
- Small increase in price.
- No change in competitiveness.

HORTICULTURE

- Free trade agreement allows cheap imports.
- Small decrease in price.
- Decrease in competitiveness.

LIVESTOCK

- Global demand for meat increases.
- Small increase in price.
- No change in competitiveness.

CROPPING

- Growth linked to the dairy industry.
- Increase in demand for bio-fuel feedstock.
- Small increase in price.
- Small increase in competitiveness.

LIFESTYLE

- Demand declines, and some return to Melbourne.

INDUSTRY IMPACTS

DAIRY

- No change in milk production as water remains in dairy and horticulture.
- Fewer farms.
- Land area remains constant.
- Irrigated area decreases 5%.
- Irrigation water use decreases 5%.

HORTICULTURE

- Production decreases 30% due to lack of competitiveness.
- Irrigated area decreases 20%.
- Irrigation water use decreases 20% .

LIVESTOCK

- Production decreases 60%.
- Irrigated area decreases 60%.
- Irrigation water use decreases 60%.

CROPPING

- Production decreases 60%.
- Irrigated area decreases 60%.
- Irrigation water use decreases 60%.

LIFESTYLE

- Land area decreases 50%.
- Irrigation water use decreases 90% (sold into market).

REGIONAL IMPACTS

GENERAL

- A rapid planned decline in irrigation occurs, causing significant adverse economic impacts to both agricultural and service industries.
- Remaining dairy, livestock and cropping producers manage adverse conditions by growth in efficiency and scale.
- Niche industries and glasshouse production increase, but remain small in terms of overall water use and regional value of production.
- Unemployment increases due to the decline in agriculture and service industries.
- Significantly more water in the Goulburn and Murray Rivers results in little additional perceived environmental benefits, given the significant economic impacts.
- Planned re-adjustment of land leads to better matching between land capability and use.

IRRIGATION INFRASTRUCTURE

- Farming systems will move toward more dryland pasture and crops.
- Irrigated area decrease 30%.
- Irrigation water use decreases 25%.

2020-2035

WATER RELATED DRIVERS

GOVERNMENT POLICY

- Water resources management becomes a Federal responsibility.
- Lack of perceived benefits from environmental flows.
- Water reallocated to economic use. 3000GL of water auctioned and sold mostly to agriculture and tourism in NSW, Vic and SA.
- Agriculture in region purchases water entitlements equivalent to 2005 levels of high reliability water and 50% of medium reliability water.
- Government uses funds to build and rehabilitate irrigation infrastructure, in partnership with irrigator-owned water distribution companies. Land suitability and infrastructure condition drive investment in infrastructure.
- Water tariffs rise to meet debt.

CLIMATE

- Several seasons of above average rainfall, with floods occurring.
- Groundwater and salinity problems emerge.

WATER TRADE

- Permanent and temporary trading of water occurs at low prices.

NON-WATER RELATED DRIVERS

GENERAL

- China floats its currency, which strengthens against the Australian dollar.
- China and India grow as markets for agricultural products.
- Multinational corporations owning processing facilities exploit their position.
- Australia's genetically modified free status becomes a competitive advantage.

DAIRY

- Export to Asian markets expand.
- Demand increases.
- Large increase in price.
- Increase in competitiveness due to genetically modified free status.

HORTICULTURE

- Exports to China and India grow.
- Demand increases.
- Large increase in price.
- Increase in competitiveness due to genetically modified free status.

LIVESTOCK

- Global demand for meat increases.
- Small increase in price.
- Increase in competitiveness due to genetically modified free status.

CROPPING

- Increase in demand linked to growth in the dairy industry.
- Small increase in price.
- No change in competitiveness.

LIFESTYLE

- No demand as a result of land use planning rules.

INDUSTRY IMPACTS

DAIRY

- Milk production increases 40%.
- Land area increases 10%.
- Irrigated area increases 30%.
- Irrigation water use increases 50% .

HORTICULTURE

- Production increases 100%.
- Irrigated area increases 100%.
- Irrigation water use increases 100%.

LIVESTOCK

- Production increases 200%.
- Irrigated area increases 300%.
- Irrigation water use increases 150%.

CROPPING

- Production increases 300%.
- Irrigated area increases 150%.
- Irrigation water use increases 200%.

LIFESTYLE

- No change in land area.
- Irrigation water use increases 1000% .

REGIONAL IMPACTS

GENERAL

- Reversed water policy and market conditions produce a rapid planned expansion of irrigated agriculture.
- Regional economy booms on the back of expansion of agriculture and investment in irrigation infrastructure. Labour is in short supply.
- Periods of above average rainfall and floods lead to salinity and water-logging problems emerging.

IRRIGATION INFRASTRUCTURE

- Rapid increase in area irrigated and water delivery.
- Irrigated areas increases 70%.
- Irrigation water use increases 70% .
- 'New water' targeted to best areas.

Summary of Scenario 4: Drying Up

Driving Forces

2005-2020

- Financial crisis in the United States creates a global recession that reduces international trade considerably between 2009 and 2012.
- As global economy recovers, China begins to export high value horticultural products and import cheaper bulk commodities.
- Australian dollar strengthens making agricultural products expensive to overseas purchasers.
- Use of genetically modified organisms prohibited.
- Drought commences in 2012 lasting until 2020. High reliability irrigation water allocations between 2015 and 2020 are 80%, 50%, 30%, 90%, 100%.

2020-2035

- International export markets recover.
- International and domestic markets demand healthy food.
- Genetically modified free status becomes a marketing advantage.
- Government assists restructure and redevelopment of agriculture with focus on health food, environmental sustainability and animal welfare.
- Climate becomes wetter and enables medium. reliability allocation of 25%

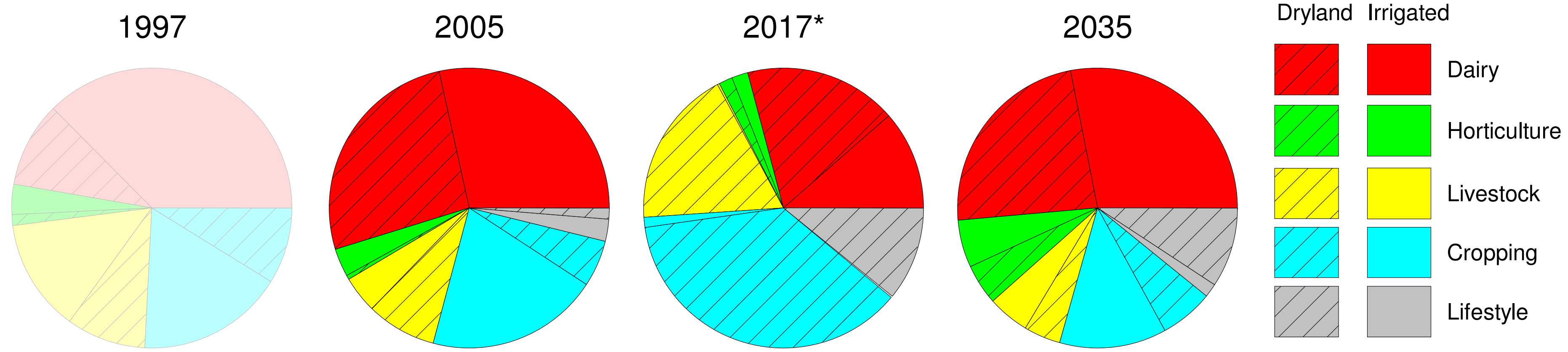
Impacts

- Initially, all agricultural industries and the regional economy is decimated by international market collapse and prolonged drought. The population is stable because employment opportunities are poor elsewhere. Unemployment is very high.
- Irrigators unable to pay for costs of infrastructure maintenance.
- Subsequently, regional economy booms as international markets grow and water availability increases. Growth of agricultural industries is constrained by land parcel size.
- Drought increases the frequency of severe bushfires.

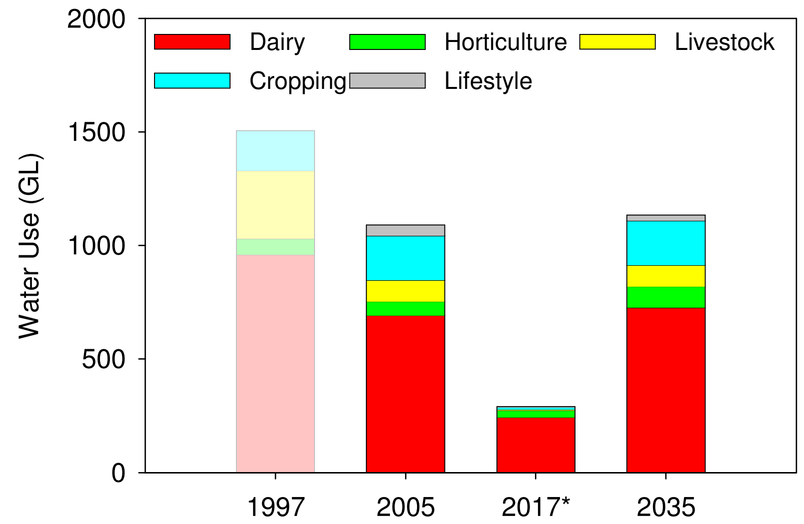
Implications

- Initially, a large decrease in irrigation water use and area irrigated as drought decreases allocations, followed by a large increase in irrigated area and water use as the drought subsides.
- Water returns along existing irrigation infrastructure as no restructuring occurred during drought.
- Infrastructure declines during times of little maintenance.

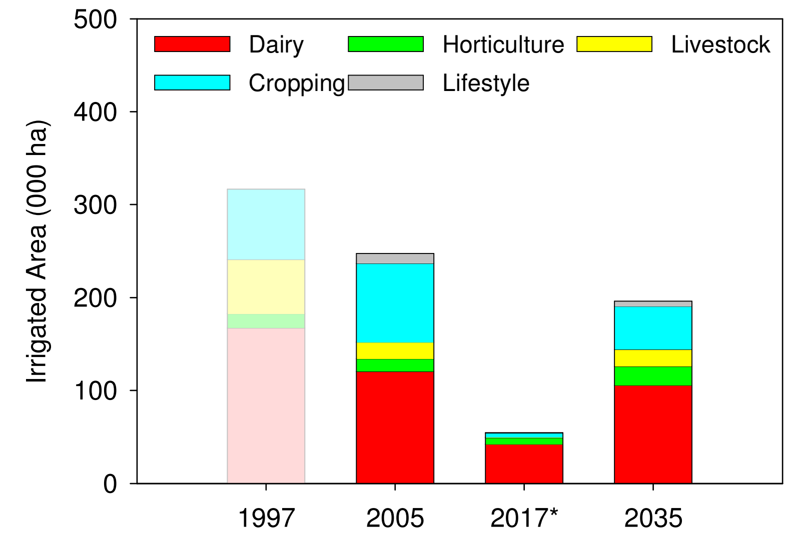
Land Use



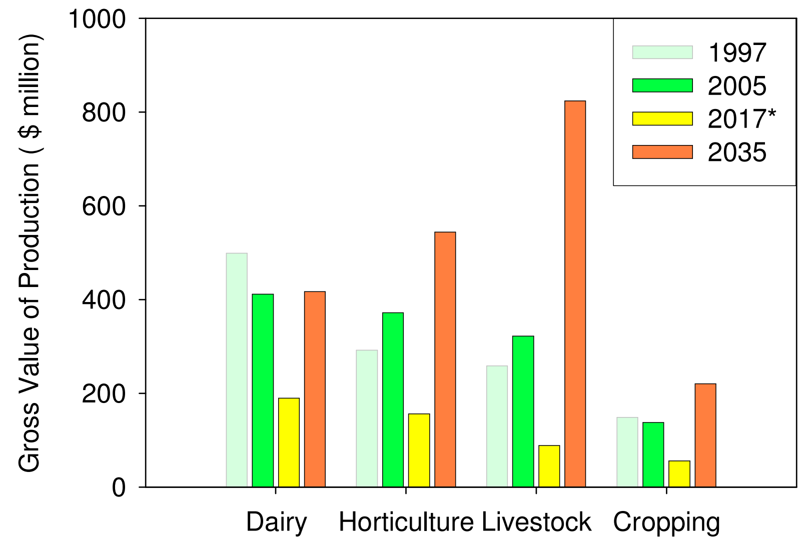
Farm Water Use



Irrigated Area



Farm Gate Gross Value of Production



* Graphics depict 2017 drought conditions with high reliability water allocation of 30%.

Description of Scenario 4: Drying up

2005-2020

WATER RELATED DRIVERS

GOVERNMENT POLICY

- Water reform white paper is progressively implemented, involving unbundling of water rights, instituting a process for infrastructure reconfiguration, making 'sales' water into an independent entitlement and returning 20% of 'sales' water to the environment.
- Tariffs constant but then moratorium as drought continues.

CLIMATE

- Initially above average rainfall following 2002 drought.
- Drought begins in 2012.
- Water allocations below 100% from 2015. 2015-80%, 2016-50%, 2017-30%, 2018-90%, 2019-100%.

NON-WATER RELATED DRIVERS

GENERAL

- Free trade agreements with USA and ASEAN create new opportunities for export, but also problems with cheap imports.
- Financial crisis in the USA causes a world recession between 2009 and 2012. The USA dries up as a market and capital is withdrawn from overseas.
- Australian dollar increases in value.
- International economy recovers around 2012.
- China exports high value horticultural products and imports cheap bulk commodities.

DAIRY

- USA dominates international market.
- Small decrease in price.
- Decrease in competitiveness.

HORTICULTURE

- Focus on local market.
- Moderate price decrease.
- Large decrease in competitiveness.

LIVESTOCK

- Global demand for meat holds but USA dominates market.
- Small price decrease.
- Decrease in competitiveness.

CROPPING

- Decrease in demand.
- Large price increase at 2017 due to drought.
- Competitiveness falls.

LIFESTYLE

- Strong demand and migration from cities especially.

INDUSTRY IMPACTS (2017)

DAIRY

- Milk production decreases 50% after 3 years of drought.
- Banks seize many farms which exit dairying.
- Processors restructure and one export processor centrally located.
- Irrigated area decreases 65%.
- Irrigation water use decreases 65%.

HORTICULTURE

- Production decreases 50% due to lack of competitiveness and drought.
- Processor scales back production but retains presence.
- Irrigated area decreases 50%.
- Irrigation water use decreases 50%.

LIVESTOCK

- Production decreases 70%.
- Irrigated area decreases 95%.
- Irrigation water use decreases 95%.

CROPPING

- Production decreases 70%.
- Irrigated area decreases 95%.
- Irrigation water use decreases 95%.

LIFESTYLE

- Land area increases 150%.
- Water use decreases 95%.

REGIONAL IMPACTS (2017)

GENERAL

- International market collapse coupled with prolonged drought decimates all agricultural enterprise and the regional economy.
- The region experiences severe unemployment, and during the recession the population remains stable because employment prospects are no better elsewhere.
- The drought increases the frequency of bushfires in the region.

IRRIGATION INFRASTRUCTURE

- Irrigated area decreases 80% .
- Irrigation water use decreases 70%.
- Major community discontent regarding payment of water fees during the drought.
- GMW loses major part of income and receives cash injection to continue.

2020-2035

WATER RELATED DRIVERS

GOVERNMENT POLICY

- Governments assist rural communities and provide support to accelerate production growth.
- Greenfield sites, land parcel restructuring and zoning used in the region based on soils and access to infrastructure.
- Water tariffs increase at the inflation rate.
- No additional water allocated to the environment.

CLIMATE AND WATER AVAILABILITY

- Climate slightly wetter than normal.
- All high reliability and 25% of medium reliability available.

NON-WATER RELATED DRIVERS

GENERAL

- Full recovery from drought and recession.
- Australia's ban on genetically modified organisms is a marketing advantage.
- International and domestic consumers demand health food.
- Government assists restructure of agriculture with strong focus on health food, environmental sustainability and animal welfare in order to tap international demand.

DAIRY

- Export to all international markets expands.
- Demand increases.
- Moderate price increase.
- Increase in competitiveness due to genetically modified free status.

HORTICULTURE, LIVESTOCK, CROPPING

- Similar to dairy.
- Moderate price increase.

LIFESTYLE

- No demand following previous large migration and regulations protecting right to farm.

INDUSTRY IMPACTS

DAIRY

- Slow and limited recovery.
- Milk production increases 90%.
- Medium, less capital intensive farms become industry standard.
- Irrigated area increases 150%.
- Irrigation water use increases 200%.

HORTICULTURE

- Most new large investment will take place in the region on greenfield sites.
- Land around towns become lifestyle farms.
- Production increases 200%.
- Irrigated area increases 200%.
- Water use increases 200%.

LIVESTOCK

- Production increases 700%.
- Irrigated area up and water use increases 1900%.

CROPPING

- Production increases 240%.
- Irrigated area increases 1000%.
- Water use increases 1900%.

LIFESTYLE

- Increase with conversion of most small horticulture to lifestyle farms.
- Irrigated area increases 1000%.
- Water use increases 1000%.

REGIONAL IMPACTS

GENERAL

- Regional economy booms as irrigated agriculture expands due to increasing availability of water and government provides assistance to agriculture.
- Labour is in short supply.
- Limited land restructuring during drought constrains growth.
- Conservation and environmental improvement works undertaken to enhance market advantage of genetic modification free status.
- Increased flows in the Murray and Goulburn Rivers due to wetter climate.

IRRIGATION INFRASTRUCTURE

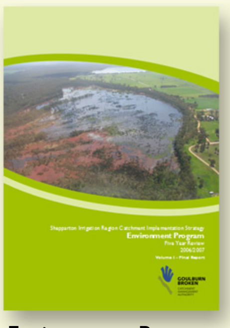
- Infrastructure allowed to decline in the last period. Poor condition at the start of this period. Injection of investment required.
- Rapid increase in area irrigated and water delivery.
- Irrigated area increases 260%.
- Irrigation water use increases 290%.
- Delivery system follows existing infrastructure pattern.
- G-MW needs to be able to manage boom & bust financial cycles.

Success in delivery of the Shepparton Irrigation Region Catchment Implementation Strategy component of the Goulburn Broken Regional Catchment Strategy is due to strong:

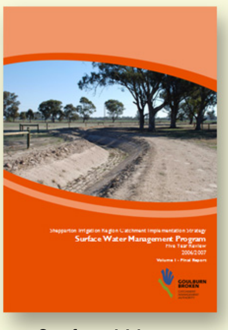
- Community involvement and empowerment through the Implementation Committee and working groups
- Partnerships between agencies and local, state and federal governments
- Partnerships with Landcare, Local Area Planning and the Goulburn Murray Landcare Network
- Integrated approach to tackling natural resource issues and protecting assets
- People skills, dedication and leadership in natural resource management

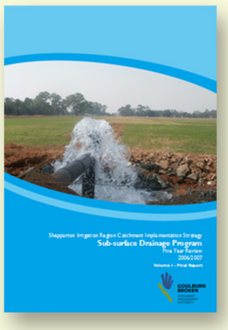
The five-year review of programs overseen by the Shepparton Irrigation Region Implementation Committee presents an opportunity to celebrate our achievements, describe our forward planning, demonstrate value of investment and describe our engagement of community and partner agencies.

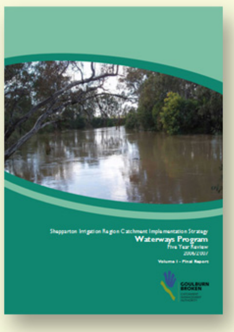
Look for these other five-year reviews:


Environment Program


Farm Program


Surface Water Management Program


Sub-surface Drainage Program


Waterways Program

For more information visit www.gbcma.vic.gov.au