Urban Water Security Research Alliance

Leading water research and knowledge in South East Queensland

Newsletter Issue 5 August 2011

A message from the director

This month marks the beginning of the final year of the Alliance's five-year research program.

While we have seen much good research completed already, our focus is now firmly fixed on finalising remaining work within the next 12 months and, importantly, on communication and adoption of results.

Our research plan has had to be fine-tuned to cater for the impact of widespread flooding in SEQ earlier this year, so while the direction is essentially the same, we have had to adjust some of our milestones and expectations.

Our emphasis during this next 12 months will be on drawing the implications out of our research and findings and making the research available in a way that effectively informs government and industry.

This is not just in terms of the SEQ Regional Water Strategy but may also cross into areas of health, treatment plant design, building and planning regulations, manufacturing, and water systems design and operation.

This is well illustrated in the research we are presenting in this newsletter, with a particular focus on rainwater tanks.

Since tanks have been typically included in all new houses in SEQ from 2007 as part of complying with water savings targets, their installation, function and use has been an important component of SEQ's water supply strategy.

Alliance research, running across several projects, is uncovering critical results that will make a real difference to the way householders install, use and maintain their tanks. Research investigating the energy efficiency of tank pumps will also have important implications for consumers and manufacturers on reducing the energy used to operate tanks.

Data on why and how householders use rainwater tanks can provide useful information to develop strategies for government in getting people to more widely adopt rainwater tanks, and in ensuring they maximise their efficiency.

Meanwhile, projects looking at how much mains water is actually saved from installing rainwater tanks have important findings for potable water savings. Preliminary research using 2008 council water billing data indicates that rainwater tanks provide a significant contribution to the total water supply.

The Residential Water End Use Study (reported in the March newsletter) is one of three projects that are due to be finalised by December 2011, with data collection largely finished and the project team preparing their final report.

The Evaporation Loss project is working to overcome the challenges of taking the testing of the effectiveness of prototype monolayers from the lab into the field, but is on track to conduct final testing over the coming summer months in time to deliver results by the end of the year.

Finally, the Water Quality Monitoring Technology and Information Collection System project team are validating the prototype event detection system at the Bundamba sewage treatment plant and will deliver their final report in coming months. The monitoring technology developed in this project seems to have great potential for adoption across the wider water system.

It is rewarding to be in a position where Alliance research is being widely communicated and adopted. However, like much good research, the findings of our research have posed as many new questions as they have answered. Urban water research capacity has been built, laying the foundation for a more secure water future in SEQ.

— *Donald Begbie*

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Strategies to promote adoption of rainwater tanks and improve operation and maintenance

Targeting the costs associated with installing rainwater tanks, promoting their usefulness and increasing awareness of ongoing water sustainability issues in South East Queensland (SEQ) could be effective strategies in getting more urban homeowners to install decentralised systems.

These are some of the major findings of an UWSRA study that has been researching and analysing community understanding and adoption of decentralised water systems such as rainwater tanks and greywater systems.

Research scientist Dr Aditi Mankad from CSIRO is part of the UWSRA project team investigating what motivates homeowners to install a rainwater tank and, importantly, how they use and manage their tanks after installation.

She said it was important to gain a better understanding of people's attitudes and motivations because, although new homes since 2007 usually install a rainwater tank to comply with water savings targets, less than 50 percent of existing homeowners have chosen to retrofit tanks in SEQ, despite incentives such as government rebates.

Operating within the UWSRA Demand Management project, the researchers have conducted interviews and/or surveys with almost 3,000 users of mandated and non-mandated rainwater tanks, as well as non-users.

Dr Mankad said now that we had mandated rainwater tanks installed with new houses, it was really important to understand how people were using and maintaining them.

"We were really interested in looking at not only why people choose to have a rainwater tank, but also how they use them," Dr Mankad said.

"This research can be used to help ensure people are using their tanks appropriately, so that in 20 years time we don't have abandoned tanks littering people's properties."

Concurrent research, relating to the demographics of rainwater tank users, is also under way through the UWSRA Decentralised Systems project.

This research indicates the extent to which householders are prepared to invest in resources such as rainwater tanks directly relates to their feelings of perceived vulnerability to water shortage and, importantly, whether or not they feel the use of a rainwater tank would make a positive difference.

"If residents believe there is a severe water shortage and if they believe they themselves could be vulnerable to that threat, residents would be more likely to install a supplementary water source like a rainwater tank," Dr Mankad said.

"People tend to engage in behaviours such as using a supplementary source of water if they believe it is a useful thing to do. If people believe they can make a difference by using rainwater, or an alternative source such as greywater, to supplement mains water, they are more likely to engage in that behaviour."

In comparison, the research has shown that people who didn't have rainwater tanks were quite removed from the whole issue.

"Those residents who didn't have a rainwater tank supported the idea of a sustainable lifestyle in terms of water, but they were also very quick to justify the reasons why they didn't have a tank," Dr Mankad said.

"The reasons centred around residents feeling they didn't have enough space on their properties; or that it was too expensive; or mistrust of authority and toward those governing water."

Other non-users felt the rebate system wasn't appropriate because it would take several months for their money to be reimbursed.

A portion of non-users simply believed there had been good rainfall and therefore water shortage was no longer a real threat in SEQ.

The study also examined how satisfied users were with their rainwater tanks. Dr Mankad said the majority of people who relied on decentralised systems as their sole form of water were happy with their system because they felt engaged and had control of the water being supplied.

However, she said people who had moved into residential developments with a decentralised system, such as a supplementary source connected to mains water, were often less satisfied because there were issues with tank installation.

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"It all boils down to how well the system has been installed and whether they feel competent enough to manage their tanks," Dr Mankad said.

"There is a limited amount of information available for people who have tanks and anecdotally, they really don't get a lot of information or guidance after the tank is installed."

Dr Mankad said the research also aimed to determine how much residents were prepared to pay for decentralised water systems.

"On a basic level, we found that people who already have decentralised systems, for example a rainwater tank, would be unlikely to invest any more in an additional system," Dr Mankad said.

"So people with rainwater tanks don't generally feel they need to go out and buy a greywater system, for example."

The next phase of the research will be to further study the differences in water-use attitudes between people who voluntarily retrofit their homes with rainwater tanks and those who install tanks in order to comply with water savings targets.

Focus needed on household tank pump systems

Household rainwater tanks may be saving water but they could be using a lot more energy than necessary because common pump designs are not being matched to everyday indoor uses, according to researchers from UWSRA's Decentralised Systems project.

CSIRO research scientist Ms Grace Tjandraatmadja is part of a team working with project leader Dr Ashok Sharma to investigate the way various pumps operate and flow when used for different household purposes.

The project used a mini-house setup at CSIRO laboratories in Victoria to create a controlled environment in which they could monitor different sized pumps.

The goal was to see exactly what factors influenced the energy footprint of the pumps as they supplied rainwater for use in dishwashers, washing machines, filling toilet cisterns and handheld irrigation.

Ms Tjandraatmadja said the optimal operating range for pumps occurs where the amount of energy employed and the amount of water provided is in the high efficiency range.

"Many indoor water-use applications, such as running a dishwasher, flushing a toilet or turning on a tap, required a low flow of water from the pump, delivering only about 5L/min," she said.

"However, a lot of popular pumps are more energy efficient when they operate at high flow rates (>15L/min), for example for outdoor irrigation, and use a lot more energy to deliver water at these low flow rates."

Ms Tjandraatmadja said that a range of factors such as pump brand and design can affect energy consumption. Of all factors, selection of the correct pump size for household use can significantly reduce the energy footprint of rainwater tanks.

Ms Tjandraatmadja said because rainwater tanks were taken up so rapidly after being mandated in new developments in 2007 in response to the drought, householders had not thought much about pump energy use, but more about the capacity of their tanks to save water.

"A lot of people buy the biggest pump they can, thinking it will give them the best performance but if you only connect that to a toilet, for example, it will operate at the high range of energy use, when instead, a smaller size pump may be just as effective operationally and more energy efficient," she said.

"The energy required to supply a toilet cistern could be up to 3.5 kWh/kL, depending on the pump used. Correct pump sizing and informed selection of system components could improve energy efficiency significantly to <1.5 kWh/kL, lower than the energy footprint of other

alternative water sources such as desalination and recycled water," she said.

"If the public becomes more aware of these issues, then they will demand pumps that are better tailored to their intended needs and uses, and place pressure on retailers and manufacturers to respond to these findings."

Ms Tjandraatmadja said the findings would also give policymakers, industry and consumer advocacy groups some scientific information to inform future guidelines or develop benchmarking around energy efficiency for pumps used for rainwater tanks.

The project is now investigating other system configurations, such as pressure vessels and header tanks, where water is pumped to a large tank, and then fed by gravity, to assess if the energy used to operate them can be reduced even further.

Water savings from rainwater tanks very significant

Preliminary research conducted as part of the Urban Water Security Research Alliance has shown that rainwater tanks significantly lower the amount of mains water used by households in South East Queensland.

Griffith University research fellow Dr Cara Beal led a desktop study of household water use in Pine Rivers, Redland and Gold Coast to explore the potential savings from internally plumbed tanks (IPT) installed in post-2007 dwellings.

The study was part of the Alliance's larger Decentralised Systems project and involved examining existing council water billing data in order to provide baseline data for further research.

Dr Beal said the preliminary research indicates that in 2008, rainwater tanks supplied an average of 50 kilolitres/household/year, or 34 percent of water used in residential properties. This is an average saving of approximately $110 per year at the current price of mains water supplied to households in the Brisbane area.

However, water reductions from main supplies varied significantly across regions, ranging from 28 to 95 kL/household/year.

She said the variation in savings was due to many factors including water restrictions, rainfall, tank volume, connected roof area, socio-demographic factors, water-efficient appliances and fixtures and householder's water conservation behaviour.

"By using tank water for flushing the toilet and on the cold water washing machine tap, the average home can offset mains water use anywhere between 40 and 50 kL/household/year," Dr Beal said.

"However, these savings can only occur if the tanks have a steady supply of rainwater, otherwise they then switch back and use mains water if the tank is nearly empty."

Dr Beal said the water efficiency of appliances was also an important factor in how much mains water could be saved with an IPT.

"Paradoxically, the more water efficient your toilet or clothes washer, the less mains water you will actually save by using an IPT. Also, if household water usage is typically low then so will be the savings from IPT," she said.

"High water consumption will generally result in high water savings using IPT. So, smaller homes with smaller gardens and only one or two residents will not save as much from their IPT as a larger home with a big family and large garden."

Dr Beal said the maximum achievable reductions from IPT were unlikely to have been achieved during this study, as much of the data was collected when external water restrictions were still in place in some regions and very little water was being used for outdoor irrigation.

"Historically, it's outdoor water use that has caused the biggest increases in water use, particularly during hot, dry periods," she said.

"If you can't water outdoors, for example due to severe water restrictions, then the high volumes of mains water associated with irrigation won't be used and the difference between mains use for homes with and without tanks will not be as obvious."

Dr Beal said the project team had recommended in a report being published this month that stage 2 of the research should include a survey to capture the anomalies found in the desktop study; and a controlled

pair-wise experiment where water consumption was logged using high-resolution smart water meters.

These recommendations are now being taken up in a study led by Dr Meng Chong from CSIRO. Phase 1 of this study, completed in December 2010, involved a baseline demographic analysis of 1,134 households with internally plumbed rainwater tanks in new houses.

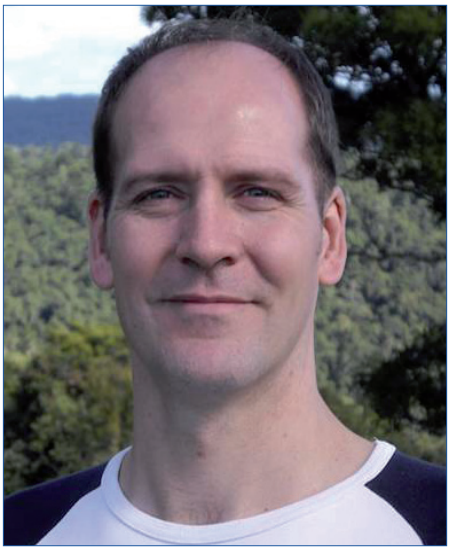
Phase 2 of the study is using the Building Sustainability Index (BASIX) analysis approach, developed by Sydney Water, to compare the average mains water usage for known IPT users in new houses to the wider SEQ average mains water consumption. This will be used to validate the potable water savings for post-2007 homes with rainwater tanks in the SEQ water landscape since the water savings target was set.

Board news

The second Board meeting for 2011 was held on 17 May with a key focus on the consideration of an extension to the Alliance research program, and reviewing progress and direction of the current program. The Board approved the proposed final year of research.

The Board also endorsed the Alliance undertaking a special project to review the science completed to date to enable adoption of the research results and outcomes, with an intent to aid the development of a business case for continuing the urban water research effort through the Alliance framework for a further two-year period.

Meet the researcher



Leif Wolf

Research team leader
CSIRO Land and Water

Dr Leif Wolf heads the Cities in Catchments Research Team within CSIRO's Urban Water Theme of the Water for a Healthy Country Flagship. He also leads the UWSRA project examining the effects of the potential supply of 20 GL/a of purified recycled water to augment the depleted groundwater resources in agricultural areas of the Lockyer Valley. Leif began his career at Germany's Karlsruhe Institute of Technology in 2000. From 2007–2009, he served as Interim Full Professor for Hydrogeology and coordinated research projects for the European Union (EU), German Science Foundation and the German Ministry for Science and Education. He has authored more than 14 journal articles, written nine book chapters and presented over 50 conference papers. As well as his work in Australia, Leif co-ordinates the key research initiative Sustainable Management of Available Water Resources with Innovative Technologies (SMART), which is researching integrated water resources management at the lower Jordan River in the Middle East.

Q. How did you come to have an interest in integrated water resources management?

A. I had seen a knowledge gap in the inclusion of groundwater resources and that is what motivated me to move into that field, especially into the urban areas, where there was a different science tradition.

Q. How did your career path bring you to Australia?

A. I was initially involved in a joint European/Australian project that was funded by the EU and produced the Urban Water Resources Toolbox as an output. Specifically what initiated that project was the availability of some innovative tools for the total water cycle which were developed in Australia, so that made the project very attractive for the Europeans. I joined CSIRO in 2010.

Q. How is your research into the potential use of purified recycled water in the Lockyer Valley contributing to Australia's future water security?

A. It's a key opportunity to improve the urban–rural linkage. The use of recycled water in agriculture is something that is practiced extensively worldwide, but not very much in Australia, so this is an opportunity to look at expanding that use. It takes about a quarter or even less of the energy to treat and to desalinate wastewater compared to sea water. Reusing wastewater is very energy efficient and we must be aware that, in the long run, we may not be a water-limited society, but we are certainly an energy-limited society.

Q. As well as your research in Australia, you are still heavily involved in international projects. How important is international collaboration in the field of water research?

A. From a global perspective, we can't view Australia as independent and we must make sure that we export some of that knowledge. Australia can also learn from the experiences of other countries.

In the urban environment, European cities are much more densely populated and some of the issues now seen in the European context may be seen in Australia in the future. The problems in water management are not only happening here but elsewhere and that's why I continue to be involved in projects in the Middle East. The SMART project I am currently involved in jointly involves Israel, Jordan and Palestine and in this context the multi-lateral water management project is even trying to contribute to the peace process.

Diary dates

23 August and 29 November
Board meetings

28 November
Research Advisory Committee meeting

14–15 September
UWSRA Annual Science Forum

Conference alert

Below is a list of conferences happening around the world in coming months that may be of interest to people involved in water research or industry.

(UWSRA is not necessarily affiliated with these conferences.)

International Desalination Association (IDA) World Congress 2011
4–9 September 2011, Perth

RiverSymposium 2011
26-29 September 2011, Brisbane

Water Reuse 2011: International Water Association
26–29 September 2011, Spain

2011 International Water Conference
13–16 November 2011, USA

First International Conference on Water and Society
5–7 December 2011, USA

Water facts

1. Although rainwater tanks have typically been installed in new houses in SEQ since 2007, to comply with water savings targets less than 50 percent of existing homeowners have chosen to retrofit tanks.
2. Preliminary research has shown the average water reductions from mains water supplies in households with internally plumbed rainwater tanks to be, on average, 50 kL/household/year in the SEQ region in 2008.
3. A UWSRA study into decentralised systems found the average specific energy required to supply a dual flush toilet cistern from a rainwater tank could be reduced to less than 1.5 kWh/kL depending on the pump used.
4. The pumps tested were typically more efficient at high flows (greater than 15 L/min), but toilet cisterns and washing machines are typically designed to operate at low flows of 4-6 L/min and 9.6-13 L/min respectively.
5. A study of communal rainwater and recycled water supply at the Capo di Monte (at Mount Tambourine in Queensland) residential community showed that of a total potable water supply of 42 kL/household/year, 37 kL/household/year was provided by rainwater harvesting, with only a 5 kL top-up needed from the back-up bore system supply.

About UWSRA

The Urban Water Security Research Alliance (UWSRA) is leading water research and security in South East Queensland (SEQ) through a $50 million, five-year partnership between the Queensland Government, CSIRO's Water for a Health Country National Research Flagship, The University of Queensland and Griffith University.

UWSRA is addressing SEQ's emerging urban water issues through targeted, multidisciplinary research into water security and recycling.

It is Australia's largest, regionally focused urban water research program, contributing to a national effort to research water solutions for Australia.

Publications

For a list of UWSRA publications including journal articles, reports, conference papers and annual reports, visit:
http://www.urbanwateralliance.org.au/publications