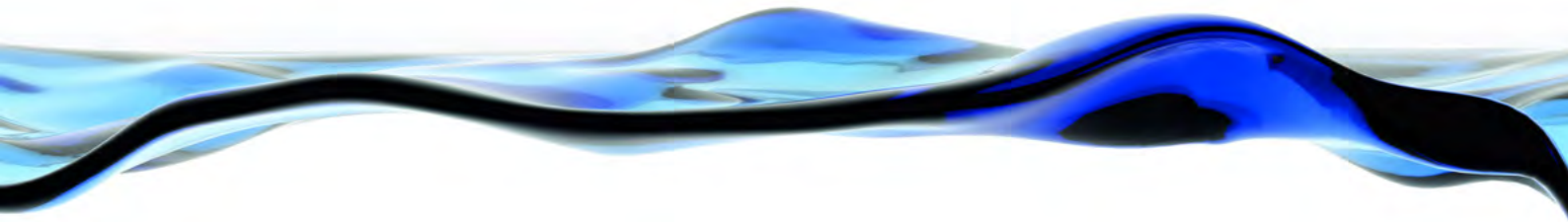
Goyder Institute for Water Research
Annual Report 2011-12



GOYDER INSTITUTE
FOR WATER RESEARCH

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Photo opposite page: "Skydiving" (at Ewens Ponds, Mt Gambier, SA) by Liz Rogers, www.lizrogersphotography.com

Message from the Chair

As the Goyder Institute finishes its second year, I am pleased to report that it has been a year of major progress for the Institute. Start-up issues have been overcome and we now have well tested processes of operation facilitated by the new highly capable Goyder Institute office team. We have established a comprehensive research portfolio prioritised in full consultation with our customers and have road-mapped objectives to measure our progress. Some of the early and high priority application of Goyder Institute water expertise has been in advising the State government on the science base for their response to the Draft Murray-Darling Basin Plans that have been issued by the Murray-Darling Basin Authority. Our ability to provide expert, independent and timely advice has been successfully demonstrated.

A highlight of the year was the inaugural Goyder Institute Water Forum held in May, which saw some 100 water researchers and policy makers meet and discuss the current research programs of the Institute and to identify future needs. Some excellent external speakers also broadened the agenda and a highlight for me was the Goyder Institute PhD students' poster displays. Over dinner, Minister Caica challenged us to ensure delivery of our research to application, really the core of innovation, and to think more broadly about the scope of the Goyder Institute in the future.

The year has seen changes on the Goyder Institute Board; Professor Caroline McMillen has taken up the position of Vice Chancellor at the University of Newcastle, Mr Scott Ashby has been appointed as the Chief Executive of the Premier's Task Force on the Murray Darling Basin Plan and Professor Mike Young has taken up several international water policy research postings. I would like to acknowledge the major contributions that all have made to the life and science of the Goyder Institute in its early years and wish them well in their new pursuits.

The Government has recently announced changes to several agencies and we have seen a new Department of Environment, Water and Natural Resources established and the Goyder Institute Board and the science teams look forward to working with the Chief Executive, Mr Allan Holmes and his new integrated teams.

Finally I would like to thank all involved in making this year such a successful one for the Goyder Institute and I look forward to seeing the fruits of our research starting to make a major difference for South Australia in the coming years.

Ian Chessell
Chair, Goyder Institute for Water Research

Message from the Director

During this past year, we have finally managed to bring the staffing of the Goyder Institute office up to full strength; with Michele Akeroyd helping to ensure that our research program maintains the highest quality and that it continues to deliver on our strategic outcomes; whilst Claire Punter ensures that everything in the office runs smoothly. Neil Power from the Department of Environment, Water and Natural Resources completes our team and he facilitates our engagement across all Government agencies. Progress has been made in streamlining Goyder Institute governance and administration processes and standard procedures for reporting and evaluation have been established. Project teams are becoming familiar with the new procedures and templates, and the quality of reporting and project monitoring has improved greatly. This has meant that we are now able to concentrate more on monitoring the quality of our ongoing research and improving the effectiveness of the delivery of project outcomes. I am especially happy about the opportunities that this has created to allow an increased engagement of the Research Advisory Committee in the project development and quality control of our research program. Stakeholder feedback indicates a high approval rating for the Goyder Institute outputs, and the quality of the science and the independence of the research findings are widely recognised.

Hon Jay Weatherill, Premier of South Australia and Director of the Goyder Institute for Water Research, Tony Minns at a Hawke Centre event in March 2012. Photo: Brooke Whatnall, Newspix

I am very pleased to see the positive effect that our roadmapping strategy has had in maintaining the focus of our research program and the quality of new research proposals. It has helped to establish the Goyder Institute as a trusted water research broker. The effectiveness of the roadmapping approach has also been recognised by the other members of the Australian Water R&D Coalition (AWRDC) during the development of strategic roadmaps for Urban Water Research across Australia. You can read more about the AWRDC further on in this Annual Report.

To reflect the evolution from project development to the delivery and uptake of research outcomes, this Annual Report pays particular attention to our key achievements to-date and some specific contributions to policy development.

Tony Minns
Director, Goyder Institute for Water Research
director@goyderinstitute.org

Photo opposite page: Claire Punter

Goyder Institute Partners

The Goyder Institute for Water Research is a partnership between the South Australian Government through the Department of Environment, Water and Natural Resources*, CSIRO, Flinders University, the University of Adelaide and the University of South Australia. The Institute will enhance the South Australian Government's capacity to develop and deliver science-based policy solutions in water management. It brings together the best scientists and researchers across Australia to provide expert and independent scientific advice to inform good government water policy and identify future threats and opportunities to water security.

** In July 2012, the former Department for Water (DFW) merged with the former Department for Environment and Natural Resources (DENR) to form the Department of Environment, Water and Natural Resources (DEWNR). Where appropriate, references in this report to former agencies have been updated to reflect the new situation.*

Goyder Institute Associates

Goyder Institute Associates typically contribute expertise and capabilities in areas outside of those contributed by the Goyder Institute Partners. Associates may participate in capacity building, knowledge exchange and/or specific research projects, and invest in the Goyder Institute Research program with in-kind commitments in the same manner as Goyder Institute Partners. The following Associate organisations have contributed to the outcomes of the Goyder Institute in 2011-12.

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Strategic Roadmap Progress

The strategic roadmaps as described in our Strategic Research Plan 2011–2015 provide a framework for planning and prioritisation of our research. The aim of the roadmaps is to ensure that we remain focussed on the medium to long-term strategic outcomes as identified by our stakeholders and customers.

Urban Water

Water Sensitive Urban Design (WSUD)

An initial project on WSUD Targets was completed and this has contributed to the WSUD public consultation document that was prepared by the Department of Environment, Water and Natural Resources. The next phase of this roadmap is to address the issues that are currently seen to be impeding a further widespread uptake of WSUD principles in urban design and management. Researchers from the Goyder Institute have engaged with the Adelaide and Mount Lofty Ranges NRM Board to discuss the development of an NRM Board business case for the implementation of a capacity-building program for water sensitive urban design for South Australia. This has led to a coordinated approach for the development of the next Goyder Institute research project aimed at identifying the actual impediments and opportunities for WSUD in South Australia. Close engagement with the State Government will ensure that the outcomes of this study will contribute directly to the development of the Urban Water Blueprint for Adelaide.

Water Resources Mix

One of the initial projects in this roadmap was devoted to the study of Managed Aquifer Recharge (MAR) and Stormwater Use Options. This project was also cofunded by the National Water Commission and the research outcomes are providing foundational information contributing to future revisions of the National Water Quality Management Strategy Guidelines in the area of groundwater and MAR. Furthermore, the catchment risk assessment approach being developed has been adopted by the projects: Water Proofing the South and Water Proofing the West in metropolitan Adelaide.

An important follow-on activity in this roadmap is the development of an integrated urban water management framework for Adelaide. The next stage towards this outcome is a detailed study of the various water resource options available in Adelaide and the development of a system to identify and evaluate an 'optimal mix' of water supply options that considers the trade-offs between multiple objectives such as supply security, economic costs (internal and external), social preferences/resistance and environmental impacts. The Optimal Water Mix project development has already involved extensive engagement with key stakeholders and research providers.

PhD Student Mostafa Razzaghmanesh working on the rainfall simulator at UniSA Mawson Lakes Campus.
Photo courtesy of Sam Noonan, www.samnoonan.com.au

Water for Industry

Water Allocation Planning and Water Quality Improvement

The aim of this roadmap is to understand the issues surrounding equitable sharing of water in multi-use catchments, with particular attention paid to the Adelaide Mount Lofty Ranges. In order identify the priority issues involved in the Water Allocation Planning process in this region, a scoping study has been carried out involving extensive engagement and consultation with stakeholders and research partners with particular knowledge of this unique region. The outcome of this scoping study will be the development of a detailed project plan for the execution of agreed priority research activities to address the most urgent issues.

In addition, a trial was carried out by the AMLR NRM Board to investigate whether a controlled upstream release of water could effectively control the occurrence of nuisance algal blooms on Torrens Lake. Researchers from the Goyder Institute analysed the outcomes of this trial to inform the effectiveness of flow management for water quality outcomes and future management and operational decisions.

Photo: Rene Kramer

Mining and Outback Water

The Goyder Institute is undertaking a research project to inform the Facilitating Long-term Outback Water Supplies (FLOWS) initiative of the State Government. Using an Aerial Electromagnetic (AEM) methodology it has been possible to undertake groundwater resource assessments in the Musgrave Ranges. The results of this characterisation of regional groundwater resources will contribute to the follow-on study related to the ongoing management of groundwater resources to support mining and outback communities.

Photo: Claire Punter

Environmental Water

River Murray

One of the early projects in this roadmap concentrated on studying the ecological response of the South Australian River Murray to the recent flooding events. This has provided invaluable knowledge and insight into the recovery processes along the river following one of the most severe droughts since European settlement. One of the main outcomes of this roadmap is to improve our detailed system understanding of the Murray-Darling Basin as a whole and the South Australian sections in particular. A scoping study has been undertaken to identify the priority research needs to inform the ongoing management of the river system and to aid in the effective implementation of the Murray-Darling Basin Plan.

During the ongoing development of the Murray-Darling Basin Plan by the MDBA, the Goyder Institute has provided reviews and scientific advice to the State Government to inform its assessments and response to various draft versions of the Plan. The work of the Goyder Institute has ranged from a detailed science review of the Guide to the Plan, an expert panel assessment of the Proposed Plan and a Peer Review of the South Australian Government analysis of additional modelled water recovery scenarios.

Photo: CSIRO Scienceimage

Surface Water/Groundwater/Wetland Relationships

The strategic objective of this roadmap is to improve understanding and to develop tools to inform the planning and management of surface water/groundwater connected systems. Work has concentrated on the South East of South Australia, where many groundwater dependent wetlands exist. One of the early projects in this area identified the priority issues and proposed a possible framework for a decision support tool to assist in operational and policy decisions, with the flexibility to incorporate new data and models as they become available, and to incorporate the uncertainty inherent in such information. This was supported by a study into the spatial and temporal variability of surface water/groundwater interactions around the drains in the South East. This has led to the development of a number of follow-on projects to identify the information and simulation models required to meet the requirements of a decision-support tool for the South East, including the overall water balance and variability, model scale and complexity, and the integration paths between models.

Climate Change

Regional Climate Change Downscaling

The only project to be undertaken in this roadmap is a large integrated project to develop an agreed set of climate change projections for South Australia to inform water resources planning and management decisions in a consistent manner across multiple agencies. The project consists of four major components:

1. Understanding the key drivers of climate change in South Australia.
2. Selection of GCMs for regional downscaling and projection.
3. Downscaling and climate change projections for South Australia.
4. Development of an application test bed.

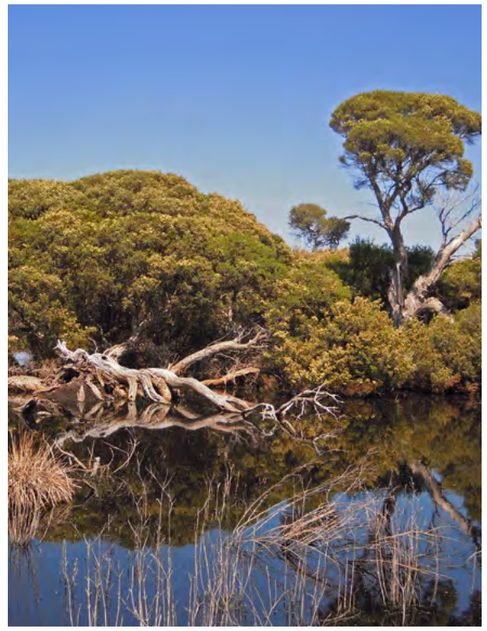


Photo: Claire Punter

The scientific research underpinning the first two tasks has been progressing very well and has been peer reviewed in leading international journals. A preliminary set of downscaled climate projections for the South Australian test case catchment of Onkaparinga has been prepared for consultation. In order to ensure that this project and roadmap is still on target to deliver useful outcomes to stakeholders in the time remaining, a mid-term review of the project will be held in October 2012.

Future directions

The 2012/13 Annual R&D Research Plan and Budget details the potential future investment in research activities over the remaining term of the Goyder Institute. Priority areas of investment will build further on the activities identified in each of the strategic roadmaps. In addition, some investment may be needed to support activities that integrate across themes and for targeted research & development advice projects that bring together existing pieces of information to support policy development and decision-making.

A small number of new research areas have been identified through consultation with Goyder Institute stakeholders, through the 2012 Annual Water Forum, the Research Advisory Committee and Management Board. The potential research areas that may form the basis for developing new project ideas in the future include:

- Further implementation of the Murray-Darling Basin Plan
- Water allocation planning of groundwater resources in regional South Australia
- Development of the overall Urban Water Blueprint for Adelaide that includes such aspects as groundwater management, urban flooding, environmental water requirements of urban streams and dealing with impacts of coastal discharges
- Implementation of the Lake Eyre Basin Rivers Assessment in close collaboration with Federal and Interstate agencies.

Knowledge Uptake

Scientific advice for the development of interim and future WSUD targets in Greater Adelaide

Julia Grant, Executive Director, Sustainable Water Resources, Department of Environment, Water and Natural Resources, has discussed the impact of the Goyder Institute project 'Scientific advice for the development of interim and future WSUD targets in Greater Adelaide'. This project contributed a scientific evidence base for the development of interim WSUD targets for consultation through regular dialogue and engagement between policy makers and researchers. This ongoing engagement process, encouraged by the Goyder Institute, was very useful in the ongoing provision of relevant and robust evidence into the decision- making process and created a strong working relationship between the researchers and policy makers. This working relationship has created many benefits, in particular, the development of a shared understanding of the policy needs of government regarding WSUD and the inquisitive nature of research and scientific investigations. The role of the Goyder Institute in providing rigorous and robust science, and being able to effectively communicate these science outcomes for policy makers, has been instrumental in the preparation of evidence based WSUD targets for consultation. The Goyder Institute process sets an example of effective interactions in the science-policy interface and gives credibility to the development of evidence based policy.

Expert Panel Assessment of the Likely Ecological Consequences in South Australia of the Proposed Murray-Darling Basin Plan

The Expert Panel ecological review process was an example of how science supported policy development in a real time situation. Diane Favier, Manager, Murray-Darling Basin Policy, Premier's Murray-Darling Basin Plan Taskforce, has explained how a cooperative approach between State Government officers and Goyder Institute scientists has helped to facilitate the provision of quality scientific information into the decision making process and also helped to further develop the knowledge base of State Government. As one of the key clients seeking delivery of outcomes from the Expert Panel, the Taskforce appreciated their timeliness, quality of advice and responsiveness. The on-time delivery and quality of the scientific assessment by the Expert Panel enabled the outcomes of this important Goyder Institute project to inform the Government's response to the proposed Basin Plan.

Photo: Claire Punter

Managed Aquifer Recharge Framework

The Managed Aquifer Recharge and Stormwater Use Options (MARSUO) project is a collaborative project between the National Water Commission (NWC) and the Goyder Institute for Water Research. The project is filling specific knowledge gaps that address water safety and the acceptance of stormwater as a viable supply option. Research results on public health risk assessment, public engagement, infrastructure assessment, and a net benefits assessment have been delivered to the NWC. This work has in part contributed to the development of a proposed national MAR feasibility assessment and implementation framework as described in the National Water Commission Waterlines Report Series No 73, March 2012.

Impacts of Climate Change book

The project leader of our major climate change project, Prof. Simon Beecham, was invited by the International Water Association to co-author a book entitled "Impacts of Climate Change on Rainfall Extremes and Urban Drainage Systems". It provides a state-of-the-art overview of existing methodologies and relevant results related to the assessment of the climate change impacts on urban rainfall extremes and urban hydrology. It focuses on difficulties and limitations of the current methods and discusses issues and challenges facing the research community in dealing with the climate change impact assessment and adaptation for urban drainage infrastructure design and management. The book was published in June 2012.

Citation:
Willems, P., Olsson, J., Arnbjerg-Nielsen, K., Beecham, S., Pathirana, A., Bülow Gregersen, I., Madsen, H. and Nguyen, V.T.V. (2012), Impacts of Climate Change on Rainfall Extremes and Urban Drainage Systems, IWA Publishing, 226 pages, ISBN: 9781780401256 (paperback), ISBN: 9781780401263 (eBook).

External Engagement

To improve communication around Goyder Institute activities and publications, a range of mechanisms has been identified and implemented during 2012. Most significant was the launch of an updated and improved website in February 2012. This update has allowed the Goyder Institute office to now manage web content directly and ensure that information is kept current as well as have the functionality to create news items on Twitter, Facebook and LinkedIn. It is possible for interested parties to download relevant publications and to subscribe to our newsletter through our website at www.goyderinstitute.org.

Annual Water Forum 2012

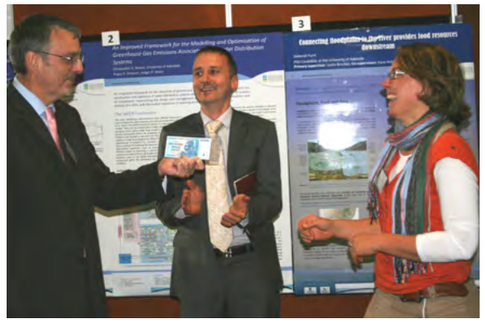
The inaugural Goyder Institute for Water Research Annual Water Forum was held on 28 and 29 May 2012 in the Goyder Pavilion at the Wayville Showgrounds in Adelaide. The event was attended by more than 100 delegates over the two days. A networking dinner was held on the first day with special guest speaker the Hon Paul Caica, Minister for Water and the River Murray.

PhD Students putting up their posters for display at the Annual Water Forum 2012. Photo: Claire Punter

After almost two years of operation of the Goyder Institute, this event provided an opportunity to showcase some of the scientific achievements and outcomes over the previous two years, and offered the opportunity to provide feedback and suggestions to inform the ongoing strategic research directions and goals.

PhD Student Eva Beh with her poster. Photo: Claire Punter

The two day program covered all areas of the Goyder Institute research portfolio. In addition to presentations from the partner research organisations, the event included a number of invited speakers from around Australia. This, combined with ample opportunity for audience interaction provided a full and diverse program that addressed local, national and international water resource issues. The Poster Session and presentations by Goyder Institute sponsored PhD students provided an opportunity for the PhD students to raise their profile and meet with stakeholders outside of their respective organisations.



Goyder Institute Director, Tony Minns and Forum Facilitator, Paul Dalby presenting PhD Student Saskia Noorduijn with her prize for the best poster presentation. Photo: Claire Punter

The next Annual Water Forum will be held in early June 2013 and the feedback received from attendees and the lessons learned in organising such an event will ensure that the 2013 Forum will be even better.

The University of Central Florida

In February 2012, the Goyder Institute signed a Memorandum of Understanding with the Stormwater Management Academy of the University of Central Florida to promote cooperation for the purpose of educational and cultural exchange in the area of stormwater management research.

The MoU focuses on a range of opportunities to foster collaboration that may include the exchange of theses, teaching materials, and other scientific and technological literature; research collaboration and international conference organization; exchange of faculty, scholars, and students for lecturing, advanced studies and research; and the creation of collaborative research proposals that benefit mutual scientific understanding.

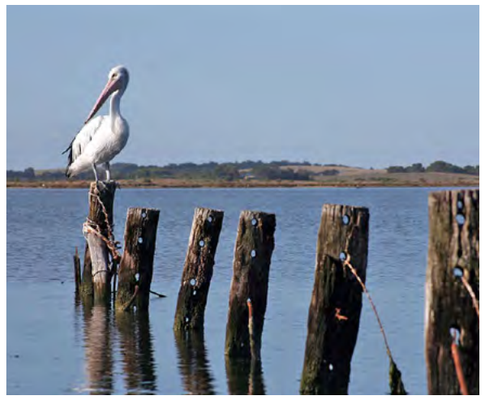


Photo: Claire Punter

GEORGE GOYDER ... DID YOU KNOW?

George Woodroffe Goyder, Surveyor General of South Australia, covered more than 32,000 kilometres on horseback to classify grazing leases in the State's north, visiting 83 stations in less than 20 months.

He led the initial survey party in the Northern Territory and recommended Palmerston (Darwin) as the capital site.

In 1867, Goyder persuaded the government to spend £300,000 on drainage in the south-east and advised many pastoralists on water problems, rejecting schemes such as irrigating the Adelaide plain by a canal from the River Murray.

Opposite page: Map of South Australia showing 'Goyder's Line of Rainfall' which was first used in the mid 1860s for the reassessment of leases and the relief of drought stricken pastoralists. Map courtesy of the National Library of Australia. Goyder's Line enhanced by Alberto Zaniolo.

Australian Water Research and Development Coalition

The Australian Water R&D Coalition (AWRDC) is a collection of the Urban Water R&D 'brokers' in Australia and includes the National Water Commission, the Australian Water Recycling Centre of Excellence, the National Centre for Groundwater Research and Training, the National Centre of Excellence for Desalination, Water Services Association of Australia, Smart Water Fund, Water Quality Research Australia, the Urban Water Security Research Alliance, and the Goyder Institute for Water Research.

Each of these organisations facilitates delivery of research through engagement with governments, industry, the private sector and researchers. The AWRDC provides a forum where holistic research investment can be brought together outside the mandate of an individual organisation. This leverage of knowledge will result in an outcome greater than any one organisation can deliver on its own, supporting urban water management from source, to tap, to wastewater and beyond.

The goals of the AWRDC include the development of roadmaps of R&D activity in support of urban water research; the coordination of a national needs and capability forum for urban water R&D; and improved engagement for key water sectors to access AWRDC member organisations and their activities. During 2011/12, the AWRDC hosted a workshop at Ozwater12 to engage with the water industry and to seek feedback on draft versions of its strategic urban water roadmaps. The AWRDC members have been engaging with key stakeholders in the government, private sector and research providers in the lead up to the first Needs and Capabilities Forum in September 2012.

In addition, the AWRDC is progressing a coordinated approach to knowledge and data management to ensure that research outcomes remain accessible well into the future. A website was also developed and launched at www.awrdc.org.au.

AWRDC

Governance

Management Board

The Management Board met six times during the 2011-12 financial year to set the strategic vision and direction for the Goyder Institute and to monitor its implementation and outcomes. It also reviewed and approved annual research programs and budgets, and monitored the effective delivery of the research programs.

The Board comprises an Independent Chair, the Director of the Goyder Institute, two representatives from CSIRO, two representatives from the State Government, and one representative each from Flinders University, the University of Adelaide and the University of South Australia.

The members of the Goyder Institute Management Board from July 2011 until June 2012 were:

Ian Chessell
Independent Chair

Scott Ashby
Chief Executive, DFW*

Jim Hallion
Chief Executive, DP&C

Bill Young
Director, WfHC Flagship, CSIRO

Scott Keyworth
Manager Research Adoption, WfHC Flagship, CSIRO

Tony Minns
Director, Goyder Institute for Water Research

David Day
DVC (Research), Flinders University

Mike Young
Director, Environment Institute, University of Adelaide
July – December 2011

Bob Hill
Executive Dean, Faculty of Sciences, Adelaide University
From January 2012

Caroline McMillen
DVC (Research and Innovation), UniSA
July – August 2011

Sakkie Pretorius
DVC (Research & Innovation), UniSA
From December 2011

Research Advisory Committee

The Research Advisory Committee (RAC) met five times in 2011-12 to review progress, milestones and implementation of Goyder Institute research activities and to consider the strategic direction for the research projects into the next years of the Institute. It reviewed and approved several reports for inclusion in the Technical Report Series and formulated recommendations for the Board regarding the direction, content and quality of project plans and expressions of interest for various research activities proposed by the Goyder Institute research partners.

The RAC is chaired by the Goyder Institute Director and comprises a research coordinator from each research provider, up to two representatives from agencies as determined by the State, a representative of SARDI and a representative of the Australian Water Quality Centre.

The members of the RAC from July 2011 until June 2012 were:

Chair: Tony Minns
Director, Goyder Institute for Water Research

Mike Burch
Manager, Research & Innovation, AWQC

Jim Cox
Principal Scientist, Water Resources and Irrigated Crops, SARDI

Ian Prosser
Science Director, WfHC Flagship, CSIRO

Ben Bruce
Director, Science, Monitoring and Information, DFW*

Neil Power
Director, State Research Coordination, DEWNR

Chris Saint
Director, SA Water Centre for Water Management and Reuse, UniSA

Justin Brookes
Director, Water Research Centre, University of Adelaide

Craig Simmons
Director, NCGRT, Flinders University
July 2011 – Feb 2012

Peter Cook
Deputy Director, NCGRT, Flinders University
From February 2012

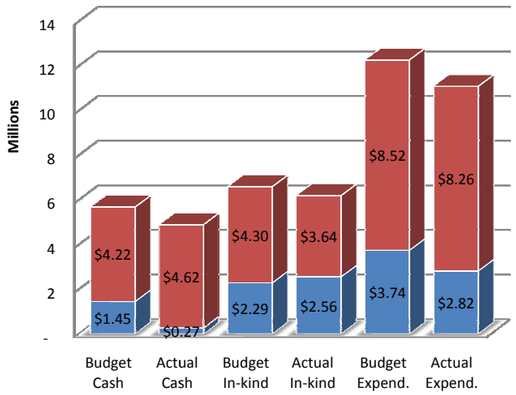
Financial Report

Overall Investment

As of 30 June 2012, the Goyder Institute has committed $24.47M of funding from a total of $50M.

Institute Budget and Expenditure by Year

(2010/11 - blue; 2011/12 - red)

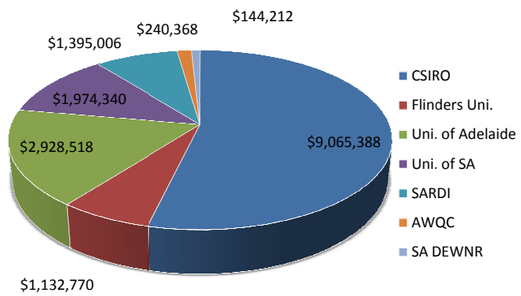


Annual Expenditure

After a slow start in 2010/11, the overall expenditure is now tracking well compared to budgeted expenditure. There has been a most noticeable catch-up in actual cash expenditure compared to budget due to improved administrative procedures for milestone reporting and invoicing.

Allocation of Research Budget per participant

Research projects	$16.88M
ANZSOG Chair	$2.00M
Knowledge Management & Dissemination	$0.40M
PhD Supplements	$0.78M
Goyder Institute office	$4.41M
TOTAL	**$24.47M**



Trust Account

The closing balance of the Trust account at 30 June 2012 was $5,565,851. During the course of the year, the Trust received $5,000,000 in cash from the State, $300,795 in interest and $65,000 from SA Water as a contribution towards Project U.2.2. During 2011/12, the Trust has paid $4,132,206 to the research participants as cash contributions to research projects and has paid $487,465 to CSIRO for reimbursement of Goyder Institute Office expenses.

Key Project Achievements

The 2011/12 year has been a productive year for the Goyder Institute, with several projects completing and delivering significant pieces of work. Some of the key achievements in 2011/12 include:

Climate Change Theme: Program C.1 Regional downscaling	
C.1.1. Downscaled Climate Projections for SA Development of an agreed set of downscaled climate projections for South Australia.	**Key Achievements:** The project leader, Simon Beecham, was invited by the International Water Association to co-author a book on the impacts of climate change on rainfall extremes, which was published in June 2012. The varying influence of climate drivers on rainfall across the 8 SA NRM regions has been published in a leading scientific journal. A preliminary set of downscaled climate projections has been produced for the Onkaparinga test case catchment. The BATEA error analysis framework provides an elegant approach for estimating predictive uncertainty, and for diagnosing modelling strengths and weaknesses. A suite of diagnostic tools have been developed to measure model performance, and identify possible actions to remedy model weaknesses.
Urban Water Theme: Program U.1 WSUD	
U.1.1 WSUD Targets Identify interim WSUD targets that are appropriate for the climate and urban environmental conditions of the greater Adelaide region.	**Key Achievements:** The outcomes of the work have been incorporated into a WSUD consultation statement by the Department for Water and this has now been issued to government agencies for consultation.
Urban Water Theme: Program U.2 Water Resources Mix for Adelaide	
U.2.1 Managed Aquifer Recharge and Stormwater Use Options (MARSUO) Assessment of the safety, public acceptance, economics and environmental impacts of alternative options for stormwater use in Australia through a case study in Adelaide.	**Key Achievements:** A research plan for pathogen fate in aquifers was produced to inform future revisions of the NWQMS Guidelines for Groundwater Protection and MAR. Work undertaken in MARSUO is providing foundational information to inform the revision process. The catchment risk assessment approach developed in MARSUO has been adopted by Water Proofing the South and Water Proofing the West projects.
Industry Theme: Program I.1 Water Allocation Planning and Water Quality Improvement	
I.1.1 AMLR WAP Scoping Review and set research priorities to aid the development of a decision support tool for the development of water allocation plans (WAPs) in South Australia, with the initial focus on the Mount Lofty Ranges.	**Key Achievements:** Preparation of a draft scoping report identifying key research priorities for investment by the Goyder Institute.
I.1.2 Torrens River Water Quality Improvement Trial Determining the feasibility of an 'amenity flow' for the Torrens Lake to reduce or eliminate algal blooms.	**Key Achievements:** The water quality improvement flow trial has shown promising signs of being able to control the formation of algal blooms with releases of water from upstream. A simple model of growth and dilution of cyanobacteria biomass has been validated.
I.2.1 G-FLOWS Building a knowledge base on the location and characteristics of aquifers, and their relationship to environmental and cultural assets, to support water management in the State's far north.	**Key Achievements:** Development of airborne electro-magnetic(AEM) methodology that can utilise data collected for resource exploration to undertake aquifer characterisation and groundwater resource assessments. Using this methodology, the hydrogeology of the Musgrave Ranges has been documented.

Environmental Water Theme: Program E.2 Surface Water, Groundwater, Wetland Relationships	
E.2.2 South East (Phase 1) A research program to support the sustainable management of water in the South East.	**Key Achievements:** Finalisation of the two project Tasks, including publication of the two Technical reports, and the development of new research activity building on the outcomes of this research.
E.2.4. Improved modelling of catchments and drains. Development of a software tool based on conceptual and stochastic modelling designed to improve the ability to estimate flow volumes of drains in the South East drainage network.	**Key Achievements:** Development of the conceptual model in the study catchment has commenced.
Environmental Water Theme: Program E.1 River Murray	
E.1.3 Murray Flood Ecology Ecological responses to flooding in the Lower River Murray following drought.	**Key Achievements:** Understanding of system processes and ecological responses that will provide a science base to planning and operating environmental watering events, for example: • Red Gum response to flooding • Radio tracking Murray Cod movements during high flows and in response to blackwater events • Investigation of the recruitment triggers for Golden Perch • Identification of flow drivers influencing the composition of macro invertebrates and in-channel productivity.
E.1.4 Expert Panel MDB draft Plan Expert advice on the potential ecological implicat ions, risks and consequences of the draft Basin Plan.	**Key Achievements:** The key findings and recommendations from the Expert Panel report contributed to the SA Government response to the draft Basin Plan and provided the scientific basis for the Government's recommendations to the MDBA.
E.1.5 River Murray Scoping Review and set research priorities in the broad area of River Murray flows and environmental flow management in South Australia.	**Key Achievements:** Workshop held with key stakeholders to identify research gaps within the River Murray Road Map and the provision of expert advice regarding the options available to address these gaps.

Photo: Claire Punter

PhD Support

The Goyder Institute for Water Research PhD program supports top quality students in the three partner Universities. The Goyder Institute PhD program provides a supplement of $10,000 per annum for three years to the selected PhD candidates. In 2012, nine PhD supplements were awarded, bringing the total number of PhD candidates supported by the Goyder Institute to 17.

The Annual Water Forum provided an opportunity for the 2011 PhD candidates to present posters on their research and to network with Goyder Institute stakeholders. Saskia Noorduijn (Flinders University) was awarded the prize for best poster at this event.

PhD Students	Title	Road Map	Candidature
ADELAIDE UNIVERSITY			
Chris Stokes	Methods for the Reduction of Greenhouse Gas Emissions Associated with Water Distribution Systems	U2 Water Mix	02/2011 to 02/2014
Eva Hooi Ying Beh	Optimal Sequencing of Water Supply Options at the Regional Scale Incorporating Sustainability and Uncertainty	U2 Water Mix	02/2010 to 08/2013
Michael Di Matteo	Multi-objective decision analysis for blending of urban water resources for potable and non-potable water supply	U2 Water Mix	02/2012 to 08/2015
Deborah Jane Furst	The Chowilla Floodplain: The influence of water regime on the development and transport of zooplankton and the implications for native fish	E1 Murray	02/2010 to 08/2013
Chaturangi Wickramaratne	Synergistic effects of nutrients and climate change on cyanobacteria	I.1 WAP & WQ	03/2012 to 03/2015
FLINDERS UNIVERSITY			
Jessica Liggett	An analysis of surface-subsurface exchange and solute transport processes in a fully integrated code	E2 Wetlands	02/2010 to 08/2013
Saskia Noorduijn	Quantifying surface water-groundwater fluxes in a heterogeneous environment	E2 Wetlands	08/2010 to 08/2013
Megan Sebben	Numerical modelling of ephemeral, transient wetland systems using a fully integrated code	E2 Wetlands	03/2012 to 09/2015
Kelly Wiltshire	Connection and Continuity - Investigating Ngarrindjeri history and life ways of Waltowa Wetland	E1 Murray	03/2010 to 02/2014
Harriet Whiley	Detection of opportunistic intracellular pathogens in potable and reuse water	U2 Water Mix	03/2011 to 09/2014
Matthew Knowling	Effect of climate change and groundwater management approaches on the Uley South Basin, Eyre Peninsula	I2 Outback	02/2012 to 08/2015
UNIVERSITY OF SOUTH AUSTRALIA			
Mostafa Razzaghmanesh	Climate change and stormwater quality effects from green roof design in Adelaide	U1 WSUD	10/2011 to 10/2014
Hamideh Nouri	Precision Irrigation of the Adelaide Parklands with Recycled Wastewater	U1 WSUD	08/2010 to 12/2013
Kelly Hill	Development of low-clogging permeable pavements suitable for harvesting and reusing stormwater runoff from roads, car parks and industrial areas	U1 WSUD	03/2012 to 04/2015
Sina Alaghmand	A conceptual model to capture salinity risks from the River Murray floodplains	E1 Murray	05/2011 to 07/2013
Sithara Gamage	Probabilistic nature of hydrologic losses in South Australian forest catchments	E2 Wetlands	03/2010 to 09/2013
Mamunur Rashid	Assessment of climate change impacts on the spatial variability of rainfall and its influence on runoff generation	C1 Climate	02/2012 to 02/2015

Publications

Goyder Institute Technical reports

Goyder Institute for Water Research, (2011). Interim Water Sensitive Urban Design Targets for Greater Adelaide, Goyder Institute for Water Research, Technical Report Series No. 11/7.

Harrington N, Noorduijn S, Cook P (2012). Evaluation of approaches to modelling surface water-groundwater interactions around drains in the South East of South Australia. Phase 1. Goyder Institute for Water Research Technical Report Series No. 12/1.

Lamontagne S, Aldridge KT, Holland KL, Jolly ID, Nicol J, Oliver RL, Paton DC, Walker KF, Wallace TA, Ye Q (2012). Expert panel assessment of the likely ecological consequences in South Australia of the proposed Murray-Darling Basin Plan. Goyder Institute for Water Research Technical Report Series 12/2.

Books

Willems, P., Olsson, J., Arnbjerg-Nielsen, K., Beecham, S., Pathirana, A., Bülow Gregersen, I., Madsen, H. and Nguyen, V.T.V. (2012), Impacts of Climate Change on Rainfall Extremes and Urban Drainage Systems, IWA Publishing, 226 pages, ISBN: 9781780401256 (paperback), ISBN: 9781780401263 (eBook).

Other Publications

Beecham, S. and Chowdhury, R. (2012) Effects of Changing Rainfall Patterns on WSUD in Australia, Water Management, Proceedings of the Institution of Civil Engineers UK, 165(5), pp 285-298.

Beecham, S., M. Kamruzzaman, A. Metcalfe (2012), Analysis of Spatial Rainfall Patterns in South Australia Between 2000 and 2010, NCCARF Climate Adaptation in Action Conference – Sharing knowledge to adapt, Melbourne, June 2012, NCCARF Publication 14/12 (ISBN: 978-1-921609-51-0).

Cai, W., van Rensch, P., Cowan, T., Hendon H.H. (2012) An Asymmetry in the IOD and ENSO Teleconnection Pathway and Its Impact on Australian Climate. J. Climate, 25, 6318–6329. doi: http://dx.doi.org/10.1175/JCLI-D-11-00501.1.

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Chowdhury, R. and Beecham, S. (2012) Characterisation of Rainfall Spells for Urban Water Management, International Journal of Climatology, Royal Meteorological Society, Wiley, doi:10.1002/joc.3482.

Chowdhury, R. and Beecham, S. (2012), South Australian Rainfall: Trends, Step Changes and Climate Drivers, 2nd Conference on Practical Responses to Climate Change, Engineers Australia, Canberra, Australia (ISBN 978-0-85825-911-9).

Chowdhury, R. and Beecham, S. (2012), Climate Change Impacts on the Hydrology of Aldgate and Inverbrakie Creeks in South Australia, 2nd Conference on Practical Responses to Climate Change, Engineers Australia, Canberra, Australia (ISBN 978-0-85825-911-9).

Gibbs M.S., Maier H.R. and Dandy G.C. (2011) Runoff and salt transport modelling to maximise environmental outcomes in the Upper South East of South Australia, Proceedings of MODSIM 2011 International Congress on Modelling and Simulation, December 12-16, Perth, Australia.

Page, D., Gonzalez, D. and Dillon, P. (2012). Microbiological risks of recycling urban stormwater via aquifers. Water Sci. Tech. 65(9) 1692-5.

Gibbs M.S., Maier H.R. and Dandy G.C. (2011). Runoff and salt transport modelling to maximise environmental outcomes in the Upper South East of South Australia, In Chan, F., Marinova, D. and Anderssen, R.S. (eds) MODSIM2011, 19th International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2011, pp. 1652-1658. (ISBN: 978-0-9872143-1-7).

Kamruzzaman, M., Beecham, S. and Metcalfe, A. V. (2012), Climatic Influences on Rainfall and Runoff Variability in the South-East Region of the Murray Darling Basin, International Journal of Climatology, Royal Meteorological Society, Wiley, doi:10.1002/joc.3422.

Kamruzzaman, M., Beecham, S. and Metcalfe, A. V. (2012), Wavelet Based Assessment of the Relationship between Hydrological Time Series in South East Australia, 2nd Conference on Practical Responses to Climate Change, Engineers Australia, Canberra, Australia (ISBN 978-0-85825-911-9).

Qiu, Y., W. Cai, L. Li, and X. Guo (2012) Argo profiles variability of barrier layer in the tropical Indian Ocean and its relationship with the Indian Ocean Dipole, Geophysical Research Letters, 39, L08605, doi:10.1029/2012GL051441.

Vanderzalm, J., Page, D., Dillon, P., Miotlinski, K., Barry, K. and Hyde, K. (2011). Using ASTR to harvest urban stormwater for drinking: assessing the safety of the aquifer storage transfer and recovery project at Parafield, SA. Aust. Water Assoc. J. Water 38(4) 79-82.

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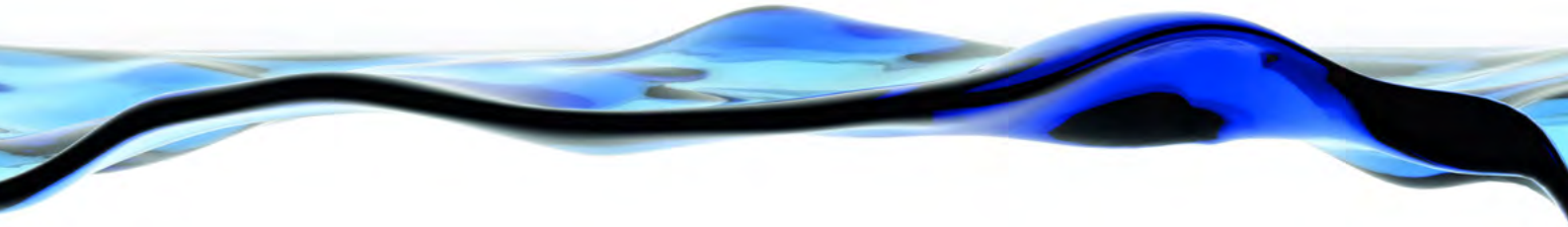

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Department of Environment, Water and Natural Resources

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The Goyder Institute for Water Research is a partnership between the South Australian Government through the Department of Environment, Water and Natural Resources, CSIRO, Flinders University, the University of Adelaide and the University of South Australia.