Before Channel Modernisation: High transmission losses

2016

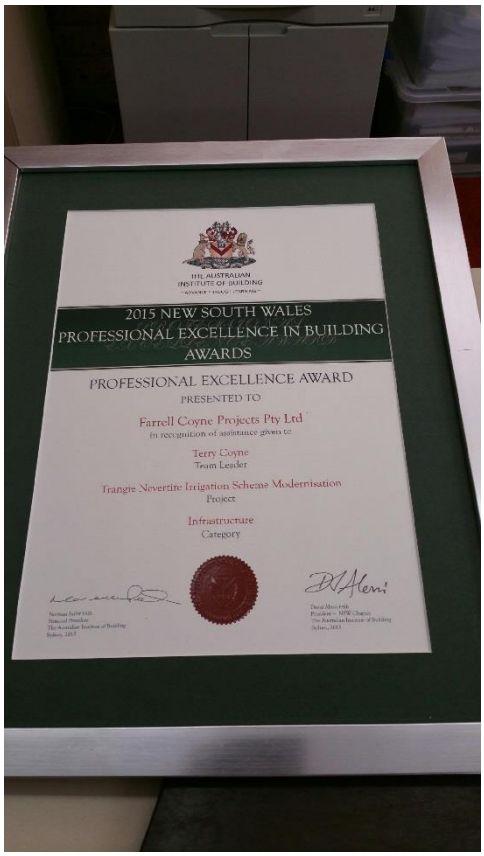
Trangie Nevertire Co-operative Ltd (TNCL) Final Project Report under Round One of the Private Irrigation Infrastructure Operators Program in NSW

After Channel Modernisation: Efficient irrigation water delivery and control

This report was compiled by Vanguard Business Services in conjunction with Trangie Nevertire Co-operative Ltd in March 2016

TNCL
PO Box 20
TRANGIE NSW 2823
tnis@bigpond.com

Award issued to TNIS for successful completion of a "world class irrigation scheme" by Firestone



Jim Winter, TNCL Chairman, with the 2015 NSW PROFESSIONAL EXCELLENCE AWARD in the INFRASTRUCTURE category at the 2015 NSW Chapter of the Australian Institute of Building Awards awarded to the TNCL PIIOP Project Management Team.

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1 BACKGROUND

1.1 Background: TNCL and TNIS

Trangie Nevertire Irrigation Scheme (TNIS) was floated as a concept in 1958. In 1965 a group of Landholders formed an organisation to seek an allocation of water rights from the newly built Burrendong Dam, on the Macquarie River, Central West NSW.

The Trangie Nevertire Co-operative Limited (TNCL) was founded in 1968 as a separate legal entity which was charged with the responsibility of building the extensive 240km open channel network and infrastructure, while the TNIS operated the irrigation scheme. Each TNIS Member has a share in the TNCL.

The TNIS extracts water from the Macquarie River at the Gin Gin Weir and delivers up to 700ML/day through over 40 regulating structures throughout the scheme.

Commercial operations started in 1971.

At the peak of operations the TNIS serviced some 17 000 ha of Irrigation. Prior to the Private Irrigation Infrastructure Operators Program NSW (PIIOP) project, flood irrigation was the dominant irrigation system. The scheme serviced over 66 Co-operative members and over 90 properties.

Irrigation in the TNIS has declined over the last decade, due to a prolonged period of low irrigation allocations. In the period to 2002/03 irrigation allocations averaged some 90%. Since 2002 allocations have averaged 13%. High scheme transmission losses at low allocations meant that a large percentage of pumped water was lost before reaching farms. An extended period of low water allocation has created significant community and social impacts in local towns as well as substantial economic hardship to landholders and local businesses.

1.2 Strategic Planning and Modernisation Plan: Pre PIIOP Planning

In 2005 the TNCL board recognised the extent of the challenges being faced by the TNIS and instigated a consultative Strategic Planning process with TNCL Membership, which highlighted the long term viability of the scheme in its current inefficient form.

The TNCL Board continued the planning process, focussing on the issue of water delivery efficiency at low water allocations. This subsequently led to the development of a scheme Modernisation Plan in May 2009 with grant funding of $300,000 from the Australian Government and a Hotspots assessment to identify where the network was losing water to seepage in July 2009 with funding of $175,000 from the Australian Government.

The Modernisation Plan focussed on the need to upgrade the water delivery system and structures and identified a range of options, recommending a clear path forward.

The Board of the TNCL recognised the win:win nature of the PIIOP program and soon gained the support of the TNCL Membership to submit an application on behalf of the Trangie Nevertire Irrigation Scheme for significant funding to modernise and rationalise.

1.3 PIIOP Application

In 2009 an application was lodged under the Private Irrigation Infrastructure Operators Program with the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) by the Trangie Nevertire Co-operative Limited for a major modernisation of the Trangie Nevertire Irrigation Scheme.

A thorough technical investigation was undertaken as part of the PIIOP Application process and a detailed cost benefit analysis prepared. A number of solutions were investigated prior to planning a clear path forward.

As well as having direct financial benefits to the TNCL, significant benefits to the wider community were envisaged; positive impacts to the local community through the construction phase and beyond, improved farm viability, positive impacts on investment and regional development and an underpinning of the local community through a more secure irrigation sector.

The aim of the PIIOP application was to:

1. Deliver substantial and lasting water savings for the environment through a modern and efficient irrigation delivery system.
2. Minimise the boom and bust cycles in the irrigation industry by allowing efficient scheme operation at a range of irrigation allocations, particularly at lower allocations.
3. Promote a sustainable irrigation industry by assisting the irrigation community to transition to lower water limits anticipated in the new Murray Darling Basin Plan.
4. Contribute to the long-term security of regional communities, through contributing to social, economic and environmental sustainability.

The project had four major components:

1. A stock and domestic pipeline system which replaced an aging open channel delivery system and which separated out the delivery of stock and domestic water from irrigation supply.
2. Modernisation of some 68% of the open channel system, involving channel reforming, channel lining, structures upgrade, metering and telemetry.
3. Upgrading the on-farm irrigation infrastructure within the rationalised scheme. These upgrades involved installing modern centre pivot and linear move sprinkler technology, upgraded tail water systems, laser levelling of paddocks, metering and introduction of modern moisture and irrigation water monitoring equipment.
4. Rationalisation of some 32% of scheme channels and scheme irrigation footprint.

The funding agreement for the TNCL round one PIIOP project was executed in January 2011 for a total project value of $115 million (excluding GST). The $115 million received by the TNCL was invested in the reshaping and lining of approximately 143km of water delivery channels, installing 230km of a piped stock and domestic scheme delivering water to 102 participating properties, and decommissioning 18 outlying irrigation properties. Approximately $18.5 million of the funding pool

was invested into irrigation and water use efficiencies (modernisation of the Green Zone farms) or to returning farms to a productive dryland farming and/or grazing enterprise (rationalisation of the Red Zone farms).

The bulk of these funds were spent in and around the local community.

The Board of the TNCL appointed a high quality professional team to assist it to successfully implement the PIIOP Project to the benefit of its membership and wider community.

The TNCL Board has diligently overseen the PIIOP process, from application to implementation. The PIIOP project is seen by the TNCL as essential to the long term viability of the TNIS. It has been integrally involved in the governance and management, which was vital to the successful implementation of the PIIOP project.

1.4 Water Savings

A total of 29,620 ML (out of 32,151 ML) of General Security and Supplementary water savings generated through the project was transferred from TNCL to the Commonwealth to help bridge the gap in the Macquarie catchment identified in the Murray Darling Basin Plan.

The figures below are the estimated water savings that were anticipated to be generated from scheme channel upgrades, increased on farm efficiency measures and allocations retired from irrigation.

Activity	Anticipated Water savings
Scheme Rationalisation	18,842 ML
On Farm Modernisation	4,071 ML
Scheme Modernisation	9,238 ML
Total anticipated water savings	**32,151 ML**

The project was able to return a share of the water savings to the Commonwealth Government in the form of water entitlements. The Commonwealth Environmental Water Holder uses allocations from its water entitlements to support environmental assets in the Murray-Darling Basin, including to create significant environmental benefits to the Macquarie Marshes.

1.5 Project Works

The major components of the scheme were as follows:

Scheme Upgrades:

The major delivery channel upgrades were designed to reduce the significant conveyancing losses of approximately 17-35% when supplying outlying irrigation businesses with water pumped from the Macquarie River.

The creation of a modern irrigation delivery system has also involved improved water control, metering and accounting for water. Some 97km of open channels have been rationalised and 143km modernised.

Channel remodelling, lining with EPDM (Ethylene Propylene Diene Monomer) rubber supplied by Firestone, and the replacement of old inefficient control structures has created opportunities to operate the TNIS in years of much lower water allocations. Simple figures suggest that whereas a total water volume of approximately 20 000 megalitres of water was necessary to operate the scheme throughout a growing season, in 2015 it was viably operated with a total volume pumped of only 4 000 megalitres. This had a significant impact on not only individual farm operators, who were able to carry on their irrigated enterprises in a low allocation year, but also the whole Trangie/Nevertire community who benefited from supplying those operators that would have ordinarily not been irrigating.

The channel modernisation has also been responsible for significantly lowering the level of water lost through the scheme. Early calculations for the current pumping season indicate that very close to 100% of water ordered by operators has been delivered to the farm gate. Prior to the scheme upgrade this was impossible as an average of 73% of water ordered by operators was delivered to the farm gate.

On Farm Irrigation Upgrades: "Green Zone"

An important component of the PIIOP project was the upgrade of on-farm irrigation systems.

The PIIOP project has modernised approximately 4,226 ha of irrigation. This modernised area is called the "Green Zone", as shown on the map on the following page.

Each landholder was involved in seeking detailed technical design and costing to upgrade their own unique irrigation system. Through the project significant on-farm irrigation efficiencies have been created. The case studies in this report illustrate this.

The majority of the on-farm water savings have been generated by changing from flood to sprinkler irrigation (linear move or centre pivot irrigation) or through making changes to tailwater reuse systems. These systems have allowed for substantial savings in water use efficiency, with case studies at Item 5 of this report outlining typical on farm efficiencies.

Stock and Domestic Supply Upgrade

Prior to this project, stock and domestic water was supplied through an open irrigation channel network with delivery that was reliant on block water supply for irrigators, meaning the supply of stock and domestic water was unable to be guaranteed and in low allocation years, not supplied at all.

The project developed a reliable and modern pressurised 230km pipeline for stock and domestic water supply, which enabled stock and domestic water to be delivered *separately* to irrigation supply to 102 participating landholdings.

The new stock and domestic scheme is operational and it is providing significant economic benefits through the supply of a regular and quality water supply for stock and domestic activities, providing an assured supply of high quality water. In recent dry years the value of this scheme has been evident.

The stock and domestic pipeline has also contributed to quality of life enhancements such as maintaining farm lawns and gardens during prolonged dry periods.

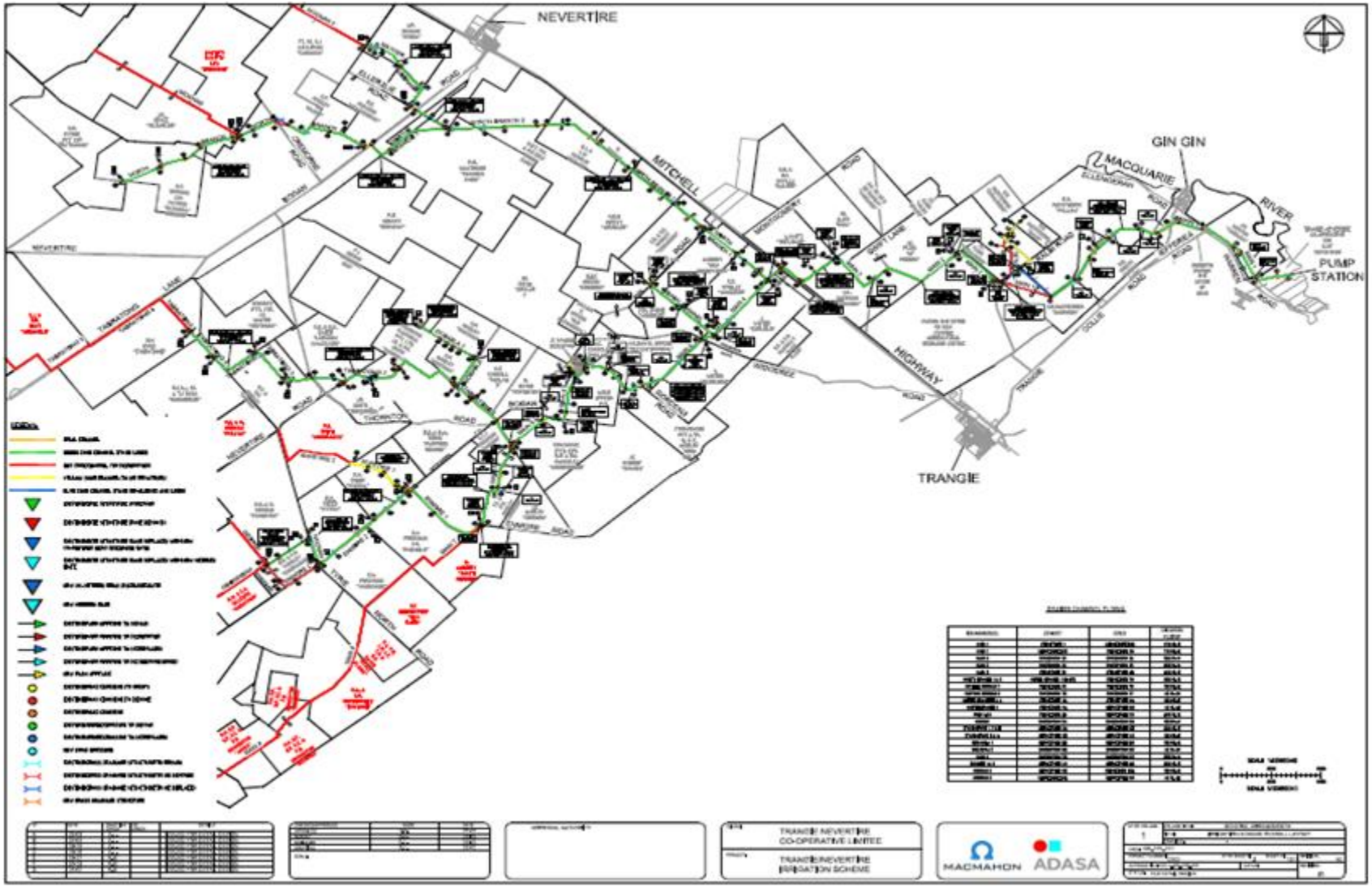
Rationalisation: "Red Zone"

Areas of the periphery of the scheme and where irrigation water cannot be efficiently delivered were rationalised from the scheme. This rationalised area is called the "Red Zone", as shown on the map on the following page.

This included some 97km of scheme channels and 18 properties.

Businesses in these areas were transitioned through a process which involved irrigation decommissioning.

Farming businesses in these areas traded their General Security water entitlements and received additional assistance to change enterprises and assist with a transition to dryland farming and grazing. Improvements included development of on farm stock and domestic water schemes, fencing and irrigation decommissioning.


NEVERTIRE
MITCHELL
HIGHWAY
TRANGIE
GIN GIN
MACQUARIE
RIVER
PUMP STATION
TRANGIE NEVERTIRE CO-OPERATIVE LIMITED
TRANGIE NEVERTIRE IRRIGATION SCHEME
MACMAHON
ADASA

2. ADMINISTRATION

2.1 Overall Program Management and Governance

TNCL structured the management systems and allocated responsibilities to various parties as per the project organisation chart to manage risks and responsibilities, defined in the Funding Agreement between Commonwealth of Australia and Trangie Nevertire Co-Operative Limited and the 6 variations negotiated to the funding agreement throughout the life of the project.

TNCL have ensured compliance and managed risks associated with:

- WH&S
- Inclement weather
- Contractors performance
- Exchange rate fluctuations
- International freight
- Material storage and distribution
- Land owners requirements
- Lawful tree removal
- Fauna damage to works
- Contract and subcontract disputes

The modernisation project has been delivered within the performance obligations set out in the PIIOP application and scope of works managed to be completed within available funding limits.

2.2 Project Management and Governance

TNCL went through a detailed selection process to appoint the project manager, proponent coordinator, design consultants and surveyors required to deliver the project.

Once the Project Manager Farrell Coyne Projects (FCP) was appointed, initially for liner trials and liner selection, the Project Delivery Methodology was developed with high priority being to transfer risk to the parties best capable of managing that risk.

The engagement of a Head Contractor McMahon Holdings to undertake the modernisation works on a Design and Construction basis, transferred the risks of design, inclement weather, latent conditions and currency fluctuations to the Head Contractor.

As a further measure to ensure that all parties were performing their roles, TNCL engaged Michael McBurnie as Peer Review Consultant. Michael's brief was broad and covered design, survey and construction. This appointment gave the TNCL Board confidence that they were never relying on any single consultants' recommendations on any issue.

2.3 Work Health & Safety

The Project was delivered in three stages in regards to Work Health & Safety. The three stages are all described in the following:

Stage 1 (2012) was delivered under the Macmahon-ADASA Joint Venture (MAJV), federally accredited OH&S Policy.

Stage 2 (2013) continued to be delivered under MAJV Policy with TNCL direct contracts with subcontractors for the North Branch 1 & 2 Works.

Stage 3 (2014) was entirely delivered through direct contracts with the various subcontractors. TNCL developed a WHS policy that acted as an "umbrella" policy for all subcontractors with each

subcontractor submitting their own WHS policy that had to meet the requirements outlined in the TNCL Policy. Refer to Attachment 3.3 in which the Department of Employment (Office of the Federal Safety Commissioner) approved the delivery of this stage as compliant with the Federal Safety legislation.

2.4 Project Communication

An effective communication plan was required to create a bridge between the diverse stakeholders involved in the project. The plan was also required to account for the differing levels of expertise, the various perspectives and interests during the project's execution with the end result being to ensure that all stakeholders were effectively involved in the project.

The main methods of communication between the Parties to the Funding Agreement were:

- Fortnightly teleconference between the Department, TNCL Executive and the Project Manager whereby the Department issued minutes / notes of these conference calls
- Monthly TNCL Board meetings including Project Control Group where the Project Manager presented his report on all aspects of the project.
- Monthly inspections of the work in progress by the TNCL Board on the day prior to the monthly meeting.
- Milestone reporting as scheduled in the Funding Agreement.

At the monthly meeting, Project Control Group Meeting, the Board members were required to consider design presentations and make decisions on the various options offered to them by the Design Consultants and the Project Manager.

Accurate financial cost reporting and scope of work assessment were fundamental activities of the Project Control Group.

3. Key Performance Indicators and Objectives

Summary:

To estimate the impact of PIIOP on the TNCL Scheme, a detailed 'whole of scheme' economic model was created by the Department of Agriculture and Water Resources, with significant input from advisers, industry experts and TNCL Board Members to examine the changes in water availability and the cumulative financial performance of remaining and exiting scheme members pre and post-project.

Modelling shows both large and small irrigation farms are able to plant more cotton more often with a Modernised and Rationalised scheme. The area of cotton planted increased in both large and small farms with corresponding positive impacts on profitability. In all instances, and farm sizes, the project allowed for higher individual business returns to be achieved.

Modelling also showed rationalised farmers who exited the scheme are likely to benefit from reduced debt, reduced costs from ceasing irrigation, and a stock and domestic system that provide significant household, stock and dryland farming benefits.

Modelling shows a significant benefit from the project in members' equity in their businesses, along with the rate of return on their farming assets. Without the project many farms may have had issues with long term viability, however the modernisation project has enabled new levels of profitability, crop diversification and financial stability to be achieved. The project has also improved the viability of the scheme as a whole.

Through this analysis all irrigation farms involved clearly have an increased opportunity for crop production and profit post-project and if this opportunity is realised in the future, there will be significant individual business and community benefit.

3.1 Background

In the five years from 2001 to 2006, irrigators in the Macquarie Valley including the Trangie-Nevertire Irrigation Scheme, had suffered a prolonged dry period. Over this period, average annual rainfall was just 361 mm/year, as opposed to 603 mm/year for the preceding five year period. Water allocations for irrigators in the Valley were correspondingly very low often less than 10% or in some years, zero. With conveyancing losses approaching 30% within the Scheme, the efficient delivery of water to the farm gate down the 240 km of open, earthen channels was not possible in these low allocation years with the original scheme.

Figure 1 below illustrates the Rainfall Balance for Warren, an irrigation town in the Macquarie Valley. Rainfall Balance is the difference between the current annual rainfall and the long term average, accumulated over time. It shows trends in rainfall patterns. When rainfall balance is falling, annual rainfall is less than average; when rainfall balance is rising, annual rainfall is above average.

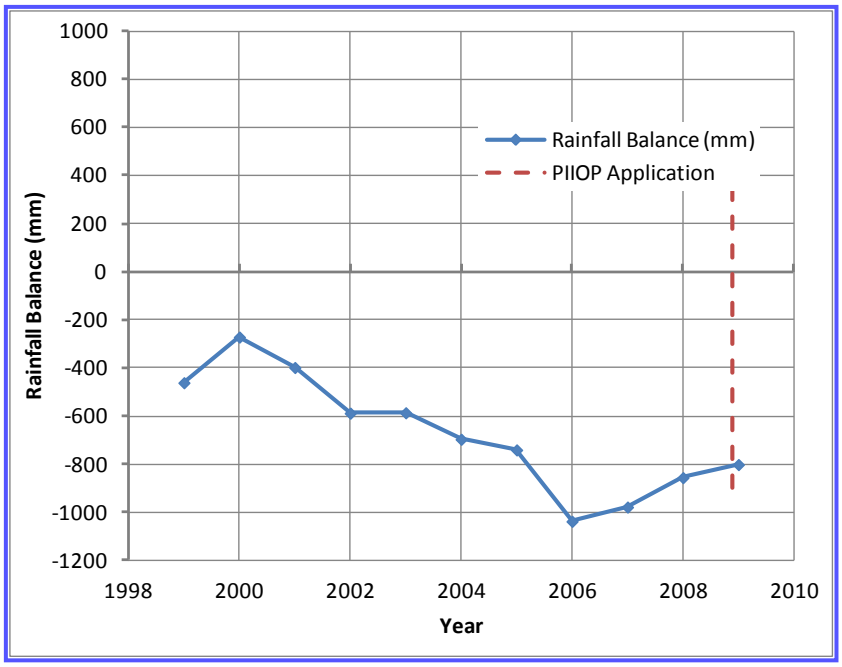


Figure 1: Warren (Macquarie Valley) Rainfall Balance

Given the above trends, and with a growing acceptance amongst the irrigation community that the long term viability of the Trangie Nevertire Irrigation Scheme (TNIS) was diminishing due to inefficient water delivery, an application under the PIIOP Round 1 was lodged by the Trangie Nevertire Co-Operative Limited (TNCL) in 2009. This application was successful and in January 2011 the funding agreement between the TNCL and the Commonwealth government was executed providing the TNCL with $115 million to expend on achieving a number of outcomes for both the irrigation community and the environment by way of a substantial rationalisation of the scheme's length and scheme modernisation. Implementation of the TNCL PIIOP project took place from 2011 to 2015.

3.1.2 Estimating the impact of PIIOP

The long-term outcomes from the modernisation of the TNCL Scheme are not yet known as the construction work to modernise the Scheme has just been completed. The real outcomes of modernisation will occur as the revised scheme operates over the next several years, across a range of seasons and water allocations.

The information presented in this Final Report of the outcomes achieved by the PIIOP project has been modelled. The post-project outcomes are based on modelling what the project could have achieved if the project was finished 14 years ago using actual physical and financial data. These estimates do not predict the future but rather present an understanding of the impact of the modernisation works as compared to a "no change" scenario. Using this approach we are able to estimate the impact of the project.

The modelling has been informed by local knowledge, external expertise, available research and has been based wherever possible on actual results from the scheme's operation over the life of the modernisation project. The model was developed over a number of workshops with TNCL Board Members, Industry Experts and the Department of Agriculture and Water Resources.

3.1.3 Water efficiency measures and productivity

The primary economic impact of PIIOP-funded infrastructure projects revolves around changed opportunities for crop production and profit for ongoing members, and reduction of debt by the sale of rationalised water.

The basic rationale of PIIOP is that the infrastructure works lead to improvements in water availability for irrigators (in terms of capacity to more efficiently manage water and/or increased volume). The main outcome of the water efficiency measures funded by PIIOP is to generate water savings by reducing the loss of water from irrigation networks and farms through seepage, evaporation and escape. Estimates of the potential results of water savings rest on the extent to which additional water (compared to pre-project) is retained by the irrigation network and its farmers and the extent to which changes in control over water and flexibility of delivery affect crop production.

Water efficiency measures, such as those undertaken in this project, create water savings which maintain or increase water availability at the crop root zone, *even when there is a reduction in the water entitlements owned by TNCL farmers.* A key element of sustainability for irrigation schemes is the capacity to deliver a higher proportion of water to the farm gate measured against the volume of water extracted from the river offtake. Improved delivery efficiency can mean that the volume extracted from the river offtake can be reduced *without necessarily reducing the volume delivered to the farm gate or to crop root zones*.

Improved water delivery efficiencies in this project means that a lower volume of water at the river offtake is needed in order to allow pumping to commence. This can result in additional years of irrigated crop production, such as in low allocation years, to what was possible prior to the delivery network upgrades. This is of significant benefit. Also, further on-farm investment into delivery and irrigation efficiencies can result in a reduction in water losses from seepage and root zone application efficiencies. Upgrading water delivery infrastructure for crops (such as replacing flood irrigation with lateral sprinkler systems) allows for less water being lost below the crop root zone and applying the right volume of water at the right times.

Improvements to water availability can enable increased crop production (in terms of more area under crop due to higher water volumes and/or improved yields through better water management) and/or better quality crops all of which lead to higher potential profit for irrigators. If productivity is a measure of output per unit of input, then PIIOP changes productivity by achieving similar outputs at crop level (which depend on the application of water to the crop root zone) using less units of irrigation water measured at the river offtake. This is because the infrastructure works, both off and on-farm, improve the capacity to deliver water more effectively to the crop root zone by minimising water losses to seepage and evaporation.

Improved water efficiency therefore reduces the business risk for farmers and delivers an improved ability to plan and manage production under variable water allocations. These are important potential outcomes for farmers. However the benefits from improved irrigation efficiency are not just limited to individual businesses. These measures also benefit local towns, through a more profitable, stable and viable irrigation industry.

3.1.4 Links to irrigation communities

Irrigation communities are the townships and rural areas within the boundary of the local government area(s) in which the private irrigation infrastructure operators are located.

There is a link to a sustainable future for irrigation communities through PIIOP infrastructure projects. Improving the efficiency of on and off-farm water management creates the potential for increased crop production and this means there is a potential for increased farm profitability, discretionary spending, investment in further on farm infrastructure (employment opportunities) and/or reduced debt (viability and stability). All of these benefits can impact local towns and communities.

Improved delivery and on farm irrigation efficiency enables irrigators to better withstand the impacts of reduced water availability. This will be of significant benefit into the future with a more variable climate being predicted. Post-project, irrigators are able to deliver similar or improved profit outcomes with less water entitlements. Irrigators are therefore more economically sustainable and have lower risk than pre-project.

To the extent that increased discretionary income converts into improved capacity for discretionary spending by irrigators in local communities for goods and services, this helps sustain irrigation communities by helping local businesses and services (post offices, banks etc.) to be more viable. In turn, this can help support secondary employment (retail etc.), and leads to more people being able to reside long term in townships because of a more secure economic base, leading to more services being available (teachers etc). There may also be multiplier effects of such increased spending that could translate into improved employment opportunities in local businesses. The multiplier effect boosts the local economy, benefiting from locally-owned independent businesses, owners, and employees spending business profit within the region.

The actual increase in discretionary income for irrigators in the future will depend on the extent to which the opportunity for increased crop production is able to be taken up. This is dependent on available water, seasonal conditions, market conditions, and business decisions. Individual financial circumstances, particularly debt levels, will change the extent to which increased profit is discretionary or debt reducing. The actual outcomes for irrigator communities in the future will depend on a large number of factors and influences that also include the Basin Plan outcomes and future infrastructure investment.

This Final Report presents the outcomes of modelling of the changed opportunity for customers of private irrigation infrastructure operators for increased productivity and profitability, created through the PIIOP program.

It presents the impact of PIIOP by comparing pre-project and post-project financial outcomes.

3.1.5 Key assumptions

To estimate the impact of PIIOP on the TNCL Scheme, a detailed ‘whole of scheme’ economic model was created by the Department of Agriculture and Water Resources in Microsoft Excel to describe the changes in water availability and the cumulative financial performance of remaining and exiting Scheme members pre and post-project. The key assumption in the model was that a lengthy timeframe would be required to best understand the impacts of water availability and efficiency, and to help understand the cumulative interaction of cost, profit and debt over time.

A long term analysis would also allow the impact of increased crop production opportunities in low allocation years to be fully examined. This approach was taken to allow for cumulative and longer term impacts to be fully assessed.

It was felt a shorter term model may not capture the full benefits of the project.

The post-project modelling is based on estimates of the impact PIIOP would have had on the TNCL Scheme if the construction work was finished 14 years ago. A fourteen year period was chosen for the model because over this period a wide range in water delivery efficiencies and crop production scenarios (dry, medium and wet years) was evident. Good quality data also existed for this period.

It was felt that there was no single 'average' year that could accurately reflect the performance of the scheme in such variable conditions that existed in real life. A fourteen year period reflected a diversity of climatic conditions and allocation decisions, with periods of relatively high water availability through to four years of no irrigated crop production. This provided a solid basis to test the future performance of the Scheme in a range of climatic conditions.

The first step to understanding the project benefits was to model the pre-project relationship between crop production and the quantity of water available over the 14-year period 1999–2013.

The second step was to assume that the modernisation works were completed 14 years ago and change the volume of water entitlements to account for transfers to the Commonwealth and apply post-project water delivery efficiency outcomes. Consideration was also given to changed business practices by irrigators to take advantage of the modernisation outcomes. Restricting the changes to these limited variables allows for no change to market prices, weather patterns, or allocation announcements in the pre and post-project modelling.

The third step was to compare pre-and post-project outcomes to estimate the difference that can be attributed to the modernisation works funded by PIIOP.

The advantages changing only the water availability and efficiency variables is that it is possible to isolate the impact of PIIOP without a complex way of accounting for the potential impact of a large range of variables, such as future business decisions, rainfall patterns, crop prices, input costs and other factors. Farmers are responding in both modelled scenarios to exactly the same set of market conditions, the only variable being water availability and efficiency.

A decision-making matrix was developed for each "model farm" to combine crop production decision-making at planting times; a multi-year farm level water balance and sensible business strategies. This matrix was used to generate crop outcomes and a financial model for each farm scenario.

The project outcomes modelled in this final report have been informed by the best data available at the time of completion of the project, as well as collaboration between members of the TNCL Board, its consultants and Departmental officials to fill data gaps and add a decision-making perspective to inform crop production and business strategies, The economic model has 14 years of data for actual water availability, rainfall and Scheme performance, along with published data on the costs of production, input from Scheme members and industry advisors to ensure the modelled data reflected the experience of those involved in the Scheme, and actual prices for water, crop inputs and crop outputs. The post-project water delivery efficiency numbers have been derived from pondage testing and

operation of the Scheme in 2012-13 to inform post-project efficiency, noting that this is not the same as long term data on the actual operation of the scheme. It is however the best available data.

The disadvantage of this approach is that the results will remain an estimate of possible post-project performance, and are subject to all the limitations of estimation. Therefore it is important to note that the following outcomes are not forecasts of post-project performance, but rather are estimates of the potential opportunities created through the infrastructure upgrades funded by PIIOP.

These potential opportunities are measured in terms of crop production translated to pre-tax profit outcomes for both farmers and for the scheme as a whole. The focus on profitability is important in the context of debt in the agricultural sector which has probably helped to shape the willingness of farmers to participate in water purchases and infrastructure upgrades through the Murray-Darling Basin Plan. According to the Reserve Bank, total Australian farm debt has risen exponentially since 1965 and increased above the exponential trend line with a rise on average of 22% annually between 2004 and 2008 before total debt levelled off (Hutchings 2013). The investments by the Australian Government in the Murray-Darling Basin area have the potential to assist farmers to cope in this context of rising debt and falling equity which occurred in the recent period of drought.

The profitability outcomes have been estimated for both pre and post project scenarios by tracking the cumulative net cash flow of model farm businesses taking into account whole of farm costs and profits in the context of debt. The cumulative cash flow outcomes across several years provide a more accurate picture of possible financial outcomes for farmers than an annual profit/loss statement which lacks the context of debt which changes year by year (Hutchings 2013).

Finally, it is important to note that a different methodology would be required to measure the *actual outcomes* of the modernisation works in future years when actual scheme performance data would be available. At this time the entire range of external factors that determine actual social and economic outcomes for irrigators and irrigation communities would need to be investigated and accounted for before any firm claims about PIIOP outcomes could be made.

3.1.6 Modelling farms

The model is based on a 'model farm' – a hypothetical picture of a representative and typical farm's water use, costs and income, based on published industry benchmarking data, consultants experience and the knowledge of people involved in the scheme. The farms do not present the costs and profits or crop production of any actual farm but are nonetheless grounded in the rich actual experience of farmers working on farms of similar scale and approaches to the model farms.

There were two broad types of typical farm in the pre-project TNCL Scheme that were selected for modelling - *large farms* with irrigators who crop as much as possible each year, and have different farming and business strategies compared to the *small farms* who are occasional irrigators. Small farms tend to crop when there is sufficient water available, but realise the value of their water assets on the temporary water market when there is insufficient water available to crop.

Post project, the small farms were split into two groups – those who received PIIOP funding for on-farm works and those that did not. All large farms received PIIOP funding for on-farm works. A separate model farm was developed for rationalisation customers post-project to understand the financial impact of ceasing irrigation.

The six types of 'model' farms within the Scheme were:

- Pre-Project - large farms (with more than 1,786 delivery entitlements)
- Pre-Project - small farms (with less than 1,786 delivery entitlements)
- Post-Project - large farms that undertook on-farm efficiency projects
- Post-Project - small farms with no on-farm efficiency projects
- Post-Project - small farms that undertook on-farm efficiency projects
- Post-Project - rationalised farms that no longer have access to irrigation.

Each model farm included a range of irrigation, dryland cropping and grazing enterprises typical of the landholders on the Scheme. All of the model farms pre-project had a primary irrigated crop of cotton. Wheat was chosen as a crop representative of the costs and profits typical of dryland cropping across several crop types.

A model farm's income and costs were modelled to avoid presenting the actual financial performance of real farms. The model farms were based on detailed financial information provided by a range of external sources; accountants, consultants, industry benchmarking information and also scheme members' individual farm financial information. These models have been shaped with the input of the TNCL Board and the Department over a series of meetings and reflect a detailed modelling of the crop production and financial impact that the Modernisation and Rationalisation Project has had on both large and small farms.

While the small numbers of farms involved in the TNCL scheme makes it relatively easy for those with local knowledge to identify which farm falls into each category. Each actual farm will have differing results based on their level of debt, the scale of their production and their business decisions. The model results do not translate directly to net profit outcomes, as the individual impacts of tax, additional debt repayments, capital investments, additional borrowings, and additional living expenses over the base case would all affect actual farm profit outcomes. Any farmer wishing to apply these outcomes to their own properties will need to make allowances for these factors and the dimensions and performance of their own property, and cannot assume that the modelled outcomes are directly representative of their own circumstances.

To reduce the complexity of the economic model, several farms that did not fit the primary farming model of cotton / wheat / dryland were excluded. The excluded farms tended to have very small amounts of water entitlements used for stock and domestic purposes and were not major crop producers either pre or post project.

Whole of scheme outcomes were developed by scaling the dimensions of the model farms to the dimensions of the scheme. For instance, as the large model farm dimensions were set by dividing the total dimensions of all the large farms in the scheme; whole of scheme outcomes could then be generated by multiplying the results of the large model farm back up to the dimensions of all of the large farms on the irrigation scheme..

3.1.7 The Impact of the Stock and Domestic System

The modelling concentrates on irrigated agriculture outcomes and does not include the impact of the stock and domestic system. The permanent availability of water for stock and domestic requirements, by way of an underground pipeline to every property formerly and currently within the TNIS, has revolutionised living standards for some members. No longer do livestock have to be sold when stock water supplied from rainfall runoff into dams

diminishes. Quality domestic water available at the turn of a tap has improved the way of life for farm families through ability to now have swimming pools, lawn and gardens. Proponent case studies in this report confirm that the program participants firmly believe their overall life has changed for the better with the modernisation of the delivery of all classes of water in the scheme.

They also provide additional support to the findings of the model farm analysis.

3.2 Outcomes: Assessment of Project against Key Performance Indicators

The modelling results have been used to assess the performance of the project against the PIIOP's key performance indicators. A summary of the implementation of the TNCL PIIOP Round 1 Modernisation Project is provided below:

- $115 million in Commonwealth funding provided to the TNCL
- 29 620ML of Water Entitlements transferred to the Commonwealth – this was 40% of all water entitlements held in the Scheme
- Modernising of approximately 143km of channels by way of reshaping and lining with EPDM and/or clay. All Scheme channels are fenced with electric fencing to keep livestock out and hence preserve functionality.
- Rationalising of approximately 97km of channels
- Installation of approximately 230km of underground pipeline to provide water for stock and domestic purposes to 102 properties within the Scheme area, regardless of seasonal conditions and water allocations
- Rationalisation of 18 farming properties within the Scheme area that can now no longer irrigate. Each of these properties received and spent funding to assist with changing their production focus from irrigated crops to dryland farming activities.
- Significant upgrades to Scheme outlets, structures and water metering technology
- Funding to 23 Scheme members to modernise and improve on-farm water efficiencies

The TNCL Modernisation Project has been an outstanding success against the PIIOP key performance indicators, as described in the table following.

Table 1: Summary of the key outcomes of the Trangie-Nevertire Irrigation Scheme Modernisation Project

Key performance indicator	Outcome
1. Program delivers the contracted share of the water savings in the form of water entitlements transferred to the Australian Government	The Trangie-Nevertire Irrigation Scheme Modernisation Project has delivered 29,620 ML of water savings in the form of water entitlements to the Australian Government.
2. Reductions in water losses to farm gate and improvements in network water use efficiency, water management and monitoring	The Trangie-Nevertire Irrigation Scheme Modernisation Project has significantly improved water delivery efficiency from a long-term average of 65% to 93%.
3. Reductions in on-farm water losses and improvement in on-farm water efficiency and water management	Thirty-seven on-farm efficiency projects undertaken as part of the Trangie-Nevertire Irrigation Scheme Modernisation Project have achieved water savings, with 10,237 ML of these savings returned to the Australian Government as water entitlements.
4. Increases in the volume of available water from water savings and improved flexibility and control of water for irrigated crop production, livestock consumption and domestic consumption for customers /members of private irrigator infrastructure operators	The Trangie-Nevertire Irrigation Scheme Modernisation Project has increased the volume of available water for its remaining members via improved water delivery efficiency, on-farm efficiency projects, improved network management and rationalisation.
5. Reduction in the risks of water availability that result in water being available more frequently or in larger volumes for irrigation production that leads to additional opportunities for economic profit for customers/members of private irrigation infrastructure operators, which assists in securing a sustainable future for associated irrigation communities.	The Trangie-Nevertire Irrigation Scheme Modernisation Project has reduced the risks associated with water availability, created opportunities for additional crop production, thereby improving the profitability and sustainability of its members and assisting with securing a sustainable future for associated irrigation communities.

3.2.1 Water Efficiency Outcomes

The modelling seeks to understand the extent of impacts on irrigators and former irrigators as a result of the project. 29 620 ML of privately owned Water Access Entitlements (WAEs) were acquired by the Commonwealth, reducing the available water within the TNIS by 40%.

Of this transfer, 4 404 ML of the WAEs were supplementary water entitlements, and the balance was general security. Of the total water acquired, 18 842 ML of WAEs were transferred to the Commonwealth by TNIS members who have now permanently retired their rights to irrigate, transforming their landholdings into dryland only properties that no longer have access to the TNIS water delivery network of channels. The balance of water transferred to the Commonwealth came from TNIS members who transferred a portion of their WAEs in return for funds to improve their on-farm irrigation efficiencies as they continue to irrigate.

The modelling shows that pre-project, there was a changing pattern of buying and selling allocations, leaving water for subsequent years as carryover, and bringing in allocations from entitlements irrigators held outside of the scheme – in response to changing rainfall patterns and water availability. Pre-project, TNIS farmers as a group tended to be net sellers of allocations on the temporary water market. In contrast to the general pattern, TNIS farmers were net buyers of allocations on the temporary market in 2002-03 and 2006-07.

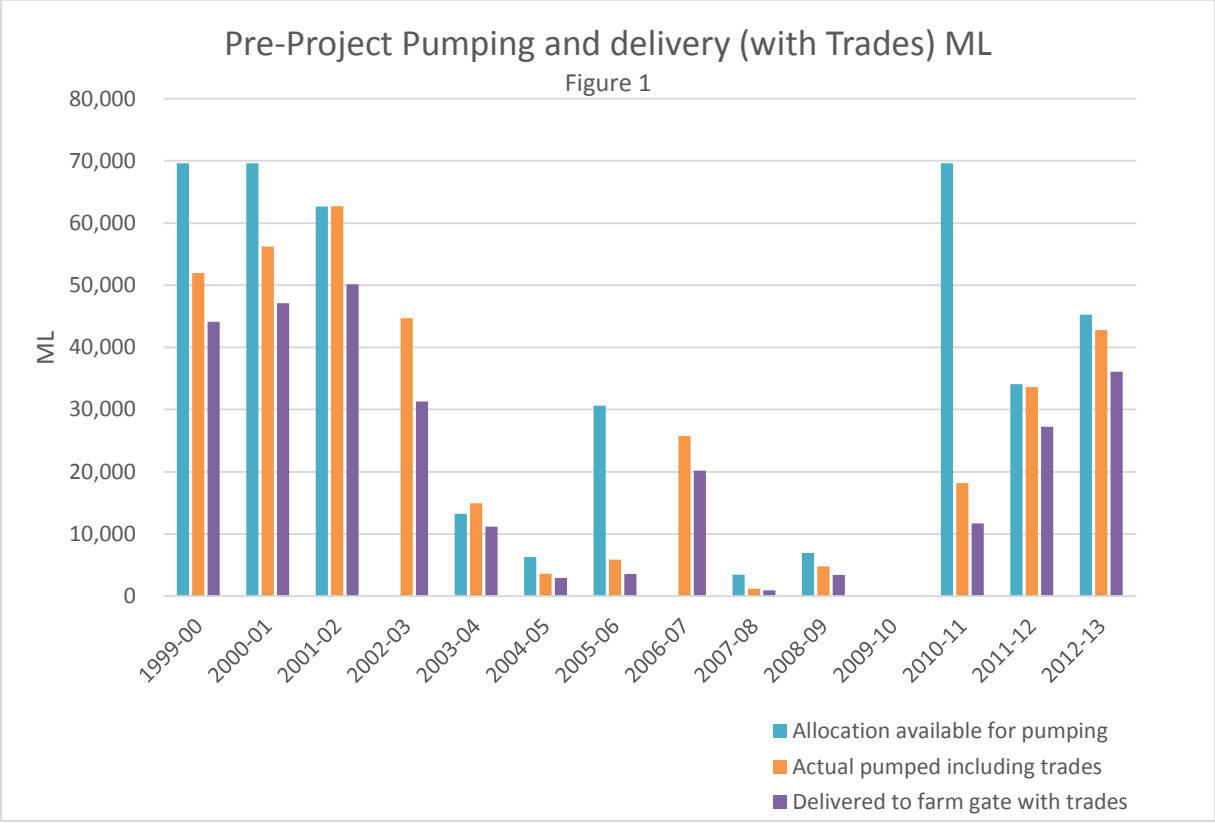


Figure 1

Major channel upgrades have been carried out to reduce the TNIS water conveyancing losses. Figure 1 above illustrates the improved delivery efficiency and reduced transmission losses within the scheme pre-project and post-project – an estimated average improvement of 27% per year. This graph is based on annual allocations only pre and post-project to ensure consistency. Actual pumping volumes would reflect carryover and trading outcomes.

In addition to the improved delivery efficiencies through channel upgrades, all structures, meters and telemetry have been modernised within the TNIS, greatly improving the ability

to manage water delivery, accuracy of monitoring and virtually eliminating any uncertainty surrounding pumping volumes and the measurability of water losses.

For the 2015/16 season, at a very small allocation, actual pumping values suggest that close to 100% of water ordered from the scheme has been delivered to the farm gate. This is due, in part, to the accumulation of captured rainfall from lined channels (an unexpected bonus gained from the modernisation project) helping to offset delivery losses.

The modelling undertaken shows a reduction in the total water available at the farm gate post project. However, the decrease is not equivalent to the 40% reduction in water entitlements, because of the improved water delivery efficiency in the scheme post project mitigates the loss of water entitlements to a significant degree.

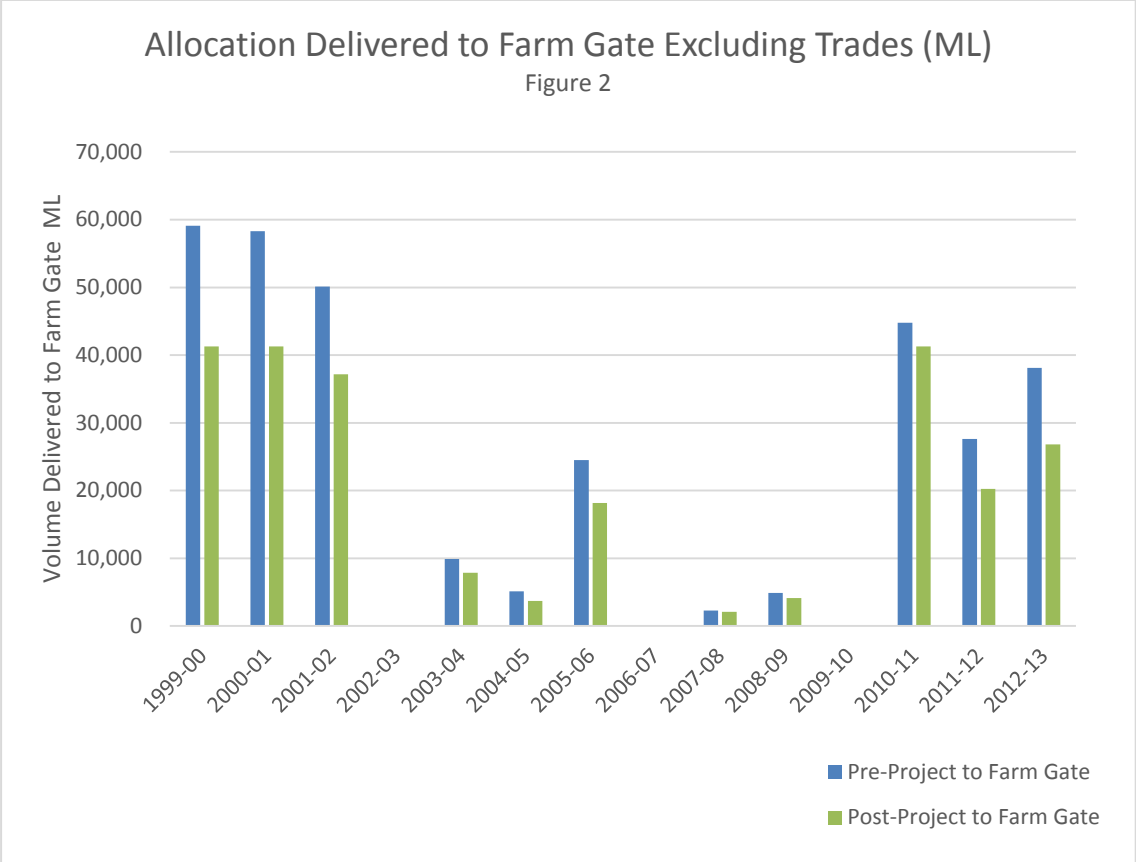


Figure 2: Delivery Efficiency and Transmission Losses

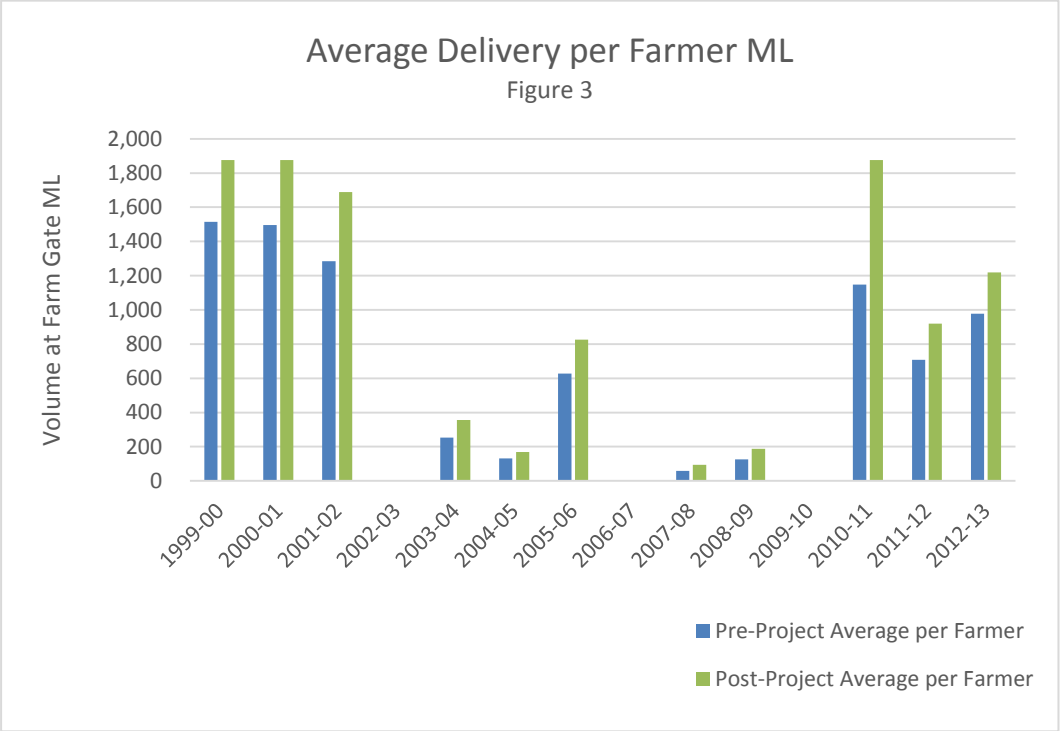
Delivery of water for remaining TNIS members has been significantly impacted by the modernised delivery network and improved delivery efficiencies. A sophisticated network of lined and reshaped irrigation channels, and new efficient gates and meters, has meant that water can be delivered in a timely and very efficient manner to all members even in years of low allocation.

Despite the reduction in total water volume delivered across the modernised scheme, as shown in Figure 2, the impact of this to remaining irrigators has been mitigated to some extent by these enhanced operational efficiencies.

Through the modernisation project, one third of the scheme's channels were rationalised and channels and structures upgraded thus reducing the scope for delivery inefficiencies. The number of irrigators remaining on the modernised scheme was reduced from 39 (pre

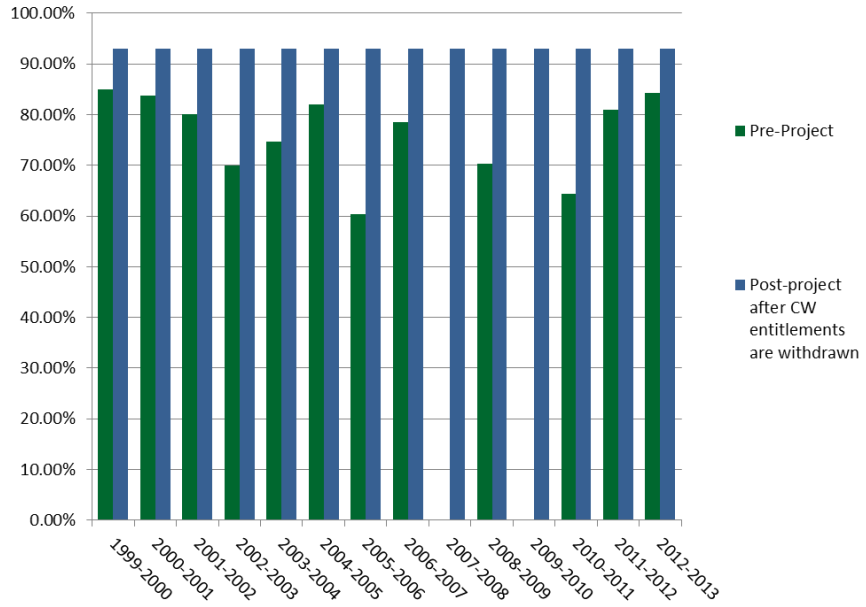
modernisation) to 22 (post modernisation). Overall there is an increase in water delivered to the farm gate, on average per irrigator, through a combination of efficiencies and a lower number of larger irrigators remaining on the modernised scheme as shown in the figure 3 below.

Scheme modernisation can enable efficient water delivery at lower volumes. Improved delivery efficiency across a smaller modernised scheme has greatly reduced the impact of WAEs being transferred to the Commonwealth.



The PIIOP project was an outstanding success at improving delivery efficiency and reducing transmission losses. Delivery efficiency has improved from 66% to 93% which is an improvement of 27%. This improved delivery efficiency, coupled with on farm efficiency works, is the key reason for the modelling demonstrating improved crop production for individual irrigators despite the reduction in total water entitlements held by irrigators post modernisation project.

Figure 4 following shows the actual transmission losses from 1999 to 2013 in green. The blue column represents the modelled transmission losses through a modernised scheme.



Water availability and delivery risk has been greatly reduced as TNIS members are now able to have water delivered in years of low allocations, made possible by the modernisation of the channel delivery network as well as on-farm modernisation projects. This is a significant benefit in years of low allocation.

Evidence from the 2015 irrigation season indicates that the post modernised scheme was able to be efficiently operated with a total pumping volume of only 4 000 megalitres whereas pre-modernisation a minimum of 20 000 megalitres was required for the scheme to be operated. This is of significant benefit to irrigators.

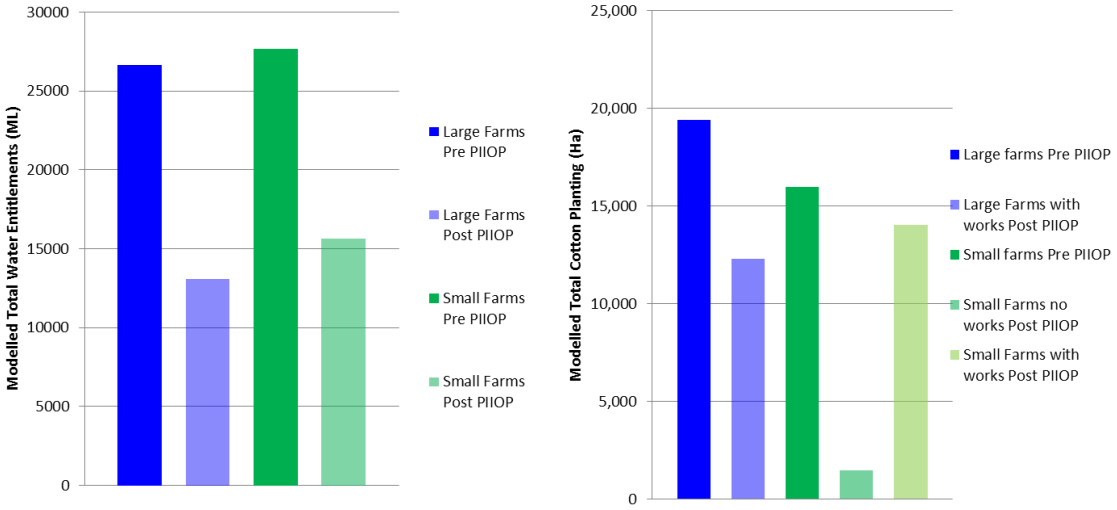
3.2.2 Crop Production Outcomes

Flexible and improved timing and delivery of irrigation water, even in small amounts, has increased options for irrigators who are now able to order water and have it delivered exactly when the crop requires it. This has significant yield advantages through accurate irrigation frequency and water quantity. Irrigators who have installed large and efficient linear move or centre pivot irrigators can potentially now venture into growing a new range of irrigated crops, not just those traditionally grown in a flood irrigation system. With the reduction in risk for TNIS members comes increased stability and sustainability for the entire community that services and provides for the TNIS members.

Through the project 23 farm businesses traded WAEs with the Commonwealth in return for significant funds that have been utilised to reduce on-farm water losses, improve on-farm water management and efficiencies. Such improvements included the construction and/or modernising of water storages and irrigation structures, the improvement of water delivery channels and overall farm design to capture tail water, storm water run-off and improve water movement around the farm. Major expenditure was carried out on the commissioning of overhead sprinkler irrigation systems, linear move and centre pivot irrigators, to efficiently deliver water to the crop in a more timely and controlled system. Contemporary management of water is now possible by way of significant telemetry upgrades that enable the remote operation of the large and efficient irrigators and irrigation gates.

Evidence of improved efficiencies was clear at the Macquarie Valley Cotton Growers' Association Awards in 2014 when TNIS members Michael, Marieanne and John Noonan won "Farm of the Year" with the highest average yielding cotton crop in the Valley, grown entirely under new efficient linear move irrigators from water delivered through a modernised section of the Scheme. In 2015 TNIS Members, the Quigley Family, won the Macquarie Valley Cotton Growers' Association Cotton "Crop of the Year" grown under a new linear move irrigator in a 2% water allocation year, yielding a very high 15.9 bales/ha.

The modelling shows that despite the 40% reduction in water entitlements and 43% less farms producing cotton, there would only be an anticipated 25% reduction in the area of cotton planted and irrigated by the Trangie scheme. In other words, the area planted by 22 remaining members of the scheme post-project would produce 75% of the area planted by 39 members of the scheme pre-project.



Figures 5 and 6: Water Entitlements and Area of Crop Planted

The modelling summarised in figures 5 and 6 above shows that large farms that remain post modernisation can plant more cotton more often and can grow two additional seasons of cropping over the modelling period. The area of cotton planted and irrigated by large farms (all with on-farm works) increased by 46 ha on average per year due to an average increase of 139 ML of water deliveries, which is 127% of pre-project irrigated crop production. Large farms were able to grow 12 crops in the 14-year modelling period (1999–2013), an additional two crops after scheme modernisation (Figure 7). The outcome of this would include improved reliability of farm income, reduced impacts of climate change, and more reliable employment opportunities in the community. Large farms clearly have an increased opportunity for crop production and profit post-project.

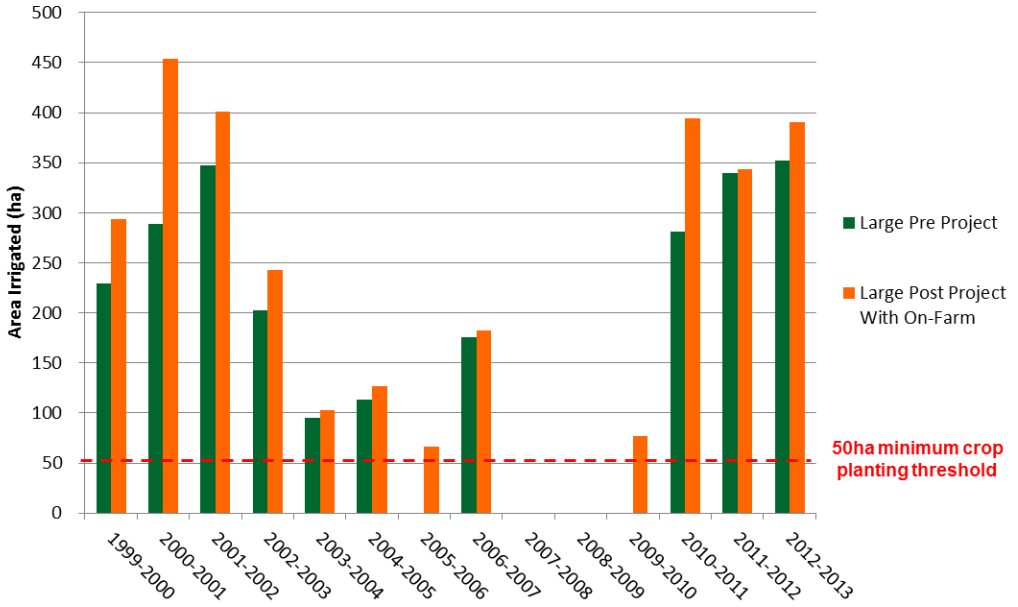


Figure 7: Area of crop planted - Large Farms

The modelling shows that small farms that remain can also plant more cotton more often – more crops nearly every year, also with two additional seasons. The area of cotton planted and irrigated by small farms with no on-farm works increased by 15 ha on average per year due to an increase of an average of 104 ML more water delivered, which is 141% of pre-project irrigated crop production. The area of cotton planted and irrigated by small farms with on-farm works increased by 19 ha on average per year, which is 151% of pre-project irrigated crop production. Small farms were able to grow eight crops in the 14-year modelling period (1999–2013), an addition of two crops after Scheme modernisation (Figure 8). This would result in improved reliability of farm income, reduced impacts of climate change, and more reliable employment opportunities in the community. Small farms also have an increased opportunity for crop production and profitability post-project.

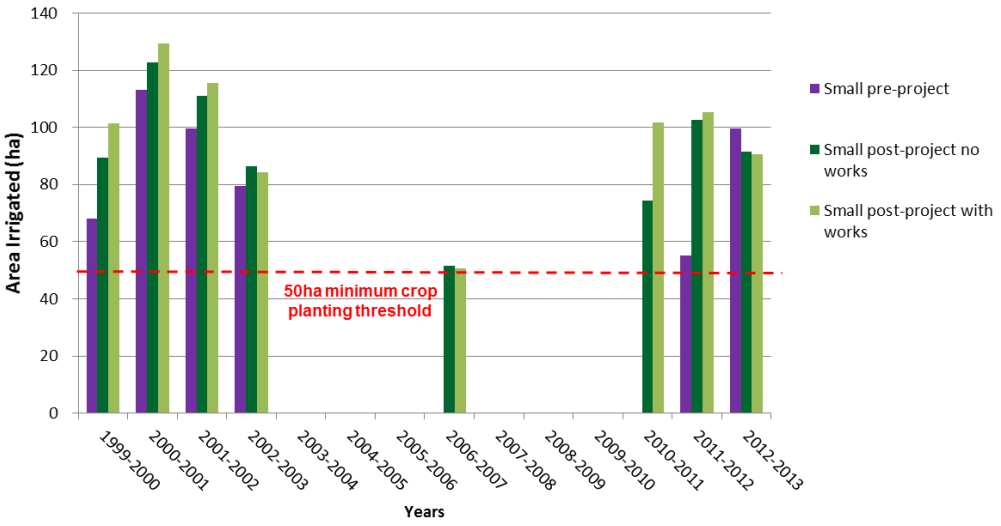


Figure 8: Area of crop planted - Small Farms

3.2.3 Large Farm Profitability Outcomes

Pre-project, large farms recorded an average pre-tax loss of approximately $50,000 per year during the 14-year modelling period (1999–2013), Figure 9. Post-project, due to the increased individual irrigator crop production, the average annual pre-tax profit for large farms would be significantly improved. Large farms recorded an average pre-tax profit of approximately $266,000 per year during the 14-year modelling period (1999–2013) up from an average loss of $50,000.

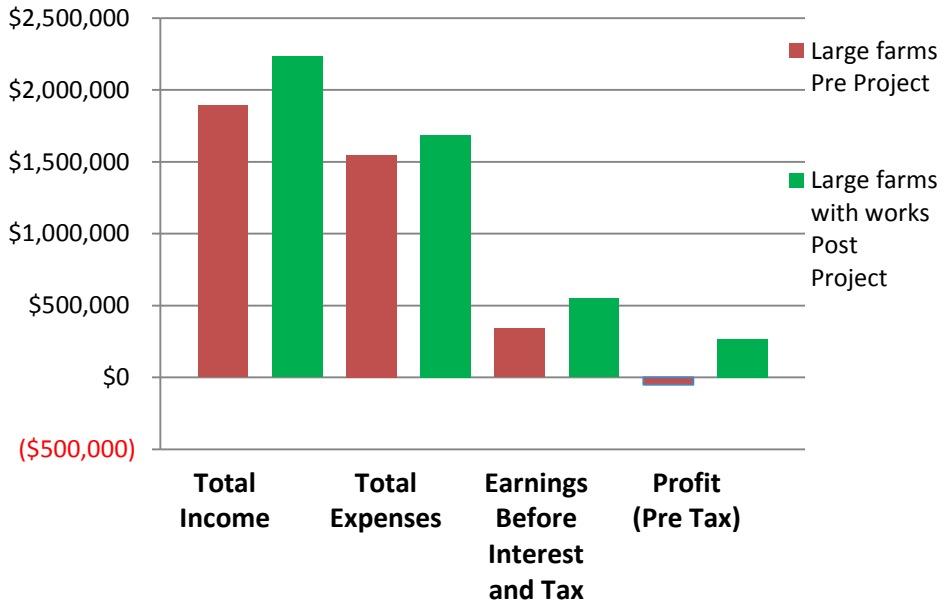


Figure 9: Modelled average Income, expenses and profit for large farms pre modernisation

The modelling shows improved financial results each year for large farms with a significant improvement in years where cropping could occur post-project but could not have occurred pre-project.

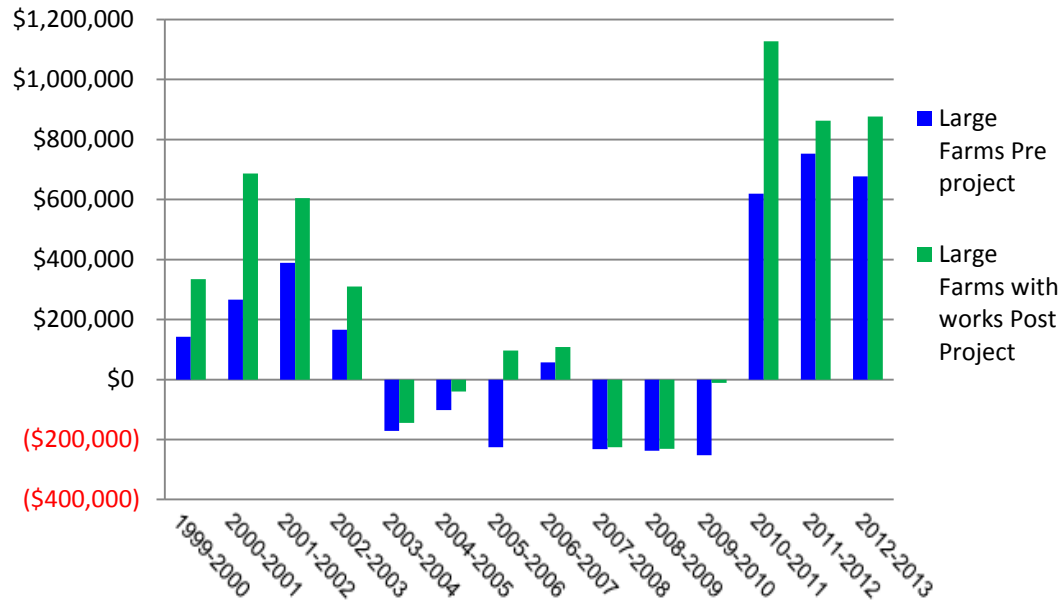


Figure 10: Modelled profit for large farms pre and post modernisation

3.2.4 Small Farm and Rationalised Farm Profitability Outcomes

Pre-project, small farms recorded an average pre-tax loss of approximately $47,000 per year during the 14-year modelling period (1999–2013). Post-project, the modelling shows a significant improvement in profit for small farms. Rationalised farms would also significantly improve their pre-tax profit compared to the pre-project outcomes for small farms.

Small farms recorded an average pre-tax profit of approximately $57,000 per year during the 14-year modelling period (1999–2013), up from an average loss of $47,000 per year (Figure 11). Small farms undertaking on-farm efficiency projects recorded an average pre-tax profit of approximately $82,000 per year during the 14-year modelling period (1999–2013), up from an average loss of $47,000 per year.

Exiting (rationalised) members recorded an average pre-tax profit of approximately $91,000 per year during the 14-year modelling period (1999–2013), up from an average loss of $47,000 per year.

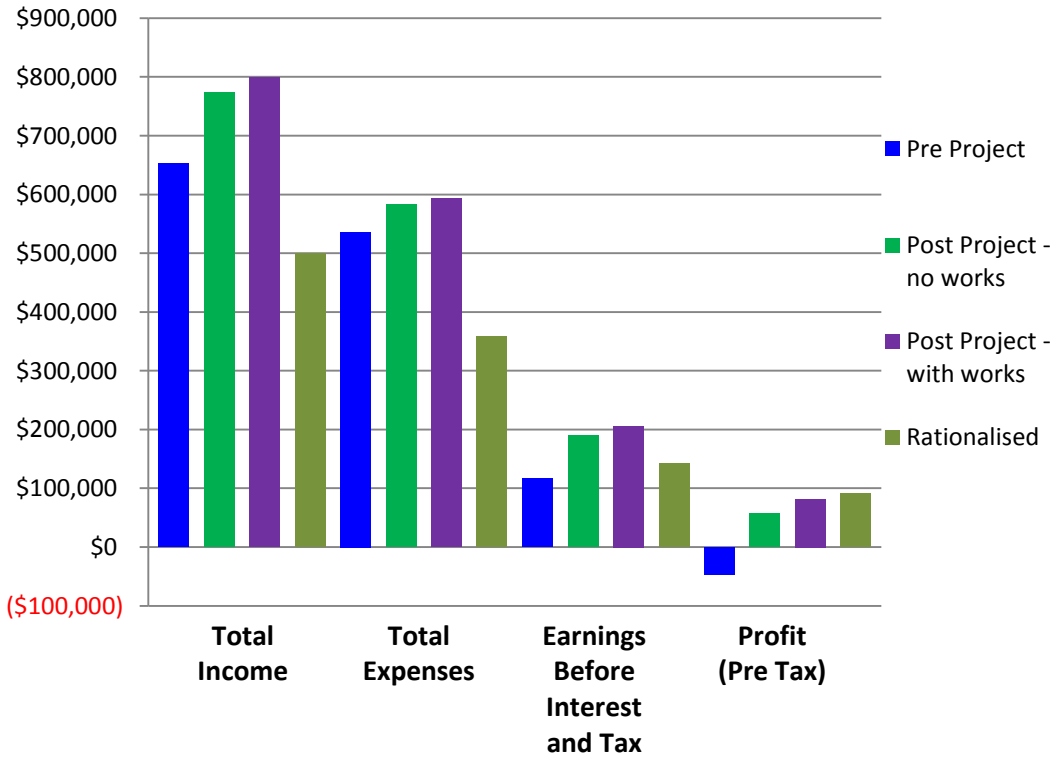


Figure 9: Modelled average Income, expenses and profit for small farms pre modernisation

The modelling demonstrates a significant turnaround in profit for small farms and a further increase for those farms that had on-farm water infrastructure improvements.

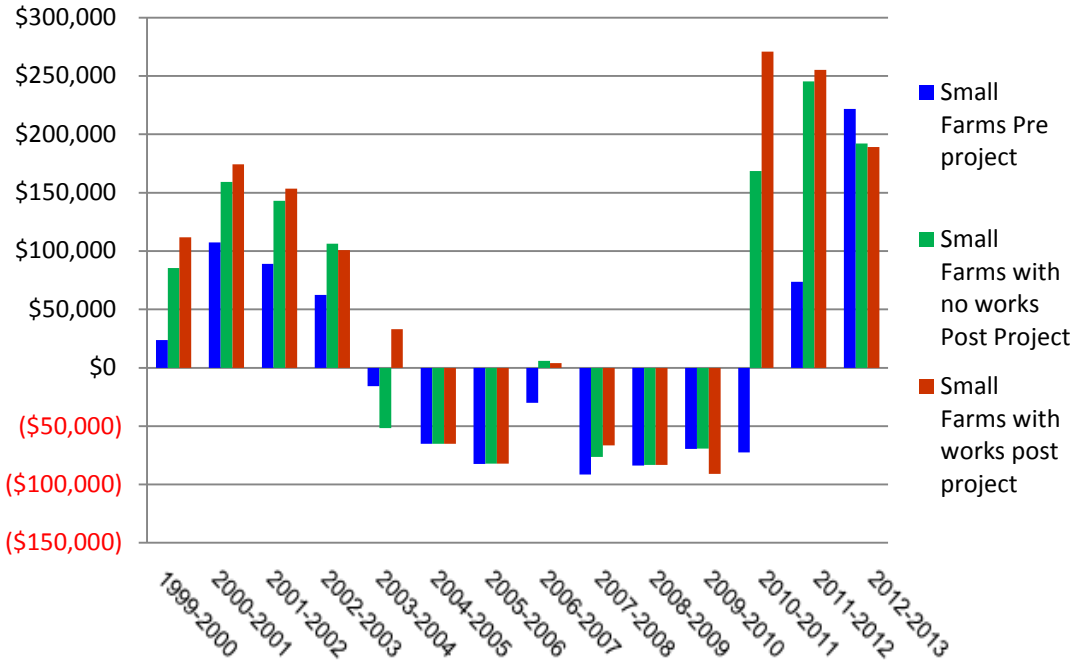


Figure 11: Modelled profit for small farms pre and post modernisation

The modelling shows that the small farms would get improved financial results each year with the rationalised farms also improving due to lower costs and debts.

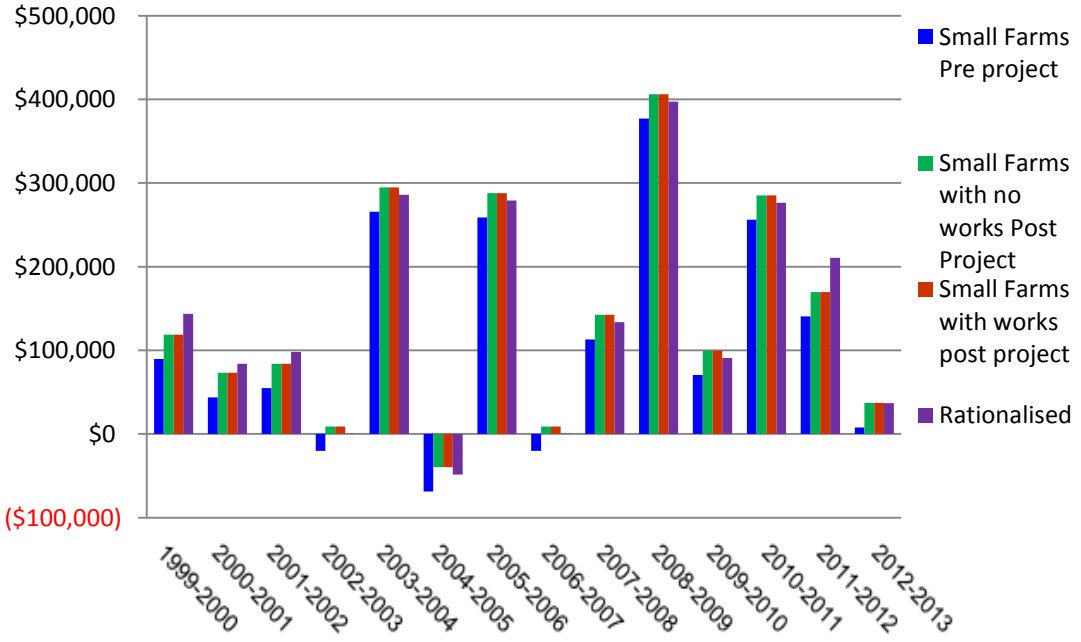


Figure 12: Modelled profit for small farms pre and post modernisation. Rationalised farms included.

Net irrigation incomes and net return per ML of entitlement also significantly improved post-project in the modelling

Summary table: Predicted average annual net return per ML during the 14-year modelling period (1999–2013)

	Water entitlement	Net irrigation Income	Net return per ML of entitlement
Large farms (before modernisation)	3,327	$132,136	$48
Large farms (after modernisation)	3,272	$310,955	$108
Small farms (before modernisation)	893	$4,486	$70
Small farms (after modernisation)	870	$48,450	$133
Small farms with on-farm efficiency projects (after modernisation)	870	$64,647	$138

3.2.5 Equity and Return on Assets Managed (ROAM) large and small farms

Before the modernisation of the scheme, equity was modelled to decrease from 70% in 1999 to 35% for large farms and 16% for small farms by 2013. This indicated long term viability was in question.

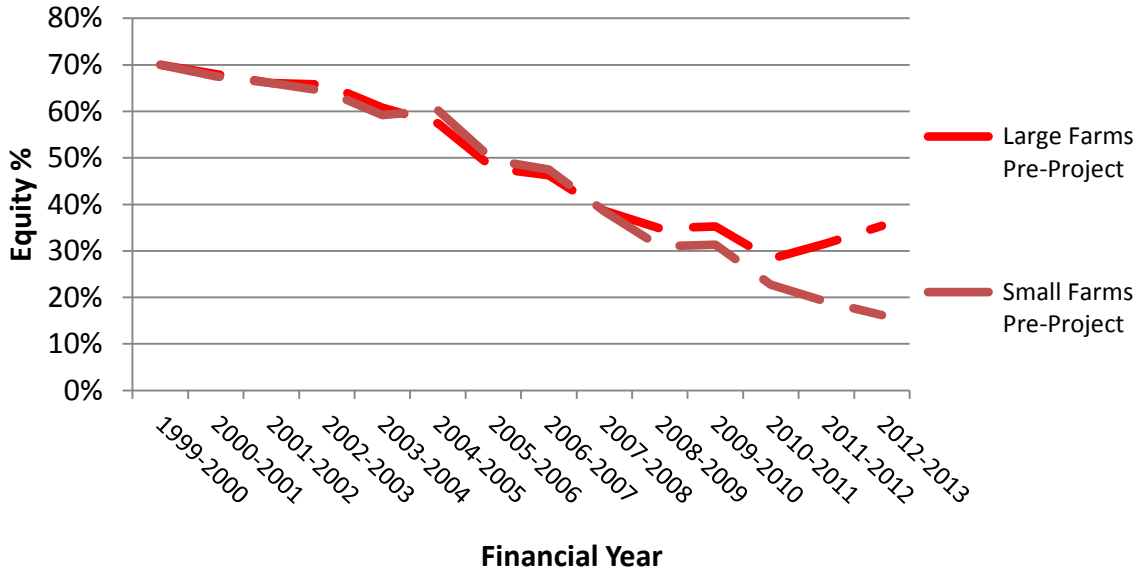


Figure13: TNIS members' equity in their business enterprises - pre-project

After modernisation, equity was modelled to remain relatively constant from 2002 to 2011 and then improve as rainfall and water availability improved. The rationalised farms equity also improved considerably compared to pre-project small farm outcomes, noting that this assumes that all PIIOP funds were spent on debt reduction.

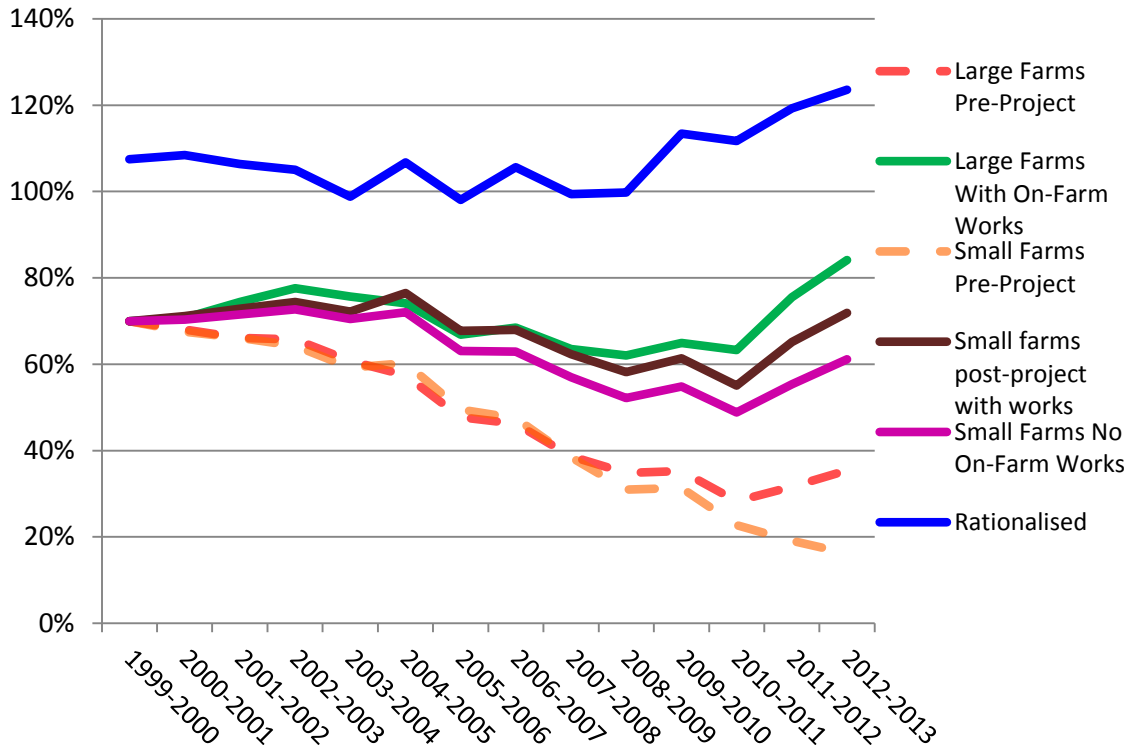


Figure 13: TNIS members' equity in the business enterprises - post-project. NB – rationalised farms equity assumes that all PIIOP funds are spent on debt reduction

Return on Assets Managed (ROAM) provides an indicator of the financial performance of the project for members relative to their farm investment. The model illustrates the improved ROAM of 2-3% for all members including both the smaller farms as well as the larger irrigators.

The rationalised farms also improved ROAM outcomes, assuming debt was reduced through the rationalisation process. This is summarised in Figure 14 below:

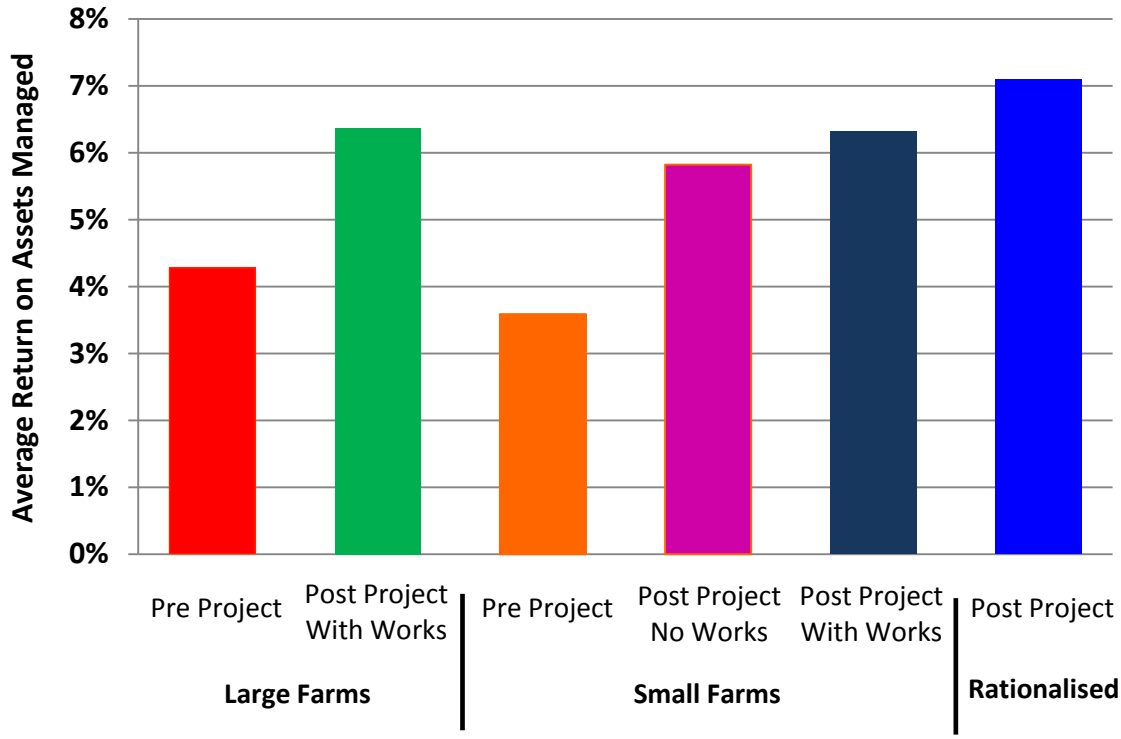


Figure 14: Return on Assets Managed – large, small and rationalised farms, pre- and post-project

Summary Table: Predicted financial performance of all farms during the 14-year modelling period (1999–2013)

Farm type		Average pre-tax income	Farm equity	Return on assets managed
Large farms (>400 ha)	Before modernisation	($50,000)	35%	4.3%
	After modernisation	$266,000	84%	6.4%
Small farms (<400 ha)	Before modernisation	($47,000)	16%	3.6%
	After modernisation	$57,000	61%	5.8%
Small farms undertaking on-farm efficiency projects>	Before modernisation	($47,000)	16%	3.6%
	After modernisation	$82,000	72%	6.3%
Exiting members	Before modernisation	($47,000)	16%	3.6%
	After modernisation	$91,000	124%	7.1%

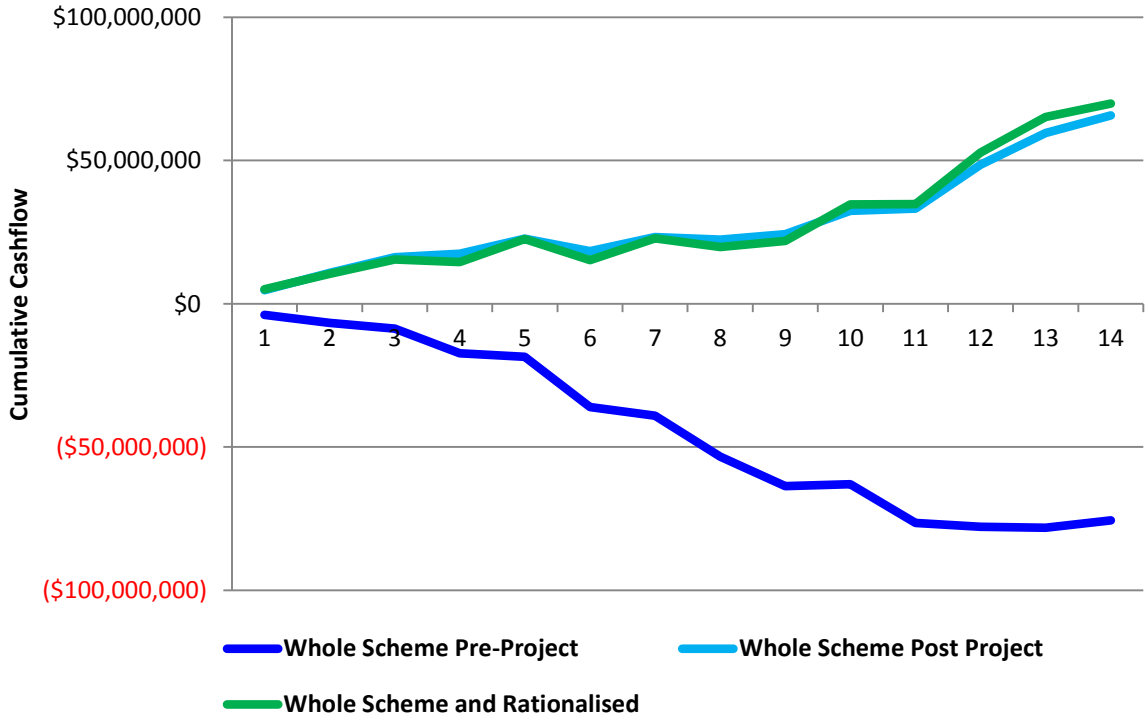
3.2.5 Overall TNCL Business Outcome

For the scheme business as a whole, the modelling showed an improved total scheme performance which indicates improved sustainability due to the PIIOP investment. The modelling indicates that there would be an opportunity created for a $130 million improvement in overall outcomes over the modelled period, for a $115 million investment.

This improved sustainability is likely to lead to improved social and economic outcomes attributable to the modernisation project.

Overall TNCL Business Outcome: Cumulative cashflow

Figure 14



4.0 CONSTRUCTION AND WORKS

4.1 Overarching Practices

The Project delivery system developed for this project focused on risk minimisation yet with sufficient flexibility to deal with issues.

The Head Contract was Design and Construct, and TNCL was involved in establishing Principal Project Requirement (PPR) so that the design developed was compliant with PPR and the Design Brief.

Although the Head Contract transferred substantial risk to the Contractor, TNCL had some exposure when the Contractor underperformed in the first year.

TNCL and its Project Managers effectively dealt with claims from the Head Contract in the order of 40% of their contract value. The Project Management systems ensured that legal costs were minimal and the Head Contract was renegotiated so that the Head Contract scope was reduced to 55% of the original contract but at the original contract rates. This outcome was very cost-effective for the project in relation to the Head Contractor's final costs and agreed and final contract sum.

TNCL and their Project Managers revised the project delivery method and process for the completion of the project, and obtained approval from the Department of Agriculture and Water Resources that the balance of the project could be delivered via a number of minor works contracts. This enabled cost savings to be achieved and deliver the remaining project with funding levels without compromise to WH and S which was managed under the TNCL WH and S policy.

4.2 Work Health and Safety

The project was delivered under two different Work Health and Safety (WHS) systems.

The first stage was delivered under Macmahon ADASA Joint Venture (MAJV) who were an accredited contractor under the Australian Government Building and Construction OHS Accreditation Scheme.

The second stage was delivered directly with the Subcontractors with the TNCL WHS Policy acting as an "umbrella" policy. The Department of Agriculture and Water Resources conducted a routine review of the implementation of TNIS' WHS system on 25 May 2014. The review process was designed to highlight the importance of maintaining vigilance over WHS processes and their application in multiple, remote workplaces.

4.3 Environment

Each Contractor was required to submit a Construction Environmental Management Plan (CEMP) for approval by the Superintendent before any works could commence.

Each Construction Environmental Management Plan (CEMP) submitted for works on the TNIS Project was assessed to ensure that it provides systems and procedures in a suitable framework to ensure the establishment and maintenance of best practice controls to manage potential environmental impacts associated with project activities in accordance with contract requirements, relevant legislation and project objectives.

4.4 Quality Assurance

4.4.1 General

To ensure that all aspects of the project were constructed to a high quality a Quality Assurance Process was required. The backbone of the process was through Inspection & Test Plans (ITP's) that were developed in accordance with the requirements of the Geolyse Specifications and Drawings for each work package. The Superintendent reviewed the ITPs before they were implemented onsite to

ensure conformance with the Specifications and Drawings. The main quality control measures are described below.

4.4.2 Regular Inspections

During the construction process, TNCL & FCP representatives regularly visited the site to ensure construction was proceeding according to the relevant designs, standards and program. The contractor requested inspections at various "hold points" defined in the contracts. An example of a hold point is when reinforcement has been placed and foundations are ready for concrete pour.

4.4.3 Photographic Evidence

During the regular inspections, photographs were taken of key areas of the sites and kept as evidence. Examples of stages at which photographs are taken were:

- documenting sub-grade conditions
- arrangement of reinforcing steel
- concrete placement
- Pre-work conditions.

4.4.4 Inspection and Test Plans

All contractors were required to develop and implement ITP's for each work process as detailed in the Specifications and Drawings. The ITPs required the inclusion of a number of "hold points" for sign off by the Superintendent. These "hold points" were a critical item to ensure all works were being undertaken in accordance with the stated processes.

Concrete and Bulk Earthworks Specifications were used. These Specifications clearly state the inspection and testing requirements.

4.4.5 Compliance Inspection & Testing

Compliance inspections and tests were carried out by the various contractors to ensure compliance with the contract requirements and included, as a minimum, all inspections and tests which are specified in the Specifications and Drawings as part of the Contract.

All compliance testing was carried out by laboratories registered with NATA and certified for the appropriate tests.

If the results indicate non-conformance, no further testing shall be permitted until a non-conformance notification has been submitted and corrective action has been approved by the Project Manager. Each such notification by the contractor shall include details of the action proposed for correction of the non-conformance or the arrangements made for its disposition and the amendments to its quality system to mitigate recurrence of the non-conformance.

Compaction tests undertaken as part of the earthworks.

4.4.6 Work as Executed Drawings

The levels of all structures and earthworks profiles are a critical element of a gravity feed irrigation scheme, as such WAE are a critical item to verify that the design requirements are met.

All contractors were required to provide detailed WAE Drawings for all works completed. This will verify that all levels have been constructed in accordance with the design.

4.4.7 Correspondence & Filing

To ensure that all Project Specific documentation was received, actioned and filed appropriately a correspondence & filing system was implemented.

The project had two office locations, a Site Office and the Head Office in Sydney.

All correspondence was directed to the Sydney Head Office for appropriate action.

A filing index and correspondence register system was set up at the commencement of the project, which is appropriate to control all correspondence and project records.

The Contracts Administrator, in liaison with the Project Manager, established a hardcopy project filing index to ensure that records are indexed and filed in a manner to facilitate easy retrieval of information.

The Project Manager informed suppliers and subcontractors of where project-related correspondence is to be addressed.

All inward correspondence was stamped with a 'Received' stamp showing the receipt date, registered and then was distributed to relevant staff as directed by the Project Manager.

Correspondence was filed in chronological order.

The Project Manager maintained, at the project site office, an up to date hard copy of the project Quality Records. The Quality Records were located in one central location for ease of access. The Site Manager was responsible for maintaining the Quality Records.

As a minimum, hard copy records included:

- Inspection and Test Plans (approved or otherwise);
- Lot Checklists documenting inspections and Hold & Witness Point releases;
- Lot Conformance Reports and associated supporting records;
- Non-Conformance Reports and associated Corrective Actions;
- Subcontract Quality Records; and
- Site Monitoring and Measurement Calibration Records.

4.4.8 Archiving of Records

Project quality records will be archived for a minimum period of seven years.

4.5 Board Involvement

TNCL Board actively managed their obligations under the funding agreement, engaging expertise in all relevant disciplines to ensure compliance.

The TNCL Board have committed substantial time to the project and where necessary established sub-committees to deal with specific issues.

The Department of Agriculture and Water Resources conduced a routine review of TNCL's compliance with the requirements of the funding agreement that relate to financial management on

20 May 2014. The review process concluded in June 2014 and confirmed that there was good compliance with the financial-related requirements of the funding agreement.

The TNCL Board have dealt with numerous contractual and financial challenges presented during a large engineering project, they have sought input from their team and acted promptly in dealing with and resolving all challenges.

The project has benefited greatly by the effective TNCL Board involvement and was instrumental in keeping administration costs to less than 6% of the total project budget.

4.6 Construction Outcomes

The Modernisation works include the following:

1. **Rationalisation of Irrigated Areas**
2. **Channel Lining (Water Losses)**
3. **Channel Regulators**
4. **Metering & Telemetry**
5. **Stock & Domestic Pipeline**
6. **Upgrade Pump Station.**
7. **Fencing of Lined Channels**
8. **Decommissioning Old Channels**

The Project Statistics can be summarised as follows:

Construction Budget	**: $67.9 million**
Length of Channel Earthworks	**: 143 kilometres – 108 lined, 35 earthen**
Area of EPDM Liner	**: 2,197,571 m²**
Number of Slip Meters	**: 35**
Number of Flume Gates	**: 34**
Number of Precast Concrete Pits	**: 171**
Number of Reinforced Concrete Pipes	**: 730**
Stock & Domestic Pipeline length	**: 230 kilometres**
Length of Fencing	**: 265 kilometres**
Completion Date	**: 14 November 2014**

4.6.1 Rationalisation

One third of the Scheme has been rationalised, with some members nominating properties to be removed from access to irrigation water, decommission their on-farm irrigation system and transfer their water entitlements to the Commonwealth. These properties have been reconfigured to support dry land farming and grazing enterprises.

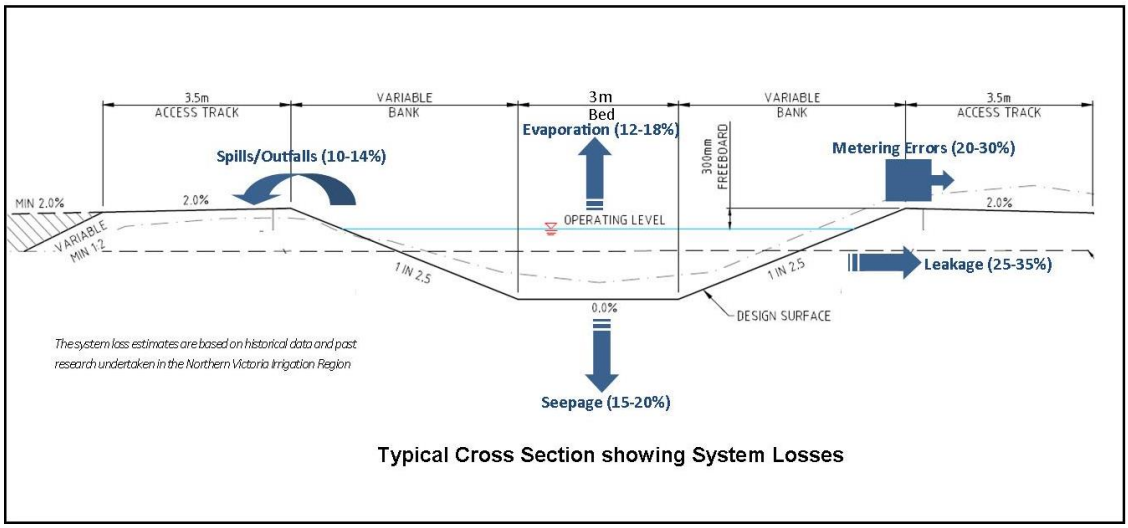
4.6.2 Channel Lining (Water Losses)

Cost Breakdown **$250 – $300,000 per km**

- **Earthwork Channel Forming** **35 – 40 %**
- **Liner Supply** **40 – 45 %**
- **Liner Install** **12 %**
- **Fencing** **4 %**
- **Design** **4 %**

4.6.3 Water Losses

A major component of the Modernisation process was to reduce the "system losses" by lining the channels, in TNCL's case, with EPDM (rubber) and providing accurate metering capable of ±2.5% accuracy as tested in the laboratory.



Typical Cross Section showing System Losses

Current water losses : 17 – 35 %

Future water losses after Modernisation: 1 – 7 %

4.6.4 Channel Regulators

Cost Breakdown **$50,000 - $70,000 per Regulator**

- **Earthworks and Beaching (Civils)** **10 – 20 %**
- **Concrete Works incl. pits and pipes** **10 – 40 %**
- **Gate Supply** **30 – 40 %**
- **Installation** **5 %**
- **Commissioning** **5 %**
- **Other** **5 %**

4.6.5 Meters & Telemetry

Cost Breakdown **$45,000 per Farm Outlet**

- **Civils** **30 %**
- **Concrete Pits and Pipes** **14 %**
- **Meter Supply** **44 %**
- **Meter Install** **7 %**
- **Telemetry** **2 %**
- **Commissioning** **3 %**

4.6.6 Stock & Domestic Pipeline

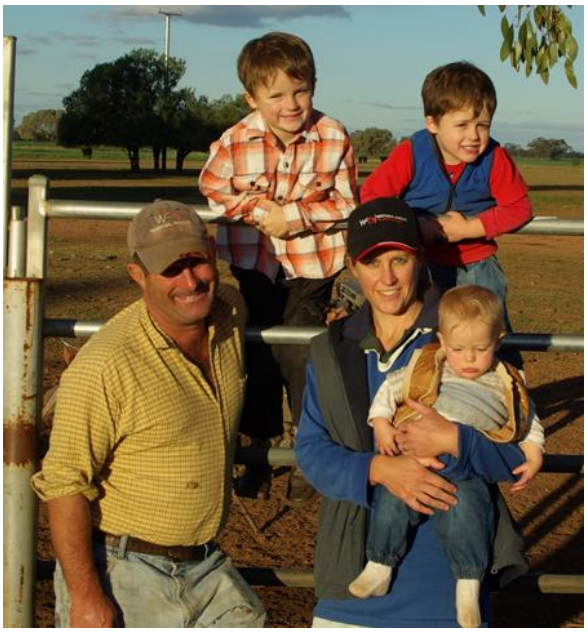
Cost Breakdown **$35 - $40 per metre**

- **Design** **5 %**
- **Pipe Supply** **40 %**
- **Pipe Install** **35 %**
- **Pump Station** **10 – 15 %**
- **Meters and Telemetry** **8 – 10 %**

5. PROPONENT CASE STUDIES

5.1 Red Zone Case Study – Chase Family – "Waitara"

"In the summer of 2014, we were running in excess of 500 head of cattle on Waitara. Without the Trangie-Nevertire Stock and Domestic Scheme, we would have been running only 100 head." Geoff Chase.



Third and fourth generation farmers in the Chase Family

"We believe that the Rationalisation and Modernisation of the TNIS has resulted in both Red Zone and Green Zone businesses becoming more viable." Geoff Chase.

1. Background to Farm/Proponent

Farm name	Waitara
Farm size	1 536 hectares
Water traded	1 333 megalitres
Farm location	50km south of Nevertire 80km south west of Trangie
Enterprises prior to rationalisation	Cattle – stud and commercial, cotton, dryland winter crops
Area of irrigation prior to rationalisation	304 hectares
Enterprises after Rationalisation	Cattle – stud and commercial, dryland winter crops, fodder crops
How long has the farm been owned	Owned since 1922.
Funding for on-farm project	$619 080

2. Pre rationalisation

Challenges about the irrigation enterprise	• Restrictions to Macquarie Valley water allocations • Scheme water losses of 17-35% • Uncertainty of water delivery • Costs of running the Scheme (O & M)
Typical cotton yields and water use efficiency	Pre Bollguard (cotton has not been grown for some time) – 7.5 bales/ha, using approx. 9ML/ha.
Why become involved in the rationalisation project?	The proponent was doubtful that, in the long term, the Scheme was economically and environmentally viable.

3. Post rationalisation

What was the on-farm project?	• Decommissioning of approximately 9km of supply channels, and return drains. Removal of irrigation structures and pipes and decommissioning of reservoir to a point where it can be safely traversed by farm vehicles. Forming and grading of roads on former irrigation areas and levelling of all banks on Waitara. • Design and installation of a working stock and domestic water reticulation system around Waitara, connecting to the TNSDS outlet, including approximately 9.5km of polypipe laid underground, 2 x 275 000 litre steel water tanks, 7 x in-field poly tanks, 13 x concrete water troughs on slabs and 2 x pressure pumps. • Purchase of materials and building of fences to allow better stock management and protect in-field tanks, fence repairs to better manage stock.
When was it completed?	The Waitara project was completed in September 2013 and inspected by Vanguard Business Services on 27 November 2013.

What are the benefits to the business since project completion?	• Security of water for stock and domestic purposes regardless of the season. • The delivery of fresh water to an increased number of stock watering points, as well as the storage of water in tanks to provide backup should there be a leak somewhere on Waitara. • Better management of grazing pressure due to strategically placed watering points and fencing. • Improved quality of water leads to better health of livestock
Are there any wider benefits to be seen beyond the farm?	The security of water has enabled better decision making processes within the family as well as the business.
What were the challenges experienced?	Trying to design a system taking into account the long term needs of the property and the business.

4. Other comments

Are there any other benefits/costs?	Costs – hoping that the TNSDS doesn't become too expensive and costs remain manageable. Benefit – being able to substitute TNSDS river water for poor quality bore water is priceless.
Are there any unexpected benefits/costs as a result of these changes?	The water is cleaner than expected so can be used when spraying herbicides, etc, and this conserves rainwater for the house. The housing evaporative air-conditioning performs better because the water is clean – and don't need to keep changing the pads. When the water system was switched over to the TNSDS it took about a week for all the sludge to be flushed out of the pipes. We don't have this problem now. There are distinct psychological benefits to keeping a green garden when the paddocks are very dry! Increased solar panels (upped capacity) at Waitara so that water pumps all day to fill holding tanks, this cuts out at night. Consequently saves energy. Because water has to run 5kms from the outlet, a central pumping point had to be devised on Waitara. This essentially means that water has to be "double pumped". To counter this, the Chases have increased their number of solar panels to cater for increased energy uses.
What does the future seem to hold?	The future with the TNSDS has made the Chase's dryland enterprise a lot more viable, and therefore secure. This is considered to be the biggest benefit to the business for a long time and is perhaps having the biggest impact on the business since irrigation was introduced by the TNIS in the early 1970s. It is conceivably going to have a greater positive impact on the business than the introduction of irrigation.

5. Photos

Figure 3: A 275 000 litre steel water tank for storage security

Figure 4: Geoff Chase at the TNSDS outlet

Figure 5: Poly tank with level indicator, guard for inlets/outlets and two water troughs in the background

Figure 6: Poly tank with stock guard

Figure 7: New fencing to better manage livestock

Figure 8: Former (decommissioned) irrigation reservoir with crop now growing in the base

5.2 Red Zone Case Study – Chase Family – "Gooninbah"

"This Stock and Domestic project has meant that our livestock and dryland farming enterprises can go ahead in leaps and bounds." Geoff Chase.

1. Background to Farm/Proponent

Farm name	Gooninbah
Farm size	1 036 hectares
Water traded	893 megalitres
Farm location	40km south of Nevertire 73km south west of Trangie
Enterprises prior to rationalisation	Previously not owned by the proponent. Very little had been carried out on Gooninbah prior to the Chases' purchase.
Area of irrigation prior to rationalisation	75 hectares
Enterprises after Rationalisation	Cattle, dryland winter crops
How long has farm been owned	Gooninbah was purchased in August 2012 so has been owned by the Chases' for two years and two months
Funding for on-farm project	$185 350

2. Pre rationalisation

Challenges about the irrigation enterprise	• Restrictions to Macquarie Valley water allocations • Scheme water losses averaging 30% • Uncertainty of water delivery • Costs of running the Scheme (O & M)
Typical cotton yields and water use efficiency	Unknown due to change in ownership and cotton not having been grown for many years.
Why become involved in the rationalisation project?	Absentee owner at the time, who was happy to comply and believed that it was generally for the better of the community.

3. Post rationalisation

What was the on-farm project?	• Decommissioning of approximately 5.3km of supply channels, and return drains. Removal of irrigation structures and pipes. • Design and installation of a working stock and domestic water reticulation system around Gooninbah, connecting to the TNSDS outlet, including approximately 5km of polypipe laid underground, 1 x 187 000 litre steel water tank, 4 x in-field poly tanks, 10 x concrete water troughs on slabs and 1 x pressure pump.

	• Purchase of materials and building of fences to allow better stock management and protect in-field tanks, fence repairs to better manage stock.
When was it completed?	The Gooninbah project was completed in September 2013 and inspected by Vanguard Business Services on 27 November 2013.
What are the benefits to the business since project completion?	• Gooninbah had no source of secure water and was virtually unfenced so this project has transformed it from a completely unviable property into a valued asset. • Security of water for stock and domestic purposes regardless of the season. • The delivery of fresh water to an increased number of stock watering points, as well as the storage of water in tanks to provide backup should there be a leak somewhere on Gooninbah. • Better management of grazing pressure due to strategically placed watering points and fencing. • Improved quality of water leads to better health of livestock
Are there any wider benefits to be seen beyond the farm?	The Gooninbah house can now be occupied because there is security of water to the place. Previously it was serviced by a dam which often ran dry.
What were the challenges experienced?	The Gooninbah water system was difficult to design because there was no existing infrastructure to use as a base from which to work.

4. Other comments

Are there any other benefits/costs?	Costs – hoping that the TNSDS doesn't become too expensive and costs remain manageable. Benefit – being able to substitute TNSDS river water for poor quality bore water is priceless. Reliability of supply.
Are there any unexpected benefits/costs as a result of these changes?	The water is cleaner than expected so can be used when spraying herbicides and the like, and this conserves rainwater for the house. When the water system was switched over to the TNSDS it took about a week for all the sludge to be flushed out of the pipes. There are distinct psychological benefits to keeping a green garden when the paddocks are very dry!
What does the future seem to hold?	The future with the TNSDS has made the Chase's dryland enterprise a lot more viable, and therefore secure. This is considered to be the biggest benefit to the business for a long time and is perhaps having the biggest impact on the business since irrigation was introduced by the TNIS in the early 1970s. It is conceivably going to have a greater positive impact on the business than the introduction of irrigation.

5. Photos

Figure 1: 187 000 litre tank at Gooninbah house

Figure 2: In-field poly tank

Figure 3: Gooninbah house water supply prior to rationalisation and connection to the TNSDS

Figure 4: Livestock on Gooninbah with new in-field poly tank, troughs and fencing

Figure 5: Example of in-field poly tank, trough and new fencing on Gooninbah

Figure 6: View along original Gooninbah irrigation supply channel - now decommissioned

5.3 Red Zone Case Study – Peter and Tina Leslie "Beverley"

"In my life at Beverley there have been three major developments. Firstly the introduction of electricity, secondly the introduction of the automatic telephone, and thirdly the establishment of the Trangie-Nevertire Stock and Domestic Scheme. These advancements seem to be, and are very basic needs to live, however have given the greatest improvement to our living standard and to life living on our farm." Peter Leslie.

1. Background to Farm/Proponent

Farm name	Beverley
Farm size	1 314 hectares
Water traded	1 000 megalitres
Farm location	36 km south of Nevertire 74 km south west of Trangie
Enterprises prior to rationalisation	Cattle, sheep, cotton, dryland winter crops
Area of irrigation prior to rationalisation	301 hectares
Enterprises after Rationalisation	Cattle, sheep, dryland winter crops
How long has farm been owned	20 years
Funding for on-farm project	$246 650

2. Pre rationalisation

Challenges about the irrigation enterprise	• Restrictions to Macquarie Valley water allocations • Scheme water losses of 17-35% • Uncertainty of delivery • Scheme running costs (O & M)
Typical cotton yields and water use efficiency	10 bales/ha and 0.8 ML/bale
Why become involved in the rationalisation project?	The scheme was becoming unviable at low allocations, costs were increasing and the delivery system desperately needed modernisation.

3. Post rationalisation

What was the on-farm project?	• Decommissioning of approximately 8 km of supply channels, and return drains. Removal of irrigation structures and pipes. • Design and installation of a working stock and domestic water reticulation system around Beverley, connecting to the TNSDS outlet, including approximately 6km of polypipe laid underground, 1 x 275 000 litre steel water tank, 4 x in-field poly tanks, 12 x concrete water troughs on slabs and 1 x pressure pump. • Purchase of materials and fencing repairs to previously irrigated areas.
When was it completed?	The Beverley project was completed in September 2013 and inspected by Vanguard Business Services on 27 November 2013.
What are the benefits to the business since project completion?	• Security of water for stock and domestic purposes regardless of the season. • The delivery of fresh water to an increased number of stock watering points, as well as the storage of water in tanks to provide backup should there be a leak somewhere on Beverley. • Improved quality of water leads to better health of livestock. • Improved management of grazing pressure due to an increased number of reliable, clean watering points.
Are there any wider benefits to be seen beyond the farm?	There is a distinct benefit to being able to maintain a garden and know that the water source will not dry up.
What were the challenges experienced?	None really.

4. Other comments

Are there any other benefits/costs?	The stock and domestic scheme has created surety around stock water, which reduces the risks associated with running stock, as you know you will have a supply of quality water for them. Previous to the new pipeline scheme this was not always the case.
Are there any unexpected benefits/costs as a result of these changes?	There are significant lifestyle benefits to having a quality and assured water supply to the house. There is a distinct benefit to be able to maintain a garden and know the water source will not dry up.

5. Photos

Figure 9: 275 000 litre water tank located at Beverley house with pressure pump to right of photo

Figure 2: Example of concrete troughs and in-field poly tank

Figure 3: Proponent Peter Leslie at point where TNCL channel previously entered Beverley. TNCL irrigation structures have been decommissioned and are evident in photo, awaiting removal.

Figure 4: Proponent Coordinator, Mark Gardner with path of newly laid poly pipe leading behind to an in-field poly tank, trough and livestock in the background

Figure 5: Decommissioned irrigation channels leading straight ahead and to the right

Figure 6: Decommissioned channel on Beverley - now an access road

5.4 Green Zone Case Study - Nahweenah Pastoral Co: "Nahweenah"

"The new irrigation developments as part of our Green Zone project have increased our yields of cotton and have improved our profitability" Kim Russ

1. Background to Farm/Proponent

Farm name	**Nahweenah**
Farm size	1 780 hectares
Water traded	175 megalitres
Farm location	30km south of Nevertire
Enterprises prior to modernisation	Cattle, cotton, dryland winter crops
Area of irrigation prior to modernisation	Approx. 280 hectares
Area of irrigation after modernisation	Approx. 238 hectares
Enterprises after Modernisation	Cattle, cotton, dryland winter crops irrigated wheat, potential for a variety of irrigated crops, such as onions, garlic, hemp, coriander…
How long has farm been owned	Nahweenah has been in the Russ family for over 100 years.
Funding for on-farm project	$535 500

2. Pre modernisation

Challenges about the irrigation enterprise	• Restrictions to Macquarie Valley water allocations for irrigators, in part due to environmental water releases lowering the level of Burrendong Dam. • Scheme water losses averaging 30%. • Uncertainty of delivery. • Scheme running costs (O & M).
Typical cotton yields and water use efficiency	Average of approximately 10 bales/hectare WUE approximately 9 to 9.5 megalitres/hectare
Why become involved in the modernisation project?	• To save water. • To have the option of growing different crops that may not be suited to flood irrigation – there is a much wider range of crops that can be grown with spray irrigation. • It was considered that the trade of water through this PIIOP was an opportunity to improve on-farm efficiencies that may not be offered ever again, and that these efficiency gains could most likely not be funded out of normal farm cashflow. • Because of the modernisation of the whole scheme there was going to be a benefit for the wider community, especially with respect to the fact that, even in years of lower allocation, water will now be able to reach the farm gate.

3. Post modernisation

What was the on-farm project?	• The installation of two centre pivot irrigators and associated pipes and pump station. • The design and installation of a stock and domestic water reticulation system, including the laying of approximately 6.6km of pipe underground, the construction of one Rhino water tank with a capacity of approximately 163 000 litres of water, the installation of three water troughs and provision of a pressure pump.
When was it completed?	The Nahweenah modernisation project was implemented in two stages. Stage 1 involved the construction and commissioning of two centre pivot irrigators, and the installing of necessary pipework and pump station. This work was completed towards the end of 2011 and was inspected by Vanguard Business Services on 30 May 2012. Stage 2 involved the installation of the stock and domestic water system and this was completed in mid 2013.
What are the benefits to the business since project completion?	• Security of water delivery allowing for better business planning. • Security of water delivery ensuring irrigated crops can be finished off. • Improved measure of water application. • Better monitoring of moisture requirements due to soil moisture probes. • Balancing of sprinkler irrigation and flood irrigation across the

	better suited country. • Saving of labour for the country under the spray irrigation. • Using less channels because of the use of spray irrigators, and therefore not losing tailwater. • The first cotton crop grown under the pivots resulted in the highest yielding crop – 12.8bales/ha. However, the second year was not so good when cotton was grown back-to-back – this practice won't be repeated. • The delivery of fresh water to an increased number of stock watering points, as well as the storage of water in tanks to provide backup. • Improved quality of stock water leads to better health of livestock.
Are there any wider benefits to be seen beyond the farm?	Definitely. The lining of the channel means that water can now be used in low allocation years. Previously, in low allocation years no irrigated crops were grown. Now water can be utilised and become productive even in years of low allocation. This benefits all businesses in the TNCL district.
What were the challenges experienced?	One particular challenge on Nahweenah is learning to operate a different farming system – ie spray irrigation is totally different to flood. Two crops have been grown in two very different summers – one was a wet summer and one was hot and dry. WUE was greatly improved and less water used in the wet summer however in the hot and dry summer it was a challenge keeping the water up to the crop.

4. Other comments

Are there any other benefits/costs?	Benefits: • Thanks to the TNSDS the garden is staying green which is a great benefit. • Because the stock have better access to quality water they are doing better. • In a wetter summer there is no water logging under the spray irrigators unlike with flood. Costs: • The irrigators are run on diesel and use a lot of it. In the hotter, drier summer a huge amount of diesel was used. • In a very hot summer it is hard to keep the water up to the crops.
What does the future seem to hold?	The future holds the potential to try the growing of some different crops – such as vegetables, garlic, hemp - and maybe the opportunity to form a growers group within the district to take a collaborative approach to exploring this.

5. Photos

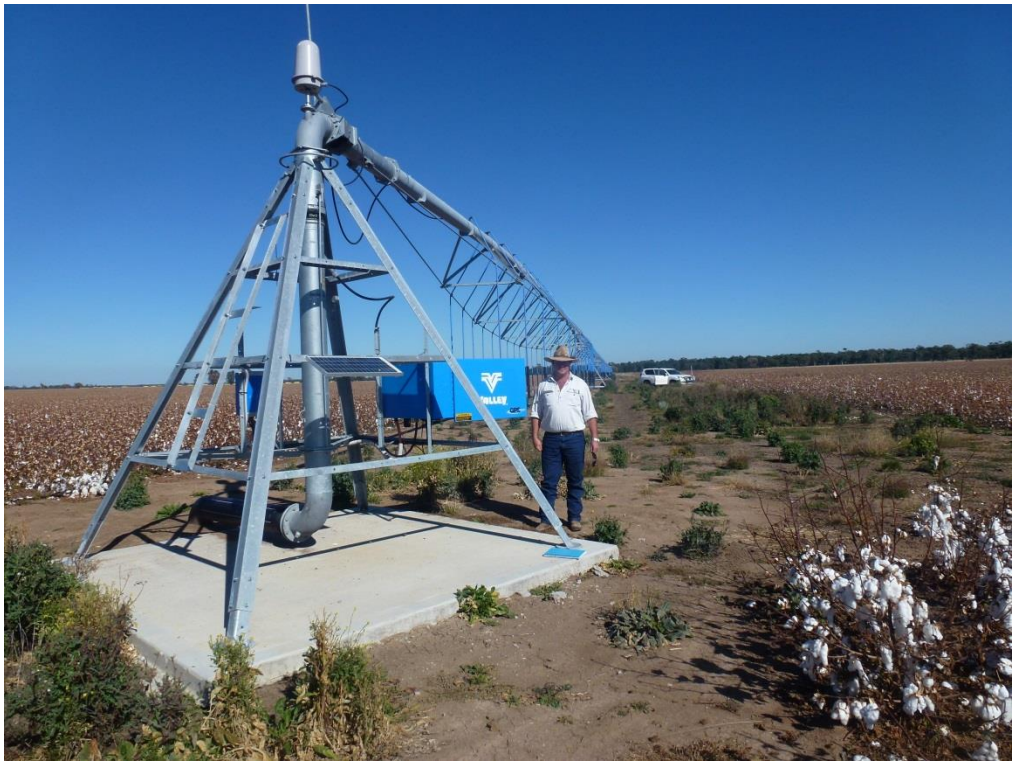


Figure 10: Proponent Kim Russ with centre pivot irrigator #1 on Nahweenah

Figure 11: Centre pivot irrigator #2 on Nahweenah

Figure 12: Nahweenah pump station #1

Figure 13: Nahweenah pump station #2

5.5 Green Zone Case Study - Nahweenah Pastoral Co: "Caroona"

"The on-farm project I have completed on Caroona will make improvements to my farming system that will greatly improve the timing of water application and the management of irrigated crops, in turn resulting in improved water use efficiencies." Kim Russ.

1. Background to Farm/Proponent

Farm name	**Caroona**
Farm size	1 266 hectares
Water traded	150 megalitres
Farm location	8km west of Nevertire
Enterprises prior to modernisation	Cattle, cotton, dryland winter crops
Area of irrigation prior to modernisation	Approx. 312 hectares
Area of irrigation after modernisation	Approx. 306 hectares
Enterprises after Modernisation	Cattle, cotton, dryland winter crops, irrigated wheat, potential for irrigated summer crops
Estimated water savings	199 megalitres
How long has farm been owned	Caroona was purchased in the 1970s
Funding for on-farm project	$441 250

2. Pre modernisation

Challenges about the irrigation enterprise	• Restrictions to Macquarie Valley water allocations due in part to environmental water releases lowering the level of Burrendong Dam • Scheme water losses averaging 30% • Uncertainty of delivery • Scheme running costs (O & M)
Typical cotton yields and water use efficiency	Very similar to Nahweenah – approximately 10.5bales/ha. WUE approximately 9.5 megalitres/hectare
Why become involved in the modernisation project?	• To save water. • It was considered that the trade of water through this PIIOP was an opportunity to improve on-farm efficiencies that may not be offered ever again, and that these efficiency gains could most likely not be funded out of normal farm cashflow. • Because of the modernisation of the whole scheme there was going to be a benefit for the wider community, especially with

	respect to the fact that, even in years of lower allocation, water will now be able to reach the farm gate. • There was an opportunity to make improvements to the Caroona farming system that would greatly improve the timing of water application and the management of irrigated crops, in turn resulting in improved water use efficiencies.

3. Post modernisation

What was the on-farm project?	• The surveying, modelling and designing of a water reservoir to capture tail- and storm-water and allow for the better timing of water application. • Purchase of lift pump, Rodney gates, pipes and fuel for earthmoving contractor. • Construct tailwater storage reservoir of approximately 200 megalitres and pump station, including building of catwalk and installation of Rodney gates and concrete structures. • Laser levelling of two irrigation blocks. • The design and installation of a stock and domestic water reticulation system, including the laying of approximately 5km of pipe underground, construction of a 100 000 litre water tank and the installation of six water troughs on Caroona.
When was it completed?	The Caroona modernisation project was completed in mid 2013 and was inspected by Vanguard Business Services on 15 November 2013.
What are the benefits to the business since project completion?	• Ability to capture tail- and storm-water, re-use tail-water and keep it on-farm allows for greatly reduced wastage of water and better business planning. • Given that water must be ordered 10 days prior to using it, having a storage allows for better timing of water application if weather events change the crops' water requirements or there is a breakdown in the farming operations. This reduces wastage and saves money. • Scheme modernisation now provides security of water delivery and this allows for improved business planning. • Security of water delivery ensures that irrigated crops can be finished off and therefore improves crop yields. • The modernisation of the TNSDS allows for the delivery of fresh water to an increased number of stock watering points. • Improved quality of water leads to better health of livestock.
Are there any wider benefits to be seen beyond the farm?	Definitely. The lining of the channel means that water can now be used in low allocation years. Previously, in low allocation years no irrigated crops were grown. Now water can be utilised and become productive even in years of low allocation. This benefits all businesses in the TNCL district.
What were the challenges experienced?	Prior to the Scheme modernisation, it was very difficult to schedule water delivery and take into account changes in the weather and rainfall. Now it is much easier to utilise all water efficiently without

	waste. Water management is now a lot easier and some flexibility is possible. When this is taken into account over a whole growing season, it could perhaps save one watering altogether.

4. Other comments

Are there any other benefits/costs?	The two laser levelled blocks have not been irrigated yet but water will be saved when this happens.
What does the future seem to hold?	The future right now appears pretty bleak without a current water allocation, however if it does increase we will be able to effectively and efficiently manage and use the water that does get to the property. This benefit is widely Scheme related and not just particular to Caroona.

5. Photos

Figure 1: Caroona tail water storage with catwalk in foreground

Figure 2: Proponent Kim Russ at the Caroona tail water pump station showing Rodney gates and concrete structures

Figure 3: Round concrete stock water trough on Caroona

Figure 4: Rectangular concrete stock water trough on Caroona

Figure 5s: 100 000 litre storage tank installed on Caroona

5.6 Green Zone Case Study – MS & M Noonan: "Braeburn"

"The future holds flexibility! This is so important because farmers can see the potential within their business and an improvement in business outcomes. This will build morale and keep the community healthy." Michael and Marieanne Noonan.

Winners of the 2014 Chesterfield Farm of the Year Award at the Macquarie Cotton Growers' Association Awards – Michael, John and Marieanne Noonan.

1. **Background to Farm/Proponent**

Farm name	Braeburn
Farm size	2 130 hectares
Water traded	521 megalitres
Farm location	30km south of Nevertire
Enterprises prior to modernisation	Cattle, cotton, dryland winter crops
Area of irrigation prior to modernisation	Approx. 947 hectares
Area of irrigation after modernisation	Approx. 750 hectares
Enterprises after Modernisation	Cattle, cotton, dryland winter crops, irrigated wheat, potential for irrigated summer crops
How long has farm been owned	Since 1987 -28 years
Funding for on-farm project	$1 615 750
Cost of on-farm project	$1 634 533

2. Pre modernisation

Challenges about the irrigation enterprise	• Restrictions to Macquarie Valley water allocations • Scheme water losses averaging 30% • Uncertainty of delivery • Scheme running costs (O & M)
Typical cotton yields and water use efficiency	Typical yields were 10-12 bales/hectare, using a minimum of 10ML/hectare of water
Why become involved in the modernisation project?	Water allocations and delivery were becoming uncertain and unreliable due to changing government decisions and policies that restricted the use of water for irrigation purposes. Drought just exacerbated this matter. An opportunity to improve water delivery and water use efficiencies had to be embraced.

3. Post modernisation

What was the on-farm project?	• The installation of three end feed linear move irrigators. • The construction of two supply channels to provide the water supply to the linear move irrigators. • Significant surveying and farm mapping to plan the placement of the irrigators and earthworks. • Significant laser levelling of fields under the irrigators to increase water use efficiencies. • Construction and placement of irrigation gates, pipes and pumps to enable efficient water management on farm. • The design and installation of a stock and domestic water reticulation system, including the laying of approximately 9.3km of pipe underground, the construction of two zincalume water tanks with capacity of approximately 234 000litres and 104 000 litres of water respectively, and the installation of a further two in-field poly tanks and 14 water troughs, two being “cup and saucer” tank/trough combos, the others being concrete.
When was it completed?	The Braeburn modernisation project was completed in two stages. Stage 1 comprised the construction and commissioning of one linear move irrigator and its associated surveying, earthworks and laser levelling. This work was completed towards the end of 2011 and was inspected on 30 May 2012. Stage 2 involved the construction and commissioning of two more end feed linear move irrigators and their associated surveying, earthworks and laser levelling. Stage 2 also included the installation of the stock and domestic water system. The commissioning of the two irrigators was completed in November 2012 and was inspected by Vanguard Business Services on 5 February 2013. The remaining earthworks and stock and domestic system was completed by August 2013 and was inspected by Vanguard Business Services 15 November 2013.
What are the benefits to the business since project completion?	• Security of water delivery ensuring irrigated crops can be finished off. • Security of water delivery allowing for better business planning. • Improved measure of water application. • Better monitoring of moisture requirements due to soil moisture

	probes. • The delivery of fresh water to an increased number of stock watering points, as well as the storage of water in tanks to provide backup. • Improved quality of water leads to better health of livestock. • Reduced labour input due to elimination of flood irrigation.
Are there any wider benefits to be seen beyond the farm?	The modernisation of the TNIS and the lining of the channels has helped the whole district by providing water security. The security of the delivery of water has flowed throughout the whole Trangie-Nevertire community because an element of certainty has returned to the farming sector. This certainty has encouraged people to remain in the district because of the improvement in job and work prospects. A benefit also seems to be evident whereby agronomists can use the TNIS proponents' on-farm projects to carry out industry research to help improve best-practice methods and identify efficient water use factors.
What were the challenges experienced?	A number of challenges have been experienced, due mainly to the need to adapt farming techniques to enable the efficient and effective use of the lateral move irrigators. For example, learning and understanding how to best operate the irrigators and what is the optimum moisture profile to maintain while irrigating via a lateral move irrigator, as opposed to using flood irrigation methods. Some changes have had to be made to farming practices under the irrigators, such as retaining wheat stubble prior to growing cotton.

4. Other comments

Are there any other benefits/costs?	The running of the irrigators requires significant power input, either by way of electricity or diesel. Due to the elimination of flood irrigation Michael and John Noonan are gaining weight due to the fact that they don't have to manually change siphons any more…….
Are there any unexpected benefits/costs as a result of these changes?	An unexpected benefit to the Braeburn irrigated cotton enterprise was the winning of the 2014 Chesterfield Farm of the Year at the Macquarie Cotton Growers' Association Annual Awards this year. They were recognised for being the farm in the Macquarie Valley that grew the highest average yielding cotton crop.
What does the future seem to hold?	The future now appears to hold flexibility. With more efficient water use, certainty of delivery and the ability to deliver water in years of low allocation, there is the potential to grow different crops in the district as well as finish off dryland crops with water that would have otherwise not been used, and this all goes back into the bottom line for farmers' profitability and water use efficiencies. Having this potential in the farming business is important because it leads to improved outcomes and increases the morale of the farming community.

5. Photos:

Figure 14: Proponent Michael Noonan with end feed linear move irrigator #1

Figure 15: End feed linear move irrigator #1 showing suction cart and supply channel

Figure 16: End feed linear move irrigators 2 and 3 showing new supply channel

Figure 17: Supply channel for irrigators 2 and 3 showing example of concrete structure in channel

Figure 18: John Noonan with irrigator 2 in the background