



# Water Research Centre

## The Environment Institute



November 2011

### What's happening in the Water Research Centre at the University of Adelaide

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- Plus many more articles about the successful members of the RWC

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##### Water Poem

Welcome to the Water Research Centre Newsletter. In this issue we learn more the successes of members from the Water Research Centre *Justin Brookes, Director*



Black box, lignum and red gum seedlings on the Lower Murray floodplain after three floods 2010-2011

Photo by Anne Jensen

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Information about the Water Research Centre's structure and members, and other Water Links, can be found at:

**WRC website: <http://www.adelaide.edu.au/environment/wrc/>**

## From the Director

Another busy and successful year has passed and it is good to reflect on the achievements of the Water Research Centre membership and our collaborators during 2011. I am continually impressed and proud of the contribution that the University of Adelaide is making in providing science and engineering advice to the water sector. This is evidenced by participation in Think Tanks, Leadership programs, awards and accolades as well as some outstanding research outputs.

2012 is shaping to be even bigger, better (and busier) as new Goyder projects come online, we develop new areas of research and have a renewed focus on developing tomorrow's leaders with an early career researcher program.

Thank you to all who have attended Water Research Centre events and taken an interest in our research program in 2011. I look forward to sharing with you some exciting new initiatives in 2012.

Justin Brookes  
Director, Water Research Centre

## NRM (Commercial Forests) Amendment Bill Passed

State Parliament has recently passed the Natural Resource Management (Commercial Forests) Amendment Bill, the first legislation of its type in the world. The Bill requires the use of water by forestry to be included in water accounting and that commercial forests be subject to the same water allocation planning processes as other water users such as irrigation. This is a clear demonstration of leadership in water policy development by South Australia. Before the Bill was taken to Parliament, a review of the impact of forestry in the South East was commissioned. The Water Research Centre and the Department for Water co-lead a team of sixty individuals from twenty different organisations to undertake the science review. The review demonstrated that commercial plantation forests have an impact on rainfall that was destined to recharge aquifers or flow as run-off into streams and water bodies and that this significantly impacts on the availability of water resources and water tables.

For a summary of the review, visit the Water for Good website:

<http://www.waterforgood.sa.gov.au/wp-content/uploads/2011/03/sewsr-exec-summary.pdf>

## New Staff

### to the School of Civil, Environmental & Mining Engineering

**Dr Seth Westra** joined the School of Civil, Environmental & Mining Engineering early September. Before joining the University, Seth worked as a senior research associate in the hydrology group at the University of New South Wales and as a hydrologist at Sinclair Knight Merz in fields of flood hydrology, hydroclimatology, and hydrological statistics.



Since commencing at the University of Adelaide, Seth has been working on a Goyder Institute for Water Research funded project looking at the implications of climate change on runoff in the Onkaparinga catchment, one of Adelaide's main sources of potable water supply.

Seth's primary research areas currently include statistical downscaling to estimate future rainfall extremes at very short (sub-daily) timescales to use as the basis for flood estimation; generation of synthetic rainfall sequences at ungauged locations; evaluation of the capabilities of global climate models to simulate hydrological time series; and the development of seasonal rainfall and stream flow forecasts at lead times of up to 12 months. Seth is also actively contributing to various aspects of the revision of the Australian Rainfall and Runoff flood guidelines, including work on continuous rainfall simulation as well as the investigation of the coincidence of extreme rainfall and coastal storm surge for coastal flood assessments.

Recently Seth has had success in an ARC discovery project "A new strategy for design flood estimation in a non-stationary climate" for a total of \$320,000. The objective of the project, administered by the University of New South Wales, will provide a renewed focus on design flood estimation that takes into account a changing climate where assumptions of stationarity are no longer tenable. In fact, evidence suggests that global warming will result in an increase in the frequency and/or magnitude of heavy rainfall, leading to flooding with potentially devastating consequences. Dr Westra will collaborate with the Prof. Ashish Sharma and Dr Rajeshwar Mehrotra, co-authors of the ARC discovery project.

## Graeme Dandy & Holger Maier win Best Paper

Congratulations to Holger and Graeme for the prestigious award for the paper "Management Option Rank Equivalence (MORE) - A New Method of Sensitivity Analysis for Decision-Making" by J.K. Ravalico, G.C. Dandy and H.R. Maier. The paper has been named as the best paper published in Environmental Modelling and Software, in the "Generic Modelling and/or Software Methods" category in 2010. (Journal link: <http://www.sciencedirect.com/science/journal/13648152>)

The relevant excerpt from the Editorial announcing the awards states, "The "Best Paper 2010: Generic Modelling and/or Software Methods" was awarded to J.K. Ravalico, G.C. Dandy and H.R. Maier for "Management Option Rank Equivalence (MORE) – A new method of sensitivity analysis for decision-making." This paper presents a sensitivity analysis method, MORE, for models used to assist in the selection of two or more alternative management options. MORE determines the smallest and largest changes in model inputs that result in a change in the ranking of management options, using parameter bounding techniques and numerical optimisation. The authors demonstrate the method with a case study of the MSMBIGMOD flow and salinity model." The full editorial can be found here:

<http://www.sciencedirect.com/science/article/pii/S1364815211002416>

## Global review of the risks of climate change on algal blooms.

**A/Professor Justin Brookes** (Director Water Research Centre) and Dr Cayelan Carey (Cornell University) recently published a paper in the prestigious 'Science' journal reviewing the risk of climate change on algal blooms in reservoirs. Cyanobacterial blooms present health risks worldwide for humans and livestock that drink or use contaminated water, and also represent substantial economic costs to communities due to water treatment, lost tourism and recreation revenue, and declining property values. These explosive growths occur in fresh and marine water, and may be increasing globally. One recommendation is that water managers must address the effects of climate change when combating cyanobacterial blooms. However, recent studies suggest that controlling nutrients may be more important in increasing aquatic ecosystem resilience to these blooms. Science 7 October 2011: Vol. 334 no. 6052 pp. 46-47,

<http://www.sciencemag.org/content/334/6052/46.full?sid=c0e55e83-a314-45fb-b8cf-ad5e77a7ff64>

## Peter Cullen Leadership Program 2011

**Dominic Skinner** who recently completed a PhD from School of Earth Environmental Sciences was invited to participate in the 2011 Peter Cullen Trust Leadership Program held in August in Adelaide, and November in the ACT. This program helps participants build their leadership, media and communication skills and have a better understanding of the policy-making process. The aims of the Leadership program are to promote the skills of being a bridge between good science and good policy,



Dominic's PhD focused on water quality and sediment distribution in the Lower Lakes, SA. He is a 2011 scholar with the Wentworth Group of Concerned Scientists and has been runner-up for the Australian Future Water Leadership Awards. Dominic now works in Melbourne on a joint position with Uniwater, on the Australian Water Project, and with eWater, using causal assessment tools to improve environmental management.

## Academy of Sciences High Flyers

**Davina White** and **Kane Aldridge** both from the School of Earth Environmental Sciences recently attended the Australian Academy of Sciences High Flyers Think Tank in Brisbane. Davina and Kane were the only two University of Adelaide candidates to be nominated and selected to attend the "Think Tank", which is held annually to discuss topics of national importance. This year the theme was "*Stressed Ecosystems: Better Decisions for Australia's Future*". Four Australian ecosystems were discussed as case studies, Queensland's Surat and Bowen Basins, Melbourne's peri-urban grasslands, the Ningaloo Marine Park, and the Murray-Darling Basin. Discussions focused on the capability of scientific models to support decision-making and facilitate the management of Australian ecosystems. The recommendations from the discussions of the four case studies offer options for a 'way forward' to underpin government policy development and research prioritisation and will be published as Proceedings and made available on the Academy's website:

<http://www.science.org.au/events/thinktank/thinktank2011/>

Please also refer to link for the Environmental Institute:  
<http://environmentinstitute.wordpress.com/>

## Outstanding Research Success

**Professor Bronwyn Gillanders** has recently achieved outstanding success in attracting nationally competitive funding for research with her collaborators. She has had two projects approved under the Australian Research Council (ARC) Linkage Program:



Seascape genetics for shark management: an innovation in sustainable fisheries modelling (\$290,000) with partners Marine Fishers Association, Nature Foundation SA, SA Department of Primary Industries and Resources, South Australian Museum, WA Department of Fisheries and research collaborators Corey Bradshaw, Steven Donnellan and Charlie Huveneers

Temperate trophic cascades: impacts of seal foraging on benthic community dynamics (\$217,000) with partners NSW National Parks and Wildlife Service, NSW Office of Environment and Heritage, Nature Foundation SA, SA Department of Environment and Natural Resources; with research collaborators Brendan Kelaher, Sean Connell, Will Figueira, Melinda Coleman and Simon Goldsworthy

Professor Gillanders was also successful in leading a consortium of researchers to attract funding from the ARC Linkage Infrastructure, Equipment and Facilities Program for new mass spectrometers capable of isotope analysis to be used across earth and environmental sciences, physiology and palaeoecology. The mass spectrometers are suitable for both laboratory and field conditions and will ensure Australia remains at the forefront of international research, attract collaborations and lead to outcomes of global significance.

## Bronwyn wins State Government Scholarship

**Bronwyn Gillanders** was one of six winners of State Government scholarships to help improve the profile of women in science and build their research reputations internationally. The \$15,000 professional development scholarships were presented on August 22 by the Science and Information Economy Minister Jay Weatherill at the inaugural Women in Science Symposium at the RiAus Science Exchange. Bronwyn was awarded the scholarship for her research in marine ecology and sustainable fisheries. The scholarships have been awarded to outstanding early to mid-career female science, technology, engineering and mathematics researchers.

## 6th ACCARNSI Early Career Researcher Forum and Workshop

**Chris Stokes**, PhD candidate and **Matt Gibbs** from the School of Civil, Environmental & Mining Engineering have been accepted as 2 of 30 participants to attend the upcoming Australian Climate Change Adaptation Research Network for Settlements and Infrastructure Early Career Researchers Sixth National Forum & Workshop in Maroochydore from 21-23 November 2011. More information regarding this workshop can be found on the flyer link: [http://www.nccarf.edu.au/settlements-infrastructure/sites/www.nccarf.edu.au/settlements-infrastructure/files/file/6th ECR ACCARNSI Call for Abstracts Nov11.pdf](http://www.nccarf.edu.au/settlements-infrastructure/sites/www.nccarf.edu.au/settlements-infrastructure/files/file/6th_ECR_ACCARNSI_Call_for_Abstracts_Nov11.pdf)

## Science Review Guide to MDB Plan

Check out the Goyder Institute for Water Research website for the releases of the **Science Review Guide to the MDB Plan** and a review of the Coorong Lower Lakes and Murray Mouth (CLLMM) science. <http://www.goyderinstitute.org/news/index.php>

If you would like to receive the Goyder Institute's newsletter and don't already do so; please email [goyder@csiro.au](mailto:goyder@csiro.au) or contact Claire Punter on [claire.punter@csiro.au](mailto:claire.punter@csiro.au).

In this current newsletter you will find an update on ongoing projects and projects completed to date. Also nominations for new stipend top-up PhD scholarships from the Goyder Institute for 2012-2014.

## Express News

**Prof. Holger Maier** has been appointed as an Associate Editor for Water Resources Research, commencing on November 1 this year.

**Congratulations to Jinzhe Gong**, PhD student, was recently awarded the "best paper" award at the recent ICPTT 2011 International Conference on Pipelines and Trenchless Technology, 2011, that was recently held in Beijing, China.

**Justin Brookes** received a Water Research Foundation grant entitled Climate Change and Cyanobacteria. With co-investment from SA Water an international team has been assembled to collaborate on this project.

Seminar by Hedwig van Delden on "**Integrated modeling for policy support: International case studies in water resource management and spatial planning**" in Benham Lecture Theatre, 6 December at 4.00pm

## WATER WEDNESDAY

**'Desalination: Future directions for Australia's world class facilities'**

**July 27th, 2011**

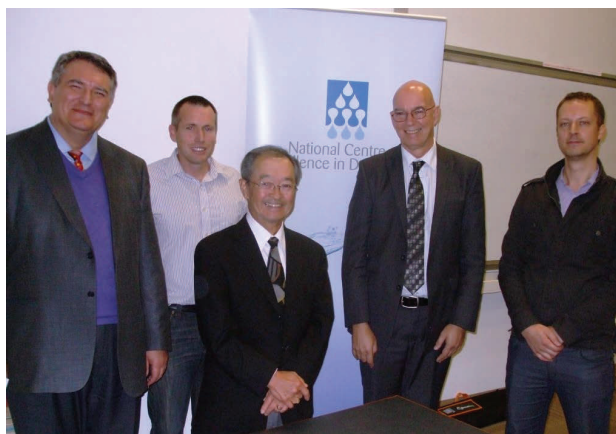
This joint AWA Technical Meeting and Adelaide University *Water Wednesday* forum delivered useful insight into the future of Australia's desalination facilities, from the viewpoint of two world leaders in the field of Desalination. The speakers addressed topics including key trends in Desalination, technology advancements for energy reduction, environmental challenges and solutions; as well as priority research themes.

**Mr. Nikolay Voutchkov**, the President of Water Globe Consulting in Connecticut USA, shared his extensive expertise in planning, permitting and implementation of large water treatment, desalination & water reclamation projects in the US and worldwide. Nikolay presented a general overview of the technology behind desalination, discussed the advantages of various plant designs and provided a detailed explanation of the Reverse Osmosis (RO) process. He explained current key desalination trends in the context of changing supply and demand for water resources, and Australia's leading status in development of new technologies. He described the technological advancements for energy reduction and the environmental challenges with reducing intake impacts, concentrate discharge management and the minimisation of plant carbon footprint.



Currently, 1% of the world's water is provided by desalination plants, with 16% of Australia's water supply produced by coastal desalination plants. The majority of desalination plants use reverse osmosis from a coastal supply to produce potable water. With continued advancement in membrane technology for reverse osmosis and in energy technology, desalination has become an economic option and will be even more cost-competitive in the future. Long term investment in research and development has the potential to reduce costs of desalinated water by 80% in the next 20 years.

Nikolay Voutchkov, Justin Brookes, David Furukawa, Neil Palmer (CEO of NCED) & Dr Aaron Zecchin (University of Adelaide)  
Photo by Anne Jensen



## WATER WEDNESDAY cont.

The second speaker, **Professor David Furukawa**, the Chief Scientific Officer of the National Centre of Excellence in Desalination (NCED) and chairman of the Research Advisory Board, National Water Research Institute, provided examples from his career in desalination, and explained how the technology is beneficial in a number of areas. Professor Furukawa is one of the world's leading experts with more than 40 years experience in desalination. Professor Furukawa highlighted the importance of collaboration with the other research institutions both nationally and internationally.



Professor Furukawa outlined some of the emerging ideas on desalination, including 'captive deionisation' and 'membrane distillation'. Future funding aims to provide further research on: affordable remote RO plants, membrane technologies, seawater algal control by reducing nutrients in desalination plants, reducing ferric sludge used in pre-treatment methods, marine organism growth in SWRO intake pipe work, coal seam gas and mining opportunities.

The audience asked questions about the necessity of a desalination plant in Adelaide and concerns over the possible future pollution of the Spencer Gulf. Both speakers answered the concerns raised with scientific evidence, with David also stating that desalination provides essential water to remote communities, therefore enabling them to survive. Nikolay also explained that although recent years have been wet, a desalination plant provides a reliable water source for future droughts.

The event was attended by over 100 people from industry and the public alike, and chaired by Dr Aaron Zecchin of the Water Research Centre. Special thanks go to our sponsor, the National Centre of Excellence in Desalination.

To hear more about these ideas, listen to the podcast on the Water Research Centre's website:  
<http://www.adelaide.edu.au/environment/wrc/event/2011/ww-july-2011.html>

Mason Willis - AWA YWP and Julie Francis, Water Research Centre

## FOUR in 40

Four in 40 forums are a collaboration between the Water Research Centre of The University of Adelaide, Department For Water and SA Water, to promote exchange of information on projects and networking between members of each organisation. During the last 6 months four forums have been held, two with Department for Water and two with SA Water. These forums comprise of four 10 minute presentations.

### Four in 40 on 30<sup>th</sup> May with the Department for Water

#### *Climate Change and forward predictions for management.*

Speakers, **Mr Graham Green**, from DFW, spoke on the topic of *"Predicting the implications of climate change for water resources"*, followed by **Dr Mark Thyer**, from the University of Adelaide, presented to the audience on the topic of *"Improving predictions from hydrological models"*.

**Mr. Brad Udall**, the Director of Western Water Assessment, University of Colorado & NOAA, a visitor to Department for Water, kept the audience entertained with his presentation on *"Managing Water in a changing climate"*. Unfortunately, **Dr Jennie Fluin**, from the University of Adelaide was unable to present due to illness, her presentation was given by a colleague, Dr John Tibby. The presentation *"A palaeo perspective on the history of the Lower Murray and its relationship to past climate"*.



If you would like to hear these presentations, please look up the link: <http://www.adelaide.edu.au/environment/wrc/event/2011/fourin40/climatechange/>

### Four in 40 on 25<sup>th</sup> August with SA Water

#### *The Changing Water Scene: Emerging issues around demand, alternative sources and water quality'.*

**Ms Fiona Paton**, a PhD candidate from the School of Civil, Environmental & Mining Engineering, University of Adelaide, began the forum with the topic of *"Options for sustainable urban water use"*. Next **Dr Rob Daly**, of SA Water followed with *"Modelling Water Quality in the lower River Murray"*. **Dr Todd Wallace**, the School of Earth & Environmental Sciences, University of Adelaide gave an interesting presentation on *"The impacts of ponded floods on dissolved oxygen conditions in managed wetlands"*

**Mr Mike Burch**, from SA Water finished the afternoon with a presentation on *"The water quality impacts of the transition from extreme low to high flows in the River Murray. A preview of future climatic shifts?"*

These presentations can be found at:

<http://www.adelaide.edu.au/environment/wrc/event/2011/fourin40/urbandesign/>

### Four in 40 on 5 September 2011 with the Department of Water

#### *What Science do we need to inform decision making?*

The first speaker, **Mr. Jim Barratt** from the Department for Water, spoke about *"Using risk based frameworks to provide science support to water planning"*. **Dr Seth Westra**, a new appointment to the University of Adelaide followed with the topic; *"The implications of climate change on flood risk in Australia"*. **Ms Chrissie Bloss**, from the Department for Water, followed next with *"What science do we need to manage rivers in response to droughts and floods – some learnings from the River Murray"*. Finally, **Dr Matt Gibbs**, a joint appointment with the School of Civil, Environmental & Mining Engineering, University of Adelaide and the Department for Water, presented on *"Decision support tools for sustainable management"*.

These presentations can be found at:

<http://www.adelaide.edu.au/environment/wrc/event/2011/fourin40/sept5/>

### Four in 40 on 22 September 2011 with SA Water

#### *Emerging water quality issues*

**Assoc Prof Sean Connell & Dr Bayden Russell**, from the School of Earth & Environmental Sciences, University of Adelaide, began the afternoon with a presentation on: *"Emerging water quality issues in marine environments"*.

**Dr Milena Fernandes**, from SA Water provided *"An overview of marine research underway in SA Water"*. **Dr David Lewis**, from the School of Chemical Engineering, University of Adelaide, gave an exciting look at the *"Opportunities for algal biofuels in waste water"*. Finally, **Dr Sandy Dickson**, from SA Water, presented on the *"Flow cytometry and fluorescence for assessing the cell health of algae and cyanobacteria"*.

<http://www.adelaide.edu.au/environment/wrc/event/2011/fourin40/emergingwaterqualityissues/>

## Condition Assessment of Pipelines Using Transients – Industry Interaction

For over 15 years the WaterSYSTEMS Research Group of the School of Civil, Environmental and Mining Engineering at the University of Adelaide has been undertaking research on pipeline condition assessment techniques and ways of modelling unsteady water flow in pipes. Members of the group investigate ways to detect and locate leaks, blockages, areas of increased pipe internal roughness and air pockets in pipelines and pipe networks as part of water distribution systems using transient pressure pulses. The WaterSYSTEMS Research Group has conducted a number of field trials in South Australia (Willunga, Parkside, Morgan - Whyalla pipeline and Iron Knob) which have demonstrated the potential of transient wave analysis in pipe condition assessment and leak detection.

Although there are a number of available commercial pipeline condition assessment techniques, such as (i) acoustic techniques, (ii) ground penetrating radar, (iii) electromagnetic techniques, (iv) tracer gas injection and (v) closed circuit TV (CCTV), they are either inefficient for long transmission mains, time consuming or costly to implement when compared to transient pressure analysis.

Prof. Angus Simpson and Dr Mike Rumsewicz (the Research Development Coordinator For the School of Civil, Environmental and Mining Engineering) recently visited water utilities in Melbourne, Sydney and Brisbane with the objective of discussing (i) the pipe condition assessment capability of the WaterSYSTEMS Research the capability of the Water Systems group using transient-based methods; (ii) the use of transients for detecting cross-connections in dual reticulation systems.

Discussion papers had been prepared on each of these topics and distributed through the Water Services Association of Australia (WSAA) to interested personnel in the 36 member organizations. A seminar was held in Melbourne at Yarra Valley Water Condition assessment seminars were also held in Sydney and Brisbane attended by Sydney Water and Hunter Water, NSW, Queensland Urban Utilities and Unity Water.

The interest of water utilities in the research has been strong and there are good opportunities for obtaining funding to carry out trials on different sized transmission mains to determine their condition. Moreover, a trial of condition assessment on sewer pipelines for SA Water is being investigated as a candidate for the pipeline from Lobethal to Bird in the Hand.

## Detecting Cross-Connections in Dual Reticulation Systems

The use of transients for detecting cross-connections in dual reticulation systems is being currently investigated by the WaterSYSTEMS Research Group. Dual reticulation systems are systems in which two independent pipe networks operate side-by-side, potable water for human consumption, and recycled water for non-potable uses, such as garden watering, toilet flushing and fire fighting. The separation of these two water types facilitates the increased usage of recycled water – an important efficiency measure aimed to tackle water scarcity issues in Australia. However, a critical issue with dual reticulation systems is the potential for cross-contamination of the potable system. Cross contamination occurs when unintentional or intentional human interference or defective valves result in non-potable water from the recycled system leaking into the potable system.

Current techniques to detect cross-connections are based on monitoring contamination by chemical, biological, physical and/or radioactive materials. However, their detection sensitivities are dependent on network scale and can be expensive both financially and in terms of time. Moreover, an important shortcoming of such physicochemical based methods is that they do not provide direct information as to the location of a cross-connection, merely its existence.

As a result, there is a need for a cost-effective and time efficient technique for identifying cross-connections in dual distribution systems. The WaterSYSTEMS group aims to reach these goals by applying the transient analysis methodology. The research consists of two phases of activities – a Technology Enhancement phase and a Field Trial phase. In the first phase, algorithms to optimise the sensor-generator layout design and algorithms to analyse and interpret the measured hydraulic signals will be developed. The second phase aims to develop a portable sensor-generator system utilising pressure transducers and pressure wave generators controlled through a laptop computer and to test it on dual mains systems, both on pipelines at a neighbourhood scale and on domestic networks at the household scale. The first part of the project is already taking place and the laboratory has been set up for testing algorithms and instruments.

*Reports by Professor Angus Simpson*

## Energy and Carbon Management in Water Distribution Systems

Given the good outcomes of the first two discussion papers, a third discussion paper has been prepared and is now being distributed to water utilities. The objective of the paper is to seek partners for applying and improving the methodology developed by the WaterSYSTEMS Research Group on the optimization of energy and carbon management in water distribution systems. The methodology takes into account the capital and operational costs and capital and operational greenhouse gas (GHG) emissions of different pumping design alternatives and can consider the different impacts of a design option on the system reliability.

Different types of algorithms can be used for the optimization of water distribution systems. In particular they can be divided in single-objective or multi-objective algorithms. In the first case, if more than one objective exists, they have to be summed up to be a unique value, i.e. the single objective, by using weights that impact the final result. In a multi-objective algorithm, the objectives are treated separately and the results is a set of non-dominated, optimal solutions, called a Pareto front. These solutions are characterized by the fact that it is not possible to improve one of the objectives without worsening one of the others. As water distribution systems have several conflicting objectives (minimizing costs, minimizing greenhouse gases, maximizing reliability, etc.), the multi-objective optimization is preferred. Moreover, the optimization can be linked to a multi-criteria analysis that allows the comparison of different design options and provides additional information to decision makers.

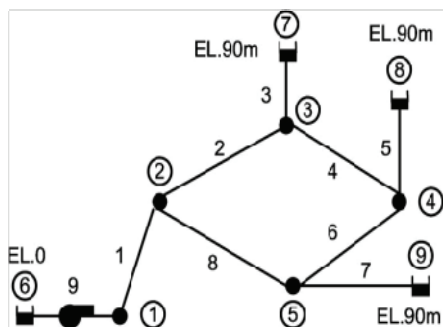
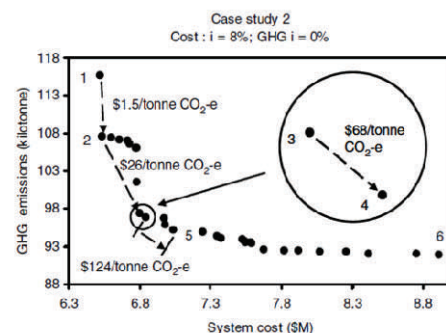


Figure 1 Case study. Optimization of costs and GHG emissions (Wu et al 2010b).

A case study from Wu et al. (2008; 2009; 2010a,b; 2011) has investigated the trade-off between costs and GHG emissions in the design of pumping systems. The study took into account total life cycle capital and operational costs, and total life cycle GHG emissions involved in the production and operation of the components, for a design life of 100 years. The problem involved the choice of pipe sizes and the pump size of the network presented in Figure 1, where one pump feeds 3 reservoirs. Hydraulic and operational constraints were also accounted for.

The result when discount rates for cost and GHG emissions are taken equal to 8% and 0%, respectively, is shown in Figure 2, where the black solid circles represent the solutions along the Pareto front. Discount rates are used in a Net Present Value analysis to compare benefits and costs occurring at different times during the design life of a project. Different values of discount rates, carbon prices and electricity tariffs have been investigated in Wu et al. (2010a), Wu et al. (2008) and Wu et al. (2009), respectively.



It can be seen that Solution 1 has the lowest cost, but the highest GHG emissions. In fact, Solution 1 has smaller pipe sizes: this reduces the capital costs but at the same time increases friction losses and the energy consumed in pumping, resulting in higher GHG emissions. By contrast, Solution 6 has the lowest GHG emissions, but the highest price. Between these two extremes, other combinations of GHG and cost are possible: the best compromise depends on the relative importance of cost and greenhouse gas emissions, as well as on other considerations such as system reliability and on the finances of the water utility.

Figure 2. Final Pareto front for the minimization of capital and operational GHG emissions and life cycle cost (Wu et al 2010b).

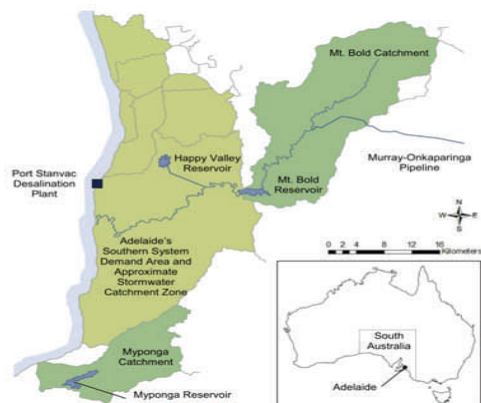


Figure 3: Adelaide's Southern Water Supply System; Map of South Australia showing the location of Adelaide (Paton et al 2010).

Another case study from Paton et al (2009) examined increasing water supply to the Adelaide Southern system through to 2100 (Figure 3). Paton et al (2009) took into account options such as the construction of a desalination plant, potentially decreased withdrawal of water from the Murray River, stormwater reuse schemes and the introduction of household rainwater tanks.

# Engineering News cont.

These interventions have different costs, GHG emissions and impacts on system reliability: the desalination plant makes the system more reliable, because it is independent on rainfall, but it produces more GHG emissions. Defining the best mix of interventions requires the assessment over a long temporal scale of the project and of the uncertainties related to population growth, climate change, water saving policies and GHG reduction policies.

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*Report from Professor Angus Simpson*

## Goyder Institute Project

The "**Optimal Water Resource Mix for Metropolitan Adelaide**" project has been submitted as an Expression of Interest (EoI) by the CSIRO, University of Adelaide, Flinders University and University of South Australia to the Goyder Institute. If the EoI is accepted, a full proposal will be developed in November-December 2011. Its final objective is to provide the scientific underpinnings for Government policy in relation to sustainable water management and water sensitive urban design (WSUD) in the context of the South Australian Water for Good plan. This includes research at the allotment / development scale to identify the most suitable WSUD options for South Australia and research at the city / regional scale to evaluate the effectiveness of WSUD, stormwater and wastewater reuse options in Adelaide in relation to other water supply options in terms of overall water security, public health, cost, greenhouse gas emissions, energy, amenity, habitat and water quality under a range of possible future scenarios (e.g. climate change).

Many of the options for reducing mains water demand are household and cluster scale water management solutions such as water efficient appliances, rainwater tanks/greywater re-use, impact of restrictions. Quantifying the impact of these small scale solutions requires an understanding of water end-uses at the household scale. The challenge is that very limited data is available in the Adelaide region on the drivers of end-use variability at the household scale.

Therefore, to accomplish this task the smart water meters project has been submitted to SA Water. The project will undertake high resolution monitoring/smart metering of a significant cross-section of households (approx. 300) with varying demographics, housing stock and appliances. The aim is to undertake intensive periods of monitoring to analyse indoor water use and combine this longer-term monitoring (within the time constraints of the project) to begin to understand the weather drivers of outdoor water use for the South Australian region. The monitoring will form an invaluable dataset which can be utilised to inform water use models and capture behavioural changes in water use in South Australia into the future and will provide the link between the key drivers of water use and the integrated urban water management (IUWM) decision framework to be developed by the overall Goyder Institute project.

*Report from Professor Angus Simpson*

# WRC Conference Calendar

## Water Management in Mining 2011 -

06 - 08 December, 2011, Holiday Inn, Perth WA, Australia <http://www.watermgmtmining.com.au/Event.aspx?id=591730>

## OzWater 12

Sydney Convention Centre, Darling Harbour, May 8-10, 2012.

There are five major conference themes and specialist stream that cover the role of water in history and heritage, traditional water management practices and non conventional systems, policy and regulations, sustainability and decision making and water and stormwater processes. <http://www.ozwater.org/>

## SimTect 2012:

Asia-Pacific Simulation & Training Conference. 18-21 June 2012, Adelaide Convention Centre, Adelaide, SA. <http://www.simtect.com.au/>

## 14th Water Distribution System Analysis (WDSA) Conference,

24-27 September Adelaide, SA.

WDSA 2012 will be held as part of the annual conference series sponsored by the American Society of Civil Engineers (ASCE). Proposed themes vary from network models, operations and optimization, to sustainable water distribution systems and to asset management, transient analysis and water quality. <http://wdsa2012.com/>

## 'Reflections on Water'

The poem 'Reflections on Water' was commissioned by the Environment Institute of The University of Adelaide as part of the project 'Water is Life'. This project is a collaboration with Zoos SA/Conservation Ark to highlight issues relating to water in the environment. South Australian poet and writer Sean Williams accepted the challenge from water scientists to create a poem around the vital issue of water, involving water researchers in a different approach to communicating key issues to Zoo visitors.

The process of writing the poem was an energetic and stimulating exercise, with the poet produced evolving versions to incorporate key messages and images in response to input from the water scientists. Sean said it was one of his most unusual and innovative commissions.

The poem is featured in a Water Soundscape at the entrance to the Zoo which is played continuously, so that visitors will hear the whole poem as they walk towards the Zoo entrance. The poem communicates the message that water is a key issue for all plants, animals and habitats, and all living creatures need water to survive.

To read the poem, click on this link:

<https://www.adelaide.edu.au/environment/wrc/event/2010/waterislife/poem.html>

Sean Williams holds a Masters in Creative Writing from the University of Adelaide and was awarded the 2009 Peter McNamara Award for Excellence for achievement in creative writing. One of his books debuted at #1 on the New York Times bestseller list.

The finished poem 'Reflections on Water' was launched at the Adelaide Zoo in National Water Week 2010, as part of the inaugural Adelaide Water Forum hosted jointly by the Water Research Centre of the Environment Institute and SA Water.

Listen to interviews as Dr Anne Jensen of the Water Research Centre talks with researchers from the Environment Institute of The University of Adelaide about the reasons why water is so important for a healthy Murray River.

<http://www.adelaide.edu.au/environment/wrc/event/2010/waterislife/>

