The Achievements of Murrumbidgee Irrigation Under Round 3 of the Private Irrigation Infrastructure Operators Program in NSW

Final Project Report
January 2020

MURRUMBIDGEE IRRIGATION LIMITED

Postal Locked Bag 6010, Griffith NSW 2680

Offices • Research Station Rd, Hanwood NSW 2680 • Dunn Ave, Leeton NSW 2705

Contact T (02) 6962 0200 F (02) 6962 0209 E info@mirrigation.com.au

www.mirrigation.com.au ABN 39 084 943 037

Contents

Document Authorisation 3

Abbreviations and Acronyms 3

1. Introduction 5

2. The Funding Agreement 6

2.1 Initial Funding 6

2.2 Deed of Variation #1 6

2.3 Deed of Variation #2 6

2.4 Deed of Variation #3 6

2.5 Deed of Variation #4 7

3. Planning 7

4. Project Overview 8

5. Planning and Delivery Challenges that were Overcome 12

5.1 Accurately Scoping Projects 12

5.2 Access to Skilled Staff and Contractors to Manage and Deliver the Works 12

5.3 Works Scheduled During a Very Short Winter Shut-Down Period 13

5.4 Adherence to WHS Requirements and Expectations 13

5.5 Altered Flow Dynamics 14

5.6 Change Management 14

5.6.1 Staff 14

5.6.2 MI Customers 14

5.6.3 Timely Completion of Sundry Works 15

6. Broader Project Outcomes 16

6.1 Impacts on Murrumbidgee Irrigation Ltd 16

6.2 Impact on Customers 17

6.3 Regional Benefits 17

7. Review of Water Savings 19

8. Statement of Expenditure 20

9. Conclusions 22

Document Authorisation

Name	Signature	Date
Approved by: Jody Rudd		8 January 2020

Abbreviations and Acronyms

AMS	Activity Method Statement	**MIA**	Murrumbidgee Irrigation Area
CEMP	Construction Environment Management Plan	**MIARA**	MIA Renewal Alliance
		NBC	Northern Branch Canal
DAWR	Department of Agriculture and Water Resources	**PIIOP**	Private Irrigation Infrastructure Operators' Program
DoV	Deed of Variation		
EOI	Expression of Interest	**PVC**	Polymerizing vinyl chloride
EP&A	Environmental Planning and Assessment	**PPE**	Personal Protective Equipment
EPBCA	Environment Protection and Biodiversity Conservation Act	**RCP**	Reinforced concrete pipe
		REF	Review of Environmental Factors
GHD	Gutteridge Haskins and Davey	**RFT**	Request for Tender
GRP	Glass fibre Reinforced Plastic	**SWMS**	Safe Work Method Statement
HDPE	High Density Poly Ethelene	**TOC**	Total Outturn Cost
HSEQ	Health Safety Environment Quality		
IMS	Integrated Management System	**TRA**	Task Risk Assessment
IP	Injured Person	**TSCA**	Threatened Species Conservation Act
KPI	Key Performance Indicator	**WHS**	Work Health & Safety
ITT	Invitation to Tender	**WHSMS**	Work Health Safety Management System
LTI	Lost Time Injury		
LVBC	Lake View Branch Canal	**WRA**	Work Risk Assessment
MI	Murrumbidgee Irrigation Ltd		

1. Introduction

Murrumbidgee Irrigation (MI) is pleased to submit our final report in accordance with Milestone 8 of the Funding Agreement with the Department of Agriculture and Water Resources (DAWR). The report provides an overview of project activities, challenges and outcomes throughout the 3 year funding period.

The $122M in project funding has contributed to the most intensive works program for the irrigation network since the area was constructed in the early 1900's. It has enabled the automation of our water delivery system and provided asset refurbishment works which together have delivered major operational efficiencies within the business and for our customers.

The investment in concert with previous PIIOP funding rounds has reinforced the position of the Murrumbidgee Irrigation Area (MIA) as one of the premier irrigation areas within Australia. It has also supported the communities of the MIA by setting them up for success in a future with less water.

2. The Funding Agreement

2.1 Initial Funding

MI applied for funding under round 3 of the Private Irrigation Infrastructure Operators Program (PIIOP3) in February 2016. The nominated projects were grouped into the following broad categories:

- channel lining;
- channel automation;
- stock and domestic pipelines;
- gravity pipelines;
- earth channel rehabilitation; and
- metering and outlets.

The funding application confirmed that MI would continue to refine the scope of each project if funding was subsequently approved through consultation with its customers.

MI was advised of funding approval in May 2016 in the amount of $84,898,556 and the original funding deed was executed in September 2016. It was anticipated that the nominated projects would secure water savings of 9,988 ML.

2.2 Deed of Variation #1

The first variation was executed in May 2017. The key changes apart from general administrative and legislative updates included:

- realignment of sub-projects by grouping like projects together;
- specifically nominating the first and second sub-projects to be delivered as stand-alone projects, namely “Automation of Main Canal and Division 3”, and “Channel Lining of Lake View Branch Canal and Northern Branch Canal”; and
- amendments to interim milestone dates and corresponding payments.

2.3 Deed of Variation #2

The second variation was executed in February 2018. The key changes apart from general administrative and legislative updates included:

- additional funding was approved taking the total funding amount to $122,246,556;
- the agreed water savings to be returned to the Commonwealth were increased to 14,382ML;
- further realignment of sub-projects;
- substantially extending the scope of metering farm outlets; and
- amending project budgets and payment schedules to accommodate the increased funding and revised cash flow projections.

2.4 Deed of Variation #3

The third variation was executed in October 2018. The key changes included:

- substitution of sub-projects to achieve better value for money;
- rescoping the automation and remote monitoring of escapes project; and
- amending project budgets to accommodate the above changes.

2.5 Deed of Variation #4

The fourth variation was executed in March 2019. The key change was to amend the Milestone dates for completion and final project reporting to June 2019. This variation was made in the final stages of project delivery with approximately 96% of funds expended. It was in response to unanticipated construction delays for the "Yanco Stock and Domestic Pipeline" and "Metering and Outlets" projects.

3. Planning

The PIIOP3 funding application followed the success of earlier applications under PIIOP1 and PIIOP2. It was submitted in early 2016 at a time when PIIOP1 works had concluded and PIIOP2 works were mid-way through delivery. MI therefore had the advantage of the experience gained from delivery of these earlier funding rounds including:

- similar scope in terms of channel automation, channel lining and pipeline projects;
- experience scoping and costing large-scale work programs;
- pre-existing concept designs and standard drawings;
- lessons learnt to improve project outcomes;
- access to expertise within the Murrumbidgee Irrigation Area Renewal Alliance (MIARA) which was specifically established to deliver the PIIOP works; and
- access to objective data and observations arising from project implementation of PIIOP1 and part of PIIOP2.

The scope for PIIOP3 included projects that addressed site-specific refurbishment needs as well as large scale works that systematically modernised entire irrigation districts. The large scale of works meant that initial scoping for the purposes of the funding application included assumptions that required later validation and refinement.

The project commenced under a self-delivery model and project staff were appointed in mid-2016. The initial focus was on the delivery of automation of the Main Canal and Division 3 along with channel lining of the Northern Branch Canal and Lake View Branch Canal. By early 2017 it was apparent that the scale of works and challenges in securing skilled resources meant that project delivery would be better managed by our project alliance team, MIARA, and the delivery model was changed accordingly.

Following completion of the first four projects in mid to late 2017 a detailed assessment of the remaining projects was undertaken. The assessment identified opportunities to substitute sub-projects to achieve better value for money. Specifically, full channel automation and automation and metering of farm outlets were identified as providing better value for money than several of the pipeline and channel lining projects and the Yenda storage project. Consequently, these projects were descoped and substituted with the automation projects.

Project delivery continued under MIARA alliance until mid-2019 except for the Yanco Stock and Domestic water supply project which was self-managed by MI from 2018. MIARA delivered several automation projects, channel rehabilitation, automation of escapes, initial work on the outlets project and part of the Yanco Stock and Domestic water supply project.

A review of expenditure against budget in late 2018 revealed a projected under-spend that was allocated to delivering further channel automation works. MIARA commenced procurement for these works in early 2019 for installation and commissioning in mid-2019.

4. Project Overview

The following table provides a concise description of each sub-project as listed in the amended Funding Deed.

Table 1: Summary of Projects Delivered by PIIOP3

Project	Description of Works	# Assets Delivered / Refurbished	Works Program	Innovations	Specific Challenges
Sub-project 1a: Northern and Lake View Branch Canal Lining	• Reprofile the earthen channel and stabilise broken concrete sections to provide a firm base • Install HDPE liner over existing earthen channel (Lake View Branch Canal) and degraded concrete lined channel (Northern Branch Canal). • Realign 2.2km of channel to provide greater delivery efficiency and customer access • Erect security fencing. • Install additional safety measures.	• 28.4km of new HDPE lining; • 56.3km of new security fencing; • 3 new silt traps constructed to assist in the removal of silt without damaging the new liner; • 46 new safety ladders to provide additional means of egress; • 46 new safety ropes strung across the channel to assist egress; and • 29 sites with refurbished rip rap in the transition between the existing regulating structures and the new HDPE channel liner.	• Initiated January 2017 and completed November 2017. • Bulk of work had to be completed during the short winter shut-down.	• Selected HDPE liner over EPDM due to superior durability. • Reverted to delivery via MIARA rather than MI self-delivery due to staff resourcing challenges. • Adopted variable channel profile to reduce the cost of reinstating compacted fill material. • Realigned channel to reduce channel length and satisfy customer request. • Worked night-shifts to maintain program.	• Short planning period in advance of winter works. • Long procurement lead times for geofabric and HDPE liner (8 weeks manufacture + 4 weeks to ship from overseas). • Short window of installation during the winter shut-down. • Groundwater intrusion following channel dewatering delayed access to the Lake View Branch canal. • High wind velocities complicated laying of the channel liner and delayed the works program. • Maintaining periodic water supply to citrus farmers to minimise frost damage. • Delays in procuring fencing to secure the new works (WHS).

Table 1: Summary of Projects Delivered by PIIOP3 (*continued*)

Project	Description of Works	# Assets Delivered / Refurbished	Works Program	Innovations	Specific Challenges
Sub-project 1b – Main Canal Seepage Interception (McNeils Bridge)	• Clear work sites at two locations. • Trench up to 3.5m depth. • Lay 6" perforated pipe as the subsurface drainage line. • Install two sumps and solar powered pumps at the terminal point of each subsurface drainage line.	• 1,750m of new subsurface drainage line. • 2 new sumps and lift pumps to dispose of groundwater	• March-April 2019 for the pipeline and sumps. • Pumps installed May 2019 to match known discharge.	• Utilised subsurface drainage rather than channel lining to provide a more cost-effective and low risk solution. • Installed and monitored piezometers at 4 potential sites to objectively assess seepage in advance and thereby confirm works are warranted. Results led to works at only two sites. • Delaying procurement of pumps to allow actual seepage flow rates to be measured, thus matching pumps to known demand.	• There are only several contractors in Australia with the necessary specialised equipment. The contractor delayed commencement on two occasions. • Super-saturated work sites.
Sub-project 2a – Sturt Canal Automation	• Retrofit automated flume gates on channel regulators, offtakes and escapes. • Replace regulators where a retrofit is not viable. • Install telemetry and tune channels for automated total channel control.	• 105 regulators automated. • New 40m communications tower at Brays Dam.	• Predominantly delivered during the 2018 winter shut-down period.	• Ensured a 25% increase in peak flow through each structure to future-proof the performance of the asset. • Detailed hydraulic modelling to confirm channel capacity, gate selection and levels. • Concurrent delivery of automation plus additional capacity increase works (in excess of 25%, privately funded). • Worked with customers to identify and realise opportunities to reconfigure the network.	• Resolving gate selection to accommodate capacity increase (subject to private funding) in a timely manner. • Short window of installation during the winter shut-down. • Timely draining of channels to permit work. • Timely provision of pre-cast concrete.
Sub-project 2b – Automation and Remote Monitoring of Escapes	• Retrofit automated flume gates on escapes. • Replace escapes where a retrofit is not viable. • Install telemetry, tune the pool for automated total channel control	• 13 escapes automated.	• Predominantly delivered in November 2018.		

Table 1: Summary of Projects Delivered by PIIOP3 (*continued*)

Project	Description of Works	# Assets Delivered / Refurbished	Works Program	Innovations	Specific Challenges
Sub-project 2c – Main Canal and Division 3 Automation	• Retrofit automated flume gates on channel regulators, offtakes and escapes. • Replace regulators where a retrofit is not viable. • Install telemetry ,tune channels for automated total channel control.	• 38 regulators (including offtakes) on Main Canal automated. • 44 regulators on Division 3 automated.	• Predominantly delivered during the 2017 winter shut-down period.	• Ensured 25% increase in peak flow through each structure to future-proof the performance of the asset. • Pump-around solution adopted for works on Main Canal to maintain water supply to citrus growers. • Worked with customers to identify and realise opportunities to reconfigure the network.	• Poor tender response (limited market interest). • Short window of installation during the winter shut-down. • Timely draining of channels to permit work. • Maintaining water supply to citrus growers where required.
Sub-project 2d – Wah Wah Automation	• Retrofit automated flume gates on channel regulators, offtakes and escapes. • Replace regulators where a retrofit is not viable. • Install telemetry and tune channels for automated total channel control.	• 75 regulators automated. • Additional radio equipment and retrofit existing tower at Gunbar.	• Predominantly delivered during the 2018 winter shut-down period.	• Ensured 25% increase in peak flow through each structure to future-proof the performance of the asset. • Detailed hydraulic modelling to confirm channel capacity, gate selection & levels. • Concurrent delivery of automation plus additional capacity increase works (in excess of 25%, privately funded). • Worked with customers to identify and realise opportunities to reconfigure the network.	• Resolving gate selection to accommodate capacity increase (subject to private funding) in a timely manner. • Short window of installation during the winter shut-down. • Timely draining of channels to permit work. • Timely provision of pre-cast concrete. • Working in remote areas.
Sub-project 2e – Warburn Automation	• Retrofit automated flume gates on channel regulators, offtakes and escapes. • Replace regulators where a retrofit is not viable. • Install telemetry and tune channels for automated total channel control.	• 28 regulators automated. • Additional radio equipment and retrofit of the existing tower at Willow Dam.	• Predominantly delivered during the 2018 winter shut-down period.	• Ensured 25% increase in peak flow through each structure to future-proof the performance of the asset. • Detailed hydraulic modelling to confirm channel capacity, gate selection & levels. • Concurrent assessment and delivery of automation plus additional capacity increase works (in excess of 25% privately funded). • Worked with customers to identify and realise opportunities to reconfigure the network.	• Resolving gate selection to accommodate capacity increase (subject to private funding) in a timely manner. • Short window of installation during the winter shut-down. • Timely draining of channels to permit work. • Timely provision of pre-cast concrete.

Table 1: Summary of Projects Delivered by PIIOP3 (*continued*)

Project	Description of Works	# Assets Delivered / Refurbished	Works Program	Innovations	Specific Challenges
Sub-project 3 – Yanco Stock and Domestic Pipeline	• Install gravity pipeline using a combination of materials (RCP, GRP, PVC). • Install HDPE pressure pipelines. • Decommission former earthen channels and associated structures such as bridges and culverts.	• 1565m of gravity pipeline and new automated regulator at the offtake. • 2,700m of new pressure pipeline. • Two pump stations for the pressurised system.	• Gravity pipeline: July-December 2018. • Pressure pipelines: July 2019.	• Facilitated voluntary exit of over half the customer base (no ongoing need for access to irrigation water), thereby reduced the extent of works required, allowing the removal of 20 redundant regulators and 34 culverts.	• Multiple services near works (buried and overhead). • Traffic control, including crossing a major traffic route (Irrigation Way). • Works near residences. • Cost originally under-estimated.
Sub-project 4 – Earth Channel Rehabilitation	• Excavation of unconsolidated material in the base of channel. • Import and compact new fill. • Re-cut new channel closer to original (smaller) channel dimensions. • Replace rip rap at structures.	• 6,251m of refurbished earthen channel	• June-September 2018	• Utilising a compact and cut technique to ensure efficient handling of materials. • Bypass channels created to meet critical needs during the construction period.	• Additional super-saturated material encountered in the base of channel. • Traffic management. • Cost originally underestimated.
Sub-project 5 – Metering and Outlets	• Replacement of dethridge wheels and doppler meters with telemetered electromagnetic meters. • Automation of outlets delivering >20ML/year.	• 367 existing outlets automated with a new meter and gate. • 354 outlets upgraded in capacity and then automated with a new meter and gate. • 266 redundant outlets removed.	• Feb 2018 - June 2019	• Increasing outlet size where requested by customers to improve flow rates (financial contribution required from the customer in some cases). • Worked with customers to identify and realise opportunities to reconfigure the network.	• Reaching firm customer agreement on capacity increase works. • Scheduling works to suit customer irrigation schedules. • Change management for customers.

5. Planning and Delivery Challenges that were Overcome

The PIIOP3 work program was an ambitious program with a large scale of works to be delivered in a short timeframe. The following section outlines the higher-level challenges that were overcome to deliver the works.

5.1 Accurately Scoping Projects

Asset data base

MI has a large number of water regulating assets that have been designed, constructed, modified and removed over the past 100 years. Due to several changes to records systems over that time, the MI asset data base was found to be unreliable in that not all assets were listed consistently or dimensions accurately recorded. In addition, asset condition had declined over time and some of these defects were not identified until channels were drained and works commenced.

Because of the inconsistencies in the asset data there was an emphasis on field reconnaissance and survey during the planning stages where possible. Despite these efforts, assumptions and estimates were used when initially scoping some projects. Any remaining uncertainty at the time of tender was reflected in tender documents. This increased the perceived risk to contractors resulting in a reduced number of tenders and higher than expected tender prices.

As a result of this learning, a high priority has been placed on ensuring all new assets are accurately documented and captured in the MI asset management system at the completion of each project.

Water savings estimation

A conservative approach has been adopted for estimating the water savings generated by the program of works. This approach was necessary because not all project sites had accurate monitoring capabilities. Where sites historically relied on visual flow estimation or hydrometric data that was taken at a certain point in time (and therefore subject to variability due to channel degradation, sedimentation or weed growth) savings estimates were based on similar sites with accurate monitoring capabilities.

Post program implementation, accurate flow measurement is now available at hundreds of new sites. With the completion of channel tuning in December 2018, initial data is available and supports the magnitude of water savings estimates. Further confirmation will follow as more of data is collected.

5.2 Access to Skilled Staff and Contractors to Manage and Deliver the Works

In the initial stages of the works program there was difficulty in attracting skilled and experienced staff resources to the area as well as competitive tenders. This is because the works were distributed across a large footprint including sites in remote areas (approximately 1,500 work sites were distributed over a 100km reach in the MIA). The challenge was exacerbated by major civil works programs under way in capital cities, water efficiency works programs in other irrigation areas and one-off projects such as the Wentworth to Broken Hill pipeline project competing for the same resource base.

Consequently, MI reverted to the Alliance model to deliver most of the remaining scope under PIIOP3. The Alliance model is suited to projects that must be scoped quickly and delivered in a flexible manner. Tier one contractors such as John Holland can readily source skilled staff due to the ongoing work opportunity they can provide. They also have an extensive experience pool across Australia.

5.3 Works Scheduled During a Very Short Winter Shut-Down Period

MI historically suspends the supply of water over winter to permit maintenance and minor construction activity. The winter shut-down coincides with a low water use period and generally applies from the last week of May through to the first week of August. This is a very short window of only 9-10 weeks to undertake the PIIOP3 works, much of which could only be achieved with a full shut-down of multiple laterals.

Contractors had to be secured, inducted and then mobilised in advance of the planned shut-down. The nominated channels had to be drained to permit works to be undertaken at the scheduled time and then refilled at the end of the shut-down period to allow customers to recommence irrigation. This substantially increased the workload on MI field staff.

Management of a channel shut-down is further complicated if customers such as citrus growers request a winter watering to manage frost risk. Such a request will arise if several days of less than 0°C are anticipated, particularly if temperatures drop below -2°C. Such occurrences can only be predicted a few days in advance which increases the tension for customers, MI customer engagement staff, MI water delivery staff and MIARA. In some cases, MI intentionally retained water in specified channels to help manage this risk.

The challenge was overcome through detailed planning, effective resourcing, good coordination, and the extensive use of engagement teams for communication. Construction teams also took the opportunity to develop techniques enabling them to carry out in-season works for smaller projects.

5.4 Adherence to WHS Requirements and Expectations

Our high priority on safety is reflected in policy, project planning documentation and construction delivery. The scale of PIIOP3 works presented challenges in maintaining adherence to WHS requirements due to a very large works footprint, remote locations and the need to induct large numbers of new employees and contractors.

Pleasingly there were no lost time injuries experienced during the delivery of PIIOP3 works. The safety data for MIARA PIIOP3 works from 2017-2019 is presented below in Table 2.

Table 2: PIIOP3 Safety Data

Classification	Number of Events
Lost Time Injury	0
Medical Treatment Injury	1
Alternate Work Injury	0
First Aid Injury	3
Near Miss Events	14

5.5 Altered Flow Dynamics

The modernisation works included a 25% design increase in peak flow at each structure. In addition, some areas had (MI funded) works to increase delivery capacity. This fundamentally changed channel operations and provided challenges for field staff who could no longer rely on experience in predicting travel times through the delivery network.

An unseasonably dry winter resulted in an increased demand from customers for water at the end of the winter period. In order to meet these needs, Operations staff were required to familiarise themselves with the new flow dynamics "on-the-run" since customer water supply commenced immediately upon refilling of the channel system and during the commissioning process. In some cases this led to temporary increases in escape flows and even channels over-topping on two occasions. Such short-term challenges were quite stressful for staff but also demonstrated that the works had delivered a substantial improvement in channel water delivery efficiency.

Full channel tuning and automated Total Channel Control was progressively delivered over a period of 6 months following construction. The delay was necessary to allow contractors to sequentially monitor and calibrate a new flow regime in each regulator pool. Confirmation of successful automation was observed when structures operated automatically, channels were operating with relatively stable water levels, customer water orders were satisfied, and negligible losses occurred via escapes.

5.6 Change Management

5.6.1 Staff

The works program impacted staff from three perspectives:

- Additional staff were employed by MI and MIARA to manage the additional work load during construction. The new staff had to be inducted and familiarise themselves with MI operations, standard designs and project requirements.

- Despite the employment of additional MIARA staff, MI staff workload increased to accommodate general day-to-day operations as well as assisting with the delivery of the PIIOP3 capital works program. For example: the MI engineering team were required to communicate design expectations, review designs and monitor works; MI operations staff workload temporarily increased to schedule temporary shutdown of water delivery and familiarise themselves with new flow dynamics; and customer engagement staff had to manage the scheduling of works, enquiries to resize farm outlets and general customer concerns.

- Modernisation and automation delivers operational efficiencies thus reducing labour force requirements. Such works also change the required long-term skill-set to operate and maintain the new assets into the future. These requirements have been discussed openly within MI for some time and staff have been engaged extensively in regards to transition strategies that are currently being implemented including retaining and retraining willing staff.

5.6.2 MI Customers

MI customers overwhelmingly responded to the project in a positive manner despite some short-term inconvenience for their on-farm operations from construction including:

- temporary shut-down of water supply to permit the installation of new works. Shut-downs were scheduled in consultation with customers to minimise the inconvenience and impact on crops.

- traffic management activities disrupted traffic flow on public roads or on-farm, including a small number of temporary road closures.

- fences were required to be removed and replaced in a small number of cases to permit access.

- MI also took the opportunity in several cases to permanently remove trees (sometimes intentionally planted) or other items owned by customers that were too close to MI works and in contravention of MI Development Rules.

Telemetry also provides real-time visibility of flow therefore MI operations staff can readily identify system anomalies and identify where customers are taking flow contrary to a valid water order.

A positive change-management outcome was a strong interest from customers to increase the capacity of their farm outlets thereby increasing flow rate on-farm. This outcome is a response to the increasing value of water and the need to irrigate broad acre crops more efficiently. The change was also supported by a revised MI pricing schedule that reflected the real cost of maintaining each asset, thus encouraging landholders to consolidate the number of current outlets if they were used infrequently.

5.6.3 Timely Completion of Sundry Works

A very small percentage of the overall works program (<3% of funding value) remained to be completed beyond the targeted completion date of mid-March 2019. This was due to the large scope of works and allocation of underspent funds to new works.

The PIIOP3 scope was extensive, investigating potential works at approximately 1,500 work sites. Most of these potential work sites were accepted and included into scope. Inevitably some of these sites encountered more challenges than others, with custom designs and extended customer engagement delaying completion at a small number of sites. These sites are commonly the last to complete in the program of works.

MI also identified in late 2018 that additional funds were available due to projects being delivered under budget. These funds were allocated to further automation works. Procurement for these works commenced in early 2019, with installation completed by mid-2019 due to a 3-month lead time on manufacturing.

6. Broader Project Outcomes

Previous sections in this report outline the physical outcomes for each sub-project. The following section focusses on the broader outcomes for each of the key stakeholder groups.

6.1 Impacts on Murrumbidgee Irrigation Ltd

Murrumbidgee Irrigation is an unlisted public company owned by the customers it services. The company operates on a cost-recovery basis. The core business of MI is to provide water supply and drainage services to around 3,200 landholdings through the irrigation infrastructure assets that it owns and operates.

A key focus of modernisation has been to increase water delivery efficiency via the progressive adoption of automated channels and farm outlets. This reflects the need to measure flow more accurately, understand real-time flow and deliver the higher flow rates that are increasingly being requested by customers. It avoids the historic practice of running channels slightly in excess of predicted demand to avoid dissatisfied customers but generating water losses via escape flows.

Likewise, the refurbishment of degraded channels and replacement of open channels with a pipeline water delivery system increases operational efficiency and improves the level of customer service.

The key benefits to MI arising from the delivery of the PIIOP3 projects are:

- An automated water delivery network that provides reliable and efficient delivery of customer orders with real time visibility thereby reducing water losses and providing greater customer confidence and flexibility.

- Hundreds of aging structures that were degraded or past their asset life have been either fully replaced or refurbished, thereby reducing operational risk arising from failures and reducing asset maintenance costs in the short term.

- Higher levels of customer satisfaction due to improved system performance and reduced operating costs.

- A safer working environment for staff through removing the manual operation of structures in remote locations and variable weather conditions.

- A modern, automated delivery network that enhances existing customer confidence, serves to attract new customers and crops and maintains the value of the historic investment in irrigation both on-farm and off-farm.

The main issues or challenges for MI going forward include:

- Maintaining the future cost pathway by realising savings in operations and maintenance to offset the higher costs associated with maintaining/upgrading automation and technology solutions. For the past 2 years annual increments in customer revenue (to cover operating costs) have been held to CPI.

- Operating the delivery network with a reduced conveyance allocation. The water savings calculations were intentionally conservative to counteract this impact.

- Developing and retaining a new skill-mix to operate and maintain the new technology that replaced the manually operated system.

- Ensuring systems are in place to avoid a major system failure that previously would have been identified via observation in the field. Mechanisms include system monitoring, system alarming, fail-safe modes and disaster recovery mechanisms.

- Responding to general change management issues for staff and customers.

6.2 Impact on Customers

Direct benefits to customers include:

- Improved water delivery reliability. Customers can now order water with a higher level of confidence that the requested flow of water will be available at the agreed time and for the duration of the water order. Total Channel Control will ensure that the water is provided at the nominated outlet and the automated outlets will then adjust the outlet gate settings, based on the metered flow, to maintain the desired flow rate despite variation in channel operating levels.

- Higher flow rates on-farm, thereby improving irrigation efficiency and generating more income per ML.

- The opportunity for farm reconfiguration and reduced fixed costs prompted by MI initiating discussion on options to reduce farm outlet numbers and increase outlet size at the discretion of the customer.

- Improved flexibility in water ordering. Customers with automated outlets can now request a water order commence or cease 24/7 rather than relying on a field operator to adjust their outlet during daylight hours.

- Reduced seepage from piped supply, lined channels, refurbished earthen channels and additional seepage interception pumping. This reduces the incidence of waterlogging and the associate decline in crop yield and trafficability.

Challenges for customers are largely around change management and relate specifically to building confidence in automation where they have been used to a manual (person) response.

6.3 Regional Benefits

The regional benefits of PIIOP3 investment include:

- The works support changes to on farm practices that enable more crop/ML for the regional economy by providing higher flow rates and more responsive water delivery.

- A positive outlook for irrigation in the MIA through attracting new development such as cotton and tree crops. The diversified income base of the region provides greater economic resilience to a downturn in any particular commodity group.

- Direct expenditure in the local area. Around $16M of project funds was paid to contractors in the Leeton and Griffith post code areas in 2018 and 2019. The most significant local expenditure items were the supply of equipment and labour hire, engineering services, sourcing clean fill material, supply of concrete and traffic management.

- There was also indirect expenditure in the region (estimated to be in excess of $20M) from staff and contractor spending on food, accommodation and leisure activities. MIARA staff and contractor numbers peaked at approximated 200 in mid-2018 and all staff resided in the local area on a temporary basis for varying durations.

- The return of 14,382 ML of conveyance entitlement to the Australian Government to deliver environmental benefits to the Murray Darling Basin, including to RAMSAR listed sites inside the MIA and to wetlands along the mid Murrumbidgee.

7. Review of Water Savings

A review of the water savings considers both:

- the original assessment of the projected water savings prior to project commencement; and
- a current assessment of the likely or known savings following implementation of the project.

The water savings in the 2016 funding application were conservatively estimated due to limited input data. The original assumptions have been reviewed and validated for all the listed sub-projects except for automation of channel escapes.

Originally a large number of channel escapes were to be automated including on laterals that were only partially automated. Experience over the past 3 years identified that partial automation achieves substantially less water savings than full automation. Consequently, the escapes project was descoped and the focus redirected to full channel automation, farm outlet automation and metering.

These changes did not affect the total water savings returned to the Commonwealth which was 9,988 ML of conveyance entitlement. This was increased to 14,382 ML of conveyance entitlement in February 2018 in return for additional funding.

The assessment of water savings following implementation is contained in the table below. It remains indicative due to the availability of only six months of flow data since the completion of channel tuning.

Table 3: Projected Water Savings

Sub Project	Projected Water Savings (ML)
CHANNEL LINING AND SEEPAGE INTERCEPTION Sub-project 1a Northern and Lake View Branch Canal Lining Sub-project 1b – Main Canal Seepage Interception (McNeils Bridge)	2,641
AUTOMATION Sub-project 2a – Sturt Canal Automation Sub-project 2b – Automation and Remote Monitoring of Escapes Sub-project 2c – Main Canal and Division 3 Automation Sub-project 2d – Wah Wah Automation Sub-project 2e – Warburn Automation Sub-project 5 – Metering and Outlets	11,066
YANCO STOCK AND DOMESTIC PIPELINE Sub-project 3	541
EARTH CHANNEL REHABILITATION Sub-project 4	134
TOTAL	**14,382**

8. Statement of Expenditure

An itemised statement of expenditure is provided below in Table 4. The statement is derived from the final auditor's report and key points include:

- The scale of individual projects ranged from approximately $300K to over $30M.
- Investment was heavily skewed towards automation of the water delivery system which included metering, automation of farm outlets and automation of escapes. These works were collectively delivered on-budget.
- Earth Channel Rehabilitation and the Yanco Stock and Domestic Pipeline projects exceeded budget projections.
- Procurement of materials represented a high proportion of the total cost for each of the automation projects.
- Project management costs were approximately 10% of overall expenditure.

Table 3: PIIOP3 Expenditure

	As per Budget (Item 4.1 in the Funding Agreement)	Organisation Contribution/Commonwealth Funds - Total project budget	Organisation Contribution/Commonwealth Funds - Total Spend for all Milestones	Organisation Contribution - Total project budget	Organisation Contribution - Total Spend for all Milestones	Commonwealth Funds - Total project budget	Commonwealth Funds - Total spend for all Milestones
1	**CHANNEL LINING AND SEEPAGE INTERCEPTION**						
1.a	**Northern and Lake View Branch Canal Lining**						
	Direct costs - Earthworks	$2,960,875.00	$3,027,393.19		$0.00	$2,960,875.00	$3,027,393.19
	Direct costs - Laying of materials - Geofab / Liner	$1,922,971.00	$1,939,477.65		$0.00	$1,922,971.00	$1,939,477.65
	Direct costs - Other (site preparation, fencing etc)	$772,944.00	$1,004,144.57		$0.00	$772,944.00	$1,004,144.57
	Procurement	$2,970,627.00	$2,970,627.75		$0.00	$2,970,627.00	$2,970,627.75
	Indirect Costs	$1,581,808.00	$1,667,636.59		$0.00	$1,581,808.00	$1,667,636.59
	Subtotal Northern & LVBC	**$10,209,225.00**	**$10,609,279.75**	**$0.00**	**$0.00**	**$10,209,225.00**	**$10,609,279.75**
1.b	**Main Canal Seepage Interception (Boundary Road/McNeils Bridge)**						
	Direct costs	$100,000.00	$155,089.00		$0.00	$100,000	$155,089.00
	Procurement	$60,000.00	$83,125.00		$0.00	$60,000	$83,125.00
	Indirect Costs	$40,000.00	$79,587.00		$0.00	$40,000	$79,587.00
	Subtotal Main Canal Seepage Interception	**$200,000.00**	**$317,801.00**	**$0.00**	**$0.00**	**$200,000.00**	**$317,801.00**
1.c	**Main Canal Seepage Lining Tharbogang**						
	Direct costs	$408,853.00	$287,747.97		$0.00	$408,853	$287,747.97
	Procurement	$0.00	$0.00		$0.00	$0	$0.00
	Indirect Costs	$23,689.00	$28,775.26		$0.00	$23,689	$28,775.26
	Subtotal Main Canal Lining	**$432,542.00**	**$316,523.23**	**$0.00**	**$0.00**	**$432,542.00**	**$316,523.23**
	CHANNEL AUTOMATION						
2.a	**Sturt Canal Automation**						
	Direct costs - Installation	$5,564,892.00	$5,662,714.97		$0.00	$5,564,892	$5,662,714.97
	MI Procurement - Precast Materials	$309,152.00	$382,026.40		$0.00	$309,152	$382,026.40
	MI Procurement - Rubicon Materials / Services	$4,067,184.00	$3,850,841.28		$0.00	$4,067,184	$3,850,841.28
	Indirect Costs	$1,026,821.00	$1,870,515.91		$0.00	$1,026,821	$1,870,515.91
	Subtotal Sturt	**$10,968,049.00**	**$11,766,098.55**	**$0.00**	**$0.00**	**$10,968,049.00**	**$11,766,098.55**
2.b	**Automation and Remote Monitoring of Escapes**						
	Direct costs - Installation	$808,670.00	$432,987.00		$0.00	$808,670	$432,987.00
	MI Procurement - Precast Materials	$88,760.00	$11,100.00		$0.00	$88,760	$11,100.00
	MI Procurement - Rubicon Materials / Services	$611,240.00	$421,656.00		$0.00	$611,240	$421,656.00
	Indirect Costs	$131,188.00	$0.00		$0.00	$131,188	$0.00
	Subtotal Escapes	**$1,639,858.00**	**$865,743.00**	**$0.00**	**$0.00**	**$1,639,858.00**	**$865,743.00**
2.c	**Main Canal and Division 3 Automation**						
	Direct costs - Installation	$7,868,122.00	$8,185,555.02		$0.00	$7,868,122	$8,185,555.02
	MI Procurement - Precast Materials	$1,270,866.00	$212,086.00		$0.00	$1,270,866	$212,086.00
	MI Procurement - Rubicon Materials / Services	$8,751,734.00	$9,450,569.18		$0.00	$8,751,734	$9,450,569.18
	Indirect Costs	$1,530,510.00	$1,605,230.67		$0.00	$1,530,510	$1,605,230.67
	Subtotal Main Canal	**$19,421,232.00**	**$19,453,440.87**	**$0.00**	**$0.00**	**$19,421,232.00**	**$19,453,440.87**
2.d	**Wah Wah Automation**						
	Direct costs - Installation	$3,737,075.00	$3,476,419.42		$0.00	$3,737,075	$3,476,419.42
	MI Procurement - Precast Materials	$367,118.00	$352,353.95		$0.00	$367,118	$352,353.95
	MI Procurement - Rubicon Materials / Services	$2,571,786.00	$2,344,682.62		$0.00	$2,571,786	$2,344,682.62
	Indirect Costs	$689,556.00	$1,053,253.71		$0.00	$689,556	$1,053,253.71
	Subtotal Wah Wah	**$7,365,535.00**	**$7,226,709.70**	**$0.00**	**$0.00**	**$7,365,535.00**	**$7,226,709.70**
2.e	**Warburn**						
	Direct costs - Installation	$2,125,971.00	$1,445,487.05		$0.00	$2,125,971	$1,445,487.05
	MI Procurement - Precast Materials	$309,152.00	$152,068.67		$0.00	$309,152	$152,068.67
	MI Procurement - Rubicon Materials / Services	$1,362,750.00	$1,091,709.94		$0.00	$1,362,750	$1,091,709.94
	Indirect Costs	$392,279.00	$576,782.66		$0.00	$392,279	$576,782.66
	Subtotal Warburn	**$4,190,152.00**	**$3,266,048.31**	**$0.00**	**$0.00**	**$4,190,152.00**	**$3,266,048.31**
	YANCO STOCK & DOMESTIC PIPELINE						
3	**Yanco Stock & Domestic Pipeline**						
	Direct costs - Pipe Installation	$2,178,440.00	$3,422,563.00		$0.00	$2,178,440	$3,422,563.00
	Direct costs - Pump Station	$233,000.00	$274,773.00		$0.00	$233,000	$274,773.00
	MI Procurement - Pipeline	$839,108.00	$505,651.00		$0.00	$839,108	$505,651.00
	Indirect Costs	$704,952.00	$1,164,295.67		$0.00	$704,952	$1,164,295.67
	Subtotal Yanco	**$3,955,500.00**	**$5,367,282.67**	**$0.00**	**$0.00**	**$3,955,500.00**	**$5,367,282.67**
	EARTH CHANNEL REHABILITATION						
4	**Earth Channel Rehab**						
	Direct costs - Earthworks	$3,241,319.00	$4,263,674.78		$0.00	$3,241,319	$4,263,674.78
	Direct costs - Other	$1,102,079.00	$1,686,120.63		$0.00	$1,102,079	$1,686,120.63
	Indirect Costs	$953,309.00	$1,623,747.45		$0.00	$953,309	$1,623,747.45
	Subtotal Channel rehab	**$5,296,707.00**	**$7,573,542.86**	**$0.00**	**$0.00**	**$5,296,707.00**	**$7,573,542.86**
	METERING AND OUTLETS						
5	**Metering and Outlets**						
	Direct costs - Installation	$19,402,901.00	$20,021,360.73		$0.00	$19,402,901	$20,021,360.73
	MI Procurement - Rubicon	$13,470,033.00	$8,237,126.92		$0.00	$13,470,033	$8,237,126.92
	MI Procurement - Aquamonix	$6,536,444.00	$5,293,260.00		$0.00	$6,536,444	$5,293,260.00
	MI Procurement - Precast	$787,739.00	$2,163,392.15		$0.00	$787,739	$2,163,392.15
	MI Procurement - Sump covers	$477,637.00	$330,834.00		$0.00	$477,637	$330,834.00
	Indirect Costs	$4,793,002.00	$2,371,924.00		$0.00	$4,793,002	$2,371,924.00
	Subtotal Metering & Outlets	**$45,467,756.00**	**$38,417,897.80**	**$0.00**	**$0.00**	**$45,467,756.00**	**$38,417,897.80**
	Total	**$109,146,556.00**	**$105,180,367.74**	**$0.00**	**$0.00**	**$109,146,556.00**	**$105,180,367.74**
	PROJECT MANAGEMENT, DESIGN & CONTINGENCY						
	Project Management / Administration	$13,100,000.00	$13,526,692.26		$0.00	$13,100,000	$13,526,692.26
	Contingency	$0.00	$3,539,496.00			$0	$3,539,496.00
	Subtotal Project Management, Design & Contingency	**$13,100,000.00**	**$17,066,188.26**	**$0.00**	**$0.00**	**$13,100,000.00**	**$17,066,188.26**
	TOTAL	**$122,246,556.00**	**$122,246,556.00**	**$0.00**	**$0.00**	**$122,246,556.00**	**$122,246,556.00**

9. Conclusions

The investment in the infrastructure through PIIOP3 has directly benefited MI, its customers and the region through the provision of a modern and efficient irrigation network. It has supported and enhanced the scope and delivery of MI's automation program and brought forward efficiency benefits for MI and its customers. The automated delivery network has provided an immediate improvement in customer service levels, operating efficiency and safety, setting the region up for success in a future with less water.

The program has also supported the local economy through direct and indirect expenditure of over $36M. Around $16M of project funds was paid to contractors in the Leeton and Griffith post code areas in 2018 and 2019 and indirect expenditure in the region is estimated to be in excess of $20M from staff and contractor spending on food, accommodation and leisure activities. MIARA staff and contractor numbers peaked at approximated 200 in mid-2018 and all staff resided in the local area on a temporary basis for varying durations.

The investment has also realised a significant volume of water entitlement for the environment from efficiency savings without impacting the productive water pool. The 14,382 ML of efficiency savings will deliver environmental benefits across the Murray Darling Basin including to RAMSAR listed sites inside the MIA and to wetlands along the mid Murrumbidgee.