Audit of Irrigation Modernisation Water Recovery 2013/14 Irrigation season

Report

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Cardno
Shaping the Future

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Summary of findings

Background and scope

This report details the findings from Cardno's audit of the estimates of the water recovery achieved through irrigation modernisation in northern Victoria for 2013/14. The majority of the water recovery is being delivered through the Goulburn-Murray Water (GMW) Connections Project (GCP). The GCP is being implemented in two stages. Stage 1, which is funded by the Victorian Government, has been underway since 2008 and Stage 2, which is funded by the Commonwealth, commenced in 2012. The GCP must be audited each year. This is the sixth annual audit of water savings from irrigation modernisation in the Goulburn-Murray Irrigation District.

The scope of activities included in this audit, as described in the audit brief, is as follows:

- The irrigation modernisation works in place for the 2013/14 'water year' (1 July 2013 to 30 June 2014).
- The GCP operating area which is the whole Goulburn-Murray Irrigation District (Central Goulburn, Rochester, Pyramid-Boort, Murray Valley, Shepparton and Torrumbarry Irrigation Areas).
- Irrigation modernisation works and savings separately accountable to GCP Stage 1 GCP Stage 2 and the Shepparton and CG1234 irrigation modernisation project.
- The cumulative water entitlement purchases up to 30 June 2014 converted to average equivalent water recovery.

Audited Water Savings Estimates

Water savings are achieved through modernisation of irrigation infrastructure. The scope of the audit is to review Phase 3 and Phase 4 water savings estimates. The Phase 3 water savings estimates represent actual savings realised in the 2013/14 irrigation season as a result of works completed. Phase 4 savings represent the long term average savings that might be expected from the works completed to date.

The audited Phase 3 and Phase 4 estimates are set out in the following tables and, as required in the project brief, are separately accounted to the:

- Stage 1 project,
- Stage 2 project,
- Shepparton and CG1-4 residual works.

Water savings from Stage 1 project (2013/14)

Water Savings Intervention	SH	CG1-4	CG 5-9	MV	RO	PB	TO	TOTAL
Phase 3 water savings								
Channel Rationalisation (ML)	-	-	945	3,561	451	2,139	6,074	13,169
Channel Automation (ML)	-	-	20,135	3,494	3,239	1,591	4,649	33,108
Service Point Replacement (ML)	-	-	12,142	7,081	5,136	5,310	5,925	35,594
Service Point Rationalisation (ML)	-	-	2,101	2,215	1,532	2,135	3,086	11,070
Channel Remediation (ML)	-	-	3,984	3,879	2,460	0	2,845	13,167
Total Phase 3 savings (ML)	-	-	**39,307**	**20,230**	**12,818**	**11,175**	**22,579**	**106,108**
Phase 4 water savings								

Water Savings Intervention	SH	CG1-4	CG 5-9	MV	RO	PB	TO	TOTAL
Channel Rationalisation (ML)	-	-	1,133	5,503	659	2,213	9,374	18,883
Channel Automation (ML)	-	-	30,748	5,947	4,796	2,739	6,740	50,970
Service Point Replacement (ML)	-	-	16,997	10,720	7,596	8,765	8,835	52,912
Service Point Rationalisation (ML)	-	-	2,938	3,429	2,182	3,460	4,652	16,661
Channel Remediation (ML)	-	-	4,253	4,186	2,396	-	2,775	13,611
Total Phase 4 savings (ML)	-	-	**56,069**	**29,785**	**17,629**	**17,178**	**32,376**	**153,036**

Note – Totals may not sum due to rounding

Water savings from Stage 2 project (2013/14)

Water Savings Intervention	SH	CG1-4	CG 5-9	MV	RO	PB	TO	TOTAL
Phase 3 water savings								
Channel Rationalisation (ML)	5	9	132	816	184	272	984	2,401
Channel Automation (ML)	-22	-	-	-	-	-	-	-22
Service Point Replacement (ML)	186	-	619	341	559	341	580	2,628
Service Point Rationalisation (ML)	17	-	93	274	91	146	263	885
Channel Remediation (ML)	-	567	-	575	-	-	-	1,142
Total Phase 3 savings (ML)	**186**	**575**	**844**	**2,006**	**834**	**759**	**1,827**	**7,033**
Phase 4 water savings								
Channel Rationalisation (ML)	189	803	330	1,272	308	454	1,861	5,217
Channel Automation (ML)	200	-	-	-	-	-	-	200
Service Point Replacement (ML)	269	-	840	631	830	560	1,040	4,170
Service Point Rationalisation (ML)	23	-	148	523	128	239	459	1,521
Channel Remediation (ML)	-	624	-	586	-	-	-	1,210
Total Phase 4 savings (ML)	**682**	**1,427**	**1,318**	**3,013**	**1,266**	**1,253**	**3,360**	**12,318**

Note – Totals may not sum due to rounding

Shepparton and CG1-4 Residual works (2013/14)

Water Savings Intervention	Shepparton	CG1-4	TOTAL
Phase 3 water savings			
Service Point Replacement (ML)	278	573	852
Service Point Rationalisation (ML)	3	144	146
Total Phase 3 savings (ML)	**281**	**717**	**998**
Phase 4 water savings			
Service Point Replacement (ML)	385	864	1,249
Service Point Rationalisation (ML)	8	443	451
Total Phase 4 savings	**393**	**1,306**	**1,699**

Note – Totals may not sum due to rounding

Total water estimated savings for all projects

Project	SH	CG1-4	CG 5-9	MV	RO	PB	TO	TOTAL
Phase 3 water savings								
Stage 1 project (ML)	-	-	39,307	20,230	12,818	11,175	22,579	106,108
Stage 2 project (ML)	186	575	844	2,006	834	759	1,827	7,033
Shepparton - CG1-4 residual works (ML)	281	717						998
Total Phase 3 savings (ML)	**468**	**1,292**	**40,151**	**22,236**	**13,652**	**11,934**	**24,406**	**114,139**
Phase 4 water savings								
Stage 1 project (ML)	-	-	56,069	29,785	17,629	17,178	32,376	153,036
Stage 2 project (ML)	682	1,427	1,318	3,013	1,266	1,253	3,360	12,318
Shepparton - CG1-4 residual works (ML)	393	1,306						1,699
Total Phase 4 savings (ML)	**1,075**	**2,733**	**57,387**	**32,798**	**18,894**	**18,431**	**35,736**	**167,054**

Note – Totals may not sum due to rounding

Note – There are additional water savings volumes that are outside the scope of this audit

Water Entitlement Entities

The audit scope requires that the ownership and details of the Water Entitlement Entities (WEEs) claimed by GMW as being in its ownership at 30 June 2014 are to be confirmed. The calculation of the long term diversion limit equivalent (LTDLE) associated with these WEEs is also required using the conversion factors provided by DEPI. For 2013/14, water recovery due to entitlement purchases is only required to be audited for the Stage 1 project.

We reconciled the ownership and details of the WEEs claimed by GMW against the details on Victorian Water Register as at 30 June 2014. We found that while the great majority of WEEs claimed by GMW reconciled with the details held on the Register and that their ownership was also recorded as being in GMW's name. We also identified instances where the details of the WEEs claimed by GMW did not reconcile with the Register. This was primarily due to the WEE ID provided by GMW referring to a WEE where the original WEE had been cancelled and the share transferred to a new WEE.

It was found that a significant volume of the WEEs that were excluded from the audited total were cancelled as part of the Inter-Project Agreement. GMW explained that these WEEs had been put forward for inclusion in the Stage 1 totals due to how it accounted for the WEEs in the Inter-Project Agreement total. The Inter-Project Agreement total was included in the scope of the 2012/13 audit but has not been included in the scope of the 2013/14 audit. Therefore it has not been possible to test the movement of WEEs between the Stage 1 project and the Inter-Project Agreement. It is understood that DEPI may review the reconciliation of WEE transfers between the two projects at a later date.

Other discrepancies observed related to the volume recorded for two WEEs and the region recorded for six WEEs. The audited total reflects the details recorded on the Victorian Water Register.

Following confirmation of the WEEs held by GMW as outlined above, the entitlement volumes have been converted into long term diversion limit equivalent (LTDLE) volume as shown in the table below.

Calculation of Long Term Diversion Equivalent

Project / Irrigation area	Volumes		Conversion factors		Long Term Diversion Equivalent		
	Low reliability (ML)	High reliability (ML)	Low reliability (ML share / ML LTDE)	High reliability (ML share / ML LTDE)	Accruing from low reliability (ML)	Accruing from high reliability (ML)	Total (ML)
Goulburn	1,935.40	2,732.70	0.546	0.927	1,056.73	2,533.21	3,589.94

Murray	3,278.10	6,980.40	0.659	0.913	2,160.27	6,373.11	8,533.37
Total					3,217.00	8,906.32	**12,123.31**

Systems and Processes

Our review for the 2013/14 audit of the information systems and processes used by GMW has found that they continue to be sufficiently robust to generate data and inputs that are as accurate as could reasonably be expected for the purpose of calculating water recoveries.

We have noted significant improvement in the construction records provided by GMW compared with previous years. We found the construction records to be mostly comprehensive and complete and therefore sufficient to confirm that the works claimed as the basis for water savings have been completed.

We have identified significant inconsistencies when reconciling a sample of outfall records sourced from operator logsheets with SCADA records. Despite the inconsistencies, we have not made any changes to the outfall volumes used in the calculations because of a lack of definitive evidence that the SCADA reading is more accurate than the operator's measurement. However, we have identified that this is an area that GMW must improve for future to ensure that the inputs are as accurate as could be reasonably expected for the purpose of water savings calculations.

Water Savings Protocol Reporting Requirements

The Water Savings Audit Process[1] is a document under the Water Savings Protocol that sets out the approach to be taken to the independent audit of water savings. The scope of independent audit work relating to irrigation modernisation is to include the elements detailed below. Where each element is addressed in this report is set out below the individual element.

Verifying that the Phase 3 (and Phase 4) water savings calculations have been calculated in accordance with the Technical Manual for the Quantification of Water Savings.

We address this requirement in Section 6 of this report.

Checking that the data collection and inputs are as accurate as could reasonably be expected for the purpose of calculating water savings.

We address this requirement in Section 4 and 5 of this report.

Spot checks that the program of works has been implemented as documented in the water saving calculations.

We address this requirement in Section 5 of this report.

Checking that water savings have been calculated based on the nature and the extent of all modernisation works

We address this requirement in Section 5 of this report.

Providing a corrected estimate of the water savings for any component where the project proponent calculations are found to be non-compliant or deficient.

[1] *Water Savings Audit Process (Water Savings Protocol), Department of Sustainability and Environment Victoria, Version 2.0 June 2009.*

We address this requirement in Section 6 of this report.

Identifying potential improvements to the data collection, data analysis, assumptions and methods used to estimate the water savings. Recommend changes to the Technical Manual for the Quantification of Water Savings to the Director of Allocations and Licences within DSE (now DEPI) that will improve useability and accuracy of water savings.

We address this requirement in Section 8 of this report.

Checking if suggestions from the previous year's audit have been actioned upon and report upon the status of each of the suggested improvements.

We address this requirement in Section 9 of this report.

Glossary

A	Ratio of the length of channel to be or actually automated to the total length of channel in the defined system (%)
CG	Central Goulburn
CG134	Central Goulburn Channel 1, 3 and 4
CG2	Central Goulburn Channel 2 System
CL	Ratio of length of spur channel length rationalised to total spur channel length in system
D_{base}	Customer Deliveries in the Baseline Year in the irrigation system
DEPI	Department of Environment and Primary Industries
DF	Durability factor to account for the durability of water savings interventions
DF_{error}	Durability factor for reducing measurement error
$DF_{leakage\ around}$	Durability factor for reducing leakage around the meter
$DF_{leakage\ through}$	Durability factor for reducing leakage through the meter
$DF_{unauthorised}$	Durability factor for reducing unauthorised use
D_{Mbase}	Customer deliveries through the Rationalised meters in the Baseline Year
$D_{MYear\ X}$	Customer deliveries through the replaced meters for the year in question
DSE	The Department of Sustainability and Environment
$D_{Year\ x}$	Customer deliveries in the year in question to the irrigation system
E_{Base}	Evaporation in Baseline Year
$EF_{bank\ leakage}$	Effectiveness Factor Channel automation (bank leakage)
EF_{error}	Effectiveness Factor for reducing measurement error
$EF_{leakage\ around}$	Effectiveness Factor for reducing leakage around the meter
$EF_{leakage\ through}$	Effectiveness Factor for reducing leakage through the meter
$EF_{rationaliation}$	Effectiveness Factor for channel rationalisation
$EF_{remediation}$	Effectiveness Factor for channel remediation
$EF_{unauthorised}$	Effectiveness Factor for reducing unauthorised use
$F(LTCE_{Base})$	Long Term Cap Equivalent Factor to convert Baseline Year volumes to Long Term Cap Equivalent volume
$F(LTCE_{Year\ X})$	Long Term Cap Equivalent Factor to convert Current Year volumes to Long Term Cap Equivalent volume
F(PA)	Pondage Testing Adjustment Factor to account for dynamic losses in addition to static losses
FL	Proportion of bank leakage recognised as fixed
GCP	GMW Connections Project
GIS	Geographic Information System
GMID	Goulburn Murray Irrigation District
GMW	Goulburn Murray Water
HR	High Reliability
IPA	Inter-Project Agreement
IPM	Irrigation Planning Module
ITP	Inspection Test Procedure
L_{Base}	Leakage in Baseline Year
$L_{Post\ works}$	Post works bank leakage

LR	Low Reliability
LTA	Defined Fixed Leakage Rate (ML/year/service point) around service points
LTCE	Long Term Cap Equivalent
LTDLE	Long Term Diversion Limit Equivalent
LTT	Defined Fixed Leakage Rate (ML/year/service point) through service points
M&E	mechanical and electrical
MCF	Adopted Meter Correction Factor for Dethridge Meter Service Points or associated with deemed Service Points
MV	Murray Valley
$N_{rationalised}$	Number of meters rationalised
$N_{replaced}$	Number of meters replaced
NVIRP	Northern Victoria Irrigation Renewal Project
O_{Base}	Outfalls in Baseline Year
OP_{yearx}	Ratio of the length of time a channel has been automated in the year in question relative to the irrigation season length in the Baseline Year
O_{yearx}	Outfalls in Current Year
PB	Pyramid-Boort
RL	Ratio of length of channel length remediated to total channel length in system
RO	Rochester
S_{Base}	Seepage in Baseline Year
SCADA	Supervisory Control and Data Acquisition
SH	Shepparton
SMC	Stuart Murray Canal
SMP	Strategic Measurement Project
$S_{post\ works}$	Post works seepage
the *Manual*	the Water Savings Protocol *Technical Manual*
the *Protocol*	the Water Savings Protocol for the Quantification of Water Savings from Irrigation Modernisation Projects
the *Technical Manual*	*Technical Manual for the Quantification of Water Savings*
t_m	Ratio of the length of time that the service point was replaced for irrigation purposes in the year in question to the irrigation season length in the Baseline Year
TO	Torrumbarry
t_r	Ratio of the length of time a channel has been rationalised in the year in question relative to the irrigation season length in the Baseline Year
TSA	Transfield Services Australia
U_{Base}	Unauthorised use loss in the Baseline Year
V_d	Deemed customer deliveries through individual unmetered service points in the Baseline Year
VL	Proportion of bank leakage recognised as variable
WEE	Water Entitlement Entity

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1 Introduction

1.1 Introduction and purpose

The Victorian State Government and the Commonwealth Government have committed significant funding for the renewal and modernisation of the Goulburn-Murray Irrigation District (GMID). The water savings achieved through the renewal and modernisation works are to be shared between the environment, Melbourne and irrigation customers. The works are also expected to improve the efficiency of delivery and increase the level of service provided to irrigation customers.

Goulburn-Murray Water (GMW) is the owner and operator of the GMID. The GMW Connections Project (GCP) (previously the Northern Victorian Irrigation Renewal Project but since 1 July 2012 part of GMW) forms the greater part of the modernisation of the Goulburn-Murray Irrigation District (GMID).

The water savings achieved by the GCP are to be audited each year. Cardno has been engaged by the Department of Environment and Primary Industries (DEPI) to undertake an independent audit of the water recovery for the 2013/14 irrigation season. This purpose of this report is to present the findings of this independent audit. This is the sixth annual audit of the water savings achieved by the renewal and modernisation works in the GMID.

1.2 Water Savings Protocol

The Victorian State Government has developed a Water Savings Protocol so that water savings can be consistently and transparently calculated and audited. The Water Savings Protocol is a series of documents including the 'Audit Process' and 'Technical Manual'. The Audit Process document sets out that independent audit of water savings is to include:

- Verifying that the Phase 3 (and Phase 4) water recoveries calculations have been calculated in accordance with the Technical Manual for the Quantification of Water Savings
- Checking that the data collection and inputs are as accurate as could reasonably be expected for the purpose of calculating water recoveries
- Spot checks that the program of works has been implemented as documented in the water saving calculations
- Checking that water recoveries have been calculated based on the nature and the extent of all modernisation works completed prior to 30th June[2] in the year of the audit
- Providing a corrected estimate of the water recoveries for any component where the project proponent calculations are found to be non-compliant or deficient
- Identifying potential improvements to the data collection, data analysis, assumptions and methods used to estimate the water recoveries. Recommend changes to the Technical Manual for the Quantification of Water Savings to the Director of Allocations and Licences within DEPI that will improve useability and accuracy of water recoveries
- Checking if suggestions from the previous year's audit have been acted upon and report upon the status of each of the suggested improvements.

The Technical Manual defines the components of water savings and the methodology for estimating them. This is the principal document against which water savings estimates are verified.

A copy of the Protocol is available on the DEPI website at this location:
http://www.depi.vic.gov.au/water/rural-water-and-irrigation/improving-irrigation-efficiency/water-savings-protocol

[2] The Audit Protocol previously set the end date for the completion of modernisation works as 15 May. The point in time for determining water savings is now 30 June, as set out in the scope of works issued by DEPI.

1.3 Scope of 2013/14 irrigation season irrigation modernisation water recovery audit

The audit scope has been set by DEPI and is set out in the Project Brief, dated 15 September 2014. The scope of works is broadly an audit of water recovery estimates for the modernisation works being undertaken in Goulburn Murray Water's operating area. The audit scope included the following:

- Irrigation modernisation works in place for the 2013/14 water year (up to 30 June 2014).
- The water recovery estimates for the whole Goulburn Murray Irrigation District (Central Goulburn, Rochester, Pyramid-Boort, Murray Valley, Shepparton and Torrumbarry Irrigation Areas).
- Irrigation modernisation works and recovery separately accounted to the GCP Stage 1, GCP Stage 2 and CG1234 projects. We note that only minor works should have taken place in CG1234 over and above the previously audited works.
- The cumulative water entitlement purchases to 30 June 2014 converted to average equivalent water recovery.

The scope has required the auditor to address the following:

- Establishing that stated works have been carried out.
- Establishing that water recovery is estimated correctly in accordance with the Water Savings Protocol – Technical Manual for the Quantification of Water Savings Version 4. The audit of water savings for all areas shall be for the following cases, namely:
  - Phase 3 – water savings generated in the 2013/14 water year.
  - Phase 4 – long term average water savings estimates.
- Confirming the water savings estimates or, if appropriate, corrected estimates.
- Identifying opportunities for improvement in the collection and processing information to establish water savings estimates.

The scope of work for the audit of the "Water Entitlement Purchases and Water Recovery" requires the audit to address the following:

- Checking that the Water Entitlement Entity (WEE) information provided by GMW aligns with that recorded in the Victorian Water Register at 30 June 2014. GMW is to provide a register of WEE details including WEE number, volume, date of entry onto register, reliability and ownership.
- Conversion of WEE volumes to long term diversion limit equivalent (LTDLE) water recovery using the conversion factors provided by the Department.

Note that there are additional water savings volumes achieved by GMW that are outside the scope of this audit t.

2 Background

2.1 Goulburn Murray Irrigation District

The Goulburn Murray Irrigation District (GMID) is composed of the following six main irrigation areas located in northern Victoria:

- Central Goulburn (CG) (which is divided into sub-areas CG1-4 and CG5-9)
- Murray Valley (MV)
- Pyramid-Boort (PB)
- Rochester (RO)
- Shepparton (SH) and
- Torrumbarry (TO).

Goulburn Murray Water (GMW) is responsible as both the Water Resource Manager and System Operator for the GMID. Figure 2-1 shows the location of the GMID and the main irrigation district.

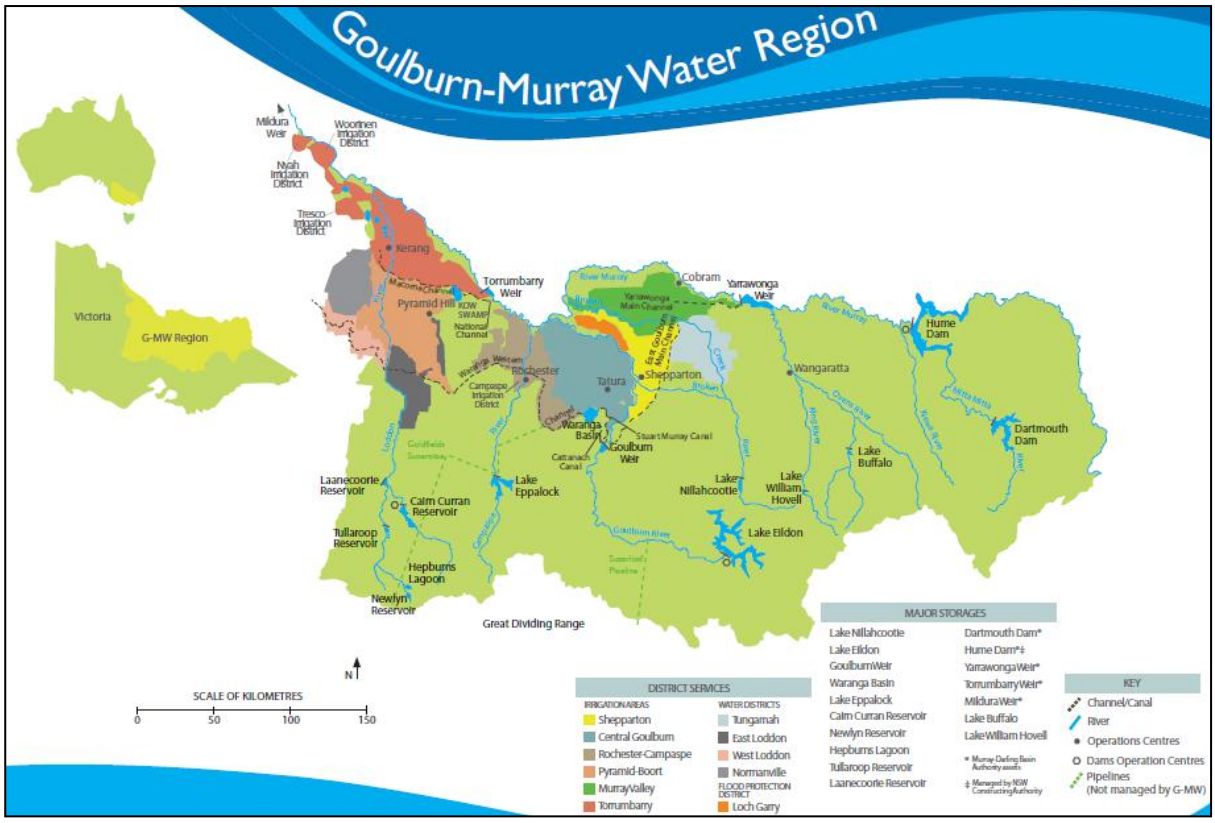

Figure 2-1 Goulburn Murray Irrigation District

Source: http://www.g-mwater.com.au/about/regionalmap

2.2 Irrigation modernisation

In 2004, the Victorian Government put in place a long-term plan for water resource management titled “Our Water Our Future”. A key initiative to deliver the sustainable outcomes targeted in this plan is modernisation of irrigation areas in northern and southern Victoria. Irrigation modernisation seeks to improve the efficiency of irrigation systems.

Irrigation modernisation typically involves the automation of channel infrastructure, construction of pipelines, upgrading the accuracy of metered outlets to farms, lining and remodelling of channels and rationalising the

channel network. Many systems are currently controlled manually and the automation of these systems allows water flows to be delivered more accurately and more quickly. These capital works, in unison with changed operational approaches, should have the twin benefits of reducing the amount of water lost in irrigation systems and improving service levels to customers.

The DEPI website[3] outlines the following main elements of irrigation modernisation:

Channel automation

Channel automation is a way of improving the efficiency of irrigation networks by using new technology to control the flow of water from the storage (usually a dam) through the distribution system to the irrigator. It involves replacing manual flow control structures in channels with updated gates that accurately measure flows, provide real time measurement data and, in most cases, are automated. The automation greatly reduces the water spilt from the end of channels (known as outfalls). Further the gate measurement allows more accurate location of the worst seepage and leakage losses and more effective targeting of channel remediation works.

Automation of the gates also provides the ability to interact with meters and on-farm automation equipment, so best practice irrigation methods can be employed on farms. Other benefits include constant flows and faster water delivery times.

Pipes and channels

Much of the irrigation system relies on open earthen channels to transport water. Inefficient operation and leaky sections result in up to 30% of the total volume being lost. Water losses can be minimised by reducing outfall losses, lining, remodelling or pipelining parts of the channel system.

Improved meter accuracy

Dethridge wheels are inaccurate and on average under-measure water delivery by about 8%. They fail to meet the new metering standards introduced by the Australian Government that specify a maximum of plus or minus 5% measurement inaccuracy. There are also occupational health and safety risks associated with using Dethridge wheels.

2.3 Irrigation modernisation projects

The GCP is being implemented in two stages. Stage 1, which is funded by the Victorian Government, has been underway since 2008 and Stage 2, which is funded by the Commonwealth, commenced in 2012. Additionally, GMW is also responsible for the delivery of the Shepparton and Central-Goulburn 1234 irrigation modernisation project which was largely complete in 2010.

2.3.1 Shepparton and CG1234 Project

The Shepparton and CG1234 project was undertaken several years ago as an alliance, (named Futureflow), between GMW, a consultant and a contractor and was substantially completed by the 15 May 2010. The water savings from this project were audited in 2011. However, some works, principally meter replacements are not yet completed. The water savings achieved for the remaining works under this project also require audit.

2.3.2 Stage 1 Project

Under the funding arrangement between the State and Commonwealth Governments, signed in October 2011, Stage 1 of the project is being funded by contributions from the Victorian Government ($600 million

[3] http://www.depi.vic.gov.au/water/rural-water-and-irrigation/improving-irrigation-efficiency/modernising-irrigation-systems. *Note - minor edits have been made to this text to clarify its meaning.*

initial contribution and $100 Million from a portion of the funds relevant to the sale of 102 GL of water associated with GMW Connections Project) and Melbourne Water ($300 Million). This stage commenced in 2008 and is planned for completion in 2018.

The objectives of the Stage 1 project are to:

- Deliver a long-term average of 225 GL of annual project generated water by July 2018 to be shared equally between irrigators, the environment and other funding contributors
- Deliver a modernised backbone channel water distribution system
- Connect approximately 30% of those customers currently supplied by smaller spur channels to the backbone channel via a modern connection
- Upgrade metering (including real time measurement) on up to 50 per cent of customer supply points, by July 2018, and
- Provide channel remediation to reduce high loss channel pools.

2.3.3 Stage 2 project

The Commonwealth and Victorian Governments are providing funding of $1.059 billion for Stage 2 of the GMW Connections Project, which commenced delivery in 2012 and is planned to be completed in 2018. The Commonwealth Government is contributing $953 million and $106 million from a portion of the funds associated with the sale of 102 GL of water associated with GMW Connections Project.

The Stage 2 project is planned to raise the efficiency of the GMID system to over 85%, generating a long-term average of 204 GL of annual water savings from reduced distribution losses. Half of these savings are to be transferred to the Commonwealth Government for environmental use and in particular, contributing to Sustainable Diversion Limits in the Murray Darling Basin.

The works planned to be implemented under Stage 2 include:

- Metering: installation of 5,900 national measurement standard compliant irrigation meters, many of which will be fully automated with remote monitoring.
- Connections: development of new connections for 3,400 customers currently supplied by smaller spur channels (approximately 2,259km) and not dealt with in Stage 1. This also provides for new on-farm infrastructure and restructuring incentives for customers wishing to retire land from irrigation.
- Modernisation works across all irrigation areas including some work in the CG1-4 and Shepparton areas,
- Channel lining: lining of 75 km of high loss pools Service enhancement projects: construction of a number of projects to improve service standards in the GMID including key bottlenecks in the Torrumbarry irrigation area.
- Environmental enhancement projects: implementation of projects to enhance key environmental assets in the GMID.

The continuing works of this stage and other future works are planned to be managed by GCP until the project's estimated completion in 2018.

3 Audit Methodology

3.1 Water Savings Audit Process requirements

The Water Savings Audit Process[4] is a document under the Water Savings Protocol that sets out the approach to be taken to the independent audit of water savings. The scope of independent audit work relating to irrigation modernisation is to include the elements detailed below. Where each element is addressed in this report is set out below the individual element.

Verifying that the Phase 3 (and Phase 4) water savings calculations have been calculated in accordance with the Technical Manual for the Quantification of Water Savings.

We address this requirement in Section 6 of this report.

Checking that the data collection and inputs are as accurate as could reasonably be expected for the purpose of calculating water savings.

We address this requirement in Section 4 and 5 of this report.

Spot checks that the program of works has been implemented as documented in the water saving calculations.

We address this requirement in Section 5 of this report.

Checking that water savings have been calculated based on the nature and the extent of all modernisation works

We address this requirement in Section 5 of this report.

Providing a corrected estimate of the water savings for any component where the project proponent calculations are found to be non-compliant or deficient.

We address this requirement in Section 6 of this report.

Identifying potential improvements to the data collection, data analysis, assumptions and methods used to estimate the water savings. Recommend changes to the Technical Manual for the Quantification of Water Savings to the Director of Allocations and Licences within DSE (now DEPI) that will improve useability and accuracy of water savings.

We address this requirement in Section 8 of this report.

Checking if suggestions from the previous year's audit have been actioned upon and report upon the status of each of the suggested improvements.

We address this requirement in Section 9 of this report.

The Audit Process also defines the expected content of the water savings audit report. The minimum requirements of the report and where they are fulfilled in this report is summarised following:

[4] *Water Savings Audit Process (Water Savings Protocol), Department of Sustainability and Environment Victoria, Version 2.0 June 2009.*

Table 3-1 Expected Content of Water Savings Audit Report

Requirement	Relevant Section
A summary of findings.	Summary of Findings
An audited supporting data set and reports.	Section 6
Full evaluation of water savings estimation against protocol.	Section 6
Documentation of any instances of non-compliance and the required changes to the proponent's estimates.	Section 5 and 6
Full tabulation of water savings estimation against Project Proponent's Business Case targets.	Summary of Findings
Description of the audit process undertaken, including a description of how the information was audited and/or verified (e.g. sighted documentation, persons spoken to etc.).	Section 3
In addition to the audit report, the auditor can recommend, to DSE, improvements to the method for estimation, calculation and reporting water savings for future years. This may include recommendations of revisions to the Technical Manual for the Quantification of Water Savings, or to the Project Proponent's processes for estimating and reporting water savings.	Section 8

The following sub-sections detail the audit process undertaken.

3.2 Overview of audit methodology

The Cardno approach to auditing water recoveries is based around structured interviews with key authority staff. These structured interviews allow us to scrutinise the water recovery calculations and assess the veracity of the supporting information. Our audit focuses on these areas:

- Reviewing the systems and procedures in place to manage the data used in the calculations, including trailing the data used in the calculations back to source records
- Verifying that the works claimed are complete and commissioned through review of works handover and commissioning documents
- Checking that the audit calculations have been performed correctly
- Validating the WEE register maintained by GCP
- Reviewing GCP's progress on the implementation of previous audit recommendations.

3.3 Schedule of audit meetings

Table 3-2 lists the meetings held to complete the audit work.

Table 3-2 Schedule of Audit Meetings

Date	Audit Work	Auditee	Position
Monday 10 November 2014	Start-up Meeting	Ian Rodgers	General Manager Connections Program
		Ross Plunkett	Manager Environment & Water Savings
		Peter Roberts	Project Manager, Water Savings
		Ben Morse	Water Savings Analyst
		Kane Dougherty	Senior Project Manager
		Trudi Woodward	Construction Database Administrator
		Ravindra Senaratne	Construction Engineer

Date	Audit Work	Auditee	Position
		Ali Alamein	Project Manager Meters & Pipelines
	Audit of water savings calculations	Peter Roberts	Project Manager, Water Savings
		Ben Morse	Water Savings Analyst
Tuesday 11 November 2014	Assignment of works between Stage 1 and Stage 2	Peter Roberts	Project Manager, Water Savings
		Natalie Sharp	Support Manager PMO
	Audit of Water Entitlement Entities	Mellissa Crosby	Manager Business Support
Wednesday 12 November 2014	Shepparton and CG1234 residual works	Jamie Cowan	Project Manager R&O
		Jeremy Nolan	Design Authority Manager
		Peter Roberts	Project Manager, Water Savings
	Review of IPM and SCADA records	Mick Doherty	Water Systems Planner
		Peter Roberts	Project Manager, Water Savings
Thursday 13 November 2014	Site visit	Peter Roberts	Project Manager, Water Savings
Friday 14 November 2014	Close out meeting	Ian Rodgers	General Manager Connections Program
		Peter Roberts	Project Manager, Water Savings
		Mellissa Crosby	Manager Business Support
		Kane Dougherty	Senior Project Manager
		Trudi Woodward	Construction Database Administrator
		Ravindra Senaratne	Construction Engineer
		Ali Alamein	Project Manager Meters & Pipelines

3.4 Document register

A list of the documents received before, during and after the audit are included in Appendix A.

4 Information Systems and Business Processes Supporting Water Savings Calculations

4.1 Introduction

Our audit considers the systems and processes in use by GMW and its contractors that support the calculation of water recoveries to determine whether they are sufficiently reliable to produce accurate, repeatable and transparent data. Our review of systems and processes focuses on those business areas central to the water recovery estimates:

- Planning and delivery of construction works
- Outfall measurement and recording
- Customer deliveries
- Assignment of works between Stage 1 and Stage 2 projects.

Because of the importance of demonstrating that the water recoveries have been calculated based on accurate information, we have complemented this review of systems and processes, with trailing of selected data, used in the calculations, to their source. The results of this trailing are documented in Section 5.

To operate its irrigation network, GMW employs a number of information systems. The key systems are:

- SCADA – provides real time monitoring of gate operation, including trending. Field readings are stored and can be accessed through a data warehouse.
- Maximo – asset information system and computerised maintenance management system
- GIS – records location of channels and control gates. Channel lengths and widths are measured from here.
- The Irrigation Planning Module (IPM) takes customer orders, checks system capacity to deliver orders and records delivered volumes
- Agresso – the finance system for the GCP which is used for tracking works progress and costs, as well as recording the categorisation of works between Stage 1 and 2.

4.2 Planning and delivery of construction works

In previous years, construction records were held across a number of different systems reflecting the different parties responsible for providing infrastructure. However, as the project has progressed, the majority of works are undertaken by a single contractor, TransCom Connect with construction records stored in its document management system, SharePoint (previously Aconex). TransCom Connect is a joint venture between Transfield Services Australia and Comdain Infrastructure. Previously, works were predominantly constructed by Transfield Services Australia alone.

TransCom Connect as the managing contractor typically manages a number of sub-contractors including designers, civil works contractors and mechanical and electrical (M&E) contractors to complete the required works. Works within the channels (e.g. regulator gate automation and channel remediation) are usually completed outside of the irrigation season, while service point replacements and rationalisations are delivered throughout the year.

Delivery of the modernisation assets generally follows the following sequence:

1. GMW's planners determines the schedule of works to be undertaken
2. TransCom Connect project manages the asset delivery:
    a. Engage designer to complete detailed design
    b. Engage civil subcontractor to complete civil works

c. Engage M&E subcontractor to complete M&E works

3. Asset commissioning
4. Handover of assets to GMW.

Some works are also being undertaken by GMW work crews, for example the Shepparton and CG1234 works.

When new assets are commissioned, or redundant channel decommissioned, an Inspection Test Procedure (ITP) certificate is produced which records relevant commissioning/decommissioning details. These ITP certificates are stored on SharePoint along with other documents relevant to the construction and commissioning of each site. These documents are collectively referred to as the 'work pack' for the constructed asset.

While handover of assets to GMW following a defects liability period is important for the successful ongoing operation of the modernisation works, we have focused on asset commissioning rather than handover, as water recoveries are typically achieved from the time that an asset is commissioned. Asset commissioning dates are recorded by TransCom Connect on schedules and forwarded to GMW. GMW then uses these dates in its water recovery calculations.

We believe that GMW's and TransCom Connect's systems for asset delivery and commissioning are sufficiently robust to completely and correctly record the details of irrigation modernisation asset installation and commissioning. TransCom Connect's document management system provides the reference database for the storage and retrieval of all construction and commissioning records. The database has been in use for several years.

4.3 Recording of outfall flow volumes

The volumes of flows through outfalls are an important data input into water savings calculations as savings from outfalls currently are a significant component of all water savings achieved. Now that irrigation modernisation works in the GMID have been in progress for several years, most major outfalls have online flow measurement which is recorded in the GMW SCADA. A number of unmetered outfalls still exist where flows are estimated by operators remain in operation (mainly on spur channels that may be decommissioned in the future). However, these account for only a small proportion of the water savings achieved and will largely be removed or replaced by SCADA monitored outfalls by the end of the Project, as decommissioning of spur channels occurs.

Where an outfall has online measurement, field staff record the outfall volume each day in a logsheet. There is a separate logsheet for each irrigation area. The field staff review the SCADA data and, if necessary, make adjustments for any erroneous readings, e.g. if the water level in the channel is particularly low, the flow reading may be a false high reading when in fact no water is leaving the outfall.

We have previously recommended that GMW conducts an audit of its outfalls to confirm their location, identification and configuration. GMW has largely completed this audit and is updating its systems to reflect the better information obtained.

4.4 Customer delivery volumes

The IPM is the business system used by GMW to manage irrigation supply orders and plan the delivery of these orders. When an order is placed by a customer online or by telephone, it is sent to IPM. For customers on fully automated channels, IPM essentially sends the order to the customer's outlet. The orders specify the times to open and close the customer outlet and the ordered flow rate. The channel automation system uses a combination of feedback control on water level with feed-forward on flow to control to the channel.

IPM also provides management reporting facilities on a range of operational aspects and records delivery volumes for billing purposes. It also records delivery volumes against entitlements and rejects orders where the entitlement has been exceeded.

For the purposes of the water savings calculations, IPM is used to determine customer deliveries through service points. We have reviewed the procedures for extracting this data from IPM and found that they adequately describe the process.

4.5 Assignment of savings between Stage 1 and Stage 2

The Victorian and Commonwealth Governments enter into funding agreements for modernisation works in the GMID which are the basis on which water savings are assigned between the Stage 1 and Stage 2 projects. For all new proposed works, a Business Case is written and this Business Case details the Stage to which the works belong with reference to the relevant funding agreement. For historical works, a Business Case may not have been written, therefore, assignment of the works is undertaken by inspection. However, because the nature of the Stage 1 works, which typically involved the backbone, are generally different to the Stage 2 works, assignment of works to a project stage is usually reasonably straightforward.

When a Business Case is raised, it is entered as a record into the GCP finance system, Agresso. The Business Case record has an identification number (referred to as the BCID) and linked to this record is the project stage. Progress and costs relating to the Business Case are then tracked using Agresso.

A separate audit is conducted to provide assurance that GCP is adhering to its ring-fencing policy for allocation of works between Stage 1 and Stage 2. We were provided with the audit report for the period ended 30 June 2014. This report found that the ring-fencing policy had been complied with in all material respects for the audit period.

4.6 Conclusions

Our review for the 2013/14 audit of the information systems and processes used by GMW has found that they continue to be sufficiently robust to generate data and inputs that are as accurate as could reasonably be expected for the purpose of calculating water recoveries.

4.7 Recommendations

We make not identified any specific recommendations in the area of systems and processes.

5 Data trailing of calculation inputs

5.1 Objective

We have trailed data used in the calculation of water savings back to source systems and original data sets as part of our audit to test that the inputs utilised to estimate water savings is based on complete and accurate data contained in GMW information systems. The data trailing undertaken at the audit is a combination of random and targeted sampling.

We discuss the data trailing undertaken in the following sections.

5.2 Construction records

5.2.1 General

As in previous year, our review of construction records has focused on works constructed during 2013/14 as we have reviewed samples of assets constructed in previous years through previous audits. As noted in Section 4.2, construction of modernised irrigation infrastructure in 2013/14 was predominantly undertaken by TransCom Connect, a joint venture between Transfield Services Australia and Comdain Infrastructure. Some modernisation works are currently being undertaken by Goulburn Murray Water.

5.2.2 Service point replacement and rationalisation – Stage 1 and Stage 2 project

We requested commissioning certificates (ITP certificates) for a sample of 22 sites where service points had been replaced or rationalised to confirm that the works have been completed. We also checked that that the date of the commissioning certificates agreed with the date claimed in the water recovery calculations.

The results of reconciling these records with the data used in the water savings calculation is summarised in Table 5-1.

Table 5-1 Results of service point replacement and rationalisation data trailing

Region	Asset	Audit notes
Central Goulburn	TN4455	A comprehensive work pack which included the ITP was provided.
Central Goulburn	RN1705A	A comprehensive work pack which included the ITP was provided.
Central Goulburn	TN4404	A comprehensive work pack which included the ITP was provided.
Murray Valley	MV2173	A comprehensive work pack which included the ITP was provided.
Murray Valley	MV5645B	A comprehensive work pack which included the ITP was provided.
Murray Valley	MV2014	A comprehensive work pack which included the ITP was provided.
Murray Valley	MV5248	A comprehensive work pack which included the ITP was provided.
Murray Valley	MV2010	A comprehensive work pack which included the ITP was provided.
Murray Valley	MV1208	A work pack which included the ITP was provided.
Murray Valley	MV1200	A work pack which included the ITP was provided.
Pyramid-Boort	PH2580	Only the ITP and photos were provided.
Rochester	RO4228	A comprehensive work pack which included the ITP was provided.
Rochester	RO5100	A comprehensive work pack which included the ITP was provided.
Rochester	RODS6801A	A comprehensive work pack which included the ITP was provided.
Rochester	RO5101	A comprehensive work pack which included the ITP was provided.
Shepparton	SP508	A comprehensive work pack which included the ITP was provided.
Shepparton	SP644	A comprehensive work pack which included the ITP was provided.

Region	Asset	Audit notes
Shepparton	SP801	A comprehensive work pack which included the ITP was provided.
Shepparton	SP693	A comprehensive work pack which included the ITP was provided.
Torrumbarry	TO2214	A comprehensive work pack which included the ITP was provided.
Torrumbarry	TO2067	A comprehensive work pack which included the ITP was provided.
Torrumbarry	TO2073	A comprehensive work pack which included the ITP was provided.

The analysis in Table 5-1 shows that the information provided by GMW is sufficient to confirm that the works claimed have been completed. For 21 out of the 22 sites reviewed (95%), a work pack that included an ITP and photos was provided which is a significant improvement to the previous year (2012/13) when only 51% of the sites reviewed were provided with a work pack that included an ITP.

5.2.3 Service point replacement – Shepparton and CG1234 project

For this audit, we are required to review the water savings resulting from the completion of residual service point replacement works in 2013/14. The majority of this project was completed in previous years and has been subject to audit.

The remaining works to be audited this year are the replacement or rationalisation of 78 meters, all located in the Central Goulburn 1-4 area. The works were originally included in the scope of the Futureflow alliance but were not completed because large diameter meters were required (large diameter meters have not become available until recent years).

We are satisfied that all works claimed are complete. We requested GMW to provide to us ITP certificates for 7 sites. For 6 sites, the ITP certificates were provided. There was no ITP or construction record for RN394A, which was rationalised. However, the abandoned asset was sighted through GIS/ Maximo. It is recommended that photos of the decommissioning works during construction and when complete be kept in record.

5.2.4 Rationalisation

We requested that GMW provide us with construction records verifying that the channel rationalisation works claimed in the water recovery calculations have been completed for a sample of 14 sites. The results of this record trailing are detailed in Table 5-2.

Table 5-2 Results of channel rationalisation construction record trailing

Business Case	Region	A-ID	IPM/Asset Code	Notes
21	Murray Valley	0021-104	CH011657 Block	A comprehensive work pack which included the ITP was provided.
9999	Central Goulburn 1-4	9999-500		A comprehensive work pack which included the ITP was provided.
2242	Rochester	2242-100	RO5200	A comprehensive work pack which included the ITP was provided.
627	Murray Valley	0627-100	ST073401	A comprehensive work pack which included the ITP was provided.
2084	Murray Valley	2084-100	MV6676 Block	A comprehensive work pack which included the ITP was provided.
1884	Torrumbarry	1884-500	CH006323	A comprehensive work pack which included the ITP was provided.
1510	Torrumbarry	1510-500	ST002595	A comprehensive work pack which included the ITP was provided.

Business Case	Region	A-ID	IPM/Asset Code	Notes
807	Central Goulburn 5-9	0807-100	ST064430	A comprehensive work pack which included the ITP was provided.
819	Central Goulburn 5-9	0819-500	ST046586	A comprehensive work pack which included the ITP was provided.
521	Torrumbarry	0521-103	ST002413	A comprehensive work pack which included the ITP was provided.
2399	Pyramid-Boort	2399-100	ST008941	GMW was only able to provide photos to confirm that this channel section had been decommissioned. No construction records or ITP certificate were provided.
1549	Central Goulburn 5-9	1549-103	ST045412	GMW was only able to provide photos to confirm that this channel section had been decommissioned. No construction records or ITP certificate were provided.
1510	Torrumbarry	1510-500	ST002386	A comprehensive work pack which included the ITP was provided.
1023	Murray Valley	1023-246	ST042499	A comprehensive work pack which included the ITP was provided.

The analysis in Table 5-2 shows that the information provided by GMW is sufficient to confirm that the works claimed have been completed. For 12 out of the 14 sites reviewed (86%), a comprehensive work pack that included an ITP and photos was provided. For the remaining two sites, ST008941 and ST045412, only photos were provided. This is a significant improvement to the previous year (2012/13) where only 48% of the sites reviewed was provided with a work pack that included an ITP.

5.2.5 Remediation

We requested that GMW provide construction records for a sample of remediation works completed in 2013/14 to verify that the channel remediation works claimed in the water recovery calculations had been completed. A total of 13 pools were remediated in 2013/14. Four pools were included in the sample of sites reviewed and these are detailed in Table 5-3.

The records provided included maps, photos, track sheets and commissioning paperwork. Based on the evidence provided, we were able to confirm that the works in our sample are complete.

Table 5-3 Sample of remediation sites

Area	Pool
CG1-4	RN111-112
CG1-4	RN338-339
MV	MV593-605
MV	MV770-772

5.3 Outfall volumes

We selected a number of monitored outfalls to compare the outfall volume used in the calculations with that recorded on SCADA. The water savings calculations use operator logsheet records of outfall volumes and operators refer to SCADA when completing the logsheets. The observations from this comparison of data sources is shown in Table 5-4.

Table 5-4 Comparison of outfall data from operator logsheets and SCADA

Outfall	Outfall volume in calculations (ML)	Outfall volume from SCADA (ML)	Observations	Action / Recommendation
RN793E	55.5	62.6	The difference between the two data sources is >10% but it is difficult to identify the reason for the discrepancy with the information available. We accept the operator's reading on the basis that they are best placed to record the volume	Operators should note reasons why their readings differ from SCADA
RN824	0.0	Null	This gate shown as "out of service" on SCADA and the last signal received on 4 May 2010. GMW advised that the gate type is not compatible with SCADA and so operates in local mode. It is not possible to use SCADA to verify the zero reported by the operator.	We recommend for outfalls not connected to SCADA that GMW's operators report on the logsheets how frequently the sites are visited and on what basis their measurements are made
MV460D	68.0	79.1	The difference between the two data sources is >10% but it is difficult to identify the reason for the discrepancy with the information available. We accept the operator's reading on the basis that they are best placed to record the volume	Operators should note reasons why their readings differ from SCADA
RO602A	155	48.1	GMW advised following discussion with the operators that the outfall volumes had been recorded against the incorrect sites due to a change in naming convention.	Operator logsheets should be reviewed to ensure that they are consistent with GMW's corporate asset identification
RO610	7	177	GMW advised following discussion with the operators that the outfall volumes had been recorded against the incorrect sites due to a change in naming convention	Operator logsheets should be reviewed to ensure that they are consistent with GMW's corporate asset identification
TO305	0	97.3	GMW advised that the outfall gate was found to be faulty during the year and that the SCADA readings were incorrect as a result. We requested the work order relating to the fault and repair of the gate but GMW was not able to provide a work order. It was stated that a work order was not available because of the type of gate. We requested GMW to provide the daily trend of outfall volumes from the gate. The trend shows that the outfall volumes recorded in SCADA occurred mostly in a 16 day period from 8/9/13 to 23/9/13 where a total of 77.2ML was recorded with daily totals peaking across the period 18/9/13 to 22/9/13. Some rainfall was recorded during this period at the 'Kerang Model Farm' weather station with falls of 13.4mm of 14/9/13 and 28.4mm on 17/9/13. We do not consider that the outfall trend provided by GMW is consistent with the gate being faulty. Faulty gates more commonly read (in error) a constant high flow rate for the period that they are faulty.	Operators should note reasons why their readings differ from SCADA

Outfall	Outfall volume in calculations (ML)	Outfall volume from SCADA (ML)	Observations	Action / Recommendation
			We have limited confidence in the operator reading of 0ML and consider that the 97.3ML reading from SCADA is likely to be more correct. However, we note that there is limited information available on which to prefer one data source over the other.	
TO1025	5	1,556.9	GMW advised that this site includes environmental outfalls to Lake Elizabeth and that 1,455 ML of environmental flows were recorded to this site in 2013/14. This leaves a discrepancy between the two data sources of around 95ML. This reason for this difference was not able to be identified.	Operators should note reasons why their readings differ from SCADA
PH636D	35.73	35.4	There is reasonable agreement between the two data sources allowing for errors and operator adjustments	
PH1211	14.62	17	The difference between the two data sources is >10% but it is difficult to identify the reason for the discrepancy with the information available. We accept the operator's reading on the basis that they are best placed to record the volume	Operators should note reasons why their readings differ from SCADA
PH1186	64.60	65.4	There is reasonable agreement between the two data sources allowing for errors and operator adjustments	

The analysis in Table 5-4 shows that for the sample of ten sites:

- For two sites there was reasonable agreement between the outfall volume recorded in the operator logsheet and that in SCADA.
- For four sites the difference between the operator logsheet and the reading from SCADA was >10%. The reason for the differences was not able to be identified by GMW.
- For two sites the outfall was incorrectly identified on the operator logsheet.

We note that the sample of outfall sites was not randomly selected; instead one to two sites were selected from each irrigation area by inspection.

A difficulty in drawing conclusions from this review is the lack of information that is provided by operators as to why their readings differ from the SCADA readings. When flow measurement and transmission is operating correctly, SCADA should provide accurate and reliable outfall measurements. However, operators have access to other information such as equipment failures and operational circumstances that may mean that there is justification for their reading differing from the value recorded in SCADA.

In the absence of information as to why operator's readings differ from the SCADA readings, we have taken a conservative approach and have accepted the operator's readings given that:

- the operator is best placed to appreciate what is occurring at each site
- GMW is still in a period of transition in how its operators record data and make use of SCADA.

However, we expect that GMW will put in place appropriate processes to understand the variances for future audit years to provide the necessary confidence in the outfall volumes used in the calculations. We also note that similar observations about outfall volumes have been made in previous years. The audit protocol requires us to check "that the data collection and inputs are as accurate as could reasonably be expected". We consider that if GMW does not address this issue in the next 1-2 years that we would consider that the

outfall volume inputs were not as accurate as reasonably expected given the time available to GMW to embed its processes for data recording and quality assurance.

5.4 Mitigating Flows

Mitigating flows are volumes of water that have been identified for alleviating the impacts of irrigation modernisation on wetlands and waterways of high environmental value. These flows are subtracted from water savings due to automation. Mitigating flow volumes are set out in Environmental Watering Plans approved by the relevant Minister. The approved Environmental Watering Plans are published on GMW's website at this location:

http://www.GMWater.com.au/connections/planningandenvironment/the_environment/effects

Mitigating flows have been included in the water savings calculation for 2013/14 at 12 sites. We reviewed the Environmental Watering Plans relating to each of these sites to confirm that the correct allowance for mitigating flows had been made in the water savings calculations. The result of this data trailing is summarised in Table 5-5.

Table 5-5 Findings of review of Environmental Watering Plans

IPM Code	Asset Code	Site of environmental significance	Environmental Water Plan	Audit notes
PH1052A	ST025235	Lake Leaghur	Lake Leaghur	Confirmed correct allowance made for mitigating flows
PH1249	ST008516	Little Lake Boort	Lake Little Boort	Confirmed correct allowance made for mitigating flows
PH1119	ST023738	Duncan	Loddon River	Confirmed correct allowance made for mitigating flows
PH1138A	ST023656	Lake Meran	Lake Meran	Confirmed correct allowance made for mitigating flows
PH1186	ST023234	River Pool	Loddon River	Confirmed correct allowance made for mitigating flows
PH1211	ST025135	Dowdy's	Loddon River	Confirmed correct allowance made for mitigating flows
PH1096	ST047427	Gannons	Loddon River	Confirmed correct allowance made for mitigating flows
PH1224	ST073298	Delamare	Loddon River	Discrepancy between GMW ST code and that in Environmental Watering Plan. Environmental Watering Plan refers to ST0023628.
TO1025	ST004154	Lake Elizabeth	Lake Elizabeth	Confirmed correct allowance made for mitigating flows
		Pig Swamp	Pig Swamp	Confirmed correct allowance made for mitigating flows
TO70	ST001206	McDonald's Swamp	McDonald's Swamp	Confirmed correct allowance made for mitigating flows
SH110	ST072390	Round Lake	Round Lake	Confirmed correct allowance made for mitigating flows

For one site (Delamare, Loddon River), we identified a discrepancy between the structure code (ST code) used by GMW to identify an outfall from which environmental flows are sourced and that recorded in the Environmental Watering Plan. This discrepancy is not material to the mitigating volume estimated. For all other sites we were able to confirm that GMW had made the correct allowance in its calculation of water savings for mitigating water.

For the site where we identified the discrepancy in the reference structure code, GMW was able to demonstrate through its GIS and through description of the waterway in the Environmental Watering Plan that the discrepancy only relates to the referencing of the site; the mitigating flows have been correctly accounted for in its estimate of water savings. We recommend that GMW document this discrepancy and publish a short note confirming the details of the mitigating flow site as referenced in its own systems compared with that in the Environmental Watering Plan.

5.5 Conclusions

We found that most assets included in our samples for data trailing had sufficient evidence to support the fact that they have been constructed and commissioned. We are satisfied that GMW has completed the works claimed in the calculations. GMW has significantly improved how it documents its construction records by keeping comprehensive work packs containing ITPs and photos.

Our review of a sample of outfall data sourced from operator logsheets with that recorded in SCADA found significant inconsistencies. These inconsistencies were not able to be readily explained. In the absence of information as to why operator's readings differ from the SCADA readings, we have taken a conservative approach and have accepted the operator's readings given that:

- the operator is best placed to appreciate what is occurring at each site
- GMW is still in a period of transition in how its operators record data and make use of SCADA.

However, we expect that GMW will put in place appropriate processes to understand the variances for future audit years to provide the necessary confidence in the outfall volumes used in the calculations. We also note that similar observations about outfall volumes have been made in previous years. The audit protocol requires us to check "that the data collection and inputs are as accurate as could reasonably be expected". We consider that if GMW does not address this issue in the next 1-2 years that we would consider that the outfall volume inputs were not as accurate as reasonably expected given the time available to GMW to embed its processes for data recording and quality assurance.

As noted in 2012/13, we found in trailing mitigating flow volumes that for one site (Delamare, Loddon River), there is a discrepancy between the structure code (ST code) used by GMW to identify an outfall from which environmental flows are sourced and that recorded in the Environmental Watering Plan. The outfall site physically exists but losses were not material to the water savings estimates or mitigating flows. For all other sites we were able to confirm that GMW had made the correct allowance in its calculation of water savings for mitigating water. This discrepancy does not impact the water savings calculations.

5.6 Recommendations

We make the following recommendations in relation to our observations from trailing outfall volume data:

- Operators should note reasons why their readings differ from SCADA measurements
- For outfalls not connected to SCADA GMW's operators should report on the logsheets how frequently the sites are visited and on what basis their measurements are made
- Operator logsheets should be reviewed to ensure that they are consistent with GMW's corporate asset identification.

6 Audit Findings –Water Savings Calculations

6.1 Structure of this chapter

This chapter has been structured to align with the structure of the *Technical Manual,* with each water saving intervention presented in the same order as found in that document. The *Technical Manual* provides additional discussion on the application of the water savings calculations that has been omitted from this report to avoid repetition.

For each water saving intervention (channel rationalisation, channel automation, service point replacement and rationalisation and channel remediation) we detail:

- The nature of the works that lead to water recovery and the scope of works undertaken to date
- An overview of the components that contribute to water recovery in each area
- The calculations from the *Technical Manual* used to determine the savings in that area
- The data used in the calculation. Input data is sourced mainly from the *Technical Manual*, the baseline year water balance and operational records
- The water savings resulting from applying the calculation.

The scope of this audit is to review Phase 3 and Phase 4 water savings achieved, where:

- Phase 3 water savings are the annual post-works measurement or verification of interim water savings able to be allocated from the water savings account
- Phase 4 water savings are the assessment of the overall long term water savings achieved through the modernisation program.

6.2 Baseline year water balance

In calculating water savings, reference is made for some components to water loss that occurred in a baseline year. For most water savings components, the baseline year was the 2004/05 irrigation season. A water balance that establishes the value for water loss components in each irrigation area for this baseline year was compiled by GMW. This baseline year water balance has been previously independently audited.

Since the completion of this independent audit, GMW has revisited the baseline year water balance and made some revisions on the basis of better information being available or a more complete understanding of the nature of losses in the irrigation districts. This revised baseline year water balance was independently audited in 2012 and has been used as the basis of this audit.

6.3 Overview of water recovery achieved in 2013/14

The 2013/14 audit requires water savings to be separately accounted to the Stage 1 and Stage 2 projects. The Stage 1 project has been in progress since 2008 while the Stage 2 project commenced in 2012. Therefore, the Stage 1 project accounts for the great majority of savings, as shown in Table 6-1. Note that this table excludes savings from the residual works undertaken in the Shepparton and CG1-4 irrigation areas.

Table 6-1 Audited Phase 4 water savings by project

Project	Phase 4 water savings (ML)	% Total
Stage 1 project	153,036	93%
Stage 2 project	12,318	7%
Total	165,354	

Figure 6-1 provides an overview of the contribution of the different modernisation activities to the audited Phase 4 water savings for 2013/14 for both the Stage 1 and Stage 2 projects. This figure shows that service point replacement (34%) and channel automation (31%) are the most significant contributors to water savings achieved to date. Channel Automation works are largely complete and the share accountable to this intervention will reduce as a proportion of the total with time. As the Stage 2 project progress, savings due to service point replacement and rationalisation and channel rationalisation are expected to increase.

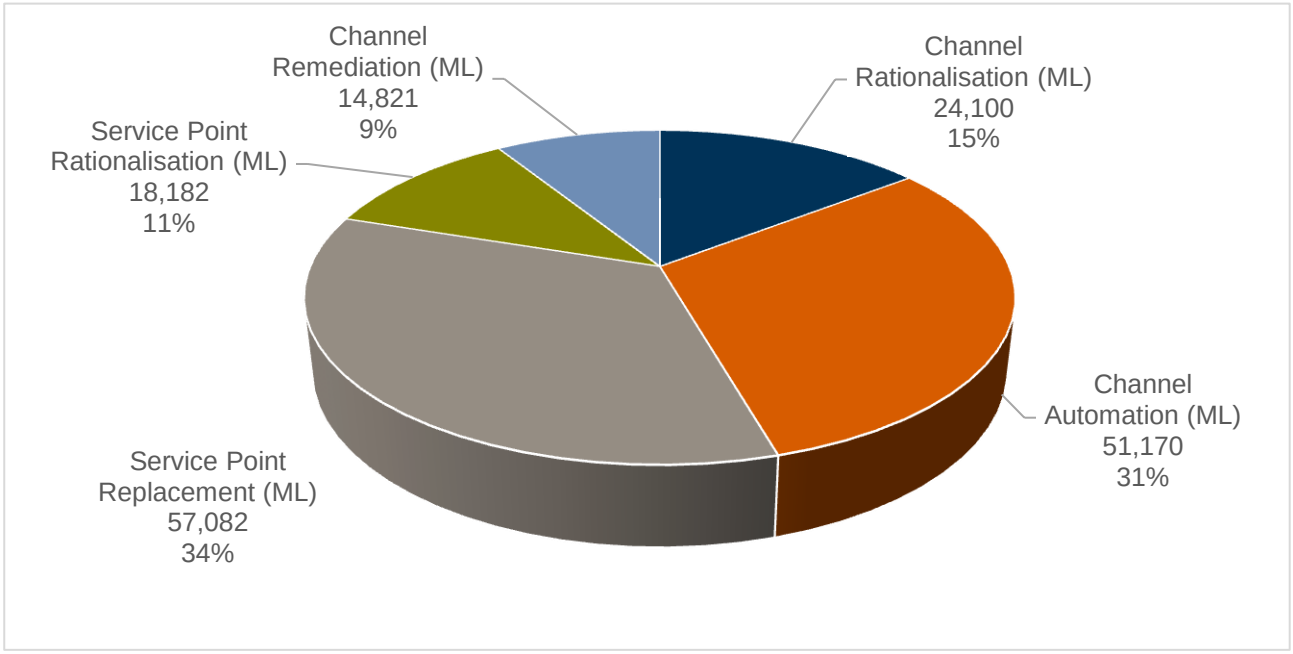

Figure 6-1 Audited Phase 4 Water Savings Estimates (Stage 1 and Stage 2 projects) 2013/14

6.4 Savings from Channel Rationalisation

6.4.1 Scope of Channel Rationalisation Works

Channel rationalisation involves redesigning the channel network so that channel length can be minimised while still providing service to customers. Channels that are determined to be redundant are abandoned and isolated from the distribution network and no flows enter them. This means that there are water savings due to reduced evaporation, bank seepage and bank leakage.

Channel rationalisation has been completed under the Stage 1 project and Stage 2 project. Rationalisation of spur channels under the Stage 2 project is expected to contribute significantly to water savings in future years as the Connections project progresses.

Figure 6-2 details the length of channels rationalised in each irrigation area under the Stage 1 and Stage 2 projects.

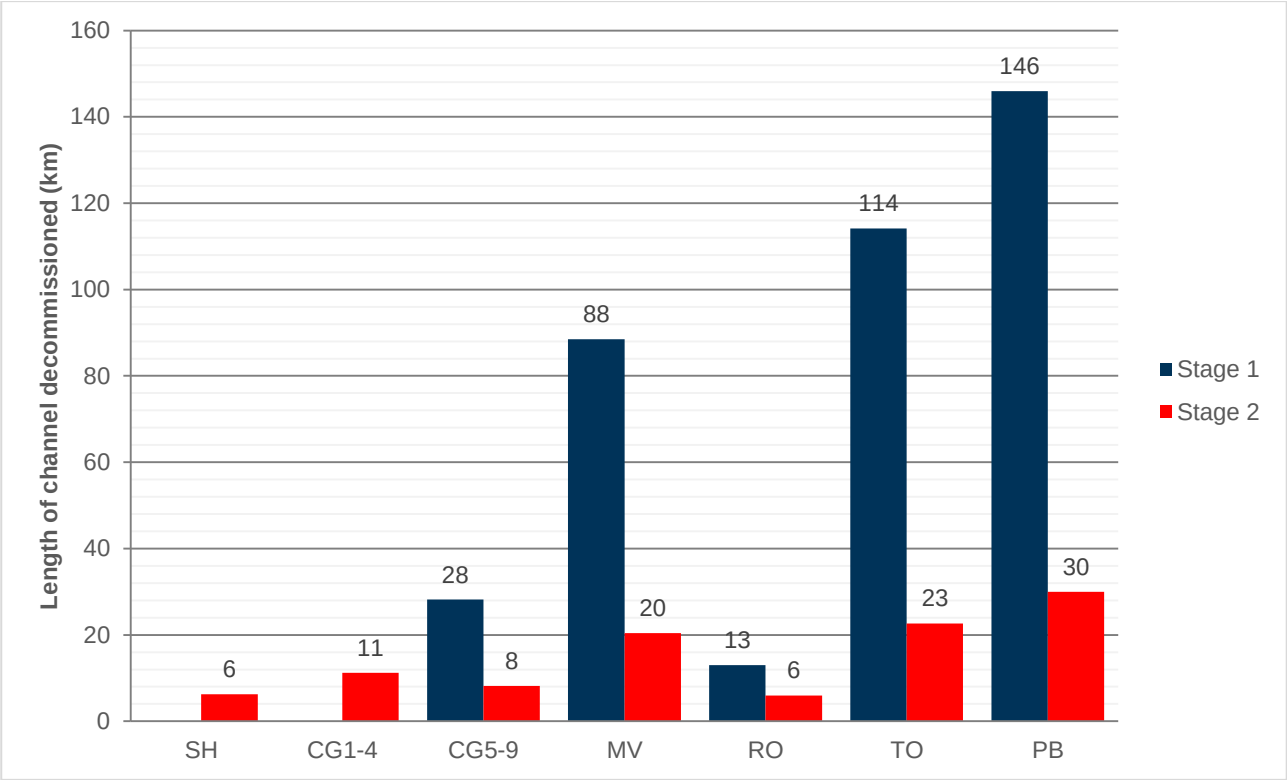

Figure 6-2 Length of rationalised channel by irrigation area under Stage 1 and Stage 2 project

6.4.2 Overview

Water savings due to channel rationalisation are the sum of the savings due to water no longer being lost in the channel to seepage, bank leakage and evaporation:

Phase 3: $WS_{Year\ X} = WS_{Seepage} + WS_{bank\ leakage} + WS_{evaporation}$

Phase 4: $WS_{(LTCE)} = WS_{Seepage(LTCE)} + WS_{bank\ leakage(LTCE)} + WS_{evaporation\ (LTCE)}$

6.4.3 Water Savings Calculations

Phase 3 Calculations

Phase 3 water savings have been calculated by GMW using the Phase 3 channel rationalisation formulae from the *Technical Manual*:

$$WS_{Seepage} = S_{Base} \times CL \times tr \times EF$$

$$WS_{bank\ leakage} = [(L_{Base} \times FL) + (L_{Base} \times VL \times (D_{Year} \times / D_{Base})] \times CL \times t_r \times EF$$

$$WS_{evaporation} = E_{Base} \times CL \times t_r \times EF$$

Phase 4 Calculations

Phase 4 water savings due to channel rationalisation are estimated by the following equations from the *Technical Manual*:

$$WS_{Seepage(LTCE)} = S_{Base} \times CL \times EF \times DF$$

$$WS_{bank\ leakage(LTCE)} = [(L_{Base} \times FL) + (L_{Base} \times VL \times F(LTCE_{Base}))] \times CL \times EF \times DF$$

$$WS_{evaporation\ (LTCE)} = E_{Base} \times CL \times EF \times DF$$

The differences between the Phase 4 calculations and the Phase 3 calculations is the addition of the durability factor (DF) and the replacement of the deliveries ratio with F(LTCE). The revision of the *Technical Manual* for Version 4 has also eliminated the time factor t_r from the Phase 4 calculation.

The revision of the baseline year in 2011/12 adjusted the baseline year losses for leakage, seepage and evaporation losses. Seepage and evaporation losses are also now taken to occur over a full year rather than just the irrigation season.

GMW applies the calculations on a channel by channel basis which gives a more accurate assessment of Phase 3 estimates than if the time and length factors were applied as an average across the entire irrigation area.

6.4.4 Input Data

The inputs required to calculate Phase 3 and Phase 4 water savings due to channel rationalisation are summarised in Table 6-2 and Table 6-3. The first table details the parameters that are fixed or have been previously audited, e.g. the baseline year parameters. The second table details the input data from the current year.

Table 6-2 Fixed Parameters and Baseline Year Parameters for Channel Rationalisation Water Savings Calculation

Parameter	Description	Source
S_{Base}	Seepage in Baseline Year	Baseline Year water balance
L_{Base}	Leakage in Baseline Year	Baseline Year water balance
E_{Base}	Evaporation in Baseline Year	Baseline Year water balance
D_{Base}	Deliveries in Baseline Year	Baseline Year water balance
FL	Proportion of bank leakage recognised as fixed	Technical Manual
VL	Proportion of bank leakage recognised as variable	Technical Manual
EF	Effectiveness Factor for channel rationalisation	Technical Manual
DF	Durability Factor to account for the durability of water savings	Technical Manual
$F_{(LTCE)}$	Long Term Cap Equivalent Factor to convert Current Year volumes to Long Term Cap Equivalent volume	Calculated from deliveries and base figure advised by Department of Environment and Primary Industries

Table 6-3 Current Year Parameters for Channel Rationalisation Water Savings Calculation

Parameter	Description	Source
CL	Ratio of length of spur channel length rationalised to total spur channel length in system	GIS and direct measurement
t_r	Ratio of the length of time a channel has been rationalised in the year in question relative to the irrigation season length in the Baseline Year	Construction records
D_{Year} **x**	Customer deliveries in the year in question to the irrigation system	IPM reports

We have reviewed the input data and confirm that the fixed parameters sourced from the *Technical Manual* are correct. We cross checked the baseline year values against the baseline year audit report and confirmed that GMW has used values from the spur channels water balance.

Our review of the current year parameters used in the calculations found the following:

Customer Deliveries in the Current Year ($D_{Year\ X}$)

Customer deliveries through the meters replaced in each irrigation district are determined through IPM. These delivery volumes are used for customer billing, as noted previously, and therefore we believe they will be reliable due to the scrutiny they are subject to by GMW and customers.

Ratio of Channel Length Rationalised to Total Channel Length (CL)

We confirm that GMW has correctly used the length of spur channels in each irrigation area as the denominator in this calculation. The numerator is the length of channels rationalised. We believe that the systems used for capturing and reporting lengths of channel rationalised are robust. GMW has improved its processes for estimating channel lengths with additional verification through GIS. We comment on our trailing of channel rationalisation records in Section 5.2.34.

Ratio of Length of Time Channels Rationalised to Baseline Year (t_r)

This variable is determined from the channel de-commissioning date recorded. This factor has previously been material for Phase 3 savings given that the amount of rationalisation work completed each year is a significant proportion of the total. However, this is less so for 2013/14 and will not be significant in future. We note in our review of channel rationalisation construction records in Section 5.2.4 that GMW provided comprehensive construction records.

6.4.5 Results

We found that GMW has correctly applied the water savings formulae to the input data. The audited water savings due to channel rationalisation are summarised in Table 6-4 for Phase 3 savings and Table 6-5 for Phase 4 savings.

Table 6-4 Phase 3 Water Savings due to Channel Rationalisation – Stage 1 and Stage 2

	SH	CG1-4	CG5-9	MV	RO	PB	TO
Stage 1							
Seepage (ML)	-	-	356	1162	136	1414	1570
Bank leakage (ML)	-	-	438	1885	254	1	3973
Evaporation (ML)	-	-	152	514	60	724	531
Total	-	-	**945**	**3561**	**451**	**2139**	**6074**
Stage 2							
Seepage (ML)	4	6	50	266	55	180	249
Bank leakage (ML)	-	-	60	432	104	-	651
Evaporation (ML)	1	2	21	118	24	92	84
Total	**5**	**9**	**132**	**816**	**184**	**272**	**984**
Total (Stage 1 and Stage 2)	**5**	**9**	**1077**	**4377**	**634**	**2411**	**7058**

Table 6-5 Phase 4 Water Savings due to Channel Rationalisation – Stage 1 and Stage 2

	SH	CG1-4	CG5-9	MV	RO	PB	TO
Stage 1							
Seepage (ML)	-	-	368	1453	172	1462	1603
Bank leakage (ML)	-	-	609	3408	411	2	7228
Evaporation (ML)	-	-	157	642	76	749	543

Total	-	-	**1133**	**5503**	**659**	**2213**	**9374**
Stage 2							
Seepage (ML)	129	227	107	336	80	300	318
Bank leakage (ML)	10	497	177	788	192	-	1435
Evaporation (ML)	50	79	46	149	35	154	108
Total	**189**	**803**	**330**	**1272**	**308**	**454**	**1861**
Total (Stage 1 and Stage 2)	**189**	**803**	**1463**	**6775**	**966**	**2668**	**11235**

Note – Totals may not sum due to rounding

6.5 Savings from Channel Automation

6.5.1 Scope of Automation Works

Automation involves the replacement of manual flow control structures with modern automated gates that accurately measure flows, provide real time operational data and can be controlled to meet the flow demands of customers. Automation greatly reduces the water spillage from the end of channels (outfalls), and reduces bank leakage by maintaining the level of water in a pool within a relatively restricted band.

Automation of the backbone channels in the GCP works areas is complete for the Central Goulburn 5-9, Rochester and Pyramid-Boort areas.

We have not undertaken trailing of the construction records associated with automation works (e.g. regulators and outfall gates) as little of this work was completed in 2013/14 and we have audited construction records in previous years. Also, the confirmation that automation works have been complete is ultimately evidenced by the reduction in outfall volumes from automated systems.

6.5.2 Overview

Water savings due to automation are the sum of the savings realised through reduced outfall volumes:

Phase 3: $WS_{Year\ X} = WS_{outfalls}$

Phase 4: $WS_{Year\ X(LTCE)} = WS_{outfalls(LTCE)}$

There has been an important change in determining savings due to automation in that the updated version of the *Technical Manual* no longer includes savings due to reduced upper bank leakage in this component. Savings due to upper bank leakage when calculated previously composed less than 1% of all savings so it was not material. However, there is significant uncertainty in this estimate. Therefore, it has been omitted from the calculation until stronger evidence supporting its inclusion in savings estimates is established.

6.5.3 Water Savings Calculations

Phase 3 Calculations

Phase 3 water savings have been calculated by GCP using the Phase 3 outfalls formula from the *Technical Manual*:

$$WS_{outfalls} = \sum [(O_{base} \times (D_{Year}\ X / D_{Base})) - (O_{YearX})]$$

Phase 4 Calculations

Phase 4 water savings due to reduction in outfalls are estimated by the following equations from the *Technical Manual*:

$$WS_{outfalls} = \sum [(O_{base} \times F_{(LTCE\ base)}) - (O_{YearX} \times F_{(LTCEYearX)}] \times DF$$

The latest version of the *Technical Manual* has omitted the time factor OP which was the ratio expressing the proportion of the irrigation season for which the channels had been fully automated.

6.5.4 Input Data

The inputs required to calculate Phase 3 and Phase 4 water savings due to outfall automation are summarised in Table 6-6 and Table 6-7. The first table details the parameters that are fixed or have been previously audited, i.e. the baseline year parameters. The second table details the input data from the current year.

Table 6-6 Fixed parameters and baseline year parameters for Automation water savings calculation

Parameter	Description	Source
O_{Base}	Outfalls in Baseline Year	Baseline Year water balance
D_{base}	Customer Deliveries in the Baseline Year in the irrigation system	Baseline Year water balance
DF	Durability factor to account for the durability of water savings interventions	Technical Manual
$F_{(LTCEBase)}$	Long Term Cap Equivalent Factor to convert Baseline Year volumes to Long Term Cap Equivalent volume	Department of Environment and Primary Industries

Table 6-7 Current Year Parameters for Automation Water Savings Calculation

Parameter	Description	Source
O_{yearx}	Outfalls in Current Year	SCADA and operator logsheets
D_{yearx}	Customer Deliveries in the Current Year in the irrigation system	IPM reports
$F_{(LTCEYear\ X)}$	Long Term Cap Equivalent Factor to convert Current Year volumes to Long Term Cap Equivalent volume	Calculated from deliveries and base figure advised by Department of Environment and Primary Industries

We have reviewed the input data and confirm that the fixed parameters sourced from the Technical Manual are correct. We also found that the parameters sourced from the Baseline Year Water Balance are correct, noting that only outfall volumes for channels that have now been automated are included in the 2013/14 calculations.

GMW has applied an adjustment factor of 1.6 to the volumes recorded at unmetered outfalls in the baseline year to arrive at an adjusted baseline outfall volume.

The following summary is a review of the inputs from the current operating year:

Outfalls in Current Year (O_{yearx})

The largest outfalls responsible for the greatest water savings are generally measured on-line with feedback to GMW's SCADA. Operators review the SCADA and enter daily volumes into logsheets. These logsheets are used as the source of the outfall flow volumes for the water savings calculations.

We have commented in Section 5.3 on the significant inconsistencies we have identified when reconciling a sample of outfall records sourced from operator logsheets with SCADA records. Despite the inconsistencies, we have not made any changes to the outfall volumes used in the calculations because of a lack of definitive evidence that the SCADA reading is more accurate than the operator's measurement. However, we have identified that this is an area that GMW must improve for future to ensure that the inputs are sufficiently robust for the purpose of water savings calculations.

Again this year, GMW has acted on the recommendation included in the 2011/12 audit and not set equal to zero the savings from groups of outfalls (pods) where the outflow in the current year exceeded that in the baseline year (which would result in 'negative' savings) unless it has been able to find sufficient justification for doing so[5].

The impact of this change is material – in 2011/12, the zeroing of outfalls contributed 1,831ML to Phase 4 savings. For the current year, no outfalls have been zeroed. We support this conservative approach.

GMW has subtracted from its savings volumes that are environmental mitigating flows. Environmental mitigating flows are specified in Environmental Watering Plans and are volumes determined by catchment managers as necessary to support specific high value habitats. Mitigating flows occur only in the Torrumbarry and Pyramid-Boort irrigation areas. Because mitigating flows occur through some outfalls that have 'negative' savings (i.e. the outfall in this year is greater than that in the baseline year) the mitigating flow cannot be subtracted from the outfall meaning that it is not possible to reconcile outfall savings and mitigating flows on an outfall by outfall basis. In this case the mitigating flow is zeroed and the loss is deducted from the overall automation savings.

As decommissioning of channels occurs, where an outfall previously existed, this may cause; outfall volumes to be directed to neighbouring outfalls, increasing outfall at neighbouring sites relative to 2004/05 losses, potentially creating negative losses. Over the next few years with decommissioning of outfalls occurring the interaction of outfalls into larger groups or for the operating system, needs to be taken into account by GMW.

Customer Deliveries in the Current Year ($D_{Year\ X}$)

Customer deliveries in each irrigation district are determined from IPM reports. The volumes used are sourced from the same reports used for GMW's annual reporting.

Long Term Cap Equivalent Factor $F_{(LTCEYear\ X)}$

This factor has been calculated by GMW in accordance with the formula in the Technical Manual using a factor of 1.3 for $LTCE_{Base}$ as advised by the Department of Environment and Primary Industries. The ratio of delivered volumes has been applied for all operating areas.

6.5.5 Results

The audited water savings due to channel automation are summarised in Table 6-8. All channel automation works are attributable to the Phase 1 project except for channel automation works for Shepparton which are part of the Phase 2 project.

Table 6-8 Phase 3 and Phase 4 Water Savings due to Channel Automation

	SH	CG5-9	MV	RO	PB	TO	Total
Inputs							
O_{base} (ML)	1,539	26,503	9,134	7,697	5,280	6,422	56,575
O_{yearx} (ML)	1,112	1,296	3,486	2,728	1,257	129	10,009
D_{base} (ML)	191,844	312,082	293,026	199,271	221,668	405,049	1,622,940
D_{yearx}(ML)	127,290	252,356	223,945	164,500	166,097	348,288	1,282,476
Phase 3 Water Savings							

[5] Where the outfalls from a pod in the current year exceeded that in the baseline year the calculated saving would be less than zero, i.e. worse performance than in the baseline year. The *Technical Manual* allows these negative numbers to be set to zero on the basis that they are considered to be operational aberrations that would disappear in time. However, we consider that it is more appropriate, and a better indication of current water savings performance, to not set these values to zero. If these are operational aberrations, the savings will be 'caught up' in future

Gross Phase 3 savings (ML)	-22	20,135	3,494	3,239	2,413	5,531	34,790
Zeroed outfalls (ML)	-	-	-	-	-	-	-
Mitigating flows (ML)	-	-	-	-	-822	-882	-1,704
Net Phase 3 savings (ML)	**-22**	**20,135**	**3,494**	**3,239**	**1,591**	**4,649**	**33,086**
Phase 4 Water Savings							
Gross Phase 4 savings (ML)	200	30,748	5,947	4,796	4,127	7,985	53,802
Zeroed outfalls (ML)	-	-	-	-	-	-	-
Mitigating flows (ML)	-	-	-	-	-1,387	-1,245	-2,632
Net Phase 4 savings (ML)	**200**	**30,748**	**5,947**	**4,796**	**2,739**	**6,740**	**51,170**

Note – Totals may not sum due to rounding

6.6 Savings from Service Point Replacement and Rationalisation

6.6.1 Scope of Service Point Replacement and Rationalisation Works

Water savings are achieved when existing customer service points, usually Dethridge Wheels, are replaced with modern outlets. The modern designs are typically pipes with magflow meters or flume gates. Savings may also be achieved when existing service points are removed and not replaced (i.e. rationalised). The savings achieved are due to the improved construction of the service points, preventing leakage through and around the meter, as well as the increased accuracy of the new meters which better account for water use.

Service point replacement and rationalisation has been completed under the Stage 1 and Stage 2 projects. For this audit, we are also required to review residual works undertaken in 2013/14 for the Shepparton and CG1234 Project. The water savings achieved under this project have previously been audited and reported separately.

Figure 6-3 shows the number of service points replaced and rationalised in each irrigation area. Note that numbers for Stage 1 and Stage 2 projects have been shown combined.

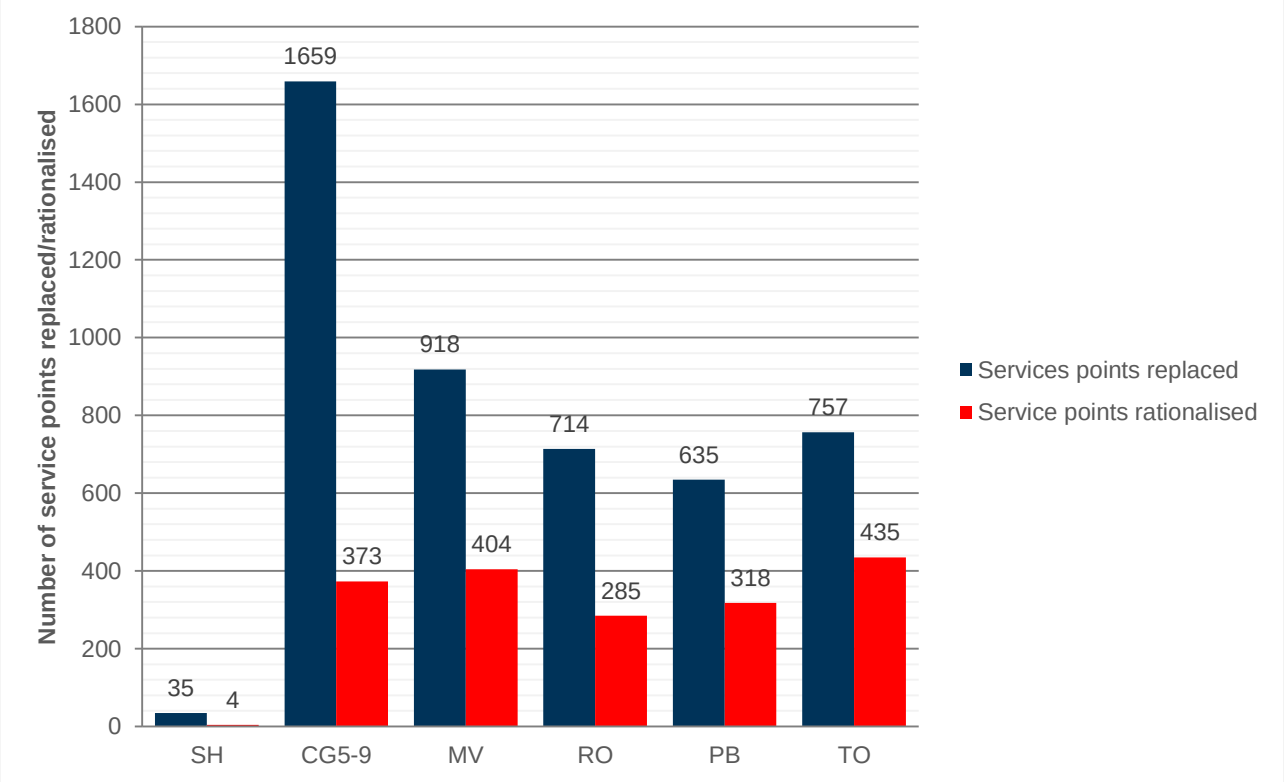

Figure 6-3 Numbers of service points replaced and rationalised (Stage 1 and Stage 2)

6.6.2 Overview

Water savings due to service point replacements and rationalisations are the sum of the savings realised through reduced meter errors, lowered leakage through and around the old meter, previously unmetered volumes and reduced unauthorised use. The same high level Phase 3 and 4 equations apply to both replacements and rationalisations although the individual components are determined differently.

The high level equations are the same for both Phase 3 and Phase 4 savings:

$$WS_{Year\ X} = WS_{meter\ error} + WS_{leakage\ through} + WS_{leakage\ around} + WS_{unauthorised}$$

6.6.3 Water Savings Calculations

The components of the Phase 3 and 4 water savings calculations are detailed following. Version 4 of the *Technical Manual* no longer includes the time discounting factor (t_m) in the Phase 4 calculations for either replacement or rationalisation of service points. GMW does not include the component for savings due to unmetered volumes as it believes that these are negligible.

Phase 3 Calculations – Service Point Replacement

Phase 3 water savings have been calculated by GMW using the formula in the *Technical Manual*:

$$WS_{meter\ error} = D_{MYear\ X} \times (1/MCF) \times (MCF - 1) \times EF_{meter\ error}$$

$$WS_{leakage\ through} = N_{replaced} \times t_m \times LTT \times EF_{leakage\ through}$$

$$WS_{leakage\ around} = N_{replaced} \times t_m \times LTA \times EF_{leakage\ around}$$

$$WS_{unauthorised} = N_{replaced} \times U_{Base} \times EF_{unauthorised} \times (D_{Year\ X}/D_{base}) \times t_m$$

Phase 3 Calculations – Service Point Rationalisation

Phase 3 water savings due to service point rationalisation have been calculated by GMW using the formula in the *Technical Manual*:

$$WS_{meter\ error} = (D_{MBase} \times (MCF - 1) \times EF_{meter\ error}) \times (D_{Year\ X}/D_{base})$$

$$WS_{leakage\ through} = N_{rationalised} \times t_m \times LTT \times EF_{leakage\ through}$$

$$WS_{leakage\ around} = N_{rationalised} \times t_m \times LTA \times EF_{leakage\ around}$$

$$WS_{unauthorised} = N_{rationalised} \times U_{Base} \times EF_{unauthorised} \times (D_{Year\ X}/D_{base}) \times t_m$$

Phase 4 Calculations – Service Point Replacement

Phase 4 water savings have been calculated by GMW using a formula from the May 2012 *Technical Manual*, with error estimated on now on D_{Base} rather than $D_{Year\ X}$:

$$WS_{meter\ error} = D_{MBase} \times (MCF - 1) \times EF_{meter\ error} \times DF_{meter\ error} \times F_{(LTCEbase)}$$

$$WS_{leakage\ through} = N_{replaced} \times LTT \times EF_{leakage\ through} \times DF_{leakage\ through}$$

$$WS_{leakage\ around} = N_{replaced} \times LTA \times EF_{leakage\ around} \times DF_{leakage\ around}$$

$$WS_{unauthorised} = N_{replaced} \times U_{Base} \times EF_{unauthorised} \times DF_{unauthorised} \times F_{(LTCEbase)}$$

Phase 4 Calculations – Service Point Rationalisation

Phase 4 water savings due to service point rationalisation have been calculated by GMW using the formula in the *Technical Manual:*

$$WS_{meter\ error} = (D_{MBase\ x} \times (MCF - 1) \times EF_{meter\ error} \times DF_{meter\ error}) \times F_{(LTCEbase)}$$

$$WS_{leakage\ through} = N_{rationalised} \times LTT \times EF_{leakage\ through} \times DF_{leakage\ through}$$

$$WS_{leakage\ around} = N_{rationalised} \times LTA \times EF_{leakage\ around} \times DF_{leakage\ around}$$

$$WS_{unauthorised} = N_{rationalised} \times U_{Base} \times EF_{unauthorised} \times DF_{unauthorised} \times F_{(LTCEbase)}$$

The same formula for calculating Phase 4 long term meter error savings (Equation 13.3.4) as the basis for both rationalised and replaced service outlets has been adopted. The meter error savings is based on customer deliveries in the baseline year (2004/05) instead of the year in question as previously used in Equation 12.3.4 for the calculation of long term meter error savings for service point replacement. DEPI has endorsed this approach and intends to revise the Technical Manual accordingly at the next opportunity.

6.6.4 Input Data

The inputs required to calculate Phase 3 and Phase 4 water savings due to service point replacement and rationalisation are summarised in Table 6-9 and Table 6-10.

Table 6-9 details the parameters that are fixed or have been previously audited. Table 6-10 details the input data from the current year.

Table 6-9 Fixed Parameters and Baseline Year Parameters for Service Point Replacement and Rationalisation Water Savings Calculation

Parameter	Description	Source
MCF	Adopted Meter Correction Factor for Dethridge Meter Service Points or associated with deemed Service Points	Technical Manual
$EF_{meter\ error}$	Effectiveness Factor for reducing measurement error	Technical Manual
$EF_{leakage\ through}$	Effectiveness Factor for reducing leakage through the meter	Technical Manual
$EF_{leakage\ around}$	Effectiveness Factor for reducing leakage around the meter	Technical Manual
$EF_{unauthorised}$	Effectiveness Factor for reducing unauthorised use	Technical Manual
LTA	Defined Fixed Leakage Rate (ML/year/service point) around service points	Technical Manual
LTT	Defined Fixed Leakage Rate (ML/year/service point) through service points	Technical Manual
U_{Base}	Unauthorised use loss in the Baseline Year	Technical Manual
D_{Base}	Customer Deliveries in the Baseline Year	Baseline Year water balance
DM_{base}	Customer deliveries through the Rationalised meters in the Baseline Year	Baseline Year water balance
DF_{error}	Durability factor for reducing measurement error	Technical Manual
$DF_{leakage\ through}$	Durability factor for reducing leakage through the meter	Technical Manual
$DF_{leakage\ around}$	Durability factor for reducing leakage around the meter	Technical Manual
$DF_{unauthorised}$	Durability factor for reducing unauthorised use	Technical Manual
$F_{(LTCEbase)}$	Long Term Cap Equivalent Conversion Factor for the baseline year	Department of Environment and Primary Industries

Table 6-10 Fixed Parameters and Baseline Year Parameters for Service Point Replacement and Rationalisation Water Savings Calculation

Parameter	Description	Source
$D_{MYear\ X}$	Customer deliveries through the replaced meters for the year in question	IPM reports
$D_{Year\ X}$	Customer deliveries in the year in question to the irrigation system	IPM reports
$N_{replaced}$	Number of meters replaced	Construction records
$N_{rationalised}$	Number of meters rationalised	Construction records
$F_{(LTCEYear\ X)}$	Long Term Cap Equivalent Factor to convert Current Year volumes to Long Term Cap Equivalent volume	Calculated from deliveries

We have reviewed the input data and confirm that the fixed parameters sourced from the Technical Manual are correct. GMW has correctly applied the different effectiveness factors for preventing leakage through automated (100%) and manual (90%) meters.

We also found that the parameters sourced from the Baseline Year Water Balance are correct. The following summary is a review of the inputs from the current operating year:

Customer Deliveries through Replaced Service Points ($D_{M\ Year\ X}$) and in the Irrigation System ($D_{Year\ X}$)

Customer deliveries through the replaced meters and in each irrigation district are determined through IPM. These delivered volumes are used for customer billing and, as noted previously, we believe they will be reliable due to the scrutiny they are subject to by GMW and customers.

Number of Service Points Replaced and Rationalised ($N_{replaced}$, $N_{rationalised}$)

The number of meters replaced and rationalised is determined from construction records. GMW demonstrated the process it undertakes for handling service point record data. This process includes collating data from different sources and then filtering this data and removing any duplicate or anomalous records. We are satisfied that this process is robust. GMW also achieves meter error savings where new meters have been installed as part of system decommissioning works.

We reviewed the commissioning certificates for a sample of service points under the Stage 1 and Stage 2 projects, as outlined in Section 5.2.2. We also reviewed this year work packs and commissioning certificates for service points replaced under the Shepparton and CG1234 project as outlined in Section 5.2.3. This review provided evidence that the sample of works claimed as complete by GMW had been completed.

Ratio of time Service Point in use compared to Baseline Year (t_m)

This factor is calculated by GMW based on the commissioning (or de-commissioning in the case of rationalisation) dates for each service point. As the works have been in progress for a number of years, the t_m factor has limited impact on the calculated Phase 3 savings. We found that the t_m factor has been calculated and applied correctly by GMW for service point replacements.

Our review of commissioning certificates for a sample of service points is outlined in Section 5.2.2 and Section 5.2.3. We found that GMW has robust construction records for meter replacement and rationalisation.

Long Term Cap Equivalent Factor F($LTCE_{Base}$)

This factor has been calculated by GMW in accordance with the formula in the Technical Manual using a factor of 1.3 for $LTCE_{Base}$ as advised by the Department of Environment and Primary Industries. The ratio of deliveries volumes has been applied for all of the GMW operating areas.

6.6.5 Results

The audited water savings due to service point replacements are summarised in Table 6-11 and Table 6-12. Note that GMW performs these calculations on a meter by meter basis and not for an irrigation area nor as a whole system.

Table 6-11 Phase 3 and Phase 4 Water Savings due to Service Point Replacement – Stage 1 project

	CG5-9	MV	RO	PB	TO	Total
Service point replacement						
Phase 3 Water Savings						
Meter error (ML)	7,946	5,055	3,396	3,798	4,272	24,467
Leakage through service points (ML)	2,734	1,338	1,133	1,008	1,064	7,277
Leakage around service points (ML)	596	290	244	215	231	1,576
Unauthorised Use (ML)	866	398	362	290	357	2,274
Total (ML)	**12,142**	**7,081**	**51,36**	**5,310**	**5,925**	**35,594**
Phase 4 Water Savings						
Meter error (ML)	12,763	8,533	5,916	7,262	7,121	41,595
Leakage through service points (ML)	2,232	1,152	890	799	903	5,977
Leakage around service points (ML)	578	299	228	203	234	1,542
Unauthorised Use (ML)	1,423	736	561	501	577	3,798
Total (ML)	**16,997**	**10,720**	**7,596**	**8,765**	**8,835**	**52,912**
Service point rationalisation						
Phase 3 Water Savings						
Meter error (ML)	1,085	1,345	748	1,291	2,019	6,488
Leakage through service points (ML)	637	551	489	539	657	2,874
Leakage around service points (ML)	134	116	103	114	138	605
Unauthorised Use (ML)	245	203	192	191	272	1,104
Total (ML)	**2,101**	**2,215**	**1,532**	**2,135**	**3,086**	**11,070**
Phase 4 Water Savings						
Meter error (ML)	1,743	2,270	1,303	2,468	3,365	11,149
Leakage through service points (ML)	654	631	481	543	699	3,008
Leakage around service points (ML)	138	133	101	114	147	633
Unauthorised Use (ML)	404	395	297	335	440	1,871
Total (ML)	**2,938**	**3,429**	**2,182**	**3,460**	**4,652**	**16,661**
Total Phase 3 savings (Replacement and rationalisation)	**14,243**	**9,296**	**6,668**	**7,445**	**9,011**	**46,664**
Total Phase 4 savings (Replacement and rationalisation)	**19,934**	**14,149**	**9,778**	**12,225**	**13,486**	**69,573**

Note – Totals may not sum due to rounding

Table 6-12 Phase 3 and Phase 4 Water Savings due to Service Point Replacement – Stage 2 project

	SH	CG5-9	MV	RO	PB	TO	Total
Service point replacement							
Phase 3 Water Savings							
Meter error (ML)	111	428	248	453	278	433	1,951
Leakage through service points (ML)	48	125	62	69	43	95	441
Leakage around service points (ML)	11	27	13	15	9	21	97
Unauthorised Use (ML)	16	40	18	22	12	32	140
Total (ML)	**186**	**619**	**341**	**559**	**341**	**580**	**2,628**
Phase 4 Water Savings							
Meter error (ML)	178	585	517	712	476	850	3,319
Leakage through service points (ML)	47	133	60	62	44	99	445
Leakage around service points (ML)	13	35	16	16	12	26	118

Unauthorised Use (ML)	32	86	38	40	28	64	288
Total (ML)	**269**	**840**	**631**	**830**	**560**	**1,040**	**4,170**
Service point rationalisation							
Phase 3 Water Savings							
Meter error (ML)	6	68	191	46	93	172	575
Leakage through service points (ML)	7	16	53	28	34	56	194
Leakage around service points (ML)	2	3	11	6	7	12	41
Unauthorised Use (ML)	3	6	19	11	12	23	74
Total (ML)	**17**	**93**	**274**	**91**	**146**	**263**	**885**
Phase 4 Water Savings							
Meter error (ML)	9	93	398	73	159	338	1,070
Leakage through service points (ML)	8	30	68	30	44	67	247
Leakage around service points (ML)	2	6	14	6	9	14	52
Unauthorised Use (ML)	5	19	42	19	27	41	152
Total (ML)	**23**	**148**	**523**	**128**	**239**	**459**	**1,521**
Total Phase 3 savings (Replacement and rationalisation)	**204**	**713**	**615**	**651**	**487**	**844**	**535**
Total Phase 4 savings (Replacement and rationalisation)	**292**	**988**	**1,154**	**958**	**799**	**1,499**	**5,691**

Note – Totals may not sum due to rounding

Table 6-13 Phase 3 and Phase 4 Water Savings due to Service Point Replacement – Shepparton and CG1-4 residual works

	SH	CG1-4	Total
Service point replacement			
Phase 3 Water Savings			
Meter error (ML)	242	397	639
Leakage through service points (ML)	24	115	139
Leakage around service points (ML)	5	25	30
Unauthorised Use (ML)	7	37	44
Total (ML)	**278**	**573**	**852**
Phase 4 Water Savings			
Meter error (ML)	348	651	1,000
Leakage through service points (ML)	20	113	132
Leakage around service points (ML)	5	29	34
Unauthorised Use (ML)	12	71	83
Total (ML)	**385**	**864**	**1,249**
Service point rationalisation			
Phase 3 Water Savings			
Meter error (ML)	0	0	0
Leakage through service points (ML)	2	89	91
Leakage around service points (ML)	0	19	19
Unauthorised Use (ML)	1	36	36
Total (ML)	**3**	**144**	**146**
Phase 4 Water Savings			
Meter error (ML)	4	234	239
Leakage through service points (ML)	2	114	116
Leakage around service points (ML)	0	24	24
Unauthorised Use (ML)	1	70	71
Total (ML)	**8**	**443**	**451**
Total Phase 3 savings (Replacement and rationalisation)	**281**	**717**	**998**
Total Phase 4 savings (Replacement and rationalisation)	**393**	**1,306**	**1,699**

Note – Totals may not sum due to rounding

6.7 Savings from Channel Remediation

6.7.1 Scope of Irrigation Channel Remediation Works

Channel remediation involves lining earthen channels, replacing channels with pipelines and bank remodelling. These works can generate irrigation water savings through reduced bank seepage and reduced bank leakage. A total of 169.1km of channel lining has been completed to date. 14.1km was completed in 2013/14 compared with 25.4km in 2012/13. The length of channel that has been remediated by irrigation area is shown in Figure 6-4.

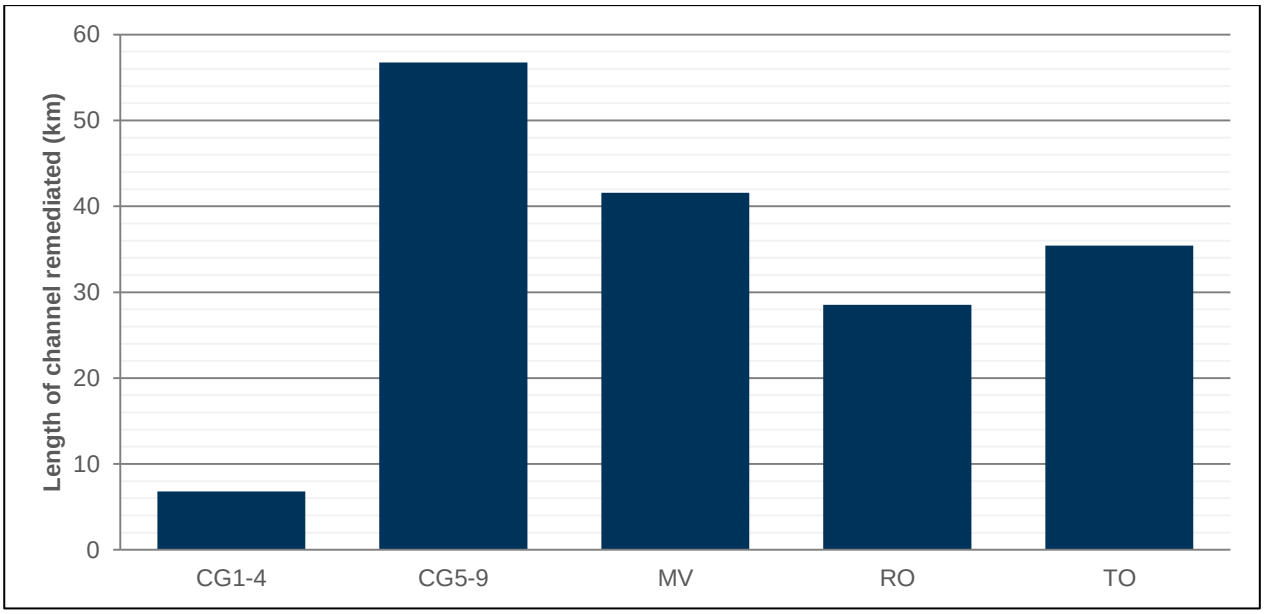

Figure 6-4 Length of channel remediated by irrigation area

6.7.2 Overview

The type of calculation employed for determining water savings due to channel remediation depends on the availability of pre and post works pondage data as detailed in Table 6-14.

Table 6-14 Calculation methods for Channel remediation works

Data availability	Calculation method
No pre or post remediation pondage testing data available	Theoretical method (No pre-works pondage test data)
Pre remediation pondage testing only available	Theoretical method (using pre-works pondage test data)
Both pre and post remediation pondage testing data available	Direct method

For the remediation works completed in 2008 (5km), no pre or post works pondage test data is available. Therefore, the theoretical method has been used for these works. The inputs and method are unchanged from the 2009/10 audit report for these works from 2008 and will not be discussed further.

For the works completed in 2009 pre-works pondage data is available for all sites except one. Post-works pondage testing data is only available for three of the 13 sites. For the works completed in 2010, 30 of 42 sites have both pre and post works pondage testing data available. This total is an increase on the 27 sites where both pre and post works data was available. The remaining sites from 2010 have only pre works pondage testing data available.

Of the 42 sites remediated in 2011, 19 have both pre and post works pondage test data available (up from 1 in 2011/12). The remaining sites have only pre works pondage test data available.

Savings estimates made using only pre works data and historical typical expected effectiveness factors will be validated with post works data over time. This may adjust the savings claimed in later years.

GMW omits the evaporation component from its savings as it assumes that there is likely to be negligible change in surface area of a channel pre and post remediation. This is a reasonable assumption and is conservative.

Both direct and theoretical equations have the same high level form:

$$WS_{Year\ X} = WS_{bank\ leakage} + WS_{seepage} + WS_{evaporation}$$

6.7.3 Water Savings Calculations

Theoretical Phase 3 calculations, where no pre-works pondage testing data is available, are not discussed as these only apply to the 2008 works. These were reviewed in 2009/10 and there has been no change since then. The equations in the updated *Technical Manual* for determining savings due channel remediation have been revised with the length and time discounting factors being removed.

Theoretical Method - Phase 3 Calculations– Pre-works pondage test data available

$$WS_{leakage} = [(L_{pre\ works} \times VL \times F(PA) \times (D_{Year\ X}/D_{base})) + (L_{pre\ works} \times FL \times F(PA)] \times EF$$

$$WS_{seepage} = S_{pre\ works} \times EF \times F(PA)$$

Direct Method - Phase 3 Calculations– Measured pre-works and post-works pondage test data is available

$$WS_{leakage} = [(L_{pre\ works} - L_{Post\ works}) \times F(PA) \times FL] + [(L_{pre\ works} - L_{Post\ works}) \times F(PA) \times VL \times (D_{Year\ X}/D_{base})]$$

$$WS_{seepage} = (S_{pre\ works} - S_{Post\ works}) \times F(PA)$$

Theoretical Method - Phase 4 Calculations– Pre-works pondage test data available

$$WS_{leakage} = [(L_{pre\ works} \times VL \times F(LTCE)) + (L_{pre\ works} \times FL)] \times DF \times EF \times F(PA)$$

$$WS_{seepage} = S_{pre\ works} \times EF \times DF \times F(PA)$$

Direct Method - Phase 4 Calculations – Measured pre-works pondage test data is available

$$WS_{leakage} = [(L_{pre\ works} - L_{Post\ works}) \times F(PA) \times FL] + [(L_{pre\ works} - L_{Post\ works}) \times F(PA) \times VL \times F_{(LTCEbase)}] \times DF$$

$$WS_{seepage} = (S_{pre\ works} - S_{Post\ works}) \times F(PA) \times DF$$

GMW has adopted an alternative direct method for calculating $WS_{leakage}$ for Phase 3 savings as the Technical Manual appears to incorrectly omit the variable proportion of bank leakage. For calculating $WS_{leakage}$ in Phase 4 using the direct method, factor $F_{(LTCEbase)}$ replaces $F_{(LTCEYearX)}$ as factor **F(PA)** in the equation is estimated for the baseline year. We consider that this is an appropriate approach and note that the water savings estimate are lower using this approach than that in the Technical Manual.

The revised baseline year water balance[6], has removed the concept of system fill. System fill was treated as operational flows that were not impacted by improved irrigation infrastructure because they occurred outside of the irrigation season. However, it has now been recognised that most channels that have been lined will hold water over the full year, including the non-irrigation season, and therefore water savings occur across the full year. In particular, there is reduced seepage in both the irrigation and non-irrigation seasons. As a result, the interpretation of the seepage calculation has been updated to be applied across the full 365 days of the year of operation, instead of only the irrigation season as previously calculated.

GMW has adjusted the water savings estimated due to channel remediation downwards for old leaking outlets existing when pondage tests were carried out. This is to avoid any possibility of double counting savings on both the remediation program and from service point upgrade works.

[6] The revised baseline year water balance was independently audited in 2011/12.

6.7.4 Input Data

The inputs required to calculate Phase 3 and Phase 4 water savings due to channel remediation are summarised in Table 6-15 and Table 6-16. The first table details the parameters that are fixed or have been previously audited. The second table details the input data from the current year.

Table 6-15 Fixed Parameters and Baseline Year Parameters for Channel Remediation Water Savings Calculation

Parameter	Description	Source
VL	Proportion of bank leakage recognised as variable	Technical Manual
FL	Proportion of bank leakage recognised as fixed	Technical Manual
D_{base}	Customer deliveries in the baseline year	Baseline Year water balance
EF	Effectiveness Factor for channel remediation	Technical Manual
DF	Durability Factor for Channel Remediation	Technical Manual
$F_{(LTCEbase)}$	Long Term Cap Equivalent Conversion Factor for the baseline year	Department of Environment and Primary Industries
F(PA)	Pondage Testing Adjustment Factor to account for dynamic losses in addition to static losses	Technical Manual Appendix F

Table 6-16 Current Year Parameters for Channel Remediation Water Savings Calculation

Parameter	Description	Source
$L_{Pre\ works}$	Pre works bank leakage	Pondage testing
$L_{Post\ works}$	Post works bank leakage	Pondage testing
$D_{Year\ X}$	Customer deliveries in the year in question to the irrigation system	IPM reports
$S_{pre\ works}$	Pre works seepage	Pondage testing
$S_{post\ works}$	Post works seepage	Pondage testing

We have reviewed the input data and confirm that the fixed parameters sourced from the Technical Manual are correct, as are the deliveries in the Baseline Year sourced from the Baseline Year Water Balance. GMW has adopted an EF estimate of 90% where no post-works pondage testing data is available. This will be revised in the future as more pre and post-works pondage testing data becomes available.

The following summary is a review of the inputs from the current operating year:

Pre Works and Post Works bank Leakage and Seepage ($L_{pre\ works}$, $L_{Post\ works}$, $S_{pre\ works}$, $S_{Post\ works}$)

Where pondage testing data is available, pre and post works leakage and seepage are determined through evaluation of site testing results. We have reviewed the pondage testing methodology and results in previous audits and commented that we believe that the pre and post works seepage and leakage estimates, determined through site testing, are sound. Where post pondage data is estimated from pre works data and assumed remediation effectiveness (based on the measured remediation effectiveness in other pools), follow-up validation of the estimates with measured post pondage test data, needs to be made in the future.

Customer Deliveries in the Current Year ($D_{Year\ X}$)

Customer deliveries in each irrigation district are determined from IPM reports. The volumes used are sourced from the same reports used for GMW's annual reporting.

6.7.5 Results

Water savings due to channel remediation are calculated on a channel by channel basis as each channel has a different leakage and seepage rate. The meter error correction is applied to whole irrigation areas.

Table 6-17 Phase 3 and Phase 4 Water Savings due to Channel Remediation

	CG1-4	CG 5-9	MV	RO	PB	TO	Total
Phase 3 savings (ML)							
Stage 1	-	3,984	3,879	2,460	-	2,845	**13,167**
Stage 2	567	-	575	-	-	-	**1,142**
Phase 4 savings (ML)							
Stage 1	-	4,253	4,186	2,396	-	2,775	**13,611**
Stage 2	624	-	586	-	-	-	**1,210**

Note – Totals may not sum due to rounding

7 Findings from Review of Water Entitlement Entities (WEEs)

7.1 Requirement for confirming WEEs

The audit scope requires that the ownership and details of the Water Entitlement Entities (WEEs) claimed by GMW as being in its ownership at 30 June 2014 are to be confirmed. Specifically, the following details of WEEs held by GMW were to be cross-checked against the Victorian Water Register:

- Water Entitlement Entity (WEE) number
- Water entitlement volumes related to particular WEE number
- Date of transfer recorded in the Victorian Water Register
- Classification of water entitlements as either high or low reliability
- Evidence of ownership of entitlements whether in the name of GMW or not.

The audit also requires the auditor to check the calculation of long term diversion limit equivalent (LTDLE) water recovery as per the conversion factors detailed in the Audit Brief.

For 2013/14, water recovery due to entitlement purchases is only required to be audited for the Stage 1 project.

7.2 Approach to auditing WEEs

To complete this requirement of the audit, we undertook the following:

1. Obtained from GMW a spreadsheet (TATDOC-#3865549-v1-WATER_SHARES_RECOVERY_ESTAIMTES_FOR_2013_14_WATER_SAVINGS_AUDIT.XLSX) detailing its WEE holdings and relevant information about the Entitlements including WEE number and volume.
2. Provided the list of WEE numbers claimed by GMW to the Department of Environment and Primary Industries, Water Entitlements and Trading and requested them to provide the volume, reliability classification, date of transfer recorded on the register, and ownership details relating to each claimed WEE number.
3. Reconciled the details provided to us by the Department of Environment and Primary Industries, Water Entitlements and Trading from the Victorian Water Register against the schedule provided to us by GMW. For WEEs claimed by GMW where the Victorian Water Register confirmed the WEE details and that the Entitlement was in GMW's ownership, we accepted this WEE for inclusion in the calculation of the Long Term Diversion Equivalent. We discuss this further in Section 7.3.
4. For WEEs claimed by GMW where the Victorian Water Register recorded the ownership of the WEE as being in the name of a party other than GMW, we required GMW to provide secondary evidence to confirm its ownership of the Entitlement, such as a mortgage over the WEE.
5. For all WEEs confirmed as being in GMW's ownership, we applied the conversion factors to the WEE volumes to determine the Long Term Diversion Equivalent. These calculations are set out in Section 7.4.

7.3 Results of reconciliation of WEEs claimed by GMW against the Victorian Water Register

Following reconciliation between GMW's schedule of claimed WEEs and the Victorian Water Register, we were able to divide the Entities claimed by GMW into the following categories:

- WEEs where the details were confirmed and are registered in GMW's name

- WEEs where the details were confirmed but are held in the name of others
- WEEs where there was some discrepancy in the details recorded on the Victorian Water Register.

The volume of WEEs (high reliability, low reliability) in each of the above categories is summarised in Table 7-1.

Table 7-1 Results of initial reconciliation

Category	High Reliability Water Share (ML)	Low Reliability Water Share (ML)
Details confirmed, and in the name of GMW	9,227.2	4,877.4
Details confirmed but held the name of others	308.9	118.1
Discrepancies over region	59.5	218.0
Discrepancies over ownership or volume	1,157.2	403.2

Note that there is overlap between the 'Discrepancies over region' category and the other three categories. However, there is no overlap between the other three categories.

The observed discrepancies over the region against which WEEs are recorded were discussed with DEPI and GMW and the region assigned on the Victorian Water Register has been accepted for the purposes of this audit. The allocation of WEEs to a particular region has an impact on the calculation of LTDE as different conversion factors apply to each region. However, as the difference between these conversion factors is less than 2% for High Reliability Water Shares and 17% for Low Reliability Water Shares and the volumes over which there is a discrepancy is small, the impact on the audited LTDE total is very small.

For all but one of the WEEs claimed by GMW but recorded on the Register in the name of others, we have been provided with evidence supporting GMW's ownership of the Entitlement at previous audits. For the one WEE (WEE016255) new this year, GMW provided a signed Application Form for transferring ownership of the Entitlement to support its claim to ownership.

Table 7-2 details the discrepancies identified between the WEEs claimed by GMW and the Victorian Water Register as well as the resolution of the discrepancy.

Table 7-2 Investigation of observed discrepancies

WEE	Volume (ML)		Discrepancy	Resolution
	High	Low		
WEE000069	14.5		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059293. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE000605		1.9	This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059297. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE003885	22.1		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059293. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE009178	12.5		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059293. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE012094		131.5	This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059297. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.

WEE	Volume (ML)		Discrepancy	Resolution
	High	Low		
WEE012418		11.5	Duplicate WEE ID in GMW's schedule	Exclude from GMW's claimed total
WEE012582		48.5	This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059297. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE012658		209.8	This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059297. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE036211	300		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059298. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE046417	47.4		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to multiple WEEs. Of these WEEs, one WEE (WEE058046) was found to be active and held in the name of GMW so has been included in the total.
WEE048115	139.5		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059298. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE051296	3		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059298. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE051564	51.9		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE055607. However, it was found that this WEE was already in the original list provided by GMW therefore no additional allowance for this volume has been made.
WEE051628	67		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE058977. It was found that WEE059877 was already in the original list provided by GMW therefore no additional allowance for this volume has been made.
WEE051648	444		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059298. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.
WEE051868	51.3		Duplicate record in GMW's schedule	Exclude from GMW's claimed total.
WEE052943	1		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059557. This WEE was found to be active and held in the name of GMW so has been included in the audited total.
WEE052949	3		This WEE has been cancelled on the Register	GMW advised that this WEE has been transferred to WEE059293. However, this WEE was found to have been cancelled in 2013/14 as part of the Inter-project agreement and therefore has been excluded from the total.

Following resolution of the above discrepancies, only two further WEEs have been included in the audited total (WEE058046 and WEE059557). All other WEEs in the table above have been excluded from the audited total.

The net impact of the adjustments to the audited total of WEE volumes due to the discrepancies observed are as follows:

- Exclusion of 1,157.2 ML of High Reliability Water Share and 403.2 ML of Low Reliability Water Share

- Addition of 13.8 ML of High Reliability Water Share, and therefore
- A net reduction of 1,143.4 ML of High Reliability Water Share and 403.2 ML of Low Reliability Water Share.

It was found that a significant volume of the WEEs that were excluded from the audited total were cancelled as part of the Inter-Project Agreement. GMW explained that these WEEs had been put forward for inclusion in the Stage 1 totals due to how it accounted for the WEEs in the Inter-Project Agreement total. The Inter-Project Agreement has not been included in the scope of the 2013/14 audit. Therefore it has not been possible to test the movement of WEEs between the Stage 1 project and the Inter-Project Agreement. It is understood that DEPI may review the reconciliation of WEE transfers between the two projects at a later date.

7.4 Calculation of long term diversion limit equivalent

Following confirmation of the WEEs held by GMW as outlined above, the entitlement volumes have been converted into long term diversion limit equivalent (LTDLE) volume in Table 7-3 using the conversion factors provided by DEPI.

Table 7-3 Calculation of Long Term Diversion Equivalent

Project / Irrigation area	Volumes		Conversion factors		Long Term Diversion Equivalent		
	Low reliability (ML)	High reliability (ML)	Low reliability (ML share / ML LTDE)	High reliability (ML share / ML LTDE)	Accruing from low reliability (ML)	Accruing from high reliability (ML)	Total (ML)
Goulburn	1,935.40	2,732.70	0.546	0.927	1,056.73	2,533.21	3,589.94
Murray	3,278.10	6,980.40	0.659	0.913	2,160.27	6,373.11	8,533.37
Total					3,217.00	8,906.32	**12,123.31**

7.5 Recommendations

Our audit of the WEEs claimed by GMW for the Stage 1 project identified a number of issues in the recording of WEEs by GMW that impacted on the audited total. These issues include:

- Two duplicate WEEs claimed by GMW
- Two WEEs that had been cancelled and transferred to another active WEE
- Twelve WEEs that had been cancelled and transferred to a different WEE which had also been cancelled. All of these WEEs were associated with the Inter-Project Agreement.

We recommend that GMW improves its processes for recording and reporting the transfer of WEEs and also the reasons for which WEEs are cancelled. We also recommend that GMW documents the accounting of WEEs between the Inter-Project Agreement and the Stage 1 Project.

8 Recommendations on Technical Manual and Water Savings Approach

The Audit Protocol requires that comment be made following audit work regarding:

- Potential improvements to estimate the water savings in the areas of :
  - data collection,
  - data analysis,
  - assumptions, and
  - Methods.
- Recommended changes to the Technical Manual for the Quantification of Water Savings.

We have observed improvements in the methods employed by GMW (and previously NVIRP) over the six years for which Cardno has completed audits of water savings estimates. In particular, GMW has made significant improvements in its records for construction works, particularly for the rationalisation of assets.

From our audit work this year trailing outfall flow records, we consider that GMW needs to significantly improve how it documents outfalls volumes. We have make the following specific recommendations relating to recording outfall volumes:

- Operators should note reasons why their readings differ from SCADA measurements
- For outfalls not connected to SCADA GMW's operators should report on the logsheets how frequently the sites are visited and on what basis their measurements are made
- Operator logsheets should be reviewed to ensure that they are consistent with GMW's corporate asset identification.

From our audit work relating to WEEs, we make the following recommendations:

- We recommend that GMW improves its processes for recording and reporting the transfer of WEEs and also the reasons for which WEEs are cancelled.
- We also recommend that GMW documents the accounting of WEEs between the Inter-Project Agreement and the Stage 1 Project.

This year, we see no grounds for making recommendations regarding the Technical Manual beyond the suggestions already identified by GMW, namely:

- Using deliveries in the baseline year (D_{MBase}) instead of deliveries in the current year (D_{MYearX}) to calculate Phase 4 water savings due to service point replacement. This aligns the equation with that for calculating Phase 4 water savings due to service point rationalisation.
- Using factor $F_{(LTCEbase)}$ in place of $F_{(LTCEYearX)}$ to calculate factor F(PA) for determining Phase 3 water savings due to channel remediation.

9 Progress against previous audit recommendations

The Audit Protocol requires the current year audit to report on the progress made by the relevant organisations in achieving the recommendations from previous audits. For the 2012/13 audit, we consolidated the recommendations from previous years to streamline the tracking of implementation of the recommendations.

In 2012/13 we identified outstanding recommendations in two main areas – recording outfall volumes and tracking WEEs. GMW has addressed the recommendations relating to WEEs and these have been removed from the register for 2013/14.

The revised schedule detailing the actions and progress to date is shown in Table 9-1.

Table 9-1 Schedule of progress against previous audit actions

Ref	Year	Area	Comment	2013/14 Audit comment
12/13-1	2012/13	Outfalls	As noted in previous years we recommend that the SCADA be used as the primary point of reference for recording, storing and reporting outfall measurement data given that most major outfalls now have online measurement. Operators should continue to record where adjustments to flows need to be made, e.g. if a sensor is out of the flow. The SCADA may be programmed to identify (automatically or by manual prompting) rainfall flood water discharge events and thereby report an outfall figure that is net of flood volumes	This recommendation is still current and is supplemented by recommendations 13/14-1, 13/14-2 and 13/14-3
12/13-2	2012/13	Outfalls	We recommend that GMW undertakes reconciliation of its outfall information. The exercise should compare the outfall IPM number, structure number, SCADA reference, location in GIS and actual location recorded on site. The works should be prioritised so that those outfalls most critical to the water savings calculations be investigated first. This recommendation follows on from our 2009/10 recommendation that the outfall names used by GMW should be reconciled with the outfall names used in the SCADA. Maintenance will be required as new outfalls are built and old ones are removed.	GMW has adopted this recommendation and the audit of outfalls is largely complete.
12/13-3	2012/13	Outfalls	We believe that GMW must improve how it records and uses outfall data for the purpose of water savings audits. Our recommendations for this area are summarised in our response to Item 4 from 2009/10 in Appendix A. We are of the opinion that GMW Operations must take the lead in these initiatives and that these should be largely implemented before the commencement of the 2012/13 irrigation season given that two years have passed since the first recommendations were made in this area.	This recommendation is still current and is supplemented by recommendations 13/14-1, 13/14-2 and 13/14-3
13/14-1	2013/14	Outfalls	Operators should note reasons why their readings differ from SCADA measurements	
13/14-2	2013/14	Outfalls	For outfalls not connected to SCADA GMW's operators should report on the logsheets how frequently the sites are visited and on what basis their measurements are made	
13/14-3	2013/14	Outfalls	Operator logsheets should be reviewed to ensure that they are consistent with GMW's corporate asset identification.	

Audit of Irrigation Modernisation Water Recovery 2013/14 Irrigation season

APPENDIX A

Document Register

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Shaping the Future

Document Name
TATDOC-#3865550-v1-AUTOMATION_REGULATORS_WATER_SAVINGS_ESTIMATES_FOR_THE_2013_14_WATER_SAVINSG_AUDIT.XLS
TATDOC-#3865542-v1-DECOMMISSIONING_WATER_SAVINSG_ESTIMATES_FOR_2013_14_WATER_SAVINGS_AUDIT.XLSX
TATDOC-#3865551-v1-METER_SAVINGS_ESTIMATES_FOR_2013_14_WATER_SAVINGS_AUDIT.XLSX
v14 to auditor SPREAD-PLAN- Estimate of Channel remediation savings .xls
TATDOC-#3869565-v1-V2_TO_AUDITOR_SUMMARY_STAGE_1_&2_WATER_SAVINGS_AND_WORKS_AUDIT_2013_2014_.XLSX
TATDOC-#3865549-v1-WATER_SHARES_RECOVERY_ESTAIMTES_FOR_2013_14_WATER_SAVINGS_AUDIT.XLSX
Loddon River Environmental Watering Plan
Round Lake Environmental Watering Plan
Pig Swamp Environmental Watering Plan
McDonald's Swamp Environmental Watering Plan
Lake Little Boort Environmental Watering Plan
Lake Yando Environmental Watering Plan
Lake Murphy Environmental Watering Plan
Lake Meran Environmental Watering Plan
Lake Elizabeth Environmental Watering Plan
Johnson Swamp Environmental Watering Plan
Lake Leaghur Environmental Watering Plan
IR124174 A0 L Regulator Rollout TO.pdf
IR124174 A0 L Regulator Rollout RO.pdf
IR124174 A0 L Regulator Rollout MV.pdf
IR124174 A0 L Regulator Rollout LV.pdf
IR124174 A0 L Regulator Rollout CG-SP.pdf
IR137830 Decommissioned Channels TO.pdf
IR137830 Decommissioned Channels RO.pdf
IR137830 Decommissioned Channels MV.pdf
IR137830 Decommissioned Channels LV.pdf
IR137830 Decommissioned Channels CG_SP.pdf
to auditor TATDOC-#2967908-v2-PONDAGE_TEST_SUMMARY_-_GMID_ALL_YEARS.XLS
TATDOC-#3723109-v2-POLICY_-_FINANCIAL_RING_FENCING.docx
MEMO-PLAN - Proposed Revision of Method for Estimation of Phase 4 Metering Error Water Savings.docx
changed methodology use eqn 12.3.4 meter error GHD review 233146.pdf
Business_case-Stage_1_for_public_release_3_February10_FINAL.pdf
Final_Arup_report_on_revised_baseline_water_balance_-_29_August_2012_issued.pdf

Audit of Irrigation Modernisation Water Recovery 2013/14 Irrigation season

APPENDIX B

WEES CLAIMED BY GMW IN WATER SAVINGS CALCULATION

WEE ID	Region	Owner	Reliability	Volume (ML)
WEE000070	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	1
WEE000333	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	28.8
WEE000604	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	5
WEE000658	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	1
WEE000660	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	158.4
WEE001429	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	High	34.8
WEE001603	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	78.2
WEE002024	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	85.4
WEE002116	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	12.8
WEE002117	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	0.5
WEE002499	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	42.7
WEE002587	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	132.1
WEE002588	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	60
WEE002793	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	7
WEE002794	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	2.9
WEE003192	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	92.2
WEE003193	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	40.8
WEE003448	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	26.9
WEE003450	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	111.4
WEE003826	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	15.4
WEE003886	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	9.6
WEE004010	Goulburn	Recorded owner is not G-MW	Low	36.5
WEE004066	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	42.7
WEE005300	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	127.2
WEE005301	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	56.6
WEE005456	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	112.8
WEE005458	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	81.1
WEE005485	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	1
WEE005665	Goulburn	Recorded owner is not G-MW	High	13
WEE005666	Goulburn	Recorded owner is not G-MW	Low	5.8

WEE005735	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	177.1
WEE005769	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	1.9
WEE006173	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	61.4
WEE006364	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	10.6
WEE006477	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	21.1
WEE006789	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	2.9
WEE006962	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	21.1
WEE006963	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	9.6
WEE006986	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	High	2
WEE006987	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	1
WEE007103	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	52.3
WEE007308	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	5
WEE007309	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	1.9
WEE007439	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	104.2
WEE007803	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	118.4
WEE007804	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	53.8
WEE008211	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	9.1
WEE008479	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	High	29.6
WEE008480	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	13.4
WEE008496	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	43.7
WEE008883	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	309.2
WEE008884	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	161
WEE009159	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	12
WEE009379	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	36.1
WEE009380	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	16.3
WEE009619	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	83.3
WEE009620	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	37.9
WEE010266	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	63
WEE010267	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	23
WEE010590	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	10.8
WEE010676	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	315.5

WEE010677	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	143.5
WEE010763	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	3.4
WEE010931	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	9.6
WEE011076	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	20.2
WEE011172	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	188.5
WEE011173	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	84.5
WEE011503	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	102.5
WEE011504	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	46.6
WEE011586	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	3
WEE011613	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	152.4
WEE011614	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	68.2
WEE011634	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	0.5
WEE011860	Goulburn	Recorded owner is not G-MW	Low	11.5
WEE011919	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	High	90.3
WEE011920	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	40.3
WEE011935	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	131
WEE011950	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	106.1
WEE012419	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	11.5
WEE012646	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	39.4
WEE012652	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	54.2
WEE012657	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	449.5
WEE013095	Goulburn	Recorded owner is not G-MW	Low	38.4
WEE013357	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	287
WEE013417	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	226.2
WEE013418	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	105.1
WEE013556	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	56.6
WEE013754	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	141.6
WEE013755	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	64.3
WEE014583	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	58.1
WEE016255	Murray	Recorded owner is not G-MW	High	270.5
WEE016327	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	26.9

WEE016856	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	84.5
WEE020784	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	56.2
WEE021963	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	1
WEE022539	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	2
WEE024092	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	50.9
WEE024473	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	55.2
WEE024671	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	196.3
WEE024672	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	88.3
WEE024802	Goulburn	Recorded owner is not G-MW	Low	38.4
WEE025433	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	49.4
WEE026653	Goulburn	Recorded owner is not G-MW	Low	1.9
WEE027059	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	38.9
WEE027121	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	244.9
WEE027122	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	111.8
WEE027542	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	21.6
WEE028063	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	48.9
WEE028064	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	21.6
WEE028096	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	112.8
WEE028099	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	6.9
WEE028101	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	359.6
WEE028520	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	14.4
WEE028522	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	111.4
WEE028999	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	9.6
WEE029675	Goulburn	Recorded owner is not G-MW	Low	24
WEE030444	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	68.2
WEE030596	Goulburn	Recorded owner is not G-MW	High	124.4
WEE031109	Murray	Recorded owner is not G-MW	High	12.1
WEE034800	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	4
WEE034877	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	Low	59
WEE035568	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	7.2
WEE036174	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	162.5

WEE037267	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	2.1
WEE039164	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	7.6
WEE042969	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	100.5
WEE043001	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	270
WEE043302	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	39.4
WEE043728	Murray	Recorded owner is not G-MW	High	1
WEE045455	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	40.1
WEE047639	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	18
WEE048037	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	13
WEE048488	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	52
WEE048492	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	44.6
WEE048902	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	250
WEE048963	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	77.5
WEE050876	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	16
WEE050931	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	58.5
WEE051040	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	1.4
WEE051089	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	4
WEE051094	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	2
WEE051096	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	72.7
WEE051192	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	7.5
WEE051268	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	39.9
WEE051298	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	53
WEE051302	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	2.1
WEE051621	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	50
WEE051630	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	30
WEE051720	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	144
WEE051827	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	189.4
WEE051868	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	205.2
WEE052188	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	213
WEE052462	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	1
WEE052638	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	2.4

WEE053348	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	28
WEE053943	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	49
WEE054474	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	12.7
WEE055333	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	230
WEE055607	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	98.1
WEE055748	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	1.2
WEE056753	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	379.3
WEE056754	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	552.7
WEE057037	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	12
WEE057039	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	124.3
WEE057043	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	91.1
WEE057044	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	High	3
WEE057045	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	121.1
WEE057052	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	57.4
WEE057056	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	6.5
WEE057058	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	200
WEE057060	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	100
WEE057099	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	166.8
WEE057125	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	High	39
WEE057127	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	108.6
WEE057129	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	21.7
WEE057145	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	19.8
WEE057147	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	103.8
WEE057149	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	3
WEE057153	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	20.2
WEE057177	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	300
WEE057181	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	5
WEE057193	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	29.8
WEE057195	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	81.6
WEE057201	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	208.5
WEE057214	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	19.7

WEE057235	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	146.8
WEE057239	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	3
WEE057247	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	153.3
WEE057251	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	110.4
WEE057253	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	91.2
WEE057291	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	61.1
WEE057579	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	55
WEE057585	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	2.5
WEE057729	Murray	GOULBURN MURRAY RURAL WATER CORPORATION	High	107.2
WEE057731	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	4
WEE057925	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	165
WEE058778	Goulburn	GOULBURN MURRAY RURAL WATER CORPORATION	High	17.6
WEE058977	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	High	42
WEE059553	Murray	GOULBURN-MURRAY RURAL WATER CORPORATION	Low	300.8
WEE058046	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	12.9
WEE059557	Goulburn	GOULBURN-MURRAY RURAL WATER CORPORATION	High	0.9