NATIONAL PROGRAM FOR
Sustainable Irrigation

THE NATIONAL PROGRAM FOR SUSTAINABLE IRRIGATION

A STRATEGIC R&D ALLIANCE FOR IRRIGATION IN AUSTRALIA

NOVEMBER 2010 PROGRESS OF PHASE 2

What is the National Program for Sustainable Irrigation and what did it set out to achieve?

The National Program for Sustainable Irrigation (NPSI) is a partnership of: the Australian Government Department of Sustainability Environment, Water, Population and Communities ; Cotton Research & Development Corporation; Gascoyne Water Co-operative; Goulburn-Murray Rural Water Corporation; Grains Research & Development Corporation; Harvey Water; Horticulture Australia Limited; Lower Murray Water; Ord Irrigation Co-operative; South Australian Research and Development Institute; Sugar Research & Development Corporation; SunWater, and the Western Australia Department of Water.

The Strategic Plan (2008-10) stated that the vision for the National Program for Sustainable Irrigation (NPSI) was … *"Australian irrigation that is valued for its environmental, economic and social contribution."* And the mission was determined to be *"investment in research, development and its adoption to improve the productivity and sustainability of irrigation in Australia".*

The National Program for Sustainable Irrigation set out to:

- provide national leadership for irrigation research and innovation
- generate new knowledge and promote its adoption
- contribute high quality science to the modernising of irrigation and its sustainability
- contribute to the capacity of people to adapt, innovate and make better decisions
- invest in the skills and knowledge of the irrigation community
- enhance collaboration between industry and implementation with high quality science; and
- enhance the global competitiveness and natural resource management of Australian irrigation.

These aims have been pursued through scientific innovation and excellence, compilation and extension of knowledge ready for adoption, collaboration across the irrigation industries, and a commitment to sustainable irrigation industries, communities and management of natural resources.

Along with these aims the NPSI program was established to improve water use efficiency and to enhance the capacity of producers to respond to changing levels of resource availability. It has also addressed environmental issues, mechanisms for practice change and the need for a skilled human resource base and strong research and development partnerships. These matters are formalised as *Goal 1 – Sustainable production in a water scarce environment, Goal 2 – Sustainable futures and the environment, Goal 3 – Knowledge into practice and Goal 4 – Research and development leadership.*

This update outlines key examples of progress against the four goals. A selection of projects is reported to demonstrate the effectiveness of NPSI to September 2010 – and to show how NPSI fulfils it mandate – "New Ideas for Irrigation".

What's going on in NPSI now?

Over the life of NPSI Phase Two, 31 projects were approved. Of these, 12 have been completed and 19 are continuing with various completion dates. In consultation with partners, it was agreed that NPSI would formally continue until 30 June 2011.

Total planned expenditure for Phase Two is $7.2 million during 2008-2011. During the final year of Phase Two, 2010-2011, the planned investment is $1.1 m.

At an organisational level, there are several key areas that NPSI has directly influenced during late 2009 and 2010.

In terms of taking a leadership role in support of its partners, NPSI and Irrigation Australia Limited developed a *Future Vision and Options for Irrigation Research, Development and Extension Report* that was released in May 2010. The report outlined a framework for future irrigation research, development and extension in Australia, consisting of a vision, priorities, implementation options and immediate actions. The framework will aid the forward planning of delivery of research results for the industry and has assisted industry input to the various reviews considering research management during 2010.

This initiative is particularly important given that there is no proposal for a national irrigation research and extension organisation following the cessation of the CRC for Irrigation Futures (in June 2010) and NPSI (in June 2011). In addition to the "balanced portfolio" of ten priorities that need to be addressed over the next ten years, the strategy defined an implementation plan of four options to improve the resourcing of future irrigation research and identified a recommended option of an Enduring Joint Venture.

NPSI's active involvement in the "Primary Industries Standing Committee Cross Sector Water Use In Agriculture Strategy" has included representation on the working group. This together with a role in the Council Of Australian Governments Water Research and Knowledge Strategy, and supporting the Horticulture Water Initiative, plus communications with the Department of Agriculture Fisheries and Forestry Rural R&D Council, is part of NPSI's role in presenting cross sector interests to the national R&D reviews and to key partners and organisations.

NPSI recently convened a meeting of all the Rural Research and Development Corporations to discuss cross sector water R&D priorities and made a presentation to the Council of Rural Research & Development Corporations in October 2010 which resulted in improved understanding and direction for cross sector R&D industry opportunities. The Rural Research and Development Inquiry of the Productivity Commission, which presented its draft report on 23 September 2010, potentially has an effect on all rural research in Australia with particular reference to a number of the NPSI partners.

In common with a number of other rural sectors, NPSI has recognised the need for increases in the skilled human resource base available to the irrigation industry. As a result a range of initiatives are underway including undergraduate student summer scholarships, travel fellowships for industry personnel, and industry information sessions.

NPSI continues to strengthen links and mutual opportunities with Irrigation Australia including continued conference support during 2011, a travel fellowship and publication of their "drip irrigation bible" which is co funded by DEWHA.

In November 2010 NPSI is launching a major new communication initiative. NPSI, Irrigation Australia and Rural Press plan to stage several newsworthy irrigation meetings that will be held in regional areas. It is planned to explore RD&E knowledge opportunities through these forums and "Irrigation modernisation RD&E" is proposed as the first topic. Rural Press will support this initiative by providing structured media coverage.

NPSI projects continue to target R&D adoption to improve the productivity and sustainability of irrigation in Australia.

Goal 1: Sustainable production in a water scarce environment

The Outcome sought by Goal 1 is … *Improved irrigation water use efficiency and enhanced ability to respond to changing levels of resource availability over time.*

Many of the NPSI projects contributed to this Goal. Examples include:

The *Soil Management For Australian Irrigated Agriculture Project* directed by Dr Bruce Cockroft in the Goulburn Murray Water region recognises that irrigated agriculture performs well below potential due to poor soil – as Australian soils deteriorate rapidly when put under crops through soil hardening related issues. To address this problem the essential two issues to be resolved are the need for high soil organic matter and high biological activity (fungi, bacteria, other micro-organisms and roots, especially very fine roots and root hairs). This is normally unachievable in agriculture because organic matter added to irrigated soil is quickly consumed by earthworms, and other fauna and fungi, and because the beneficial biological agents cannot build up in our difficult soils.

The project studied the use of rye grass whose roots have a unique effect on the structure of soils. The researchers aimed to understand and document what rye grass is doing to the soil, providing direction to what should be done in the field. This has been a significant advance and, according to Dr Cockroft *"it has resulted in a giant leap made possible by NPSI funding".*

Three commercial irrigation orchards have been using the technology and, according to the research, are very close to having super soil status. These growers are considered the best and most influential. The project has recently run three field days with about ten growers attending each. Reports from the field work and supporting analyses are also sent to 50 growers who have been involved in the field work at some level every three months. It was noted that word of mouth was very effective – *three years ago there was no rye being used in orchards – now it is evident in every orchard.* Three quarters of irrigation farms were described as using the previous system and it is envisaged that the new improved system will rapidly be taken up across the irrigated industries.

The gains made in managing soil structure in this project are seen to be applicable to all major irrigated corps and pasture (except rice). Benefits include increased yields, cheaper and simpler orchard and row crop soil management, reduced water use per tonne of plant product, improved soil, high carbon sequestration (soil organic carbon increase from 1% to 4%) and improved knowledge of soil management.

The solution: ryegrass keeps the soil loose, soft and porous in perpetuity

The new ryegrass based system in the orchard in the Goulburn Valley, Vic.

The *Root Zone Water, Salinity and Nutrient Management Under Precision Irrigation Project* managed by Dr Tapas Biswas and Dr Gerrit Schrale of SARDI focused on changing awareness of what good water and salt management involves. The aim was for local irrigators and the community to better understand the need to actively monitor and manage root zone salinity, in addition to achieving high water use efficiency. The particular focus is on avoiding salinity build up at the root zone at times of limited water availability.

The project has provided tools and techniques, including the SoluSAMPLER™ soil water salinity monitoring tool, to enable irrigators to easily monitor and manage salinity throughout most of the growing season. Irrigators who previously used only soil testing to identify salinity, had little or no basis to use this information in a management sense. This new technique of irrigated crop salinity management may become most useful to the Lower Murray Basin growers in the approaching season when the river water salinity can be expected to spike drastically caused by the mobilisation of large amounts of salt accumulated in the geological strata adjacent to the river during the drought years.

There are now about 200 trained growers from Sunraysia, Riverland, Lower Lakes and South-East of South Australia who are aware of the salinity threats and its active management in irrigated horticulture. The project contributed to national irrigation capacity building by producing five university graduates with Honors and Masters Degree awards related to irrigation and salinity management.

Key cooperating growers involved in the project have now adopted active monitoring and management of salinity on commercial plantings on their properties, leading to increased production and economic returns. Salinity management workshops for irrigators were implemented by the SAMDB NRM Board as part of a larger on-going training program for better irrigation management, seeking incorporation of initial awareness of on-farm salinity management being firmly incorporated into future irrigation management. This is expected to lead to district-wide economic and environmental benefits of reduced root-zone salinity as more irrigators attend training.

The project has resulted in new thinking by water regulators that will assist irrigators in implementing better salinity management. For example one group is considering the use of carry-over water allocations for winter leaching, to reduce salinity levels below individual crop target thresholds. By better understanding root-zone salinity build-up the Board now realises that a blanket level of water use efficiency across it's area is no longer appropriate, and this will be reflected in future water regulations.

The project has had an influence well beyond the original project area with results extended across the nation and through international conferences. Approximately 2000 SoluSAMPLER™ units have been in use nationally, and are now being commercially promoted in 33 countries.

Finniss River grape grower Tony Brook using the soil water salinity monitoring tool in South Australia with Dr Tapas Biswas SARDI and Michael Cutting SA MDBNRM

The key outcomes of the *Managing Soil Salinity for Wine Quality in Groundwater Irrigated Vineyards Project* led by Rob Stevens of SARDI, is seeking to develop strategies to adapt wine grape production systems to the prevailing soil and climatic conditions, groundwater flow and quality regimes and irrigation technology to achieve premium wines that meet world food health standards and ensure export growth. The progress in terms of the key project elements has been:

- Managing supplementary saline irrigation – reporting on experimental findings regarding new vineyard soil management practices for managing rootzone salinity and soil structure has been via conferences used to inform the wider scientific community and through research papers.

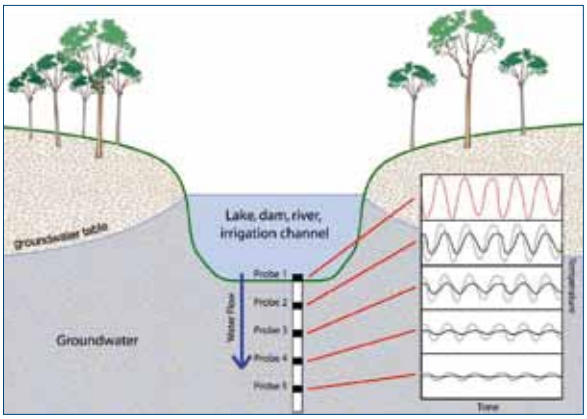
- Determining rate of soil decline – reports on findings regarding changes in soil physical properties as a consequence of 10 years of saline irrigation have occurred to the researcher community.
- Establishing regional salinity trends – reporting on the regional trends in soil and fruit salinity has been undertaken directly to project networks and local growers via seminars.
- Model root zone salinisation – further improvements have occurred on the hydro geological model for Padthaway prescribed Wells Area.
- Rootstock salinity tolerance assessment – technical findings have been publicised in technical press and at the Australian Wine Industry Technical Conference through scientific papers.

The *Groundwater and Surface Water Interactions in the South West of Western Australia; Implications for Water Planning and Licensing Project* managed by Fionnuala Hannon, GHD in Bunbury, undertook investigations into surface and groundwater interactions in the Wilyabrup and WarrenPemberton agricultural regions of south west Western Australia. This work demonstrated a methodology that may be readily applied in Western Australia, where interactions between surface and groundwater are less understood – in order to consider the implications of the findings on water planning and allocation. Field assessments, geomorphological assessment, soils and geological assessment from spatial interrogation of data, hydrologic and hydrogeological assessment from available data, baseflow assessment of surface water flow data and a water balance assessment were used to identify water partitioning at a catchment scale, based predominately on landuse.

The results from these assessments *described both the surface water and groundwater status for these catchments and an indication of their interactions.* The investigations concluded that both catchments are surface water driven watersheds, caused largely by the prevalence of duplex soils throughout the region. This was supported by the baseflow assessment, which identified baseflow contributions to total annual streamflow at both catchments ranging from 0 – 3 per cent. It was the opinion of the team that *interflow was a significant hydrologic process contributing to streamflow.* Interflow is currently interpreted as groundwater but is formally classified as surface water. The outcome of this work has implications for water planning and allocation, in that the existing allocation limits for both groundwater and surface water may need to be reviewed.

A project titled *A Tool for Measuring Water Exchange Using Heat as a Tracer*, managed by Martin S. Andersen of UNSW is jointly funded by NPSI and the National Water Commission. The project has developed and tested a novel tool using temperature data to measure water seepage from streams to groundwater aquifers. The methodology can potentially be used for streams, rivers, lakes, irrigation channels, and storage dams.

Rob Stevens, SARDI maintaining experimental sites. The plastic covers are for rain exclusion.



Schematic of the field tool installed in the sediment of a surface water body showing the change in temperature signals over time and depth, the surface water body (red), the sediment with larger downward flow (grey) and smaller downward flow (black).

The tool successfully records a profile of the natural daily temperature variations in streambeds needed for the estimation of water exchange rates. This work illustrates how surface water and sediment temperature data can be used to measure the vertical velocity of water flow. It can therefore be used to quantify the water loss from, or gain to, surface water bodies. As such the tool can be used to gain much needed field data for sustainable water management from the farm to the catchment scale.

Installation of the temperature array in the streambed

GPS positioning of arrays

Progress against Goal 1 … *Sustainable production in a water scarce environment*

In its formal report to NPSI, QualDATA summarised NPSI's achievements this way:

Projects have focused on upgrading irrigation infrastructure and its management (including centre pivot irrigation, precision irrigation trends and channel management), improved decision tools (risk management and fertigation), improved practices (soil, hydroponics, water aeration and solutes management) plus development and management of regional strategies.

Upgrading irrigation infrastructure: The project outcomes to-date include examples of irrigators auditing centre pivots with a view to upgrading and potentially improve WUE by 25%. There are potential benefits from collecting and collating information for effective and efficient precision irrigation and for water authorities to use 'best management practice' to reduce evaporation from channels.

Improved decision tools: Project outcomes have also included potential benefit from the development and testing of decision support tools to improve irrigation business decision-making and reduce risk. For example, 32 citrus producers and agribusiness participants over three workshops in Riverina, Sunraysia and Riverina reported benefits from the SoluSAMPLER™ tools presented to them for review in reducing water and fertiliser costs (one estimating $10,000 potential savings).

Improved practices: Potential benefits from projects included reducing salinity under vines and improving wine quality. There are indications that irrigators in the citrus and almond industries have used and benefited from the Cost Calculator and associated information packs. Potential improvements have occurred to support irrigation through soil aeration and use of rye grass with potential resultant improvement in yield and quality of irrigated crops. There are expected to be potential improvements to solute management on irrigated farms – through training of key personnel through development of a Masterclass module and further development of a Probe by the private sector as follow-on from a NPSI project.

Regional decision-making: There are expected to be future benefits from improved regional water management through improved understanding of decision-makers as a result of forums initiated by NPSI and through knowledge sharing of various management options including capacity sharing.

Goal 2: Sustainable futures and the environment

The outcome sought by Goal 2 is … *Reduced environmental impacts, more sustainable ecosystems and more prosperous communities.*

Many of the NPSI projects contributed to this goal.

The *Farm Dam Management Project* managed by Deborah Atkins of Irrigation Futures CRC drew together information from a range of research that farmers and advisors found to be very valuable. Farmers reported that they had not considered the information about water loss from farm dams in the past.

The project developed the "Dam Economic Ready Reckoner" software and integrated online tutorial which calculates an economic assessment of evaporation mitigation and a Farm Dam Management Resource Kit maintained by the National Centre for Engineering in Agriculture (NCEA). This tool was seen to be a highlight for the project in that it was able to show farmers what their water was worth.

The project brought together relevant experts to interact with farmers and their advisers through five workshops, three field days, media, conference displays and direct contact with the target audience. Over 240 people attended eight events held in Victoria and New South Wales. A key part of the project was to provide training to irrigation and agricultural advisors who can then provide this information to farm dam managers. Advisors made up about half of the audience at workshops and field days. While there was strong engagement with CRC Irrigation Future partners and Growcom, it was noted that there could have been improved levels of involvement of extension officers, consultants and NRM groups through better targeting to ensure that the messages from the project were distributed more widely.

A Farm Dam Management website http://farmdammanagement.ncea.biz has been developed where information on farm dam management and the online calculator is hosted. This is now managed by National Centre for Engineering in Agriculture. Fact sheets, links, reports, posters, five case studies and brochures were developed on dam evaporation and seepage management and biodiversity.

The specific use of the Ready Reckoner http://www.readyreckoner.ncea.biz and the website indicates an *increased level of interest and follow up with extension staff* who were involved with the project and who could provide information about uptake of project outputs. The project has improved the quality of advice available to farm managers from advisors and consultants working in all horticultural, livestock and cropping industries.

Seepage and evaporation mitigation measures in place on a farm dam

Farmers and advisors at a farm dam workshop

The *Long Term Sustainability of Precision Irrigation Project* managed by Dr Rob Murray, University of Adelaide, co-funded by the Grape and Wine Research and Development Corporation, investigated concerns about the sustainability of drip irrigation in irrigated vineyards in Australia. These concerns recognised that the extensive adoption of drip irrigation conserves water but the concentrated nature of its application was believed to cause serious soil structural decline directly under drippers. This project aimed to identify such decline under drippers in Barossa Valley vineyards, to establish the causes of the decline and to suggest management and monitoring strategies to deal with the problem.

While there was no evidence of any preferential subsoil structural decline under drippers, it was noted that all the subsoils examined were of such generally poor structure that there was little prospect of further decline. Recognising that application rates in the Barossa Valley are dwarfed by those used elsewhere, their investigation was expanded to the finer-textured soils of Sunraysia and the Murrumbidgee Irrigation Area (M.I.A.). Results were no different and it became clear that the structural status of subsoils in vineyards is generally poor and is probably undermining good water use efficiency by vines. In 22 distinct soils air-filled porosities were universally very low, resistance to root penetration was high and infiltration rates were frequently poor. A comparison of root length density with subsoil structural properties strongly suggests that poor aeration poses the chief limitation on root proliferation and water use efficiency.

There are few strategies available for subsoil structural improvement in the vine row, including the application of Gypsum when applied to a red-brown earth. Other strategies trialled during the project failed to improve subsoil structure.

It was concluded that these are inherently poor subsoils and there is a clear need for greatly improved preparation procedures ahead of new plantings. There is a need for changes in the management of existing vineyards if efficiency of water use is to be improved. The researchers concluded that these will necessarily include modified traffic, soil mounding and the use of calcium, mulching and cover crops in the vine row. It was also concluded that the recommendations of Bruce Cockroft for the stone fruit industry seem just as relevant to viticulture but have not been demonstrated or adopted. In their review of soil properties in relation to vine performance, Lanyon et al. (2004) have also recommended that much closer attention be paid to soil preparation and management in vineyards.

The project resulted in a series of conference presentations and papers and posters; presentations at four research forums/workshops/symposia; three magazine and newspapers interviews; one radio interview; two workshops; four presentations at NPSI investor/partner forums; eight NPSI publications; a range of informal grower talks and regular formal presentations to the Project Steering Committee. While the project concluded in mid-2010, further activities have included: a presentation to the "Grape to Graze" tour after the 19th World Congress of Soil Science Congress in August, three presentations and discussions with large grower groups, further magazine articles and a letter to project participant growers to advise them of project observations in their vineyards and their implications. Data is being assembled for three manuscripts to be submitted to *The Australian Journal of Soil Research* A set of grower guidelines has also been prepared and reviewed by a grower committee and can be found on (http://www.npsi.gov.au/).

Infiltration rate measurement (clockwise from top left): a subsoil surface prepared for measurement, levelled permeameter in place ready to commence measurement, simultaneous measurements underway directly beneath and mid-way between well-spaced (2 metres) drippers.

From the *Optimising Delivery and Benefits of Aerated Irrigation Water Project* managed by Professor David Midmore and Dr Suyra Bhattarai of Central Queensland University, a training system and decision support tools are being prepared to *support implementation of oxygation in perennial crops across a range of industries* in QLD, NSW and SA. These aim to increase crop yield and quality by overcoming root oxygen starvation caused by challenging irrigation situations. Trials being undertaken in the range of sites has not only confirmed understanding of oxygation, they have served as a focus for a range of crop consultants, growers, researchers and industry personnel to better understand the merits of oxygation through *use of a range of communication processes*. These include a training manual, a website, personal interactions from the research team to key informants to disseminate the information and published materials in scientific settings, both in Australia and internationally, as well as an oxygation calculator.

Pineapple field with randomized oxygation treatments

Mazzei venturi aeration apparatus

The *Channel Evaporative Mitigation Project*, managed by Michelle Winter and Bruce Albrecht of Goulburn Murray Water, is focussed on achieving significant reductions in evaporative losses from channels and supporting increased adoption of new practices by irrigation channel managers. Such reductions will result in considerable financial and water savings thereby benefiting water authorities and companies that manage irrigation channels, as well as satisfying environmental, urban and other demands.

The project proponents, Goulburn-Murray Water, estimate the benefit to the national water industry to be five to ten times the savings expected in the Goulburn-Murray Water Irrigation District , which they consider to be close to 60 GL/ year and $118.5 million over storages, channels and farm storages. In addition it will lead to improved measurement of evaporation losses and greater certainty regarding managing losses, which is currently an issue in water savings projects.

Currently the project is investigating the monitoring and characterisation of the channels in itsdistrict for evaporation levels and considering the environmental risks. Trials will also commence to assess the impact of monolayers on evaporation.

The *New Technologies to Reduce Evaporation from Large Water Storages Project*, led by Professor David Solomon and Dr Emma Prime CRC Polymers, has been developing chemical evaporation suppressants to apply to stored water for reducing evaporation. The developed suppressants substantially outperform commercial products of this type in laboratory tests. They are currently being evaluated in field trials on progressively larger water storages, in conjunction with commercial partner Orica. The project is planning for *commercial release of an evaporation control system in late 2011.* The project is co funded by the National Water Commission.

Progress against Goal 2 … *Sustainable Futures and the Environment*

In its formal report to NPSI, QualDATA summarised NPSI's achievements this way:

Projects have focused on improved management of water storages (including rationalising carryover rights and water sharing, improved farm dam management and improved understanding of surface-groundwater interaction), improved soil management (precision irrigation and root zone management) and biodiversity.

Improved management of water storages: There are expected to be potential benefits through the future use of capacity sharing rather than carry-over rights This concept has been taken up in Queensland with interest from other authorities. There is potential benefit from reduced evaporation from farm dams as a result of new information and development of an On-Line Calculator.

Heat as a tracer, which has resulted from work in the project, *Quantifying Surface Water – Groundwater Exchange Using Thermal and Chemical Measurements*, managed by Prof Ian Acworth and Dr Martin Anderson, UNSW, has been used to quantify surface-groundwater interaction. This technology has now been incorporated into the National Centre for Groundwater Research and Training (NCGRT) as the focus of a sub program with participants at a specific forum on the topic rating the value of this work highly. It provided a basis for a PhD scholarship (Gabriel Rau) and has resulted in a prototype temperature array being tested. In addition it supported significant engagement with the National Water Commission and NSW state government water policy development.

Improved soil management: There are potential benefits from increased knowledge on how to improve sub-soil structure in vineyards, citrus orchards, stone fruit orchards as well as from improved approaches to managing root zone drainage, salt and nutrients.

Improved management for biodiversity: There are expected to be benefits from an improved understanding of how irrigation practice affects biodiversity, through the development of broad principles. These originate from work commenced in the Riverina which is applicable to other irrigation regions and are expected to be applicable at the farm, supplier and policy levels. Collection and analysis of data is occurring as a result of interactions with landholders and irrigation company staff. They are helping define how watering of remnant vegetation could best fit with the use of water for production under a range of scenarios. Information is currently being compiled on different ways irrigation water can be used for crops under differing levels of water availability. This has implications both for the amount of water used and the timing of delivery, which in turn has implications for delivery of water for biodiversity needs. Interviews and workshops are currently occurring between the project personnel and key stakeholders that have identified some opportunities while raising questions for further investigation regarding appropriate management programs.

Improved water quality and salinity management: The NPSI projects are leading to improved water quality in catchments. Improved salinity management by irrigators has been a major focus of activity.

Goal 3: Knowledge into practice

The Outcome sought by Goal 3 is … *Improved skills, knowledge and decision making of end users which leads to practice change, and more efficient and sustainable use and management of water.*

NPSI at the program level has supported the distribution of information in a range of ways.

The NPSI website www.npsi.gov.au operates as the program's major public information access point supported by the recent Irrigation Essentials Magazine www.npsi.gov.au/products/npsi1090 . These sites support others in the industry, as reported by Rob Palamountain, South East Natural Resources Management Board, Mount Gambier on 24 September 2010 … *"During recent internet searches, as part of the development of a locally relevant irrigation information database for the South East of South Australia, I have found information on the NPSI website to be particularly pertinent. As such, please be advised that the web module I am developing will incorporate links to this website."*

NPSI posted a quarterly four page newsletter to stakeholders to keep them informed of project outcomes. In the last 12 months, NPSI has adopted a new strategy and commenced an Irrigation Essentials e-news publication to stakeholders on its mailing list, which continues to grow. The list includes irrigators, water organisations, government agencies, community groups etc. In addition, a Partner's Update is sent to the NPSI Partner representative at the end of each month.

News items are posted on the web site and have been distributed on average every fortnight during 2009/10 http://www.npsi.gov.au/national-program-sustainable-irrigation/news.

A team was commissioned to 'harvest' the information and insights from across the breadth of NPSI and predecessor irrigation research spanning nearly two decades through the NPSI Knowledge Harvest Project. The harvest process was completed in late 2009. It addressed the three key areas of: supporting Effective Communication and Extension of NPSI outcomes (mainly from Phase 1) by considering the main products and delivery mechanisms that were best used including any key events and case studies of success.) ; Market Research including relevant reports on 'market segments' or unique features about the defined target markets; known R&D gaps, and canvassing Irrigators main current knowledge needs, plus defining Key Contacts such as people and organisations to consult in future.

The four key themes and the eight associated products were:

1. Irrigation Overview – facts, figures and key concepts about irrigation.

- Vital role for Australian irrigation project
- Irrigation in Australia: Facts and figures project
- Planning tools: Future scenarios and ecological risk assessments project
- Water use efficiency project

2. Water Delivery Systems – the efficient storage and distribution of water for irrigation.

- Modernisation: Enhancing water supply systems project
- Modernising Irrigation Forum DVD

3. On-farm Irrigation Essentials – principles for efficient irrigation.

- Irrigation Essentials: Research and innovation for Australian irrigators

4. Recycled Water – recycling treated effluent and stormwater for irrigation

- Using recycled water for irrigation project

Two examples of significant Knowledge Harvest events were the Modernisation Forum, which was a significant communication event of key Australian water supplier representatives. Also the Irrigation Essentials event presented information from a workshop of key researchers and providers aligned with the regular Irrigation Essentials publication.

It was concluded that the Knowledge Harvest has been successful in:

- developing an overall 'story' for the NPSI program
- collating and synthesising information from an array of individual projects
- developing and presenting useful guidelines and concepts in an informative manner
- generating a range of products (events, a DVD, web downloads, fact-sheets and hard-copy reports) tailored to the needs of different audiences (that were identified through market research), and
- supporting the distribution of products, through the preparation of media releases and mailing lists (e.g. to tertiary institutions with an expressed interest in irrigation topics).

It is noteworthy that the overall evaluation findings demonstrate the importance of providing researchers with support to maximise the delivery of their NPSI R&D outcomes to target markets. This is in alignment with the findings reported across the Australian RD&E sector (see the QualDATA National RD&E Survey findings August 2010, unpublished, covering the RDC and CRC sector).

Where appropriate, projects have Published Findings in refereed scientific journals which has contributed to the availability of high quality science relevant to industry modernisation and sustainability. This continues to contribute to the knowledge of the irrigation research sector and in turn can be passed on to those who directly advise irrigators.

A number of cross organisation programs exist and include the Horticulture Water Initiative with which NPSI has collaborated on many projects.

The Water Smart Cotton and Grains Project is another example of this two-way flow of information due to its focus on improving the efficiency of both cotton and grains systems through measuring and benchmarking cotton and grain crop water use on farms. Another project funded by the GRDC aims to provide growers with best-practice guidance on how to integrate traditional irrigated rice and cotton production with irrigated and rain-fed grain crops.

Pictured at Moree in January 2010 are, from left: Bruce Finney (Executive Director of the Cotton R&D Corporation); Minister of Agriculture, Fisheries and Forestry, Hon Tony Burke; Guy Roth NPSI Coordinator; and Keytah farm manager and NPSI PMC member Andrew Parkes.

On 21 January 2010 the Federal Minister for Agriculture, Fisheries and Forestry Hon Tony Burke launched the NPSI Knowledge harvest report known as ***Irrigation Essentials.*** The document covers irrigation enterprise establishment and management, irrigation methods, business management, creating a water budget, scheduling and monitoring, agronomy and soil considerations, and other topics.

Communications Manager, Tony Clancy who worked with LWA and very familiar with NPSI, works 1-day per week with NPSI assuring NPSI of continuity in its industry communications. He has worked on a range of specific media focussed news stories including articles on; the Central Irrigation Trust, Barmera, focusing on infrastructure modernisation; a cherry grower from Barmera addressing orchard floor management to aid soil/water functioning; a grape grower from Winkie (near Berri) covering filtration/re-use of water for irrigation; irrigation efficiency in the almond industry focussing on 480ha at Century Orchards near Loxton, SA; linking high quality production with availability / management of water at Lowana Stonefruits, Renmark, SA; in Lower Murray Water, Mildura, a story on modernisation of infrastructure; another covering the links between irrigation efficiency and drip maintenance at Irymple, via a site managed by Victorian DPI; at Red Cliffs a citrus grower who is reducing water use using precise timing of their irrigation / fertigation process; and at Robinvale where table grape growers are taking advantage of a system upgrade to implement a best practice program.

The *Upskilling Water Managers Project*, managed by John Shannon, is a NPSI collaboration with the West Australian Vegetable Growers Association Inc. The project aims to support Association members to fine tune their water management through use of the Vegetable Irrigation Scheduling System or VISS, which was developed by Department of Agriculture and Food Western Australia. VISS determines water application rates based on three factors – the Crop Growth Factor (relevant to the particular vegetable crop), local evaporation rates and soil type.

The project was launched in September 2010 with information in the industry's quarterly magazine and a seminar in Bunbury. Other events are being organised. A substantial part of the project is daily face-to-face extension work being undertaken by Charlotte Butler, a recently appointed Field Extension Officer, who supports growers' use and application of VISS. While the program has only recently commenced, encouraging results have been achieved to-date, particularly given that WA has experienced its second driest winter on record.

A number of projects have been effective at generating new knowledge and promoting its adoption. To-date a range of projects have contributed to the capacity (building) of those in the industry to adapt, innovate and make better decisions.

Anthony Ivankovich –
Carrott grower, WA South West

The *Water Smart Cotton and Grains in NSW* project managed by Deb Slinger and Dr Janelle Montgomery NSW I&I and co funded by GRDC/CRDC, involved the training of 113 participants. There is significant evidence that it is successfully increasing capacity and stimulating practice change. This is demonstrated by these reports:

The majority of participants reported that they had a very limited understanding and knowledge of CPLM technologies before attending the workshop. Based on an assessment of the evaluation sheets all recorded a significant increase in their knowledge and understanding of CPLM technology and management (CPLM Evaluation).

This work helps consultants like myself make better decisions, which in turn benefits the productivity of growers. Farmers are notoriously poor self-evaluators (as a farmer's son I realise this first-hand). Benchmarking is a difficult concept to get across, but it does lead to better practice. (Consultant attendee)

It was reported that seven participants are likely to start benchmarking as a result of attending training at the Metering Workshop that resulted from this project.

The *Adaptive Learning Through Five Strands of Root Zone Knowledge* project, managed by Dr Richard Stirzaker, in a joint CRC Irrigation Futures and CSIRO project, involved linking existing grower and researcher knowledge to create new insights into irrigation management regarding soil solution sampling and soil moisture management through automated soil solution monitoring. Over 40 participants drawn from State agencies and private companies attended training programs, using those learnings, via Master Classes of participants, as part of the CRC Irrigation Futures "Solute Signatures" initiative.

Collaboration occurred with a private company, Measurement Engineering Australia (MEA), to develop a soil monitoring probe. While this relationship progressed well, the EC sensor did not reach the stage of a product for commercial release during the project due to the durability of the EC probe itself (the four platinum probes on the chip). The research team acknowledges some deficiencies in their collaborator farmer contact.

MEA sought replacement chips in order to keep the project going post-NPSI funding. MEA now plan to deploy probes at the Oxford Landings trial site where salinity work from several agencies is being coordinated. The data collected from initial trails relating to different irrigation and leaching strategies for vines at Oxford Landings was very promising and work is expected to be continued by CSIRO PI. This demonstrates a successful public-private collaboration.

NPSI financially supported two sugar industry personnel to attend the Master Classes in order to support cross-industry learning. Attendee Toni Anderson, Natural Resources and Production Extension Officer, BSES Limited reported … *'(this was a) perfect introduction to the soil solution monitoring, which really helped me with my new research project on water quality'.*

The *Increasing the Resilience of Eastern Australia Irrigated Farm Businesses* project managed by Daniel Rodriguez, QDEEDI, and funded by GRDC aims to provide farmers with best-practice guidance on how to manage the impact of increased climate variability and decreased reliability in water supply by assessing agronomic and business options presented under a range of irrigated and dryland/rainfed enterprise possibilities. The focus of the work is engage with farmers in discussions to improve use of a range of modelling tools such as the APSIM and APSFarm models (www.apsim.info), and simple farmer orientated tools like the Irrigation Optimiser (www.irrigatedcropping.blogspot.com), so it can be made more widely available to key stakeholders beyond the project life.

Initial farmer engagement to canvass whole farm management options has been very strong and *farmers have been prepared to consider confronting questions* regarding changed management options that are 'outside the norm'. Additional farmers have sought involvement in the project, particularly in SE Queensland, through new discussion focused groups. In the southern project area, some on-farm experimentation has been required to fine tune the inputs to the models being used.

While the project is half way through a number of advances have been made and lessons learned. These include the importance of allowing adequate time for famer interaction during workshops and interviews, as well as the lower than expected engagement of the private consultant sector. As a result there has been the need to establish additional farmer groups some of which have proved to be highly motivated. In addition there has been greater interest than expected by some in the *advisor sector* and further engagement is being sought during the second half of the project with larger data focussed organisations such as Bureau of Meteorology. Such links have significant potential to lead to greater longer term collaboration and sharing of data, information and learnings.

Workshop with Central Queensland grain farmers at Emerald

Summaries of other projects include:

- The Impact of Open Hydroponics Irrigation in the Citrus Industry managed by Dr Tapas Biswas, SARDI outcomes focused on this question 'Is it economic to up-grade from conventional fertigation to open hydroponics?' Observations were made on blocks of citrus irrigated using Open Hydroponics (also called Advanced Fertigation) and conventional fertigation. An economic model using Washington Navel oranges growing in the Sunraysia compared these options and resulting in production of an information booklet and CD on 'what if scenarios' of Open Hydroponic Systems. This is being field tested during late 2010.
- The Review of Precision Irrigation Technologies and Their Application project managed by Prof Rod Smith at USQ aimed to developing a framework to guide research, development and adoption of precision irrigation as part of a precision agricultural system. It was noted that support of decision making systems requires access to information and crop simulation type models that cover multi-dimensional issues that link to agronomic goals. It also covered the 'adoption limitations' and covered steps forward on these issues.
- The Knowledge and tools to Manage Fertigation Technologies in Highly Productive Citrus Orchards for Minimal Environmental Footprint project managed by Dr Michael Treeby, NSW I&I / SARDI has demonstrated strong collaboration with several other NPSI projects including the Solute Masterclass and Open Hydroponics project. During three workshops held in the Riverland, Sunraysia and Riverina at which a total of 32 citrus producers, agricultural suppliers and agronomists attended, feedback was provided on the particular value of providing the means to compare costs readily, map out programs on the basis of better estimates of needs and the trees' physiology, information on monitoring and evaluating fertiliser programs and comments on the need for research on irrigation/fertiliser effects under Australian conditions. One citrus producer identified approximately $10,000 of potential savings related to excessive rates of fertiliser being applied as a result of the workshop.

Citrus growers at one of the citrus fertigation workshops.

Progress against Goal 3 … *Knowledge into practice*

In its formal report to NPSI, QualDATA summarised NPSI's achievements this way:

While many projects are focusing on developing the research products and accompanying information, some are engaging irrigators, farmers, consultants and extension personnel in training. Some of these activities are captured under Outcomes 1 and 2. So far many people from various irrigation sectors have directly participated in training through NPSI projects with one project providing strong evidence of effects on capacity and practice intentions.

Similarly , in Outcome 4 a range of strategies is reported in which NPSI is facilitating communication and access to knowledge. A number of the strategic initiatives are reported under that outcome.

A range of publications, tools, training courses and materials continued information provision through the website, newsletters and general information including fact sheets, research bulletins and media releases.

Workshops: Of the 113 participants in Water Smart Cotton and Grains workshops many reported significant increases in their capacity to manage CPLM technology with indications that some irrigators intended to commence benchmarking to improve their practices over time.

Farm visits: Individual farm visits and on-farm trials and demonstrations are included in a number of projects.

It is noteworthy that more work is required to access data to obtain a true understanding of how knowledge is being put into practice and adopted by users. Over the remaining year of NPSI a robust approach to knowledge adoption would be beneficial to set up the program to demonstrate the extent to which knowledge is being adopted and put into practice.

A couple of examples of impacts recorded to date (capacity gains)

- 83 farmers, consultants and RDE staff trained in reducing evaporation from farm dams
- 32 citrus producers and agribusiness trained in the use of tools to reducing water and fertiliser costs
- 40 participants of Master class module on solute management
- 113 participants of Water Smart Cotton and Grains workshops with significant increases in their capacity to manage Centre Pivot / Lateral Move technology

Goal 4 – Research and development leadership

The goal of Outcome 4 is for NPSI to focus on … Research and Development Leadership. The outcome is to develop and take … *A national approach to irrigation related R&D in Australia, which includes a strong focus on a skilled human resource base and enhanced R&D capacity and collaboration.*

In common with a number of other rural sectors, NPSI has recognised the need for increases in the skilled human resource base available to the irrigation industry. As a result, each year it has offered summer scholarships valued at $6,000 each to encourage undergraduate university students into the irrigation research sector. (11 scholarships have been awarded to date). Most past student recipients have gone on to work in the irrigation industry or to work in aligned research programs.

Summer scholarship winner Megan Sebben, SARDI, (whose project concerns salt distribution under drip), and her supervisor A/Prof Jim Cox from SARDI. NPSI has invested in student scholarships and it is reported that previous winners are now working in the industry.

Ross Stotteler undertook his student scholarship with Goulburn Murray Water.

"The Scholarship Program has been an ideal way to provide me with additional experience in the water management field which has evolved into a fulltime job with the Tweed Shire Council working on water quality within the region. Once again I would like to thank (you and) the National Program for Sustainable Irrigation for the Scholarship program and the opportunities it presents'. Michael Law, scholarship recipient, Qld.

"Through my NPSI scholarship project, I worked with a consulting firm who employed me after I graduated" Ross Stotteler, scholarship recipient, Victoria.

In addition, NPSI has funded joint NPSI / Irrigation Australia (IAL) travel fellowships – including one to the US, Turkey and Israel to investigate factors influencing water-energy emissions and another to the United Arab Emirates, Israel and Spain to consider alternative and recycled water use.

"The fellowship not only provided me with a fantastic opportunity to view sustainable irrigation irrigation practices in Spain, Israel and the UAE, but introduced me to a number of Australia's leading irrigation professionals, and provided me with the chance to debate and 'pick their brains' on integrated water management. The trip has resulted in me increasing my networks and profile within the irrigation industry, which has been extremely positive."

Matthew Shanahan, Senior Consultant, RM Consulting Group

The 2010 Travel Fellowship winner, Alison McCarthy, has created the VARI-wise software model for simulating specific site situations and an article on her work was prepared for the Cotton R&D Corporation's Spotlight magazine. The 2009 IAL Travel Fellowship winner Tamara Jackson made a presentation at the 2010 IAL Conference on water and energy consumption patterns, providing a framework for consideration of resource use and emissions factors when planning new irrigation projects or improving performance of existing operations. NPSI continues to strengthen links and mutual opportunities with IAL including continued conference support during 2008-2011 and sponsorship of the annual IAL Conference and is finalising production of a "drip irrigation bible" which is co funded by DEWHA. NPSI is launching a major communication initiative. NPSI, IAL and Rural Press plan to stage three strongly-newsworthy irrigation meetings that will be held in regional areas. It is planned to explore RD&E knowledge opportunities through these forums and "Irrigation modernisation RD&E" is proposed as the first topic. Rural Press will support this initiative by providing structured media coverage.

Several unexpected outcomes based on leveraging the work of NPSI have been reported. For example, SunWater has taken the work of the *ABARE Capacity Sharing Project* (Management of irrigation water storages: carryover rights and capacity sharing, managed by Tim Goesch and Neal Hughes) and applied the findings in the Burdekin area of Queensland.

The ABARE project findings demonstrated that the concept of capacity sharing, as opposed to the more traditional announced allocation/carryover rights approach between storages, is feasible as demonstrated through two capacity sharing schemes implemented in Queensland – St George and MacIntyre Brook. This has potential to make more water available for irrigators as well as ensuring that more water is available for environmental purposes.

The wider implementation of this concept in the Burdekin is a tangible demonstration of the potential of NPSI funded work to affect industry structural and policy settings.

Peter Day, who managed the Knowledge Harvest Project, reported that during the *Modernisation: Enhancing Water Supply Systems Project,* a group of 54 water managers participated in the Modernisation Forum and Field Trip to share information about modernisation of water supply and consider future research needs. He noted that at the forum … *the participants represented 80% of the key personnel who are responsible for water distribution in Australia. While they all knew each other, their overall work pressures precluded regular detailed interaction. This forum provided a welcome opportunity to share knowledge, undertake strategic development and agree on R&D priorities that would be beneficial to supporting industry modernisation.*

This demonstrates how one NPSI initiated forum (or intervention in order to build capacity) has influenced water distribution Australia wide and influenced strategic thinking about the future of water distribution and associated research.

The project Preparing Irrigated Agriculture for Statutory and Climate Change, led by Mark Gibberd, recognises the need to increase the capacity of WA irrigators to effectively assess their requirements to manage and secure adequate water resources for the future, in the face of the pressures of current statutory change towards licensing and predicted climate change. It also recognises concerns over water availability that reduce investor confidence and the lack of understanding of on-farm and catchment scale water resource management issues. The project, which commenced early in 2010, is currently preparing training and other materials to deliver a series of workshops for irrigators, local government agencies, state department employees and natural resource management groups. The focus of the workshops is to support attendees in this change process – with a particular focus on those who are supporting irrigators. The project will achieve its aims with delivery through workshops and by generating online resources.

NPSI has invested in a strategic monitoring, evaluation and reporting function, through QualDATA Pty Ltd to ensure it can demonstrate, with robust data, its level of effectiveness in meeting its objectives. In addition this function has supported the training of key project personnel, plus providing insights on the process of delivering R&D outcomes to irrigators, advisers and other target markets.

Peter Toome, Chairman IAL, presents IAL/ NPSI travel fellowship to Tamara Jackson at the 2009 IAL conference.

The NPSI Modernisation forum field trip discussing Goulburn Murray Water infrastructure modernisation learnings.

Progress against Goal 4 … *Research and Development Leadership*

In its formal report to NPSI, QualDATA summarised NPSI's achievements this way:

NPSI as a program has provided funds for projects, which have provided a basis for strengthened collaboration between 16 investment partners, institutions and organisations involved in irrigation research and management. These funds have provided direction to progress the research, scientific experience and project (activity) portfolios in the industry.

It has supported capacity building through supporting nine (soon to be 13) undergraduate students with scholarships and three young researchers with travel experience. NPSI has provided NPSI project leaders with training and support related to monitoring and evaluation and reporting of their projects, as well as technical support and advice in relation to their projects and their management.

NPSI has participated in forums and conferences while also developing strategies to consider and take initiatives regarding the strategic direction of irrigation research and management into the future – to the extent that the strategy provides a … *balanced portfolio of ten RD&E priorities for the next ten years*. The project outcomes *have directly influenced industry innovations* including improved irrigation scheduling and application techniques, as well as other measures, which have resulted in significant water savings while improving productivity.

These innovations have the potential to improve risk management and to increase yields and quality. For example, through specific improvements to pivot irrigation producers can potentially improve water productivity by as much as 25% . There is also the potential for environmental benefits to the irrigation industries through improved management of water storages, improved understanding of relationships between water repositories (including wetlands), improved soil management understanding and techniques, and proven approaches to maintaining biodiversity in irrigation areas.

These achievements have helped to fulfil NPSI's aim to be …. *more than simply the sum of its projects*.

Summary

In summary QualDATA concludes that NPSI has shown national irrigation industry leadership in supporting irrigation industry research and innovation. Supply of scholarships and fellowships; input to key reviews of R&D and water management, etc; the development of strategic 10-year plans and capacity building of personnel in the industry are several tangible examples.

While NPSI can take responsibility for generating considerable new knowledge and supporting promotion of its adoption as demonstrated in this Update, QualDATA has reported a range of examples where more could be done. However it also notes that this is a common experience across the RD&E sector of Australian agriculture and NPSI ought not be singled out.

In its future endeavours NPSI could take a lead role in the adoption and practice change continuum to support its R&D program as it could in further building irrigation industry capacity. This will require a more disciplined approach – noting this is also generally required across the whole of the agri-foods and fibre industries. NPSI is not alone in grappling with how to effectively ensure all irrigators, advisers and farmers can access R&D outcomes.

A number of products and services are expected to become available as a result of NPSI and many have been produced or are close to completion. They include probes, decision support tools, calculators, websites, etc. Similarly specific interaction with particular target audience groups in particular projects will ensure that key products and services will prove beneficial to members of the irrigation industry. Some international engagement has also occurred.

A strong feature of NPSI has been its commitment to rigorous science based outcomes making the scientific community aware of potential innovations. It has shown collaboration with all sectors of the irrigation industry to ensure that this work influences on-ground management – at a farm level, through water storages and in decision making – at government and business levels. This aligns to its commitment to environmental sustainability through reduced water use, use of recycled water and seeking out innovations through its R&D work including a focus on biodiversity.

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Prepared by QualDATA

NPSI Partners