Innovation in **Irrigation**



6 CASE STUDIES FROM ACROSS AUSTRALIA

Natural Heritage Trust
Helping Communities Helping Australia
An Australian Government Initiative

FOREWORD

Agriculture in Australia is undergoing enormous change, driven by shifts in consumer demand and markets; technological advances and innovation; sustainability issues, especially concerning water and native vegetation; declining terms of trade; and microeconomic reform.

It is a heady mix of challenges, and Australia's farmers are continuing to perform magnificently.

They have been consistent leaders in the productivity improvement that has underpinned 13 years, to date, of continuous national economic growth, even in the face of drought.

Irrigated agriculture has been at the forefront of this tremendous effort, while engaging what is perhaps the biggest challenge confronting all Australians: the sustainable use of water.

Australian farmers are also working their way through tough over-allocation issues. They are working with government to establish an appropriate property right to water, and they are working towards water trading.

At the same time they are widely adopting new irrigation technologies that boost production, in many cases very significantly, from each unit of water.

Irrigated agriculture now represents about 28 per cent of Australia's gross value of agricultural production.

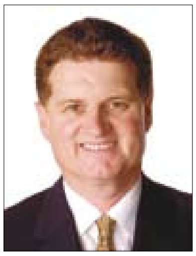
The six case studies in this brochure, reflecting excellence in Australian irrigation, are great examples of how hard work and innovation by individuals and communities are spearheading the success of irrigation in Australia and improving the value of Australia's water resources.

With support from the Australian Government's $3 billion Natural Heritage Trust, the six irrigators in this booklet, along with the 12 featured in last year's inaugural Innovation in Irrigation Showcase, are demonstrating how creative strategies can ensure high productivity for every megalitre of water used.

The drivers of change in each of this year's case studies, and the responses to them, are different but they all have one thing in common: each innovator is a recognised leader in their field.

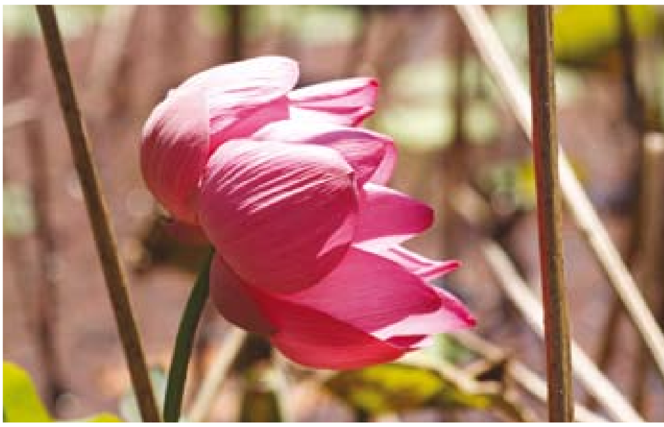
The studies vary from individual farmers to regional town resource managers. Their stories range from developing strategies to manage regional inland city effluent, to combining water savings and productivity increases in crops such as maize, table grapes, mangos and citrus.

The purpose of these studies is to inspire and encourage others to follow their lead, and in doing so, help the irrigation industry to continue to develop even more efficient and sustainable production systems.



THE HON. PETER McGAURAN MP
MINISTER FOR AGRICULTURE, FISHERIES AND FORESTRY





"THE SIX CASE STUDIES IN THIS YEAR'S INNOVATION IN IRRIGATION SHOWCASE DEMONSTRATE AGAIN HOW CREATIVE STRATEGIES CAN ENSURE HIGH PRODUCTIVITY FOR EVERY MEGALITRE OF WATER USED."

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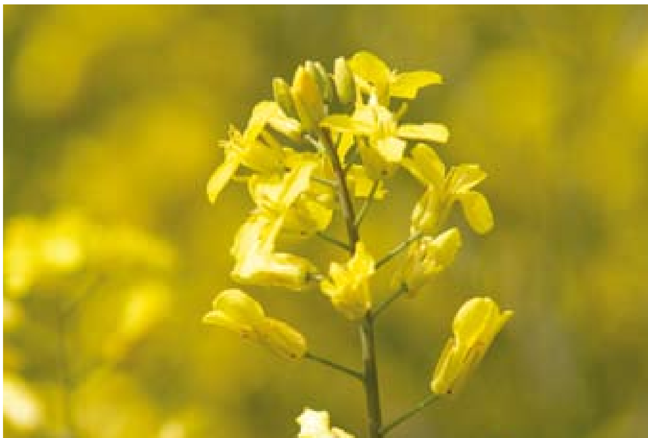



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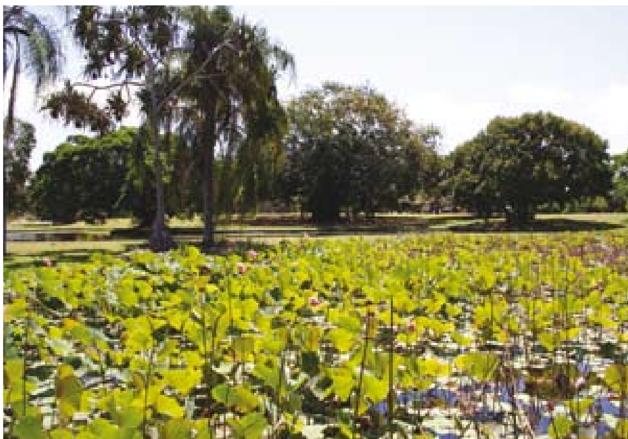
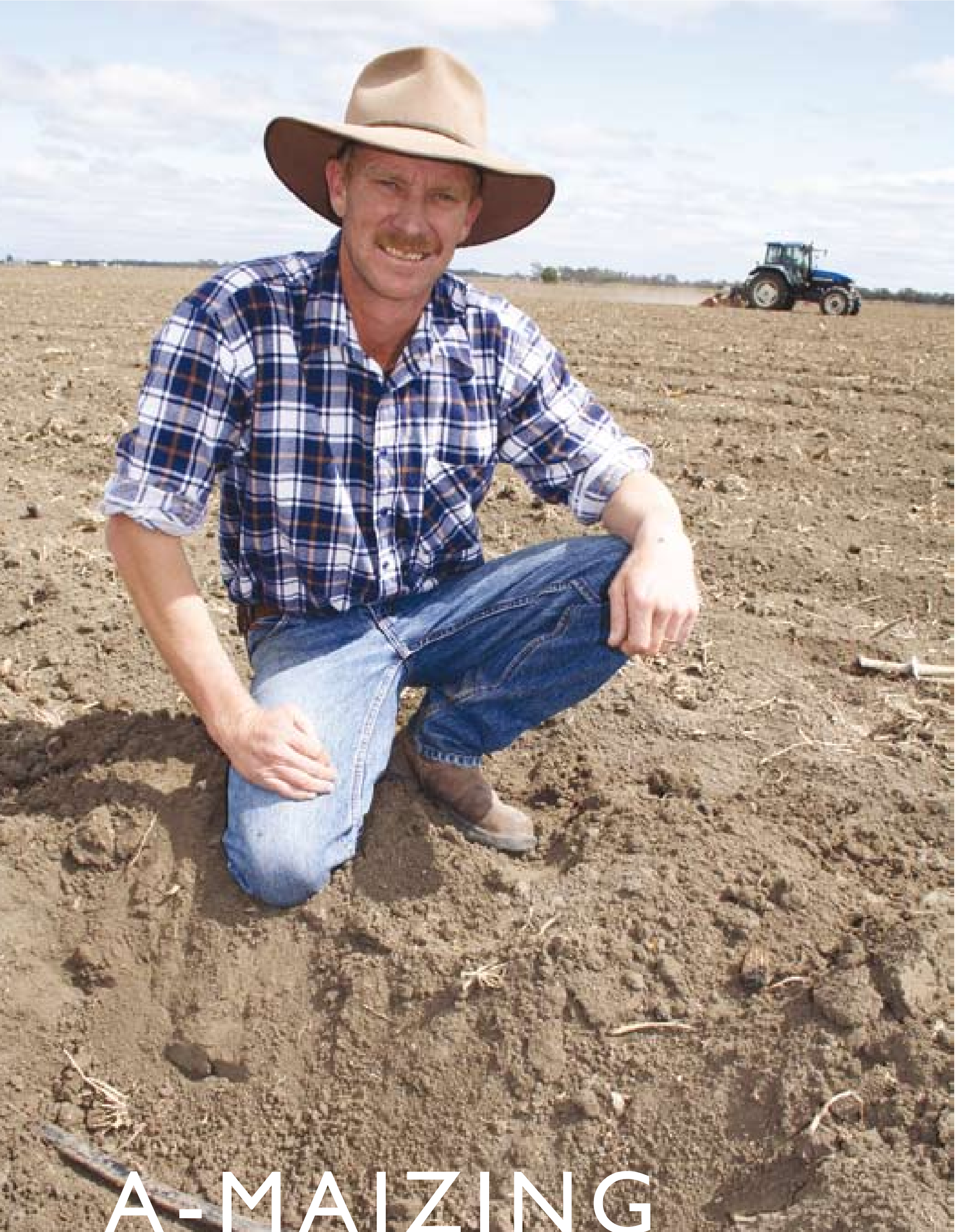
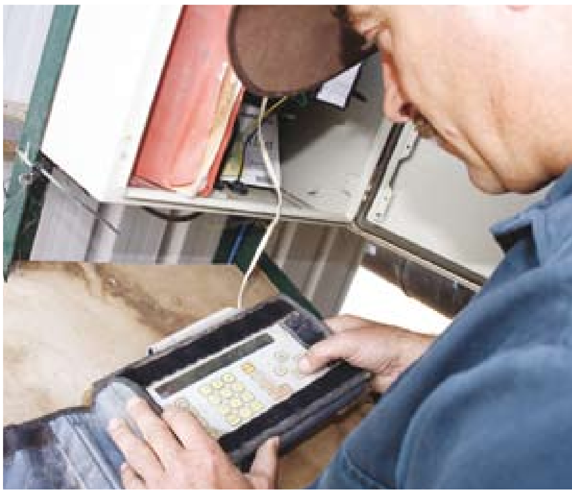






A-MAIZING RESULTS FROM UNDERGROUND

NAME:
RON BRAMLEY, SAWERS FARMS

LOCATION:
BOORT, VIC

INDUSTRY:
MAIZE (CORN)

DRIVERS OF CHANGE:
- DESIRE TO INCREASE PRODUCTION AND LOWER COSTS
- GREATER CONTROL OVER PRODUCTIVITY
- INCREASE RETURN ON INVESTMENT
- MAXIMISE WATER ALLOCATION

A Victorian farm that set an Australian record in irrigated maize yield in the 2004-05 season isn't resting on its laurels, testing new techniques and varieties in an effort to increase production and lower costs.

Sawers Farms, at Boort in Victoria's Northern Districts, harvested up to 20.5 tonnes per hectare from its 232 hectare maize crop set up with an underground drip irrigation system on raised beds.

Farm Manager Ron Bramley said that while a great season helped, the result was largely attributable to the irrigation.

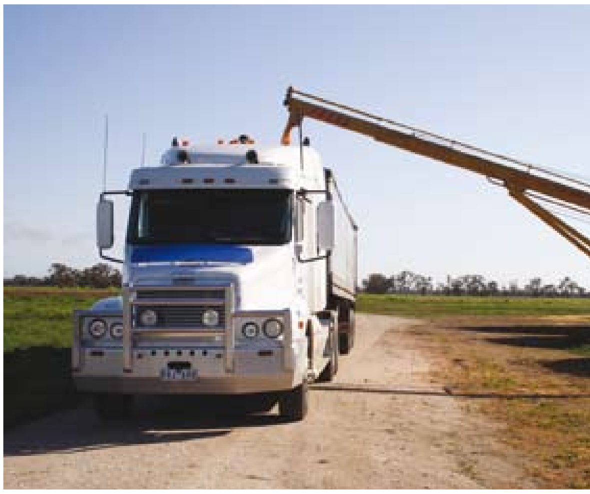
"We averaged 19.2 tonnes per hectare, compared to 12-15 tonnes from conventional furrow-irrigated maize on other farms in the region, and used approximately 20 per cent less water," Ron said.

Sawers Farms has around 1 500 hectares under irrigation, using largely flood irrigation for winter crops of canola, wheat, barley and faba beans in rotation.

The summer maize crop is grown on raised beds 1.63 metres apart with tape buried down the centre about 25 centimetres below the surface. Drippers are spaced every 50 centimetres, and the maize is grown in two rows either side of the tape. The system comes at a cost of approximately $3 750 per hectare.

The beds are inspected for moisture once or twice a day, and a computer controls watering times in sections of around eight hectares. Typically, three sections are watered at a time by three drip pumps.

"The soil has to be wet enough for the water to be almost running out the sides of the beds just after planting, to initiate germination and provide a reservoir of water in the soil profile for later use.



As well, this encourages the depth and spread of the root system. After that, the moisture levels are cut back and kept fairly constant throughout the season," Ron said.

"We test the soil before each season to determine what nutrients are needed and apply mono-ammonium phosphate (MAP) fertiliser before planting.

"Through the season any nutrients that are needed are dissolved in a tank of water and applied through the drippers, which gives much greater control over quantities. We find we use approximately 25 per cent fewer units of nitrogen per tonne of grain or tomatoes grown this way," he said.

"We attribute this apparent efficiency to less volatilisation and less leaching of the nitrogen fertiliser. Zinc sulphate and monopotassium are also put in through the drip, and this year we will be trying a few more micronutrients to see if we can further improve the yields.

"Similarly, much of the apparent improvement in water use efficiency could come from never getting the soil surface wet, save for the initial soaking, and less deep percolation losses due to irrigating daily on an as needs basis. It could be that the plants perform better without being regularly inundated as happens with furrow irrigation.

"I don't think we could achieve the yields we have without the drip irrigation, and I would definitely recommend that others consider the potential benefits."

Having said that, Ron is keen to investigate other options in an effort to maximise yield compared to input costs, and this year will trial other irrigation systems to benchmark the drip irrigation.

"It's important to compare the mix of costs, including labour, infrastructure, fuel for pumps and the water itself, versus the yield you achieve," he said.

"The pumps are going a lot of the time with the drippers, and you think twice about that with fuel prices being so high.

"We'll water through raised beds and furrow irrigation, which will cut the fuel bill but use more labour to get the syphons going. We're also going to look at growing corn on border check flood irrigation, because that's less labour intensive again than furrow.

"Yields will no doubt be down, but there will be offsetting reductions in capital costs and a host of increases and decreases in our variable operating costs. Unfortunately these alternative systems will not have the same water use efficiency as drip, but in the wash up, it will be an interesting comparison."

Ron said plans have been drawn up to convert more land to drip irrigation, but the timeframe will depend on the results of the trials over the coming season.

Sawers Farms also conducts regular trials of new grain varieties, often setting aside areas of land for the seed companies to use as well.

"If you find a good variety then stick with it, but don't close your mind to other possibilities because you never know when something different could beat its production," Ron said. "Even if something doesn't work as well, that's useful knowledge.

"It's also important to talk to the neighbours and growers in other regions to compare performance, because you will always learn something to help your own operation."

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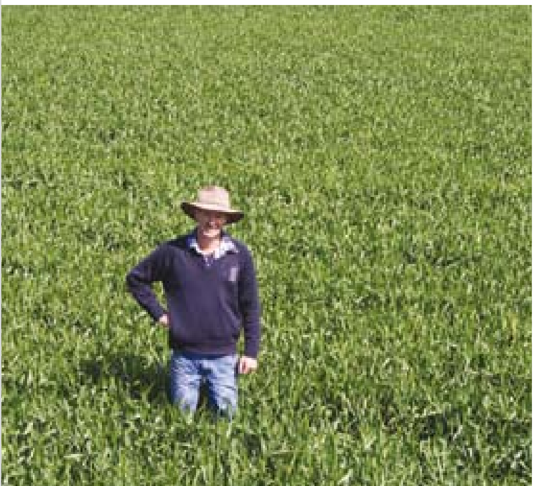
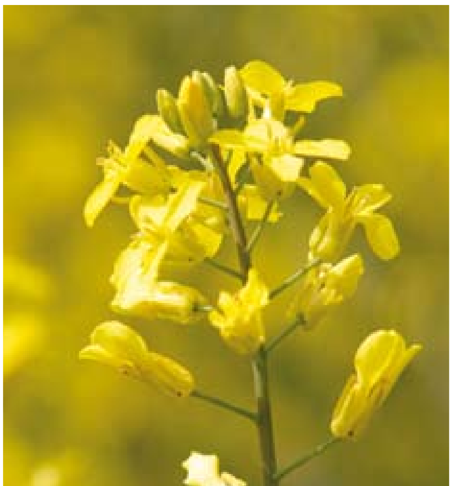
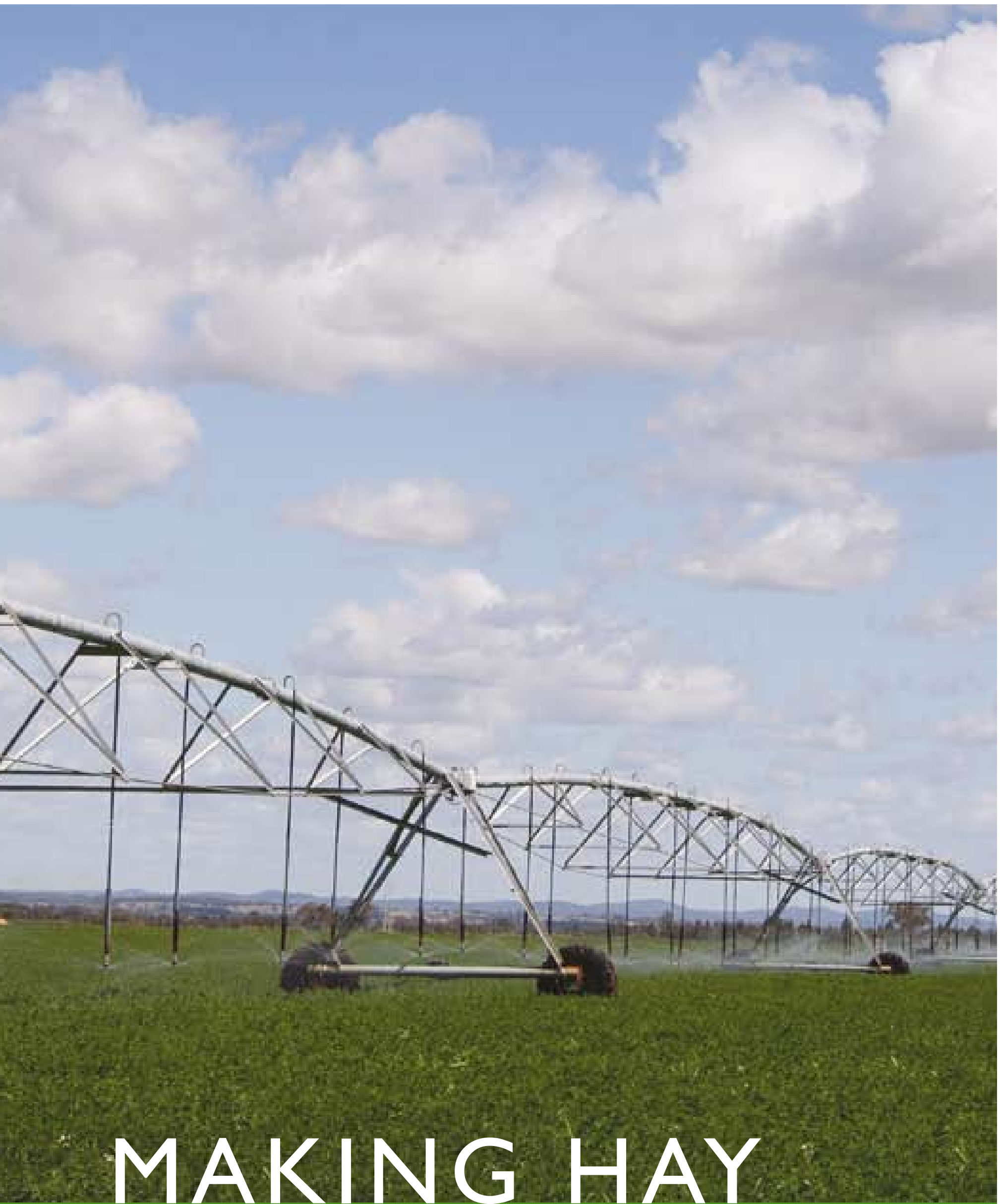






MAKING HAY FOR HEALTHY RIVERS

NAME:
STEWART McLEOD, DUBBO CITY COUNCIL

LOCATION:
DUBBO, NSW

INDUSTRY:
FODDER

DRIVERS OF CHANGE:

- NEED TO REDUCE POPULATION'S IMPACT ON SURROUNDING ENVIRONMENT
- OUTBREAKS OF BLUE-GREEN ALGAE
- WATER SHORTAGES DURING DROUGHT
- NEED TO REDUCE NUTRIENT LOAD IN RIVER AND SURROUNDING SOIL
- DESIRE TO CAPITALISE ON BENEFITS OF EFFLUENT AS NATURAL FERTILISER

The pressure is on urban and agricultural communities to reduce the impact they have on their surrounding environment, and through the innovative use of the town's effluent system, Dubbo City Council in NSW has managed to do just that.

The Greengrove Effluent Irrigation Facility, operational since December 2004, is Dubbo City Council's answer to protecting the environment and helping farmers in times of drought.

The Council's Director of Technical Services, Stewart McLeod, has overseen the effluent re-use project for the past 11 years. He is proud of the innovative and practical solution to the city's effluent disposal, which now achieves 100 per cent beneficial re-use of this important resource.

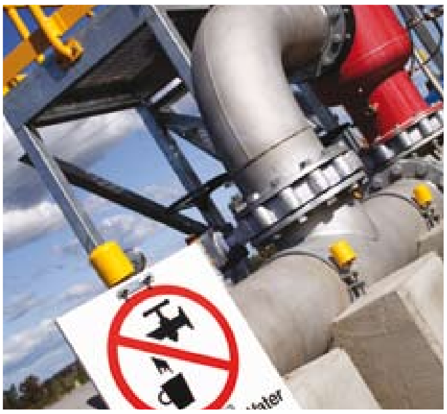
"In the early 1990s the blue green algae explosion in the Murray-Darling Basin shook up a lot of urban and agricultural areas and made them really look at their waste disposal and management systems," Stewart said. "Dubbo in particular was targeted at that time as a nutrient 'hotspot' within the Basin.

"In response to wider environmental and urban pressures, Dubbo City Council reviewed its sewage strategy in an effort to address increasingly stringent environmental standards, new occupational health and safety standards, an ageing sewage treatment plant, and Dubbo's growing population, which was putting increasing pressure on the existing effluent disposal infrastructure.

"Despite having a license from the Environment Protection Authority to discharge up to 15 per cent of the town's treated effluent into the Macquarie River, we wanted to come up with an effluent re-use scheme which would effectively use all of the treated effluent as a resource," Stewart said.

In 1996 a local company began taking up to 1 000 megalitres of treated effluent each year for use on fodder crops. The benefits of using effluent as a natural fertiliser and soil conditioner became clearer to the Council through its strategy review, so it decided to pursue the idea of setting up its own sewage effluent re-use scheme.

In 1998, Council purchased the 608 hectare property Greengrove, and undertook a preliminary analysis on the suitability of effluent irrigation at the site. A more detailed study and concept design were completed in September 2000, followed by an Environmental Impact Statement in May 2001. The Development



Application to commence construction of the site was approved in June 2002.

Construction of the Greengrove facility took two years, and involved combining existing infrastructure with new plant. While one of Dubbo's sewage treatment plants was decommissioned, the other one was upgraded to handle all the sewage for treatment before it is pumped to the Greengrove facility.

Treatment at the plant involves screening, aerating, clarifying and disinfecting the sewage before pumping it to two storage dams with a combined capacity of 1 090 megalitres. Solids are removed during the clarifying process to become bio solids. From these storage ponds, the effluent can be pumped to either Greengrove or a private landholder's property for irrigation.

Once the effluent arrives at Greengrove it is used to irrigate fodder crops for livestock. Crops are irrigated according to a schedule supported by soil moisture probes. There are six centre-pivot irrigators covering an area of 208 hectares. The pumps are capable of delivering up to 185 litres per second (16 megalitres per day) to selected pivots, which are fitted with low pressure nozzles and droppers to reduce spray drift, and deliver a carefully controlled amount of water evenly on to the ground.

"In constructing the facility we took particular care to minimise any chance of effluent drift or contamination beyond the boundaries of Greengrove," Stewart said.

"We planted 12 000 trees to intercept any spray drift as well as to provide a visual screen and keep groundwater at a satisfactory level. This bank of trees also provides a root barrier to groundwater flowing beyond the boundaries of the property.

"We also constructed six kilometres of earthen bunds around Greengrove in order to contain any run-off and prevent any other surface water entering the facility from further up the catchment.

"A monitoring system of 28 bores at 10 locations was installed 18 months ahead of commissioning to constantly monitor groundwater in and around the site at varying levels, and we established a groundwater sampling system to record both water levels and quality on a regular timetable."

Foremost in the Council's mind when constructing the Greengrove facility was to ensure it is sustainable far into the future.

"Dubbo City produces around 3 000 megalitres of effluent every year," Stewart said.

"The Greengrove facility has been designed to handle up to 2 500 megalitres of treated effluent, and the privately-owned local company will take up to 1 000 megalitres per year, so we aren't running at capacity.

"If current population projections prove to be correct, the facility should be fine for the next 50 years.

"We recently took five expressions of interest from surrounding properties to be eligible to receive the effluent for irrigation purposes. Of these, three have been found to be eligible to receive between five megalitres and 600 megalitres of effluent in the future. The first one should be operational in the next 12 months, and if these come into effect, it should extend the life of the facility even further."

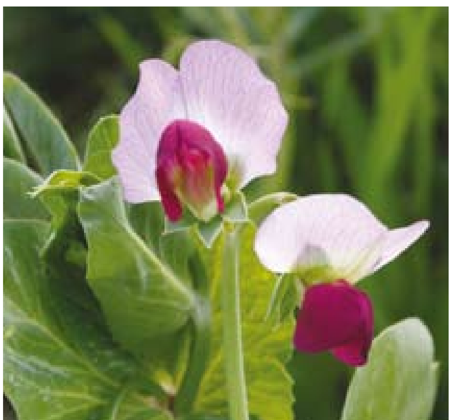
Other regional centres in NSW have started following Dubbo's lead, with Tamworth, Shoalhaven, Narrabri and Narromine in various stages of installing their own effluent re-use facilities. Stewart is also holding inspection tours of the facility, as well as participating in conferences and field days talking about the success they have had with Greengrove.

"There is definitely more for us to learn about optimum operation of the Greengrove facility, but at the same time I am keen to share the knowledge and experiences we have had with other communities," he said.

"We have tendered out the management of the facility to an outside organisation for an initial two-year term with a two-year option to extend. It is important to have recognised expertise in both farming and environmental compliance being applied at Greengrove, so I don't see Council day labour ever taking over the running of this facility.

"As it stands we wouldn't be considered by a commercial irrigator as the most efficient operation going around, but because we have other constraints on us, that really isn't our main objective.

"If we can fully comply with our environmental management plan, and minimise or eliminate effluent discharge into the river system, then we will have reached our primary goals."



A WINNING COMBINATION

NAME:
DEAN MORRIS & WAYNE PROTHEROE

LOCATION:
LEETON, NSW

INDUSTRY:
CITRUS

DRIVERS OF CHANGE:
- NEED TO INCREASE PRODUCTIVITY AND REDUCE WATER USE
- NEED FOR TIMELY HARVEST OPERATIONS
- COST OF WATER
- SOPHISTICATED TREE GROWTH TECHNOLOGY
- COST OF IRRIGATION SYSTEM LED TO PARTNERSHIP

A new high-tech irrigation and nutrient supply system on two citrus orchards in Leeton, NSW has made natural elements such as soil and rainfall virtually redundant in the production of high quality fruit.

Developed by Spanish plant physiologist Professor Rafael Martinez Valeor PhD the Martinez Open Hydroponics Technology (MOHT) system has resulted in increased yield and productivity for neighbours Dean Morris and Wayne Protheroe.

Dean, who runs 'Willyhama Grove' in partnership with his father, had heard about the potential of the MOHT to improve fruit size, quality and yields while conserving water use, but the cost of purchasing and installing the system was too much for a relatively small orchard to bear.

"I knew that with our current practices we weren't hitting capacity production levels, but I couldn't find a drip irrigation system which would save water and also dramatically increase production," Dean said.

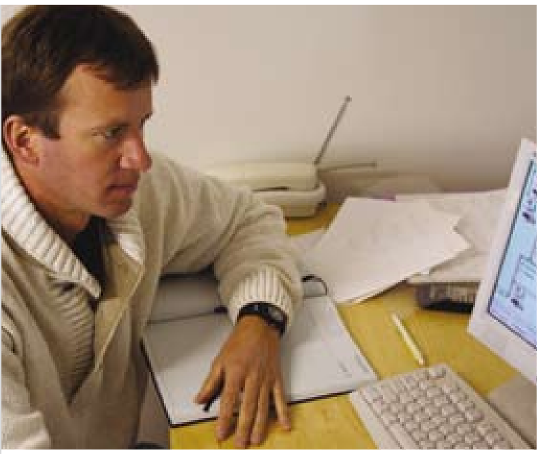
"In 2001 I went to three areas in South Africa to look at some farms where MOHT had been installed for a number of years, and I was amazed at the results being achieved.

"The system works by combining drip irrigation with nutrient solutions and tree management, so the end result is you can manipulate the fruit trees to set more crop and push the trees to achieve marketable fruit size. This means you're halving water consumption while increasing fruit production."

The MOHT is operated by a computer system, with lateral lines carrying water and the nutrient solution to the trees through a drip irrigation process. Each tree has two drippers, spaced apart so that the soaked areas don't touch and the trunk is not wet. Highly condensed root zones are achieved, giving greater control over the tree.

The system is only operated through the day, which is the optimum time for the trees to take up the nutrients, however such is the crop's dependence on the system that it must be operated every day.

It's certainly not cheap to install an MOHT system. Before taking into account the cost of pipes and drip lines, the cost of installing the nutrient injection system, the necessary software and paying the technology usage and transfer fee was $200,000, so Dean started to look elsewhere for a co-investor. As it happened, he just needed to look over the fence.



"Wayne Protheroe, who is my father's cousin, lives next door to us and runs his own orchard, so he was the logical partner to team up with for this system," Dean said.

"We formed an agreement to split the costs of the major infrastructure, as well as the costs of upkeep, and now we are both experiencing the incredible benefits the system has produced."

Wayne produces eight varieties of citrus on his 13.6 hectare orchard and is impressed with his investment, but said it was definitely the partnership with Dean that convinced him to install the new system.

"When I compared the cost of the water saved with the cost of installing a traditional drip system, financially it wasn't worth it to make the switch from flood irrigation," Wayne said.

"Sharing the costs of installing and running the system with Dean greatly increased the viability of the project, and since it was installed, my trees have all increased their tonnages by one-third, so I am producing more fruit for less cost, which is exactly where I need to be."

To help out with the total cost of the system, which was estimated to be around $300 000, Dean and Wayne accessed the Murrumbidgee Irrigation Area Envirowise Grants. These grants are funded through the National Action Plan for Salinity and Water Quality, and provide financial incentives for upgrading irrigation systems to become more water efficient.

In addition to increased water efficiency, Dean has seen fruit yields grow exponentially since the new system was installed in September 2003.

Before installing MOHT, 'Willyhama Grove' was using between 9.5 and 10 megalitres of water per hectare of orchard every year with the flood irrigation system, and producing between 25 and 30 tonnes of fruit per hectare. Now, the same trees are using 4.5 megalitres of water per hectare, and producing between 38 and 55 tonnes of fruit per hectare depending on tree age.

"The most immediate benefit of MOHT has been the marked improvement in tree health, and that came about within six to eight months of installation," Dean said.

"Older trees that we were prepared to knock down and replace have regenerated and are producing good fruit again, and all our trees are producing consistent crop loads.

"While water wasn't our biggest expense prior to changing irrigation systems, labour shortage was, and if the fruit harvesters hear that an orchard is producing large tonnages, they will come to you."

Another benefit is that the two days a week the neighbours used to spend maintaining their flood irrigation systems has been reduced to just half a day, including mixing the nutrient solution, although Dean now checks his system between three and four times a day.

"Our fertiliser bills have tripled, and are now sitting at about $1 200 per hectare, but when you consider that we are producing an extra 50 per cent to 80 per cent of fruit per hectare, the benefits are clear," Dean said.

The system has also worked successfully in Spain and South Africa on fruit crops such as peaches, plums, avocados, table grapes and olives.

Dean is also employing an Integrated Pest Management approach in his orchard, through adopting techniques such as pheromone tags for insects and Aphytis wasps to control red scale (Aonidiella aurantii) in citrus crops.

"It is my firm belief that growers in the citrus industry need to change their practices to continue operating successfully and profitably, and by changing irrigation systems I can now claim total tree management over my orchard," Dean said.

"After two full seasons, and looking at the current flowering, it is clear that alternate bearing is something of the past. My goal is to produce one kilogram of fruit per 100 litres of water used, and given we are currently using 120 litres of water to produce that kilogram of fruit, we are not too far away from reaching that goal.

"I also never thought the day would come when I could confidently say that the orchard can survive completely without rain!"

MAKING EVERY LAST DROP COUNT

NAME:
CHRIS AND SUE ALLAN

LOCATION:
MUNDUBBERA, QLD

INDUSTRY:
TABLE GRAPES, MANGOS, AVOCADOS

DRIVERS OF CHANGE:
- LACK OF RELIABLE WATER SUPPLY
- INCREASED UNDERSTANDING OF VINE HORTICULTURE
- IMPROVED TECHNOLOGY FOR BETTER WATER USE EFFICIENCY
- NEED TO INCREASE UNIFORMITY OF FRUIT SIZE

Question: What makes a farmer an efficient water user?

Answer: The lack of it!

For most farmers, expanding an irrigated horticulture operation without a regular water allocation may seem like an insurmountable goal. However, for Mundubbera horticulturists Chris and Sue Allan, innovation and adoption have been the keys to successful expansion against the odds on their Queensland property.

The Allans bought their property 'Weemillah' as a bare block, with the intention of becoming full-time farmers. They had a vision – but everything had to be done in small steps as time and money permitted. As part-time bee keepers and while still teaching, in 1989 they planted 200 mango trees and installed a 30 megalitre dam on their property, to provide water for expansion.

"When we planted our first mango trees we mulched them all with lucerne hay, and our 'little nests' were a standing joke with the rest of the community," Chris said. "But when you are watering your trees with buckets, you need to know that every drop is working for you.

"Because we didn't have a constant water source we needed to maintain a high level of water use efficiency from the outset, and we planted all the trees with water crystals in the soil. These crystals are made from a granular, super-absorbent polymer, which can absorb up to 400 times their density in water, storing it until it is needed by the plants.

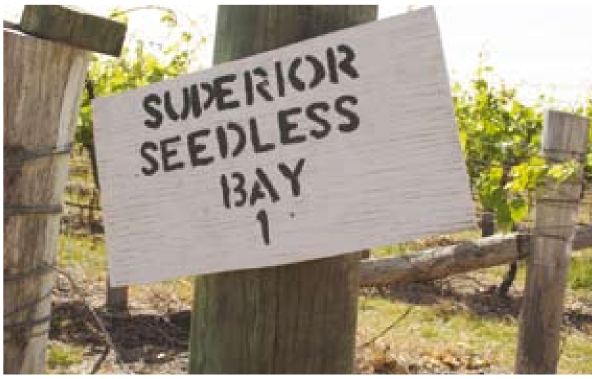
"Later we were able to install an under-tree irrigation system, consisting of 60 litre per-hour spinners, which we ran for two hours a week when we had sufficient water in the dam."

By 1993 the Allans had increased their mango crop to 1 200 trees over three hectares, still relying on the water from their 30 megalitre dam. In 1994, they expanded their operations further by moving into table grapes, planting 8.2 hectares of vines over the next four years.

"Expanding into table grapes provided another set of challenges and initially we installed a drip irrigation system consisting of one eight litre per-hour emitter under each grape vine," Chris said.

Throughout this expansion period, the Allans were still relying on their dam as their main source of water. Projected to fill every three out of four years with rain, the dam had only filled once. In fact, in the first seven years, the dam only held five per cent of its capacity.

In 1994, the Allans worked out a temporary transfer arrangement with their neighbours, exchanging a portion of their water allocation for bee pollination services. In 1996 they installed a pipeline to the river and were able to pump, with a water harvest licence, whenever a flood occurred.



"At the end of 2002, we were using an average of five megalitres of water per hectare, producing 10 tonnes per hectare of red grapes from young vines, and four tonnes per hectare of white grapes," Chris said. "However, the majority of the red grapes verged on non-commercial size."

This problem was identified as inconsistent water supply to the red variety of vines, with a consequent lack of fertiliser to the plant. The white variety in the clay soil always produced excellent quality grapes but had its own problems with production volumes.

In 2004, after 10 years of relatively successful table grape production, the Allans were able to obtain a water allocation of 30 megalitres. Keen to see their new water put to work, the Allans decided to investigate their current level of water use efficiency, and called on GrowCom to assist them.

"GrowCom supplied their services to us free of charge through their Water for Profit program, funded by the Queensland Government's Rural Water Use Efficiency Program," Chris said.

"The field officers helped us conduct a water use efficiency test, which showed that the distribution uniformity of the irrigation system was operating at 83 per cent efficiency on our grapes and 90 per cent efficiency on our mangos.

"The tests showed that although the flow rate of the dripper suited the soil types in our grape blocks, we needed to encourage the vines' root systems to spread out, increasing their capacity to reach more nutrients and water. To do this, we replaced the eight litre per-hour dripper with two four litre per-hour drippers placed on either side of the vine."

Through changing the drippers and doubling the wetted area around the vines, the Allans saw a 10 per cent increase in root development, and the plants were able to increase their water and nutrient uptake.

They had been using tensiometers to measure the moisture content of the soil, but as the vines grew and their operations increased, more information was needed about their soil profiles. To assist with this, Water for Profit officers installed an EnviroSCAN soil moisture monitoring system, which uses capacitance probes to log moisture data. They installed two probes in the porous soil and one in the clay; which measured the soil every 10 centimetres, to a depth of 50 centimetres. This data is then interpreted to enable better scheduling of irrigations.

GrowCom also carried out a test on the fertigation system (a system by which nutrients are delivered to plants in solution via the drippers) for the Allans, which Chris had mainly been running on guesswork. The tests measured the time the system took to effectively fertilise the vines, and by using the EnviroSCAN Chris is also able to work out the exact timings to run the system without flushing the nutrients beyond the root zone.

The changes to the irrigation and fertigation system have brought about immediate changes for the Allans.

"As a result of the changes, our 4.4 hectares of white grapes are using 3.43 megalitres in the red clay and 3.98 megalitres in the porous soil, an average of 3.56 megalitres per hectare per year, which is significantly lower than the industry average (between 5 and 7 megalitres per hectare) and what we were achieving two years ago," Chris said.

"Vine productivity has also increased since 2002, going from an average yield of 6.43 tonnes per hectare to 13.4 tonnes per hectare, which is an increase of 208 per cent. In 2004, the first year of our new system, we produced 14.9 tonnes per hectare of red grapes and 12.5 tonnes per hectare of white grapes, all of a consistent size. Comments from agents and pickers alike suggested that the berry size was remarkable. So the amount of grapes we are producing has gone up and quality has improved yet we are using less water per hectare.

"For the 2005 season, we have had projections of producing 14.6 tonnes of red grapes and 12.68 tonnes per hectare of white grapes."

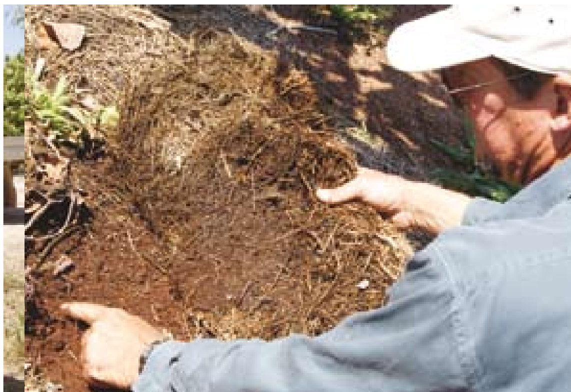
These incredible results can be attributed to the combination of changes to the irrigation system, continued mulching around the plants, and installation of hail netting over the vines resulting in water savings of up to one-third of previous total water usage. The hail netting has the added benefit of creating a micro-environment which is much more humid than the outside air, helping to retain moisture in the canopy area.

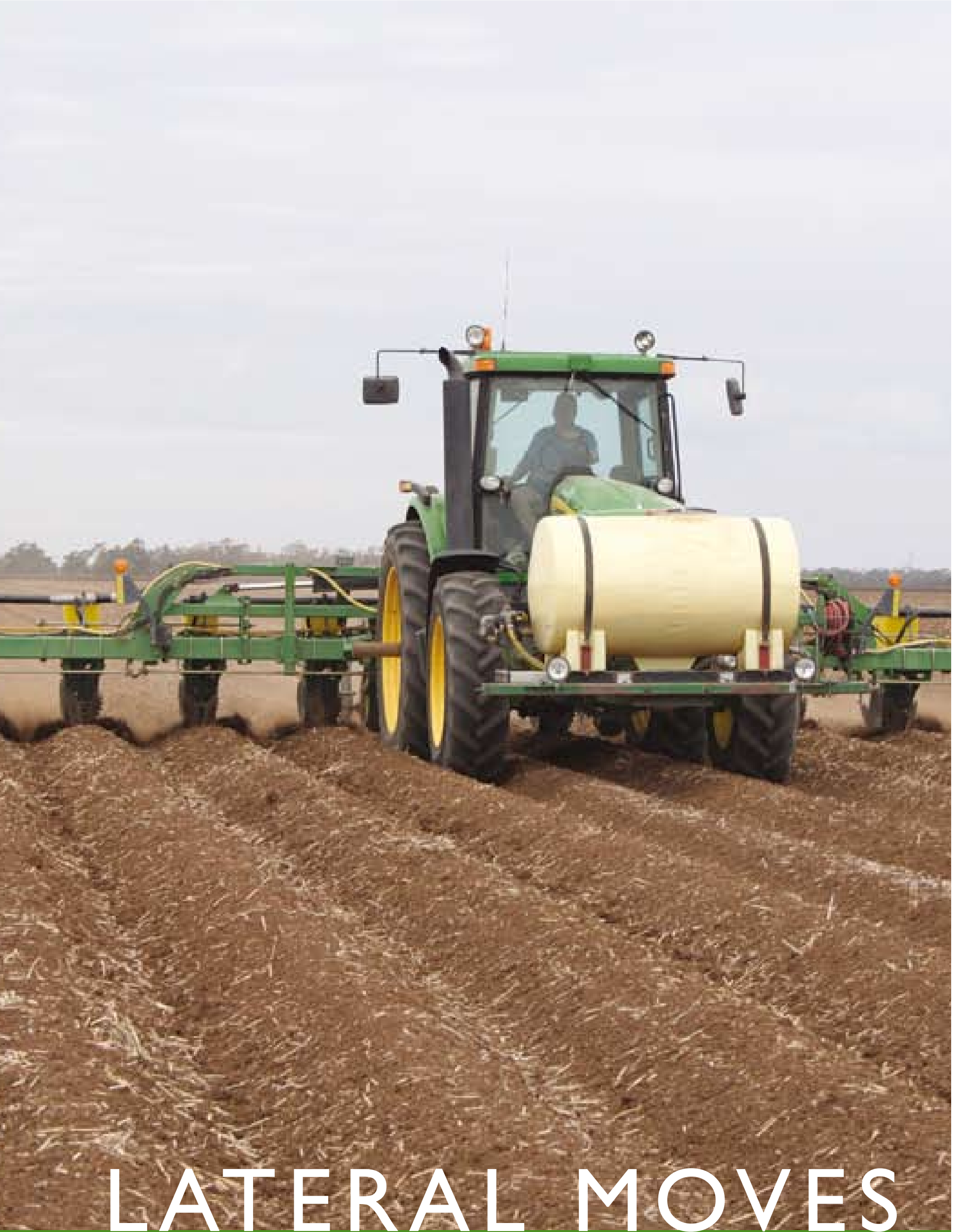
Looking forward, Chris and Sue are keen to turn their attention to their mango trees and their recently leased established orchard of 1 200 avocado trees, 1 200 mango trees and 12 000 grapevines. The leased orchard presents a new challenge, with its irrigation supply coming from a river where the water is often highly saline and the levels fluctuate regularly.

"There is a lot of work to do on the mango and avocado trees such as monitoring the salt and water levels in the root zones, which we are keen to carry out," Chris said.

"We are also looking at an Israeli drip irrigation system that runs lateral lines of three litres per-hour drippers, spaced every 35 to 40 centimetres, and we are keen to test this on a three-hectare block of vines."

The Allans' success with limited water supply should serve as a lesson to growers of what can be achieved by closely monitoring their water. Their main aim has always been to use water wisely and effectively, and accessing the latest information and technology has been beneficial to this cause.





LATERAL MOVES MEAN LITERAL SAVINGS

NAME:
HARVEY GAYNOR, AUSCOTT

LOCATION:
MOREE, NSW

INDUSTRY:
COTTON

DRIVERS OF CHANGE:
- REDUCED COSTS OF INPUTS, E.G. FERTILISER
- MAXIMISING WATER ALLOCATIONS
- ADVANCES IN AGRONOMIC KNOWLEDGE
- QUEST FOR GREATER PRODUCTIVITY GAINS AND GREATER RETURNS ON INVESTMENT

For an industry that is under the environmental spotlight as much as cotton, an irrigation system that not only uses 30 per cent less water, but can also reduce the need for nitrogen fertilisers, is a terrific good news story.

Auscott, part of the Californian J G Boswell company, has been experimenting with lateral move (also known as overhead) irrigation systems on its properties at Moree, Narrabri and Warren in NSW with immediate improvements in water use efficiency.

Harvey Gaynor is the General Manager of Auscott's 'Midkin' property at Moree. He said the company started looking at alternatives to flood irrigation in order to maximise their returns from their water allocations, and uncertainty due to climate change.

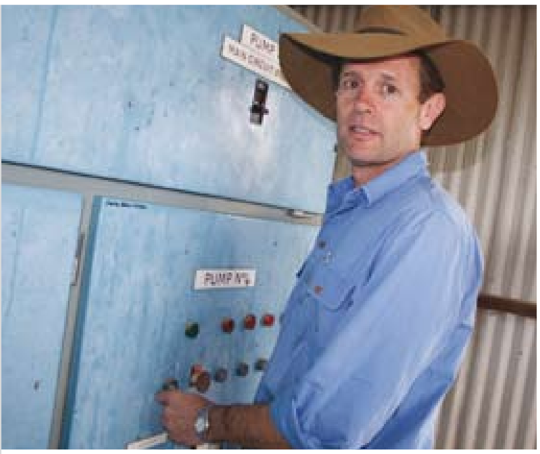
"We had been working on our water use efficiency under flood irrigation, and were producing between 0.8 and 1.3 bales of cotton per megalitre, but we just weren't making the gains we were looking for," Harvey said.

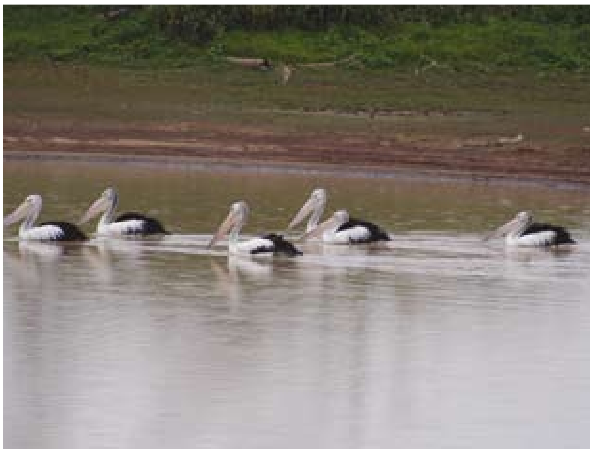
"About eight years ago, we trialled drip irrigation on our Narrabri property, and while we did achieve some water savings, they weren't enough to cover the costs of installing the new system."

In 2002, Auscott made the decision to trial lateral move irrigation on 'Midkin'. The 14 500 hectare property has 7 500 hectares developed for irrigation and 3 000 hectares allocated to dryland farming, whilst the remainder is old grazing country set aside for native vegetation.

"In 2002 we installed one overhead irrigator about 700 metres wide with a run of 2 700 metres, and it proved to be far more cost effective than installing drip irrigation," Harvey said.

"Operating lateral move irrigation does require the country to be well developed enough to drain in case of summer rain storms, but also enables farming to be carried out on the flat.





"Other standard flood irrigation infrastructure such as supply channels is also needed, but there are clear advantages for rotation cropping, where crops can be irrigated in the early germination stages, and then given a 'helping hand' if required during later peak growing periods."

Lateral move systems had been used in cotton production previously, however old technologies had given them a bad name.

"Older systems used sprinklers to water the plants, and this tended to spread disease amongst the older, more susceptible cotton crops," Harvey said, "and the systems often couldn't keep up enough water to the plants in the middle of summer."

The new lateral move system installed at 'Midkin' has outlets every metre, to which sprinklers can be attached to water the crop in the initial germination stage. These can then be replaced by low energy precision application (LEPA) droppers, which wet a track between 10 and 15 centimetres wide in the rows.

"In the first two years of using the lateral move system we achieved water savings of between 19 per cent and 42 per cent, and our water use efficiency increased dramatically because the plants were never subjected to stress from water-logging," Harvey said.

"Because the droppers didn't wet the whole soil surface, combined with the fact that there was never any tail water, one of the biggest savings we made was through reducing water loss through evaporation."

Despite not making any immediate productivity gains, Auscott was impressed with the water savings and called on the National Centre for Engineering in Agriculture to help with the systems design for three more overhead irrigators.

They placed two more on newly developed parts of 'Midkin', and one on an established paddock in Narrabri. During the 2004–05 cotton season, 567 hectares of 'Midkin' cotton country was watered by the lateral move system.

"With each machine saving between 1.5 and 2.5 megalitres per hectare per year, which adds up to a total of 200 to 250 megalitres per year, the water saving means we are able to use that water for additional cropping," Harvey said.

"In addition, we are able to add fertiliser to the water when we irrigate, which reduces our use of nitrogen fertilisers at the end of the season. This saving in fertiliser costs offsets the diesel costs of running the irrigators, which are about $15 per megalitre."

The switch from flood irrigation to lateral move has provided several challenges for Auscott, but according to Harvey, the benefits of the system far outweigh these.

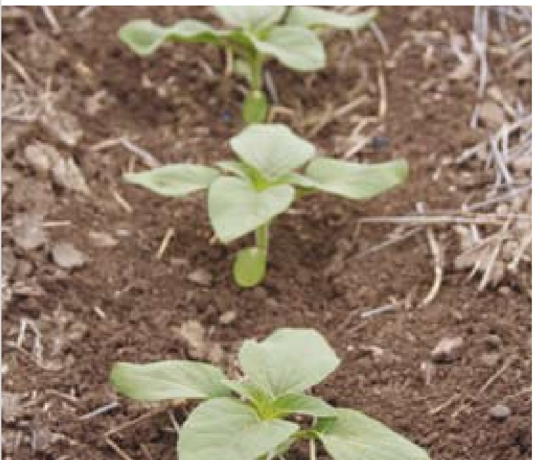
"The overhead system requires far less physical labour to water the crops, but it does require a different approach to managing the irrigation system. In addition to requiring more mechanics to maintain the machines, the overhead system will change the shape of our workforce over time because we will require employees with different skills," he said.

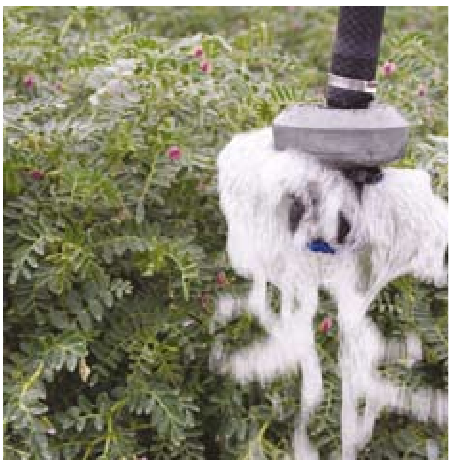
"We have also seen more variability in the crop by soil type, so we need to work towards improving the precision application of the irrigation to overcome this."

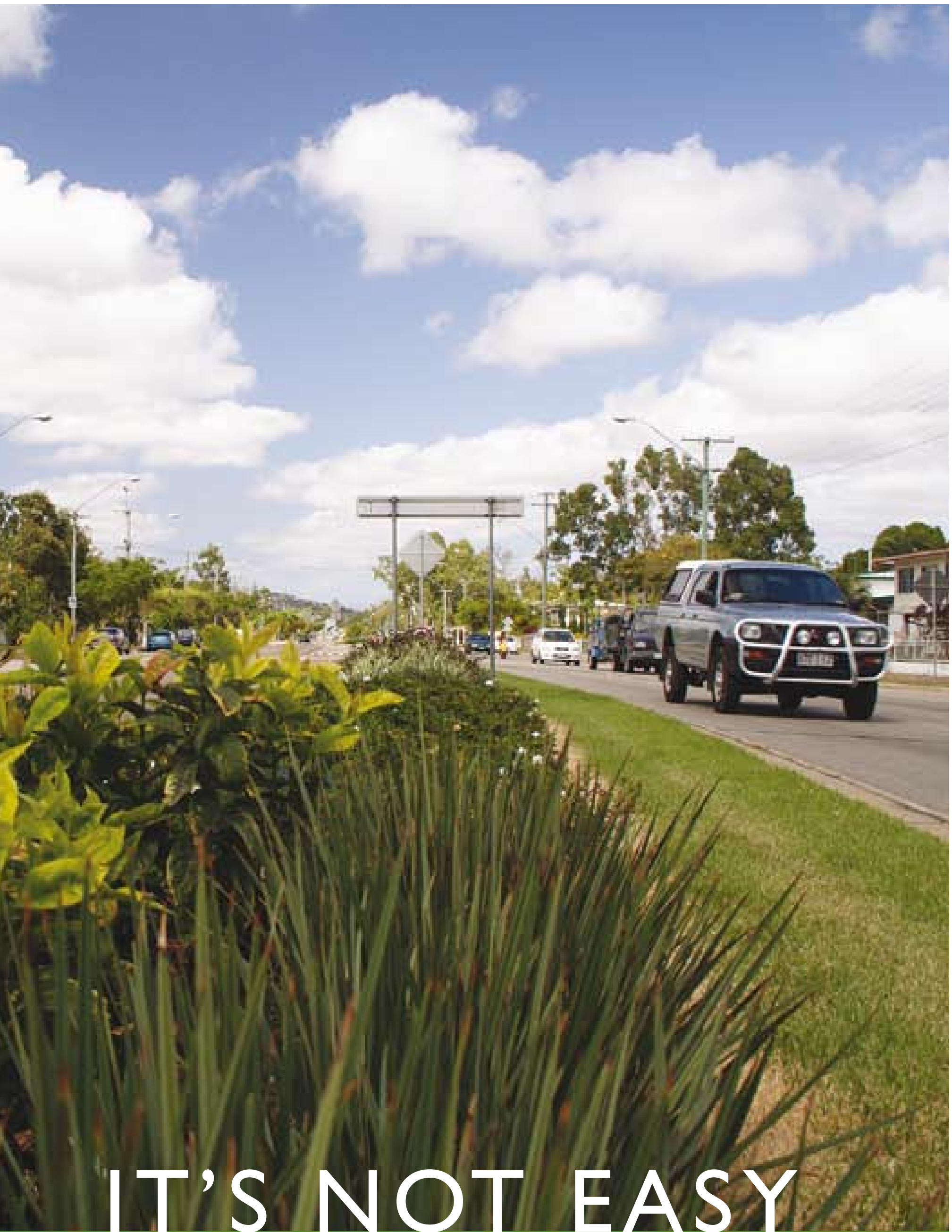
Looking ahead, Auscott has plans to install another lateral move system on the Narrabri property where the initial trial has proved successful in productivity gains as well as water use efficiency. They are also investigating niche rotation crops such as mustard or coriander to replace areas of the wheat, chick peas and sorghum crops to increase the return on their investment.

"I would like to look at centre pivot irrigation as a viable alternative to flood irrigation, but there is a big mind set to get past if we are going to start farming in circles," Harvey said.

"In the first two years of using the lateral move system we achieved water savings of between 19 per cent and 42 per cent, and our water use efficiency increased dramatically because the plants were never subjected to stress from water-logging."







IT'S NOT EASY KEEPING GREEN

NAME:
ROSS PILLAR, TOWNSVILLE CITY COUNCIL

LOCATION:
TOWNSVILLE, QUEENSLAND

INDUSTRY:
URBAN

DRIVERS OF CHANGE:

- COST OF WATER
- NEED TO UPDATE IRRIGATION SYSTEM
- ENVIRONMENTAL PRESSURE TO KEEP GREAT BARRIER REEF CLEAN
- NEED TO MAINTAIN LARGE AMOUNT OF OPEN SPACE
- RESIDENT AND TOURIST EXPECTATIONS OF GREEN GARDEN AREAS

When a city is built on half a dozen different soil types, experiences three micro-climates, receives only three months rain a year, and is located next to one of the world's great natural assets, the pressure is on to maximise water-use efficiency.

Townsville City Council in Far North Queensland has adopted an holistic approach to its water management to fit these variables.

Townsville is located in the dry tropics region of North Queensland and lies in the Ross River catchment of the Great Barrier Reef Catchment Area. With an average annual rainfall of 1 143 millimetres and an average daily evaporation rate of 7.3 millilitres, maintaining an aesthetically pleasing green city can be a challenge.

When Irrigation Planning Officer Ross Pillar joined Townsville City Council in 1998, he was challenged with maintaining one of Australia's largest per capita urban open-space areas.

"In 1998, Council was using approximately one gigalitre of water for urban irrigation every year, mainly via pop-up sprinklers," Ross said.

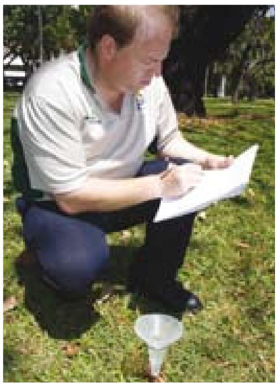
"In 2005, the Council controls a total of 600 irrigation sites, using approximately three gigalitres of water per annum, and our irrigation system has to keep these sites well watered and maintained."

There are two key costs driving the Council's water management system: economic and environmental. Most of the water the Council uses comes from the Ross River, Paluma and Burdekin Dams, at a cost of about $6 million a year. Any surface water run-off or seepage of excess water to the water table, drains to the Great Barrier Reef.

The combination of these factors has driven the Council to take a comprehensive approach to their water management. Through improvements in soil and weather monitoring, and system application and control technology, the Council is making a real attempt to match actual water applied to theoretical plant water requirements. This approach contrasts to irrigation operations that distribute water evenly.

The Central Irrigation Control System is the heart of the Council's water management operations. One of the largest centrally controlled irrigation systems in Australia, the system has been custom-built with generic software to suit the needs and demands of Townsville city.

"An internal study conducted in 2002 recommended that we update our central control system, and suggested the replacement system be capable of operating



a network of 1 200 irrigation sites, and last around 12 years," Ross said.

"We found the best system would be one we constructed ourselves, because of the increased flexibility it offered. Installed in 2004, the new Central Irrigation System allows us to alter irrigation schedules in response to changes in the environment, increasing our water use efficiency by around 20 per cent."

An extensive soil moisture monitoring system forms part of the Central Irrigation System. Townsville is built on a number of different soil types, ranging from heavy clay, to loam to loose, sandy soils, and their different water-holding capacities provide a number of challenges.

"The primary soil sensor we use is a three metre long sensor strip buried just below the soil surface in turf areas. Because the sensor returns digital pulses, it was easily attached to the Central Irrigation Control System, meaning soil moisture levels can be viewed in real time," Ross said.

"The Council also has a number of other sensors, which measure soil moisture levels at various depths. At the moment, the data from these sensors is collected manually, however we are moving towards online data collection."

The Council has also upgraded its irrigation delivery system to match the needs of the various soil types and land uses.

"Over the last few years we have been moving away from pop-up surface sprinklers towards sub surface drip irrigation on areas such as road-side verges, garden beds and median strips," Ross said.

"Sub-surface drip irrigation delivers water savings of up to 30 per cent per annum, primarily through eliminating run-off on to roads and pavements, which is a common problem with pop-up sprinklers."

Sub-surface drip irrigation works through tubes buried a couple of centimetres below the soil surface and fitted with drippers at regular intervals that deliver water directly to the plants' root zones.

"Where pop-up sprinklers are appropriate, such as on sporting fields, we use modelling software called Space Pro to design the system and space the sprinklers correctly. The software allows us to virtually measure the irrigation efficiency of the spacing and pressure for a given sprinkler in seconds, and we often carry out physical audits to confirm these results."

The third aspect of the Council's water management program is the weather monitoring system, which works with the soil monitoring system. The Council has a weather station network that consists of five dedicated weather stations across the city. These stations measure rainfall and evaporation rates, with some stations also measuring wind speed and direction.

"By collating the information we receive from our weather station network and combining it with information the Council receives from the Bureau of Meteorology's Townsville Station and Storm Gauging Network, we obtain a fairly accurate picture of rainfall and evaporation across the city," Ross said.

"The weather data provides the final piece of the irrigation scheduling puzzle. Along with the data from the soil sensors and staff reports, we can ensure that we schedule irrigations as efficiently as possible."

Research and development partnerships make up the fourth component of the Council's water management plan.

"The information we have been able to gather through working with the Queensland Department of Primary Industries and the Commonwealth Scientific and Industrial Research Organisation has helped us investigate different irrigation techniques, as well as the associated soil, vegetation and environment issues that are directly impacted upon by irrigation," Ross said.

"We recently formed a partnership with James Cook University to research soil types and turf species in the Townsville region, and their salinity, sodicity and nutrient load levels."

The Council's Irrigation Specifications document sets out stringent guidelines for its water management system. It governs the design and installation of all irrigation assets managed by the Council, and its key function is to set benchmarks for water use efficiency through a detailed set of design criteria. Once constructed, systems are regularly maintained by trained staff to ensure they maintain their intended efficiency.

"By maintaining these design specifications, I believe we have increased our water-use efficiency by at least 20 per cent in the last seven years," Ross said.

"Adding this to the savings made through our Central Irrigation Control System and those gained by moving to sub-surface drip irrigation translates to an increase in water use efficiency of around 50 per cent.

"In terms of real benefits for Townsville, residents and visitors are now treated to a more aesthetically pleasing city, incorporating green parks and sporting fields, as well as assets like our Botanic Gardens.

"I believe we are now getting a better return on our water use because of these social benefits."

Ross believes that the central planning approach that Townsville City Council has employed could be exported to agricultural industries that rely on irrigation.

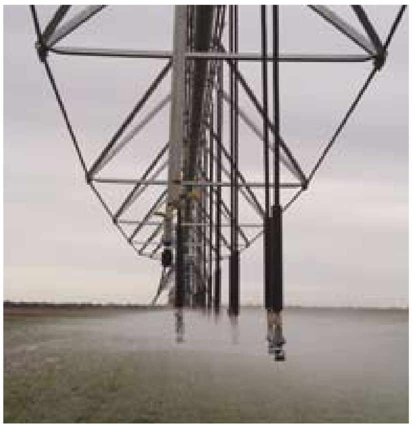
"The principal element of the Central Irrigation Control System is designing irrigation systems that conform to the benchmarks of the operation, regardless of industry," Ross said.

Although the new system has been operational for 12 months, there are still a number of goals the Council is working towards.

"We are looking towards making the whole system web-based, which means people external to the organisation such as developers and construction contractors will be able to access relevant parts of the system," Ross said.

"Now that we are constantly collecting an amazing amount of information, the challenge is to use that information, so we are constantly refining the systems and creating new benchmarks.

"We are also looking at increasing our efficiency in terms of labour, and generally aiming to do more with less."



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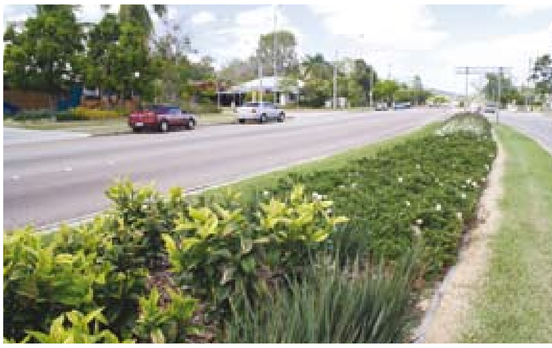

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