Annual Research & Development Plan and Budget 2013/14

GOYDER INSTITUTE FOR WATER RESEARCH

www.goyderinstitute.org

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.

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 the outcomes of the Goyder Institute research projects.

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1 Introduction

The Goyder Institute for Water Research Agreement requires that the Director prepare an Annual Research and Development Plan and Budget for each financial year. This plan is to be submitted to the Research Advisory Committee for endorsement and then to the Management Board for approval.

1.1 Strategic Research Plan

The Strategic Research Plan 2011-2015 details the long-term strategic outcomes for the Goyder Institute research programme, which will help ensure the water resources of the State of South Australia are sustainably managed for economic, social and environmental benefits. The Strategic Research Plan links the ongoing and proposed research activities to these outcomes through Roadmaps.

1.2 Annual R&D Plan

Each strategic Roadmap is implemented through an integrated set of Research Projects with associated Research Project Plans. The Annual R&D Plan describes this annual rolling portfolio of projects that are the mechanism for achieving the outputs required to contribute to the Roadmaps.

Each financial year, the Director will produce an update of the Annual Research and Development Plan and Budget. This updated Annual R&D Plan describes the progress of ongoing projects and the development of new projects. Individual projects identified within the Annual R&D Plan may be varied and updated annually as policy priorities and budgets dictate.

The Annual R&D Plan and Budget for a given financial year describes:

- The proposed Research Projects to be undertaken by the Institute in that year; and
- The proposed budget for each Research Project.

In addition, potential investment in research activity over the remaining term of the Goyder Institute will be identified. These figures are indicative only and are designed to support strategic investment in research projects that will deliver outcomes by 30 June 2015, which is the current expiry date of the initial term of the Goyder Institute Agreement.

1.3 Approved Research Projects

An Approved Research Project consists of a Project Plan and Budget Pack that has been signed by all participating Partners in the project and that has been endorsed by the Research Advisory Committee (RAC) and approved by the Board. Board approval is documented in the form of a Project Agreement that has been signed by the Chairman of the Board.

During the execution of an approved project, changes and modifications to the Project Plan and Budget Pack may be submitted to the Director for consideration. The Director may approve minor modifications to Project Plans that do not significantly alter the proposed outcomes, and do not have significant financial consequences for the project. The Director may consult the RAC about these modifications. Major modifications to Project Plans that may involve financial consequences will be prepared in consultation with the Director and in consultation with the RAC. After endorsement of these modified Project Plans by the RAC, the Director will formulate recommendations for approval by the Management Board.

2 Current Research Investment

2.1 Project Overview 2012/13

A summary of the Goyder Institute projects by Roadmap up to the end of the 2012/13 financial year are identified in the table below. The projects listed are at various stages from newly approved through to complete. This status is based on that at 30 June 2013. Additional information on each of the projects is provided in the following sections of this report.

Theme	Roadmap	Project Number	Project Title	Status
Climate Change				
C.1 Regional downscaling		C.1.1	Downscaled Climate Projections for SA	Active
Environmental Water				
E.1 River Murray		E.1.1	MDB Review	Completed
		E.1.2	Murray Flood Ecology Urgent	Completed
		E.1.3	Murray Flood Ecology	Active
		E.1.4	Expert Panel MDB draft Plan	Completed
		E.1.5	River Murray Scoping	Closing
		E.1.6	Peer review	Completed
		E.1.7	River Murray Program	In prep
		E.1.8	Riverbank Collapse	Active
		E.1.9	River Murray Channel EWRs	Active
		E.1.10	SDL Adjustment Technical Panel	Active
E.2 Surface water, groundwater, wetland relationships		E.2.1	South East Urgent	Completed
		E.2.2	South East Phase 1	Completed
		E.2.3	South East Regional Water Balance	Active
		E.2.4	Improved modelling of catchments and drains	Active
		E.2.5	Water Requirements of Wetlands	Active
Water for Industry				
I.1 Water allocation planning & water quality improvement		I.1.1	AMLR WAP Scoping	Completed
		I.1.2	Torrens River Water Quality Improvement Trial	Completed
		I.1.3	Salinity Management of Irrigating with Recycled Water	Active
		I.1.4	AMLR WAP Program	Active
		I.1.5	Torrens Dilution Trial 2	Closing
		I.1.6	Adelaide Plains Groundwater Study	Active
I.2 Mining & outback water		I.2.1	G-FLOWS	Closing
		I.2.2	G-FLOWS 2	In prep
		I.2.3	LEBRA	In prep
Urban Water				
U.1 Water sensitive urban design		U.1.1	WSUD Targets	Completed
		U.1.2	WSUD Impediments and Opportunities	Active
U.2 Water resources mix for Adelaide		U.2.1	MARSUO	Active
		U.2.2	Optimal Water Mix for Adelaide	Active
		U.2.3	Governance for the Urban Water Blueprint	Active

2.2 Actual Project Expenditure to end of FY 2012/13

A detailed description of Goyder Institute expenditure in FY 2012/13 can be found in the 2012/13 Finance Report. A summary of the expenditure (cash + in-kind) in active projects up until the end of FY 2012/13 is given below.

Goyder Institute
Budget Expenditure from 2010/11 through 2012/13 and
Total Approved Budget and Expenditure over lifetime of projects

		Expenditure				
		Financial Years 10/11 - 12/13			Total Approved	
		Budget	Actual	Actual %	Budget	Actual %
Research Projects	CSIRO	9,790,684	9,863,222	101%	14,533,871	68%
Research Projects	Flinders	1,093,509	895,410	82%	3,708,463	24%
Research Projects	Uni of Adelaide	3,699,304	3,209,893	87%	6,310,391	51%
Research Projects	Uni of SA	2,118,181	1,970,373	93%	3,421,303	58%
	Subtotal	16,701,678	15,938,898	95%	27,974,028	57%
Research Projects	SARDI	2,286,965	1,572,901	69%	4,054,634	39%
Research Projects	AWQC	369,714	257,176	70%	532,500	48%
Research Projects		19,358,356	17,768,975	92%	32,561,162	55%
Research Adoption	PhD Stipend TopUps	455,000	495,000	109%	780,000	63%
Research Adoption	ANZSOG	-	-	-	1,000,000	-
Research Adoption	Knowledge Management	200,000	123,832	62%	400,000	31%
Research Adoption	PhD Cont - Goyder Office	911,053	877,371	96%	1,733,146	51%
Research Adoption		1,566,053	1,496,203	96%	3,913,146	38%
Admin	Goyder Office	2,177,709	2,175,222	100%	4,272,442	51%
Goyder Total		23,102,118	21,440,400	93%	40,746,750	53%

			Expenditure				
			Financial Years 10/11 - 12/13			Total Approved	
Roadmap		**Project**	**Budget**	**Actual**	**Actual %**	**Budget**	**Actual %**
Climate Change	C.1	Regional Downscaling	4,863,439	4,945,568	102%	7,012,255	71%
Environmental Water	E.1	River Murray	2,940,528	2,726,167	93%	3,849,191	71%
Environmental Water	E.2	Surface water, groundwater, wetland relationship	1,892,640	1,590,315	84%	2,913,367	55%
Industry Development	I.1	Water allocation planning & water quality improvement	2,074,267	1,115,971	54%	8,042,988	14%
Industry Development	I.2	Mining & outback water	3,086,872	3,224,282	104%	3,086,872	104%
Urban Water	U.1	Water sensitive urban design	1,248,077	1,148,346	92%	1,830,330	63%
Urban Water	U.2	Water resources mix for Adelaide	3,252,532	3,018,327	93%	5,826,160	52%
Total Research Projects			19,358,356	17,768,975	92%	32,561,162	55%

This table indicates that the expenditure on research is on target for most projects. The slight underspend in FY 2012/13 was primarily due to some delays in sign-off and start-up for a number of projects, in particular project I.1.4 AMLR WAP Program.

The budgeted and actual expenditures for each individual active project are given in detail in Table A1 in Appendix 1.

3 Research Portfolio: Roadmap Investment to-date

In June 2009, the South Australian Government released *Water for Good,* its policy directions and actions for water security in South Australia to underpin a growing population and the State's economy, and to preserve the State's environment and quality of life against the challenge of an outlook for reduced rainfall. *Water for Good* outlines actions to be taken to ensure the State's water supplies are secure, safe and reliable to sustain growth for at least the next 40 years. It provides actions to diversify the State's water sources, improve water conservation and efficiency, and improve and modernise its water industry.

The State Strategic Plan Goal for water resources is that South Australia has reliable and sustainable water resources and is a leader in wastewater, irrigation, stormwater, and groundwater management. However, managing water supplies in a variable climate will require adaptive and innovative solutions.

The Goyder Institute for Water Research themes of Urban Water, Environmental Water, Water for Industry and Climate Change were selected as areas for priority research that would most clearly and effectively support these policy directions. The research themes contribute to a number of the state government's seven strategies priorities, namely; "*Premium food and wine from our clean environment*"; "*Realising the benefits of the mining boom for all South Australians*"; and "*Creating a vibrant city*".

3.1 Climate Change Theme

This is cross-cutting research theme to support the incorporation of climate adaption policy into the research outcomes from the urban water, environmental water and water for industry research themes.

3.1.1 C1 – Regional Climate Change Downscaling

Investment in this roadmap has been focused on downscaling climate projections for South Australia to provide an agreed set of climate projections for South Australia. The climate projections for each of the eight natural management regions will support proactive responses to climate change in water resource planning and management. They will be adopted as the agreed climate projections for the development of climate adaption policy by all State government agencies in areas such as health, agriculture and infrastructure planning. The climate projections will support the State Strategic Plan Goal; "*We adapt to the long term physical changes that climate change presents*" and implementation Target 62: Climate change adaptation, **"***Develop regional climate change adaptation plans in all State Government regions by 2016*".

Water for Good indicates that climate change impacts (temperature increases and water inflow reductions) are expected to increase demand and reduce water supply in the Greater Adelaide region. Climate change can give rise to; greater variability and more extreme weather events; changing rainfall patterns; increased evaporation and less surface water runoff and recharge, and water quality impacts such as increased salinity and blue green algae blooms. Agriculture, natural ecosystems and water resources are likely to be significantly affected if rainfall declines. General increases in rainfall are only indicated for the northern regions of the state, which can be subject to monsoonal influences from northern Australia. In the southern agriculture areas annual rainfall is projected to decrease by up to 8 or 9 percent in 2030 and up to 25 or 30 percent in 2070.

Regional water demand and supply statements are being prepared to ensure that long-term solutions for each region are based on a thorough understanding of the state of local water resources, the demand for them and likely future pressures. Potential climate change impacts are a critical scenario affecting future water availability and will be incorporated in each of the regional demand and supply statements.

C.1.1. Downscaled Climate Projections for SA

Project Lead: Prof. Simon Beecham, UniSA
Project Partners: UniSA, CSIRO, Flinders University, Adelaide University, SA Water, SARDI, DEWNR
Status: Commenced October 2010
Development of an agreed set of downscaled climate projections for South Australia.

Project Overview:

This project involves four major components:

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

This project will produce far more than a set of environmental data. It will develop a robust fit for purpose framework that will allow the projections downscaled from IPCC AR4 to be readily updated with AR5 modelling results when they are released. In addition, this project will lead to greatly increased levels of confidence in State Government policy decisions since they will always be based on the most reliable scientific evidence about both climate change and the localised climate variability caused by seasonality, trends and identified climate drivers for South Australia.

Research Highlights

The varying influence of climate drivers on rainfall across the eight SA NRM regions has been published in a leading scientific journal and a preliminary set of downscaled climate projections has been produced for the Onkaparinga test case catchment. A suite of diagnostic tools have been developed that not only measure model performance, but also provide an indication of possible actions which can be taken to remedy model weaknesses. The project has also produced a number of peer reviewed journal publications, including an article in *Nature* and an invited paper in a book commissioned by the International Water Association on climate change impacts.

3.2 Urban Water Theme

Water for Good provides an outlook that water availability and reliability varies substantially across South Australia. The key drivers for future water availability will be climate and population growth. South Australia now faces climate variability and changing climate conditions that put new pressures on water use and threaten supply. Planning for future supply with a high level of uncertainty is complex and requires a flexible approach. Water planning must consider the quantity and quality of all current and potential water resources in each region. *Water for Good* calls for strategies to reduce the reliance on rain-dependent sources, such as the River Murray and the Mount Lofty Ranges reservoirs, by increasing stormwater-harvesting and wastewater reuse.

The *State Stormwater Strategy* released in 2011 provides a 'road map' for achieving the stormwater-related targets in *Water for Good*. The objectives of the Strategy are:

- to manage water resources in an integrated way
- to better mitigate flood risk
- to clarify roles and responsibilities, and
- to move towards Water Sensitive Urban Design.

The Strategy initially focuses on Greater Adelaide and recommends that the initiatives and policies be applied first in the city. In the medium to longer-term, their reach will be widened to include regional South Australia, particularly larger urban centres. A water sensitive city uses its water resources sustainably. It seeks to be resilient to climate change through a diverse range of water supplies, such as watercourses, groundwater, stormwater, rainwater tanks, wastewater and desalinated water.

Water for Good identifies a need to develop master plans for effectively managing stormwater and wastewater in Greater Adelaide. This strategy is a precursor to a more detailed '*Blueprint for Urban*

Water', which will bring together stormwater and wastewater and examine matters such as the costs and benefits of various strategic water projects and products, a demand study to identify possible users of various water products, including the demands of agriculture to the north and south of metropolitan Adelaide, and land-use planning considerations for strategic infrastructure investment (including investment related to mitigating flood risks).

The Goyder Institute has commissioned research into WSUD, the Optimal Water Resources Mix for Adelaide and a national project on Managed Aquifer Recharge and stormwater reuse options. Allied projects under the Water for Industry Theme are researching the storage capacity, sustainable yield and salinity constraints of the Adelaide Plains groundwater resources, Adelaide Mount Lofty Ranges water allocation planning to improve catchment surface water storage and runoff models and the hydro-ecological response of catchment environmental assets. These complement and will contribute to this urban water research programme.

3.2.1 U1 – Water Sensitive Urban Design

Water for Good supports the development of South Australia as a water sensitive state. WSUD is a key tool to delivering a water sensitive city. A proposed Policy and Strategy for Water Sensitive Urban Design in South Australia was developed by DEWNR in 2012/2013, which includes targets for WSUD that are based on a Goyder Institute review of interim targets and stakeholder consultation.

The State Stormwater Strategy recommended research to support the implementation of WSUD by:

- Investigating current management and governance models for the long-term operation and maintenance of WSUD options and systems, and explore ways to facilitate third party access to water systems (including investigating associated risks),
- Understanding the drivers for public perceptions and behavioural changes in water use, and investigate current water end-use in South Australia; and
- Supporting the development of policies to encourage the widespread adoption of water sensitive urban design.

The Goyder Institute investment is focused on understanding the impediments and opportunities in implementing Water Sensitive Urban Design in SA. The outcomes of this research will provide government agencies and other stakeholders with the scientific, technical, social and economic basis to elevate implementation of WSUD and enable the government to achieve the relevant actions in the proposed WSUD policy.

U.1.1 WSUD Targets

Project Leader: David Pezzaniti, UniSA
Project Partners: UniSA, CSIRO,
Status: Completed
Identify interim WSUD targets that are appropriate for the climate and urban environmental conditions of the greater Adelaide region.

Project Overview

The Government's water security plan, *Water for Good*, includes a number of commitments to manage water supplies effectively, including the adoption of WSUD measures. While considerable work on WSUD targets has been carried out interstate, climate characteristics significantly affect the performance of WSUD systems. One of the primary purposes for developing interim targets for Adelaide is that they are appropriate for the region and that local data such as climatic information is used. This project investigated and identified potential WSUD targets for Adelaide's regional conditions in three main areas:

- Mains water conservation
- Stormwater runoff quality
- Stormwater runoff quantity

Research Highlights

The interim water sensitive urban design targets for greater Adelaide recommended from this research were incorporated into a broader WSUD consultation document by the Department for Environment, Water and Natural Resources. Following this consultation process, a WSUD policy ('*Water Sensitive Urban Design for South Australia - Creating More Liveable and Water Sensitive Cities*') was developed was developed by DEWNR in 2012/2013, which includes targets for WSUD that are based on the outcomes of this project and on stakeholder consultation.

U.1.2 WSUD Impediments & Opportunities

Project Lead: Dr Ashok Sharma, CSIRO, and David Pezzaniti, UniSA
Project Partners: CSIRO, UniSA,
Status: Commenced October 2012
The project aims to identify and address impediments and constraints as well as identify opportunities and enabling mechanisms to facilitate the strategic uptake of WSUD in the State, with a focus on local capacity building and cost of living.

Project Overview

The project consists of three components:

- A post implementation assessment of developments designed with WSUD systems and consultation with various stakeholders for South Australian to identify specific impediments and constraints in the uptake of WSUD.
- A community consultation, investigating the social and technical impediments, drivers and opportunities for the uptake and management of WSUD systems.
- Research into the potential for WSUD in South Australia to achieve water conservation through alternative resources application, water quality, water quantity and flood management. It will review the economic impacts of WSUD strategies and options.

Research Highlights

Interim reports have been produced on an inventory of WSUD activities in SA, the social acceptance of WSUD, and a methodology for investigating WSUD potential in SA.

3.2.2 U2 – Water Resources Mix for Adelaide

Adelaide water source options include the MLR water supply catchments, River Murray, seawater desalination plant, stormwater recycling, effluent recycling, groundwater and conservation measures for fit for purpose supplies. The *State Stormwater Strategy* recommended research to underpin urban water policy, in particular, the integrated management of water resources.
Water for Good states that demand for South Australia's limited, high quality natural fresh water for drinking can be reduced by recycling and using stormwater to provide the following benefits:

- increasing the security of our water supply by diversifying and supplementing supplies from other sources,
- environmental and economic benefits by reducing the discharge of polluted effluent and stormwater into the environment and increasing the value and potential uses of receiving waters,
- cost sharing opportunities,
- planning opportunities-recognising potential to tailor investment in water infrastructure to the pace of new development and redevelopment.

Recycling can be more costly than other traditional supply options, however the value lies in the opportunity to simultaneously diversify water supplies and provide other benefits. *Water for Good* specifies targets for stormwater and waste water reuse for greater Adelaide and statewide. There will be capacity to harvest 60 GL/annum of stormwater into fit for purpose, non-drinking quality water in Adelaide and 15 GL/annum in regional areas by 2050. The *State Stormwater Strategy* recommended that by 2013, further studies be completed to improve the knowledge and management of public health risks relating to the recycling of stormwater, including assessing the risk of augmenting drinking water supplies.

The *State Stormwater Strategy* recognised that a key issue of 'ownership' of stormwater relates to certainty of investment and protecting the interests of those who invest in stormwater harvesting and reuse infrastructure. It recommended the development of access rights to stormwater for water re-use scheme owners to provide certainty for stormwater resources, thereby creating incentives for investment in stormwater capture, treatment, storage and use.

The Goyder Institute Water Resources Mix Programme is supporting the achievement of these statewide aims through focussed investment in assessing potential uses of stormwater, analysis of water governance options in delivering a diversified water supply, understanding household water use and developing methods for determining trade-offs between the multiple objectives of water security, economic efficiency and environmental benefits of different water supply options.

To facilitate ongoing interaction with key government stakeholders responsible for delivery of urban water management in South Australia, a Stakeholder Reference Panel has been established. The Stakeholder Reference Panel provides a mechanism for ongoing dialogue between the Goyder Institute experts and government policy makers in providing the best available science regarding integrated water resource management issues for consideration in the development of the '*Blueprint for Urban Water*'.

U.2.1 MARSUO

Project Lead: Dr Peter Dillon, CSIRO
Project Partners: CSIRO, National Water Commission, Adelaide University, UniSA, AMLR NRMB, United Water, City of Salisbury, DEWNR, WQRA
Status: Commenced January 2011
Investigating managed aquifer recharge and stormwater use options for Adelaide

Project Overview

This is a national project to assess a range of potential uses of stormwater including via managed aquifer recharge is currently underway with a project hub site in the City of Salisbury and satellite sites at various locations around the country and overseas. The project is addressing the health risk assessment of uses for public open space irrigation, third pipe non-potable supplies to households and industry and for drinking water supplies. For several of those uses prototype risk management plans are being developed. The economics of some specific options are also being considered taking account of environmental impacts, and surveys of public acceptance of the more novel options have been undertaken. This NWC/Goyder Institute research project is intended to be of use to inform policies, blueprints and plans for stormwater harvesting in South Australia, and to provide methodologies to assist in maximising the total economic value of harvested stormwater in Australia.

Research Highlights

The catchment risk assessment approach developed in MARSUO has been adopted by Water Proofing the South and Water Proofing the West projects and National Guidelines are being developed for Managed Aquifer Recharge with the National Water Commission.

U.2.2. Optimal Water Resource Mix

Project Lead: Sue Cuddy, CSIRO
Project Partners: CSIRO, Flinders University, Adelaide University, UniSA, SA Water
Status: Commenced October 2012
Supporting integrated water management for metropolitan Adelaide

Project Overview

The 'Optimal Water Mix' project will provide foundational knowledge to inform the development of policy and planning for integrated urban water management in metropolitan Adelaide. A key product of this project will be to develop methods for determining trade-offs between the multiple objectives of water security, economic efficiency and environmental benefits of water

supply options that are consistent with the city's social values.

The tradeoffs analysis methodology that will be developed provides a framework that could be applied to other cities/regions to inform the development of total water cycle management plans. The project is highly innovative because it is the first time that these methodologies to identify options and evaluate trade-offs will be applied at a city-wide scale. The knowledge gained from this complex research project will inform policy development and progression of a total water cycle management plan for Adelaide.

Research Highlights

A Stakeholder Reference panel has been established and an initial stakeholder workshop to identify the broad objectives the project should focus on has been held. A modelling framework has been established, with initial modelled estimates of end-use demand, Mt Lofty catchment inflows and identification of discharge objectives for environmentally sensitive locations. A draft technical report has been produced summarising capital and operating costs of, and greenhouse gas emissions from, all major sources of water. Installation of 150 smart meters in households has been completed with follow-up attitudinal/behavioural surveys underway. Another draft technical report on the use of greenspace as a function of park type and summary of grey and published literature on externalities for each water source investigated in this study. A draft technical report has been prepared that has reviewed the institutional arrangements for implementing a portfolio of supply sources in Australian cities as well as international practices.

U.2.3. Water Governance Assessment

Project Lead: Prof. Jennifer McKay, UniSA
Project Partners: UniSA, Adelaide University, CSIRO, SA Water, Flinders University, Water Industry Alliance, DEWNR, City of Holdfast Bay, AMLR NRMB
Status: Commenced June 2013
Identify options for improved water governance in managing the complexity of diversified supply options

Project Overview

The project will assess the legal and governance options and risks of the scenarios identified in the development of the proposed Urban Water Blueprint to inform decision making around the selection of models and implementation approaches. Where there are unresolved legal or governance issues, the project team will work with key stakeholders in government to identify solutions, based on South Australian law and national and international experience. Solutions could include legislative (changes to the law), regulatory (changes in the way the law is implemented) and institutional (changes in the governance of water supply and management).

Research Highlights

The project will evolve with the needs of the Blueprint based on the direction provided by DEWNR and will be informed by Project U.2.2 Optimal Water Resource Mix for Metropolitan Adelaide and U.1.2 Water Sensitive Urban Design (WSUD). Project U2.2 will identify a limited number of optimal water supply scenarios for input into the considerations of the Urban Water Blueprint and U.1.2 will identify impediments to the implementation of WSUD. Each of these scenarios will include legal and governance risks, challenges and benefits that will need to be assessed.

3.3 Water for Industry Theme

In this research theme, techniques are being developed to promote equitable water sharing in multi-use catchments and in remote regions of the state. The objective is to develop sustainable water management practices for communities and industries (e.g. food, wine, forestry and mining) that are heavily reliant on safe and secure water supplies. Research projects may concentrate on a number of issues including the characterisation of the regional water resources; the identification of the community and industry water needs; environmental water needs and cultural values associated with the water.

3.3.1 I1 – Water Allocation Planning and Water Quality Improvement

Water allocation plans for prescribed water resources in South Australia specify environmental water provisions for water dependent ecosystems, the consumptive pool for licensed water allocations for consumptive purposes such as irrigation, town water supplies, industrial, recreational and commercial uses within sustainable diversion limits (SDL's). Critical elements in determining SDL's is the specification of environmental water provisions, which will in part determine the available water in the consumptive pool, which can also be limited for specific purposes by water quality such as salinity. A critical issue in water allocation planning in providing for healthy ecosystems is being able to specify environmental water provisions based on a sound understanding of eco-hydrological responses balanced against provisions for consumptive use.

The Mount Lofty Ranges and metropolitan Adelaide region encompasses one of the major water resources areas in South Australia. This highly inter-connected hydrologic system encompasses the multi-use catchments in the western MLR with the Adelaide Plains surface water and stormwater systems and the Adelaide coastal waters through discharges. The surface water and stormwater systems are now strongly connected to the Adelaide Plains groundwater systems through managed aquifer storage and recovery of treated stormwater. Draft water allocation plans have been prepared for the eastern MLR catchments draining to the River Murray system and the western MLR, where the proposed environmental water provisions was a contentious issue with some user groups and a plan is being developed for the Adelaide Plains groundwater systems, which used for industrial purposes, horticulture irrigation, irrigation in the urbanised areas with managed aquifer recharge and potentially for human needs as an emergency water supply.

The research programme if focusing on a number of critical elements of the interrelated Adelaide-MLR hydrologic system to address specific issues relating water allocation planning by improving surface water modelling and modelling capability, developing a consistent framework to specify eco-hydrological responses for the determination of environmental water provisions, catchment runoff water quality improvement and managing the risks of algal bloom outbreaks in the Torrens Lake associated with stormwater quality and better specification of the capacity of the Adelaide Plains groundwater system for water supply and water banking. Reducing the impacts of wastewater discharges to the Adelaide coastal waters by creating new opportunities to reuse treated wastewater for irrigation is being addressed as part of a national project to expand the water source options for agricultural industry.

I.1.1. AMLR WAP Scoping

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: Adelaide University, SARDI, CSIRO, UniSA, DEWNR, SA Water, EPA
Status: Completed
Identify high priority R&D needs to support water allocation planning

Project Overview

Research and policy staff within this project reviewed then prioritised research needed to refine a decision support framework for developing water allocation plans (WAPs) in South Australia.

Research Highlights

The project has provided a review and evaluation of components of the WAP framework including the establishment of relationships between hydrology and ecological expression, a process to determine the effectiveness of returning low flows for environmental watering, and the notion of a library of metrics to support future WAPs across the state. It also assessed surface water-groundwater interaction models that may help in the WAP process in SA, and it explored opportunities for new areas of research such as hydro-economic modelling (i.e. transparently balancing social, economic and environmental needs for water).
The Technical Report summarises existing knowledge and monitoring activities, and identifies key research priorities for future investment. The high priority R&D gaps have formed the basis of the AMLR WAP program (I.1.4.).

I 1.2 Torrens River Water Quality Improvement Trial

Project Lead: Assoc./Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI, SA Water, AMLR NRMB, DEWNR, Adelaide City Council
Status: Completed
Determining the feasibility of an 'amenity flow' for the Torrens Lake to reduce or eliminate algal blooms.

Project Overview

A trial was undertaken during the summer of 2011/12 to determine the effectiveness of using dilution flows as a strategy to control cyanobacteria in the Torrens Lake. The aim of this dilution flow trial was to monitor the release of water from an upstream storage to dilute cyanobacteria in the Torrens Lake. In addition, a fish monitoring component was established to evaluate the effect of flow management on fish populations within the lower Torrens and Breakout Creek. This component was developed to provide a baseline survey of fish communities, against which post- flow patterns could be compared and to conduct a survey during flow releases to determine any short-term responses or impacts.

Research Highlights

The use of flows to control cyanobacterial growth shows promise as an event management technique to control the growth of cyanobacterial biomass. This is supported by both the modelling of growth and dilution and the results of the field trial. The coordination of the 2011/12 trial demonstrated that it was feasible to deliver flow in response to cell counts two days prior, which was observed to be appropriate considering the rate of growth, and this should again be considered in the operational planning of flow releases. The results of the trial suggest that if dilution flows are released early enough, the size of the cyanobacterial population can be controlled, recognising that there is a reliance on rain events to flush the system and dilute the resident cyanobacterial population. On average, the flow return interval analysis suggests that rain events occur frequently enough in summer for this strategy to be effective. However, in a variable climate like that observed in Adelaide, there may be incidences of very long periods between significant rainfall events. This may reduce the confidence in rain events to reset the population. The dilution flow was not observed to have any impact on the freshwater fish community.

I.1.3. Recycled water and salinity

Project Lead: Tim Pitt, SARDI
Project Partners: AWRCoE, SARDI, Adelaide University, Treasury Wine Estates
Status: Commenced February 2013
Demonstrating the economic and environmental value of water recycling to Australia's agri-food industry.

Project Overview

The project is collaborating with local viticulture and horticulture businesses and the University of Adelaide, to demonstrate the economic and environmental value of water recycling to Australia's agri-food industry.
More specifically, the project will test whether re-directing rain falling on the mid-row, to the soils immediately under the vines, will reduce the salinity pressure on vines and will assess how the changing concentrations of salt, in the various soils being assessed, affect plant response in terms of vigour, yield and crop quality.

Research Highlights

Rainfall redirection treatments have been established at the grape site at McLaren Vale and year one plant samples have been collected. Analysis of these samples is ongoing. Preliminary data suggests little difference in salt uptake between treatments. This is not an unexpected result given the dry growing season and the early stages of this work. Treatment effects will become more apparent as rain events accumulate and future seasons data, both plant and soil, are assessed.

I 1.4 AMLR WAP Program

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: SARDI, CSIRO, AMLR NRMB, SAMDB NRMB, DEWNR, SA Water, EPA
Status: Commenced March 2013

Project Overview

Building on the existing knowledge, management and monitoring systems in the Mt Lofty Ranges, the Water Allocation Planning project will refine the understanding of environmental water needs, patterns of flow and water quality within the Mount Lofty Ranges. It will also develop a tool to help bring together all the information needed to make robust decisions on water allocations and assess the potential outcomes of alternative management options. The tool and the research outcomes can then help to underpin the further development of sustainable water use in the region, and support the review and improvement process built into water planning in the Mt Lofty Ranges and other parts of the state.

The research will also involve collecting important hydro-ecological data to support the ongoing development of water allocation plans for the region, including installing monitoring equipment in high priority regions over to measure water flow and quality and the subsequent ecological response from fish, vegetation and macro-invertebrates.

Research Highlights

The overall objective is to develop an integrated catchment water planning support system for a multi-use catchment based on best practice methods and modelling and enable the evaluation and planning for risks of water extraction both on catchment water resources and water dependant ecosystems.

At present, baseline environmental monitoring has been completed and installation of instrumentation to undertake full monitoring (flow, veg and macroinvertebrates) has been completed and full monitoring is now underway. The modelling framework has been developed and the background databases on water quality in the Mount Lofty Ranges has been collated.

I 1.5 Torrens Lake Dilution Flow Trial for Summer 2012/13

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI, SA Water, AMLR NRMB, DEWNR, Adelaide City Council
Status: Commenced December 2012
A second trial to further examine the feasibility of an 'amenity flow' for the Torrens Lake to manage algal blooms.

Project Overview

Following the initial trial in 2011/12, a second trial in 2012/13 was undertaken with a focus on the key aspects of:

- cyanobacterial growth responses to managed flows over a long period, Lake inflow mixing performance and potential enhancements;
- water temperature, quality and cyanobacteria monitoring;
- native and exotic fish responses;
- water quality of inflows and outflows checking their fit for purpose use; and
- monitoring community response generally and in terms of the Torrens Lake and Linear Park's amenity.

Research highlights

The final report of the second trial is being prepared to inform any future decision making regarding the provision of amenity flows to manage algal blooms in the Torrens Lake.

I.1.6. Adelaide Plains Groundwater Assessment

Project Lead: Prof. Okke Batelaan, Flinders University
Project Partners: Flinders University, NCGRT, CSIRO, DEWNR
Status: Commenced June 2013
Assessment of Adelaide Plains Groundwater Resources

Project Overview

The project will build upon existing knowledge to provide a thorough assessment of the groundwater resources beneath Adelaide, and the impacts of current and future extraction and climate change. One of the key outcomes will be an upgraded and improved groundwater model capable of predicting impacts of current and future extraction, and uncertainties surrounding these predictions. It will be the first study to provide an integrated assessment of the groundwater resources of the entire Adelaide metropolitan region.

Research Highlights

The focus area of the project is the Adelaide plains region west of the Eden-Burnside fault (which separates the plains from the Mount Lofty Ranges). The study area will extend north to the Light River. Although the focus will be on the region north of Seacliff, the study region will extend south to include the Noarlunga Embayment and the Willunga Basin. Inclusion of the Willunga Basin within this project area will facilitate transfer of research findings from the Willunga Basin to similar environments within the Adelaide Plains region. Ongoing research within the Willunga Basin (being undertaken through NCGRT) will provide an understanding on issues like flow across faults, leakage between aquifer and seawater intrusion that can inform our understanding of the Adelaide Plains region.

3.3.2 I2 – Mining and Outback Water

There has been significant growth in mining and energy exploration in South Australia, which has identified new major potential opportunities. The scale of the planned developments and potential activity from current mineral exploration is set to generate significant economic value for the State. However, the delivery of this value to the State is dependent on the mining and energy sector being able to access reliable water supplies.

The 2011 Resources and Energy Infrastructure Demand Study released by the South Australian Resources and Energy Sector Infrastructure Council (RESIC) stated:

> *'Of particular concern for project proponents was the current available capacity and the potential of water source options. Related to this was the lack of information concerning future potential locations from which to source water. Many proponents expressed a particular interest in gaining a greater understanding of groundwater sources.*
> *Water scarcity and the lack of information has created uncertainty for projects and some have stated that it could lead to unsustainable solutions, selecting less preferred options or delays to their project while they sought new sources'.*

The RESIC (2011) report identified an increase in demand for water from approximately 40 GL to over 170GL over 10 years. One of the main water resources over that time period will be desalinated groundwater, which is expected to provide approximately 45% of the mine and mineral processing water requirements. The South Australian Chamber of Mines and Energy (SACOME) recently released the Research, Development and Innovation – Roadmap for the South Australian Mining Industry, which states that water and energy are two challenges facing the development of mining in South Australia.

The Department of Environment, Water and Natural Resources (DEWNR) has developed an initiative called 'Finding Long-term Outback Water Solutions' or the FLOWS Initiative, which is supported by Department of Manufacturing, Innovation, Trade, Resources and Energy. The Goyder Institute is addressing the research and development component of the FLOWS Initiative under a staged G-FLOWS program. The research has developed methodologies to interpret airborne geophysics to locate and

better define new groundwater sources. The G FLOWS program is contributing to the State's strategic priority '*Realising the Benefits of the Mining Boom for All South* Australians' by providing new knowledge on groundwater resources. This work will also assist in the development of water supplies for remote Far North communities under Action 66 in *Water for Good* by identifying alternate groundwater sources to improve water supply security.

I.2.1 G-FLOWS – Phase 1

Project Lead: Dr Mat Gilfedder, CSIRO
Project Partners: CSIRO, Flinders University, SARDI, Adelaide University, DEWNR, DMITRE
Status: Commenced January 2011.
Facilitating long-term outback water supplies.

Project Overview

This project has focused on data poor areas of arid South Australia, and made advances using a range of scientific methods to better understand the water resources of arid inland South Australia. G-FLOWS-1 has used multiple data sources to bring together a comprehensive current conceptual model of hydrogeology in the Musgrave Province. This harnessed remotely-sensed datasets, with on-ground and borehole measurements, to provide a much greater sense of the subsurface variability in the area.

Research Outcomes

Key aspects of the work include the development of a new hydrogeological framework for the Musgrave province which combines and interprets multiple datasets from industry and government to help target finer-scale assessment of groundwater resources. It has included the application and further development of a range of approaches and techniques, including hydrogeophysical (AEM, NMR) methods; and recharge understanding through use of isotopes/tracers (groundwater age and chemistry measurements). It has provided a summary of existing and ongoing social/cultural/ecological research relating to water in the arid-zone of Australia.

3.4 Environmental Water Theme

The Environmental Water theme is concentrating on developing a detailed understanding of the ecosystems of our major water resources like the River Murray and the groundwater-fed system of wetlands in the South East of South Australia. These systems contain several RAMSAR wetlands of international importance, which require a robust integrated management approach to maintain the environmental values of these regions while also achieving social and economic outcomes.

3.4.1 E1 – River Murray

The priority policy issue for the River Murray with the establishment of the Goyder Institute was the negotiation of the Murray Darling Basin Plan to ensure water security for critical human needs, provision for consumptive purposes such as irrigation and that sufficient flows would be achieved to meet the environmental water requirements of key environmental assets in the lower River Murray for a healthy river system.

The breaking of the extended period of drought in 2010 with flood flows enabled analysis of the ecological responses to flooding in the lower River Murray, which will provide new knowledge for the development of annual and long term watering plans under the Basin Plan.

The River Murray Programme has primarily focused research and expert advice to support:

- The development of the Murray Darling Basin (MDB) Plan and understanding its implication for South Australia;
- Implementation of the Basin Plan;
- The impact of low river flows and ecological recovery to increased flows; and
- Environmental water requirements of the River Murray and floodplains.

The Goyder Institute provided scientific expert analysis and review of the Guide to the Murray Darling Basin Plan, an independent expert analysis on the ecological consequences for South Australia of the proposed Basin Plan and a peer review of the State Governments' scientists' analysis of the ecological implications, risks and consequences of the draft Basin Plan. A key element of the South Australian Government's response to the Basin Plan was its strong scientific analysis of the MDBA's work to determine the volume of water necessary to achieve environmental water requirements for key environmental assets in South Australia based on the Goyder Institute advice. The work underpinned the South Australian Government's successful negotiation of the Basin Plan and $1.77 billion in additional funding to return 3200 gigalitres of water to the environment and to remove constraints that impede delivery of that water.

E.1.1 Science review of the guide to the Murray-Darling Basin Plan

Project Lead: Sue Cuddy, CSIRO
Project Partners: CSIRO
Status: Completed

Project overview

Prior to the release of the Guide, the South Australian Government invited the Goyder Institute to determine whether the proposed sustainable diversion limits would meet the Government's environmental water requirements and improve or maintain water quality. The review was also to assess the socioeconomic implications of reductions in diversion limits to the major water users within South Australia.

Research Highlights

This project produced a synthesis report that described the findings of the review, with the following four accompanying peer-reviewed technical reports describing the methods and findings of the work undertaken:

- an analysis of the South Australian Government's environmental water and water quality requirements and their delivery under the Guide to the proposed Basin Plan;
- an independent peer review of the science underpinning the environmental water requirements of the Coorong, Lower Lakes, and Murray Mouth;
- a report on the socioeconomic implications of the Guide to the proposed Basin Plan;
- a compilation of reports informing a socioeconomic review of the Guide to the proposed Basin Plan.

E 1.2 Murray Flood Ecology - Urgent monitoring program

Project Lead: Dr Qifeng Ye, SARDI
Project Partners: SARDI,
Status: Completed
Monitoring the fish spawning response to the flow increase in the Lower River Murray, South Australia.

Project Overview

This study investigated the annual change in abundance and species diversity of native fish populations in the lower River Murray during varying hydrological conditions. Larval assemblages of both native and introduced species were examined after the 2010 flood and compared to those recorded during the Millennium Drought.

Research Highlights

The project developed a quantitative sampling protocol for larval and adult fish sampling which was conducted over a period of two months between October and November 2010. The sampling protocol has been applied in a larger project investigating the ecological response to flooding in the River Murray (E.1.3.).

E 1.3 Murray Flood Ecology

Project Lead: Dr Qifeng Ye, SARDI
Project Partners: SARDI, CSIRO, Flinders University, Adelaide University, SA Water, SAMDB NRMB,
Status: Commenced December 2010
Ecological responses to flooding in the Lower River Murray following drought.

Project Overview

The 2010 flood event is a unique opportunity to undertake time critical ecological investigations, measuring how biological systems respond and recover when water is restored to the system after a long period of drought. This research project takes a more empirical approach to understanding ecological responses to flow regimes, and fills significant knowledge gaps in how flow affects various ecological components (e.g. vegetation and fish) and processes (e.g. river metabolism). Further, the project takes a landscape scale approach to understanding ecological responses, in some cases, assessing how movement of species with large ranges (e.g. large bodied fish) respond to water across the landscape, as opposed to within a single geographic location such as a wetland.

The Project will contribute to delivery of the following:

- Advanced knowledge of environmental water requirements (including quantity, flow regimes and water quality), that account for landscape-scale processes and connectivity
- Determination of early warning indicators, critical thresholds and triggers for key environmental assets
- Improvement in understanding of links between the River Murray and the wetlands/floodplain and implications of the return of flows after a protracted drought period for ecological outcomes.

Research Highlights

Technical reports have been completed and approved for publication for eight out of ten research tasks. A synthesis of research learnings from each of the tem research tasks is currently being prepared, together with an analysis of conceptual models and their applicability for the lower River Murray. The final project report is due by end of June 2013.

Some key findings of the research investigations include:

- The river requires flooding to transfer nutrients into and along the River channel. Floods improve longitudinal and lateral connectivity, facilitate natural processes, and lead to a more diverse and interesting River. Artificially inundating the floodplain during a period of low flow, although required at times, will not serve the complete ecological function of a natural flood. Low flows are also important for some species that thrive under these conditions.
- Recognising that some species may have a lag in response time is essential for accurately and effectively quantifying and understanding the processes involved in riverine ecology
- It is very important to recognise the origin of the water. Water from different sources will have different biological and chemical characteristics that will have different effects on the ecosystem response to watering events.
- Floodplains provide a valuable service to the health of the river: as a food source, and a source of propagules to repopulate populations from areas where they have disappeared. Some floodplains, such as Chowilla, are major sources of microbiota (protitsts, algae, zooplankton) that are important food resources for the River; they provide a disproportionate amount of nutrients and propagules to feed the River system during flood events and thereafter because of their significant inundation area, but also their geomorphology. It is important to maintain the floodplain ecosystem and its connectivity to the river channel, and recognise its importance during different flow conditions.

E 1.4 Expert Panel MDB draft Plan

Project Lead: Dr Sebastien Lamontagne, CSIRO
Project Partners: CSIRO, SARDI, Adelaide University, Flinders University
Status: Completed
Expert advice on the potential ecological implications, risks and consequences of the draft Basin Plan.

Project Overview

The South Australian Government evaluated the extent to which the South Australian Government's and the Murray-Darling Basin Authority's Environmental Water Requirements would likely be met for key environmental assets in South Australia under the proposed Basin Plan. The South Australian Government sought advice from the Goyder Institute on the likely ecological consequences for South Australia of the proposed Basin Plan. Given the very limited time available to formulate and provide advice, the Goyder Institute assembled an Expert Panel to provide (largely qualitative) advice based on the South Australian Government analysis.

Research Highlights

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 Study

Project Lead: Dr Kate Holland, CSIRO
Project Partners: CSIRO, Adelaide University, SARDI, Flinders University
Status: Closing
Identify research priorities in the broad area of River Murray flows and environmental flow management in South Australia.

Project Overview

The purpose of this project is to scope out (a) potential follow-on project(s) by providing an inventory of knowledge and knowledge gaps, on:

- flows within the Murray-Darling Basin, the resulting flows into South Australia, and how they are affected by climate change, SDLs, environmental flow management and other influences;
- the constraints and opportunities presented by those flows for environmental and Indigenous flow management within South Australia; and,
- the relation of the knowledge and knowledge gaps to SA departmental priorities for environmental and Indigenous flow management.

To assess these matters, the project team comprises experts in flow modelling and water accounting, and ecological responses to flows within South Australia. The team will consult widely with other experts and, particularly, the relevant South Australian departments with which a workshop will be held to assess departmental priorities in relation to knowledge and knowledge gaps.

Research Highlights

A 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. This advice has been prepared into a synthesis report to support decisions regarding future investment.

E.1.6. Peer review of the SA Government analysis of the Murray Darling Basin Plan

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: SARDI, Adelaide University, CSIRO
Status: Completed
An independent peer review of the additional model scenarios for the proposed Basin Plan

Project Overview

The Premier's Murray-Darling Basin Plan Taskforce requested an independent peer review process of the South Australian Government analysis. The purpose of the Goyder Institute peer review process was to critique the hydro-ecological analysis undertaken by DEWNR and to suggest improvements, where deemed necessary, to achieve the best quality analysis within the available timeframes.

Research Highlights

The major highlight was the ability of the South Australian Science Team (in DEWNR) to rapidly extend the modelling done by the MDBA to show and communicate the ecological benefits to the South Australian River Murray floodplains and CLLMM region within very short timelines. The outcomes of the Peer Review were directly relevant to policy makers within the state government in supporting the states position on environmental water to support ecological objectives.

E.1.7 River Murray Program

Project Lead: Dr Kane Aldridge, Adelaide University
Status: In development

Project Direction

The aim of this project is to conceptualise the current understanding of the ecological and cultural response to flow for the entire SA MDB and use this information to build a decision framework for decision making. This will build on previous Goyder Institute projects as well as other research. The outputs of the project will be:

- An assessment of appropriate decision support tools for the particular 'problem'
- Consolidation of our understanding into conceptual models including, documenting the environmental and cultural water management system, the hydrology and ecological and cultural response to flow (incorporating outputs of previous Goyder projects)
- Development of 'watering principles' that can be used to inform environmental and cultural watering decisions based on our current understanding of the ecological and cultural response to flow in the SA MDB
- Development of an adaptive management framework that can be used to guide future research and monitoring programs and decisions about environmental water provisions

E.1.8. Riverbank Collapse

Project Lead: Prof. Mark Jaksa, Adelaide University
Project Partners: Adelaide University, DEWNR, University of Sydney, Durham University
Status: Commenced January 2013
Understanding riverbank collapse to inform management

Project Overview

A systematic process of risk management to date has identified a number of critical knowledge gaps in understanding hazard dynamics. This research project focuses on addressing fundamental knowledge gaps of collapse processes which is affecting DEWNR's ability to accurately and reliably assess the likelihood of failure events and riverbank collapse risk.

Research Highlights

The outcomes of this research will support DEWNR in developing a long-term management strategy for riverbank collapse and identify changes that are required to development planning

guidelines and legislation to reduce the likelihood of future risks associated with riverbank collapse events.

E.1.9. In-Channel EWRs

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: SARDI, Adelaide University, CSIRO, DEWNR
Status: Commenced March 2013
Development of ecological objectives and ecological targets for the River Murray in-channel functions and assets.

Project Overview

This project will contribute to the development of the first draft of the long-term watering plan for the South Australian River Murray water resource area (SA River Murray LTWP), which is a requirement under Chapter 8 (Environmental Watering Plan) of the Basin Plan. Sound State long term environmental watering plans and annual watering priorities, based on best available science, will be instrumental in supporting the allocation of environmental water to South Australian River Murray environmental assets.

Research Highlights

The information generated is intended to feed directly into the first draft of the SA River Murray LTWP which in turn will facilitate the development of the state's annual environmental water plan. It is also anticipated that draft outputs from this short-term project will be available by late spring/early summer 2013, which is a critical time for real-time management of environmental water in SA. This project will contribute directly to DEWNR planning for environmental water management and will be undertaken in close consultation with DEWNR staff.

E.1.10 SDL Adjustment Mechanism

Project Lead: Prof. Jim Cox, Adelaide University/SARDI
Project Partners: SARDI, Adelaide University
Status: Commenced June 2013
Science review of the benefits and risks of the adjustment methodology for South Australian ecosystems

Project Overview

Experts from the Goyder Institute for Water Research have been engaged to provide eco-hydrology advice on the development of the ecological elements of the SDL adjustment method. The Goyder expert advice will supplement the Department's technical expertise and will assist the Department's representatives on the Ecological Elements Inter-jurisdictional Technical Panel to provide constructive and informed feedback on the science informing the development of the method.

3.4.2 E2 – Surface Water, Groundwater, Wetland Relationships

The South East is one of the major water resource domains in South Australia. The water resources have historically been managed as separate groundwater and surface water systems. Both systems emanate in western Victoria and flow regionally towards the coast or north westerly with surface water towards the Coorong and groundwater towards the Mallee and the River Murray. The groundwater systems of the south east comprise a regional unconfined Tertiary Limestone Aquifer and a deeper Tertiary Confined Sands Aquifer. The surface water and groundwater systems are highly interconnected due to the relatively shallow groundwater levels of the unconfined aquifer recharged directly by surface water and groundwater discharging to wetlands and coastal lakes. The extensive wetland systems in the South East are either surface water dependent, or partly groundwater and surface water dependent.

Regional policy and resource management issues are the delivery of environmental water to wetland systems in the upper South East through the South East drainage system and a revised management approach for the high value (low salinity) groundwater resources of the Lower South East. The

groundwater in the lower South East is high quality and supports the economic base of the South East through irrigation, town and industry water supplies. The groundwater salinity in the upper South East is more saline limiting its use for irrigation. Groundwater provides town water supplies throughout the South East including Mt Gambier from the Blue Lake with the back-up water supply from the deeper confined sands aquifer.

The current management approach for water allocation based on a percentage of recharge to a large number of management areas needs to change in time to a sub-regional basis reflecting the groundwater flow system accounting for recharge and discharge processes, water quality, connectivity with surface water and provision for environmental water requirements for significant environmental assets or dependencies. This will provide a more robust management system for water allocation and use.

The groundwater system in the lower south east is complex due to the inter-relationship between the confined and unconfined aquifers, the influence of geologist faulting on the groundwater flow regime, discharge to the marine environment and coastal lakes groundwater dependent wetlands such as Piccaninnie Ponds and the impacts of land use. The development of a regional groundwater model or models of the lower south east would provide a tool to help understand the impact of these geologic and hydraulic factors on the regional water balance of the lower South East and to test the long term implications of extraction patterns or climatic influences on the availability of water for consumptive purposes and alloction.

The surface water systems are now able to be routed through the waterways and floodways from the lower south east to the upper south east wetlands and the Coorong to mimic the historic flow paths prior to the establishment of the drains in the lower south east. The capacity and operation of the new drainage system in the South East to direct flows, including the timing, frequency and duration of flows into wetland complexes will require a management system, or a Decision Support System to provide wetland environmental water provisions in accordance with a South East Drainage Strategy. An improved understanding of the environmental water requirements and ecological responses to various hydrological conditions is required to effectively management the flows to maximise environmental outcomes with respect to potential risk issues associated with salinity and water quality of the drain water.

The Goyder Institute surface water, groundwater, wetlands programme is to enable the water resources of the South East to be managed as a holistic system recognising the interconnection between surface water and groundwater and wetlands to maximise the economic and social benefits of the regional water resources and to provide adequate environmental water provisions to the region's wetland systems and natural discharge processes and contributions to the Coorong.

E.2.1 South-East Urgent Monitoring program

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI
Status: Completed
Detecting salinity thresholds of aquatic plants in the South East.

Project Overview

For the management of wetlands and the drainage network in the South-East, there is a critical need to identify salinity threshold values for the condition of wetland ecosystems. This project harnesses the occurrence of the 2010 wet season in order to fill this knowledge gap. Field and laboratory investigations were carried out, utilising the natural north-south salinity gradient that exists in the South East.

Research Outcomes

This project produced a database to support policy decisions of the state government, particularly in relation to the provision of environmental water to support ecological outcomes.

E.2.2 South East Wetlands and Groundwater Research program - Phase 1

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, Flinders University, NCGRT, CSIRO, SARDI
Status: Completed
A research program to support the sustainable management of water in the South East.

Project Overview

This project was identified as a priority to:
1. Develop a conceptual model of how the hydrology, water use, land use and ecology interact – based on recent research undertaken in this region and to use best-practice science to determine how a decision support system can be used to inform policy development;
2. Improve the understanding of the relationship between groundwater and drains in the South East and how this varies in time and space;
3. Evaluate the utility of trace techniques in understanding and quantifying this process in the region; and
4. Install monitoring infrastructure in the newly constructed REFLOWS floodway prior to the release of floodwaters.

Members of the South Eastern Water Conservation and Drainage Board were involved in planning the fieldwork for this project. The infrastructure investment at two key sites enabled detailed assessments of how interactions between groundwater and drains change in time and vary with land use to assist in water management and planning for the South East.

Research Highlights

This project produced an extensive literature review of current science and knowledge to form one basis for further work in the South East region and has developed a decision support framework that draws on new science techniques that could be incorporated into the decision support frameworks used for water management in South Australia. It has also investigated the connectivity of surface and groundwater along drains of the SE, using a recently cut drain as a study site, by undertaking field work at two sites and conducting a reconnaissance assessment of the surface water-groundwater connection across the SE region. Preliminary results from this project showed potential for future application of methods to identify connectivity between surface water and groundwater but further refinement and data is needed.

E.2.3.Regional Groundwater Balance

Project Lead: Dr Sebastien Lamontagne, CSIRO
Project Partners: CSIRO, Flinders University, DEWNR,
Status: Commenced September 2012.
Development of a framework for a regional groundwater flow model for the Lower Limestone Coast region.

Project Overview

This project will lay the foundations for the development of a regional water balance model, to facilitate future water allocation planning for the Lower Limestone Coast region in the South East of South Australia. It includes:

- Development of a regional water balance framework;
- A preliminary assessment of the spatial variability and indicative fluxes of groundwater discharge to the marine environment;
- Assessment of the role of geological faults on regional groundwater flow and inter-aquifer leakage.

Research Highlights

A number of important datasets have been collated, including the production of historical land use time series and hydrogeological data related to geological faults, and methods to quantify submarine discharge have been tested. The final stages of the project will bring together the pieces of data to inform a conceptual model, or options for a model framework, and the suggested approach for the full development of a fit-for-purpose regional model.

E.2.4. Improved modelling of catchments and drains.

Project Lead: Dr Matt Gibbs, Adelaide University
Project Partners: Adelaide University
Status: Commenced May 2012
Improving the ability to estimate flow volumes of drains in the SE drainage network.

Project Overview

The need for an enhanced method accounting for the ecological response of the South East wetlands has been identified by DEWNR to provide more scientific rigour to the decision making process for water diversions from the drains. As a basis for this method, an accurate conceptual representation of the hydrology of the drainage network is required to inform the decision making process, on aspects including water availability, the volumes required to meet desired objectives, and as an input to ecosystem response modelling. This project aims to extend existing modelling of the Upper South East catchments and drainage network to include interaction with recharge and groundwater processes. The resulting models will be fit for the purpose of ecological response modelling and integration into the Drain Operation DSS and decision making processes.

Research Highlights

Initial results of the statistical modelling component of this project indicate that novel inputs including remotely sensed soil moisture and modelled rainfall forecasts provide valuable information for forecasting flows in the upcoming month. Investigation into subset selection methods is being carried out to better address this difficult issue and ensure the best subset of inputs are selected from a wide range of potential model inputs (including different catchment wetness and climate information) for the statistical model.

Changes in runoff model parameters, to represent declining trends in streamflow, have been related to changes in groundwater level to allow these trends to be simulated based on a trend in groundwater level.

E.2.5 Wetlands in SE

Project Lead: Assoc. Prof. Justin Brookes, Adelaide University
Project Partners: Adelaide University, SARDI
Status: Commenced February 2013
Understanding the response of wetland ecosystems in the South East to changes in water quantity and salinity.

Project Overview

This project will provide information on wetland ecosystem response to changes in water quantity and quality (salinity). This information will be available to be used to inform future water allocation planning and management in the South-East region and decisions regarding directing water to wetlands through the drainage and floodway system by providing an understanding of the response of various wetland types to altered hydrological conditions.

Research Highlights

A number of activities have now commenced, including stakeholder engagement, identification of sources of data and literature with some preliminary analysis already undertaken. In the process of engaging stakeholders, a South-East wetland working group has been identified that provides a great avenue of engaging a broad range of stakeholders within the project. This group will be important in assisting with accessing data and relaying outcomes of the project within their respective organisations and networks.

4 Future Research Investment

4.1 Proposed Investment Profile

Based on the outcomes of prioritisation workshops held with stakeholders and research providers, as well as discussions with the Board and the RAC, a proposed investment profile for all of the remaining research funds was discussed and endorsed at the Board meeting of 5 February 2013 and the RAC meeting of 15 February 2013.

Table 3.1 shows the proposed future investments per roadmap for the lifetime of the Goyder Institute. It indicates which new areas of investment are most likely to be related to short-term, targeted R&D advice projects and which areas are dedicated to medium to long-term strategic research. In all cases, the proposed level of investment is based upon a realistic estimate of the desired outcomes that would be achievable for the available finance and within the remaining timeframe of the first round of funding for the Goyder Institute (until June 2015). The prioritisation of areas of investment for the remaining research funding is also related to the desired investment across the research themes as described in Section 4.3.

A brief discussion of the proposed future priority areas per roadmap related to desired policy outcomes is given in Section 4.2. These descriptions are not meant to provide the specific descriptions of new research projects but rather they are to provide an indication of the desired outcomes and policy priorities that may still need to be addressed with the remaining research budget. The budgets given in Table 3.1 provide an indication only of the potential maximum level of funding available. They do not represent approved project budgets, and must not be construed as a guarantee for future funding of these activities. Proposals to develop project plans for the issues identified will be invited from appropriate research teams amongst the Goyder Institute partners. Proposals will be developed in close consultation between the RAC, DEWNR and other government agencies to reach agreement on concise and realistic research outcomes and products. Final project plans and budgets will be endorsed by the RAC before being submitted to the Board for approval.

The overall investment profile of the Goyder Institute for the lifetime of the Institute is given in Table A2 in Appendix 2. This table also shows the global total budgets for Research Project, Research Adoption and Dissemination Activities, and the Admin Expenditure for the lifetime of the Goyder Institute until June 2015.

Table 4.1 Current and future investments per roadmap

	Currently committed	Pre-approved commitment	Future Strategic funding	Targeted R&D Advice Projects	TOTALS
C.1.1 Climate Change	7,012,255				
	7,012,255	0	0	0	7,012,255
E.1.1 MDB Review	477,783				
E.1.2 Murray Flood Ecology Urgent	41,927				
E.1.3 Murray Flood Ecology	1,527,329				
E.1.4 Expert Panel MDB Plan Review	160,759				
E.1.5 Scoping River Murray Catchment	199,408				
E.1.6 Peer Review MDB Plan	58,679				
E.1.7 River Murray Catchment proposed research	0	2,000,000			
E.1.8 Riverbank Collapse	989,523				
E.1.9 River Murray Channel Env. Water Req.	393,784				
E.1.10 SDL Adjustment Technical Panel	100,420				
E.1.x Implementing MDB Plan				1,000,000	
	3,949,611	2,000,000	0	1,000,000	6,949,611
E.2.1 SE Urgent	84,175				
E.2.2 South East – Phase 1	543,103				
E.2.3 SE Regional Water Balance	817,847				
E.2.4 Improved modelling of catchments & drains	362,399				
E.2.5 Wetlands in SE	1,105,842				
E.2.x Additional issues SE			2,000,000		
	2,913,366	0	2,000,000	0	4,913,366
I.1.1 Scoping AMLR Water Allocation Planning	264,238				
I.1.2 Torrens Lake Amenity Flows	406,383				
I.1.3 Salinity & Recycled Water	329,222				
1.1.4 AMLR WAP proposed research	3,794,951				
I.1.5 Torrens Lake Amenity Flows (2nd trial)	248,226				
I.1.6 Adelaide Plains Groundwater Assessment	2,999,968				
	8,042,988	0	0	0	8,042,988
I.2.1 G-FLOWS - Stage 1	3,086,872				
I.2.2 G-Flows - Stage 2	0	1,750,000			
I.2.x LEBRA			1,000,000		
	3,086,872	1,750,000	1,000,000	0	5,836,872
U.1.1 WSUD Targets	308,809				
U.1.2 WSUD Impediments & opportunities	1,521,521				
U.1.x Urban flooding issues				1,000,000	
	1,830,329	0	0	1,000,000	2,830,329
U.2.1 MAR & Stormwater Use Options	2,260,216				
U.2.2 Optimal Water Mix	3,063,031				
U.2.3 Governance of Water	502,914				
U.2.x Urban Water Blueprint & other urban issues			1,000,000		
	5,826,161	0	1,000,000	0	6,826,161
PhD Supplements	780,000				
	780,000	0	0	0	780,000
	33,441,583	**3,750,000**	**4,000,000**	**2,000,000**	**43,191,583**
	AVAILABLE BUDGET				**43,186,793**

4.2 Priority policy areas for future research

4.2.1 River Murray Roadmap (E1)

Implementation of the Murray Darling Basin Plan is a high priority issue for the State Government to support the successful outcomes for the future of the Murray River in South Australia. A key priority is for targeted, R&D advice and support from Goyder Institute experts for the immediate actions that South Australia is required to take for the implementation of the Plan (e.g. SDL adjustment, etc.). The Goyder Institute will collaborate closely with DEWNR to identify short-term, targeted R&D advice projects to assist in this process.

In addition to the short-term, targeted R&D advice projects mentioned above, some longer-term strategic research will be focussed on understanding the connectivity requirements of floodplain-riverine ecosystems. This has the strategic aim of providing a mechanism or tool for robust and transparent decisions about environmental and cultural water management in order to maximise the ecological and cultural outcomes of the Murray Darling Basin Plan in the South Australian reaches of the River Murray, the Lower Lakes and the Coorong.

4.2.2 Surface Water, Groundwater & Wetlands Roadmap (E2)

The groundwater resources in the lower South-East of South Australia are a major source of town water supplies as well as being a high-value resource for irrigation. Further work in this area is required to address specific knowledge gaps related to the development of a regional groundwater modelling framework for the Lower Limestone Coast that will help quantify the regional water balance. A significant feature of the south east hydrology and landscape are the wetland complexes, which can be dependent on both surface water and groundwater. A risk assessment categorisation of the potential dependence of the wetland complexes on the regional groundwater has been made by DEWNR. There is a need to refine this analysis to increase understanding of the degree of connectivity of wetland systems to the regional groundwater, and the significance of changes in groundwater levels to the ecological health of those wetland systems

A desired outcome is the re-evaluation of the sustainable use of groundwater in the lower limestone coast region based on the whole groundwater water balance, taking into account extractions, recharge and discharge processes, flow through the groundwater systems and the water requirements of groundwater dependent ecosystems. This will support future reviews of the Water Allocation Plans, enable an appropriate redefinition of sustainability criteria for the region, and identify opportunities to adopt management areas based on the groundwater system rather than simply maintaining administrative boundaries.

4.2.3 Water Allocation and Water Quality Improvement Roadmap (I1)

The newest project in this roadmap that was approved at the end of FY2012/13 is related to understanding the inter-relationship between the various aquifers comprising the Adelaide Plains groundwater system (project I.1.6). This project will attempt to quantify the recharge relationship between the fractured rock aquifers in the Mount Lofty Ranges and the Adelaide Plains groundwater system, and an updated groundwater model will support the future development of Water Allocation Plans in the Adelaide Plains, which sustain the irrigation industry in the Northern Adelaide Plains as well as industrial water sources in central Adelaide.

An important component is also the conjunctive use of groundwater in managed aquifer recharge systems as guided by the State Stormwater Strategy and the Urban Water Blueprint. Updated knowledge of the groundwater system will help to quantify the capacity of groundwater resources to store water arising from potential alternate water sources, which are being identified and evaluated under the Optimal Water Mix project (U.2.2). Possible future research may be related to the potential to use these aquifers for water banking during periods of extended drought.

4.2.4 Mining and Outback Water Roadmap (I2)

Following the successful trial in the G-FLOWS-1 project of the AEM methodology to identify and quantify potential groundwater sources in the far north of South Australia, a subsequent project (G-FLOWS-2) will apply the techniques to a focus area in the northern Eyre Peninsula, which has been identified by the mining sector as a high-priority, prospective mineral development province. The objective of this follow-on project is to confirm the value of the techniques and to provide new information to mining companies and communities about the groundwater reserves in this area and the potential for conjunctive use of these water resources.

In addition to the mining provinces, another area of interest in outback water resources is the Lake Eyre Basin. Through the Lake Eyre Basin Rivers Assessment (LEBRA), it is possible to contribute to the development of a suitable methodology that will provide the basis for evaluating changes in status and ecological health of Lake Eyre Basin water resources. A possible future program of activities may build upon the Lake Eyre Basin – River Monitoring (LEBRM) program, which is currently being carried out in the region with funding from the Office of Water Science as part of the Bioregional Assessments. The aim is to ensure that all of the LEB activities in South Australia will be productive in advancing the objectives of the LEBRM and LEBRA programs and to maximise the synergy between these programs. The goal is to improve our understanding of the ecology and hydrology of the LEB and improve the ability for the States and the Commonwealth to assess future development proposals based on the best available scientific information and management practice.

4.2.5 WSUD Roadmap (U1) and Water Resources Mix Roadmap (U2)

Future investments in the roadmaps associated with the Urban Water theme will be closely aligned with the requirements of the Urban Water Blueprint for Adelaide. This plan is currently under development at DEWNR and specific gaps in knowledge associated with the future implementation of the plan will be identified and prioritised during the development and consultation phase of the Blueprint. This will also incorporate the interests of SA Water and EPA.

Areas of potential future research investment may include, but are not limited to, the following:

- The potential use of water-sensitive urban design practices in relation to stormwater management and flood risk mitigation. This also has the potential to reduce long-term infrastructure costs of stormwater and flood management by enabling the management of stormwater flows within catchments. An additional benefit is related to the reduction of water quality impacts on the waters of Gulf St Vincent.
- Extension of the Optimal Water Mix project to develop the optimisation process beyond water security alone by taking into account water quality issues associated with the use of alternate water sources.
- Aquifers as reservoirs: to increase the capacity and resilience of Adelaide's long-term water storages (also related to Roadmap I1)

4.3 Investment across Research Themes

The selection of future research projects must also take into account the desired mix of research investment across the strategic research themes of the Institute as determined by the Goyder Institute Management Board. The following table provides an indication of the distribution of research funding across the Themes based on the proposed investments indicated in Table 3.1. In the last column, the proposed investment across research themes is compared to the desired level of investment that was identified in the 2012/13 R&D Plan and Budget, which was based on the SA Government priority directions.

THEME	Approved Budget	Future research	TOTAL	%	2012/13 R&D Plan
Climate Change	7,012,255	0	7,012,255	16.2%	16.1%
Environmental Water	8,862,977	3,000,000	11,862,977	27.5%	27.5%
Water for Industry	12,879,860	1,000,000	13,879,860	32.1%	33.6%
Urban Water	7,656,490	2,000,000	9,656,490	22.4%	20.9%
PhD Supplements	780,000	0	780,000	1.8%	1.9%
	37,191,583	**6,000,000**	**43,191,583**	**100.0%**	

This table indicates that it may be necessary to slightly decrease the proposed investment in the Urban Water theme and to subsequently increase the proposed investment in the Water for Industry theme.

4.4 Portfolio mix of projects

In general, a Goyder Institute project can be considered to comprise a number of related activities that can be classified in terms of the "policy-readiness" of the research; ranging from a clear and immediate uptake pathway to less clear and protracted uptake. For ease of classification, we can define the following types of research activities:

- short-term targeted *R&D advice* activities with clear and immediate uptake in policy & management (e.g. 6 month – 12 month path to uptake);
- longer-term *applied* research activities. Demand-driven with clearly defined outcomes, but with less clear and protracted uptake (e.g. 1 – 3 year path to uptake);
- *fundamental* and enabling research activities. PhD-style research of fundamental principles aimed at supporting applied research outcomes, but not directly related to uptake. (e.g. 3 – 4 year path to uptake)

Each project may contain a different mix of each of the above types of project activities.

Table 4.4 provides the results of an analysis of the current and proposed future research projects in terms of their mix of project activities.

Table 4.4 Portfolio mix of projects

THEME	Fundamental	Applied	R&D advice
C1 - Climate Change	30%	50%	20%
E1 - River Murray	19%	45%	36%
E2 - SW/GW & Wetlands	19%	71%	9%
I1 - WAP & WQ Improve	18%	55%	28%
I2 - Mining & Outback	20%	63%	17%
U1 - WSUD	5%	51%	43%
U2 - Water Res Mix	14%	54%	32%
PhD Supplements	100%	0%	0%
OVERALL	**21%**	**55%**	**24%**

On balance, the mix per roadmap is appropriate to support the strategic intent of the Goyder Institute for Water Research, which is primarily to provide excellent science to underpin policy. It should be noted that the current balance of investment in the Surface water, Groundwater and Wetlands roadmap is heavily biased towards Applied and Fundamental research. This indicates that any proposed future investment in this roadmap should pay particular attention to the uptake of the research results in policy and decision-making.

5 Research Adoption and Dissemination

5.1 Knowledge Management and Dissemination

To further improve the collaborative approach to science and policy integration in Goyder Institute projects and to assist in capacity building within stakeholder agencies, regular workshops between scientists, policy-makers and other stakeholders will be organised by the Goyder Institute Office, in consultation with the project teams.

The annual budget is used for stakeholder engagement activities of the Goyder Institute and may include test-bedding workshops; capacity building workshops; the Annual Goyder Institute Water Forum; networking and team-building activities; support to visiting fellows; sponsorship of conferences and symposia; and scoping of the knowledge encapsulation requirements for project outcomes. Other possible activities include a Science Retreat for research project team members, and a PhD Forum for the Goyder Institute PhD Fellows.

An important part of the knowledge management strategy of the Goyder Institute is the development of a common framework for data management. Together with the Australian National Data Service (ANDS), a project has been developed to bring together key stakeholders to develop and implement a set of consistent processes to ensure research data arising from Goyder Institute funded projects is well described and discoverable through Research Data Australia (RDA). The project will also be an opportunity to address issues around secure storage and access to the research data itself.

5.2 ANZSOG Appointment

In 2010, as part of the negotiations to create the Goyder Institute for Water Research Agreement (the Agreement), it was agreed that the Goyder Institute would make a cash contribution to co-fund the ANZSOG and Goyder Institute Chair of Public Policy and Management. The position was advertised without success in 2010 – 2011.

In 2012, Flinders University, the Australia and New Zealand School of Government (ANZSOG) and the Goyder Institute for Water Research agreed to reformulate the position as a series of short-term (3 to 6 month) Visiting Professorships. This approach was endorsed by the Goyder Institute Management Board on 28 September 2012 and a final proposal was accepted by the Board on 27 November 2012.

Flinders University has estimated the total cost for the revised Program as $988,906.
This will be funded as follows:

Flinders University	$247,227	cash and in-kind
ANZSOG	$247,226	cash
Goyder Institute	$494,453	cash
TOTAL	**$988,906**	

Advertising for the Visiting Professorships was commenced at the beginning of 2013 and it is anticipated that the first appointments will commence in the second half of 2013.

5.3 PhD Supplements

The Goyder Institute for Water Research awards PhD Supplements to outstanding PhD candidates from each of the University partners. Each PhD Supplement is valued at $10,000/pa for three years. Eight supplements commenced in 2011, nine supplements in 2012 and eight supplements in 2013.

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
Kayla Gilmore	Hypoxia in the Murray River region: identifying impacts to fish and tracking long-term trends	E1 Murray	01/2013 to 07/2016
Sanjina Upadhyay	Flow and nutritional resources: does DOC or phytoplankton productivity drive food webs in the Lower River Murray?	E1 Murray	03/2013 to 02/2016
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
Robert Andrew	Natural and managed hydrological changes and the implications for urban planning and water management	U1 WSUD	02/2013 to 02/2016
Saeedeh Gharib Choobary	Land surface and atmosphere interactions in selected environments with emphasis on the temperature effects	C1 Climate	08/2012 to 08/2015

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Mostafa Razzaghmanesh	Climate change and stormwater quality effects from green roof design in Adelaide	U1 WSUD	10/2011 to 10/2014
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
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
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
Alaa Abdel Hamid Ismail Ahmed	Hydrogeology of fractured rock aquifers in the Central Flinders Ranges, SA	I2 Outback	05/2012 to 12/2015
Niranjani Premila Semananda	Experimental investigation into performance of capillary subsurface irrigation of container gardens using recycled water	U1 WSUD	10/2012 to 10/2016
Shiv Umapathi	Integrated water consumption characteristics through real-time monitoring and ongoing community engagement at a new development that is representative of future residential living	U1 WSUD	12/2012 to 12/2015
Jonathan Cohen	Impacts of catchment conditions, climate and seasonality on water quality	I.1 WAP & WQ	03/2013 to 03/2016

A.1 Financial report to end of FY 2012/13

Project Budgets

Goyder Institute Annual Research and Development Plan
Annual Budget

		Participant	Goyder Budget 2010/11	2011/12	2012/13	2013/14	2014/15	Total	Goyder Cash Total	In-Kind Budget Total	In-Kind to Goyder	Partici- pant Interest
Research Projects		CSIRO	1,495,999	3,317,407	4,977,277	3,948,135	795,053	14,533,871	7,217,403	7,316,468	101%	52.0%
Research Projects		Flinders	184,459	394,634	514,416	1,952,258	662,696	3,708,463	1,810,981	1,897,482	105%	13.3%
Research Projects		Uni of Adelaide	218,904	1,125,338	2,355,062	2,163,439	447,648	6,310,391	3,030,771	3,279,619	108%	22.6%
Research Projects		Uni of SA	265,701	762,850	1,089,630	1,303,123	-	3,421,303	1,637,286	1,784,017	109%	12.2%
Research Partners		Sub Total	2,165,062	5,600,229	8,936,386	9,366,954	1,905,397	27,974,028	13,696,442	14,277,586	104%	100%
Research Projects		SARDI	443,697	612,002	1,231,266	1,183,549	584,120	4,054,634	2,007,296	2,047,338	102%	
Research Projects		AWQC	6,588	20,208	342,919	152,138	10,648	532,500	269,682	262,818	97%	
Research Projects Total		**Total**	**2,615,347**	**6,232,438**	**10,510,570**	**10,702,641**	**2,500,166**	**32,561,162**	**15,973,419**	**16,587,743**	**104%**	
Research Adoption	PhD Stipend TopUps	Total	-	240,000	215,000	180,000	145,000	780,000	780,000	-	-	
Research Adoption	ANZSOG	Flinders			-	500,000	500,000	1,000,000	500,000	500,000	100%	
Research Adoption	Knowledge Management			100,000	100,000	100,000	100,000	400,000	400,000		-	
Research Adoption	PhD Contributions - Goyder Office	Total	85,862	390,621	434,569	431,743	390,350	1,733,146	-	1,733,146	-	
Research Adoption Total		**Total**	**85,862**	**730,621**	**749,569**	**1,211,743**	**1,135,350**	**3,913,146**	**1,680,000**	**2,233,146**	**133%**	
Admin	**Goyder Office**	**Total**	**444,616**	**867,176**	**865,916**	**1,020,135**	**1,074,598**	**4,272,442**	**2,412,794**	**1,859,648**	**77%**	
Goyder Institute Total		**Total**	**3,145,825**	**7,830,236**	**12,126,056**	**12,934,519**	**4,710,114**	**40,746,750**	**20,066,213**	**20,680,537**	**103%**	

Program	Project		Goyder Budget 2010/11	2011/12	2012/13	2013/14	2014/15	Total	Goyder Cash Total	In-Kind Budget Total	In-Kind to Goyder	Other Funding
Urban Water	**U.2.1 MAR & Stormwater Use Options**	**Total**	15,317	331,306	1,244,457	669,136	-	2,260,216	1,065,000	1,195,216	112%	4,625,271
Environmental Water	**E.1.1 MDB Review**	**Total**	477,783	-	-	-	-	477,783	237,148	240,635	101%	259,055
Environmental Water	**E.2.1 SE Urgent**	**Total**	84,175	-	-	-	-	84,175	38,601	45,574	118%	
Environmental Water	**E.1.2 MFE Urgent**	**Total**	41,927	-	-	-	-	41,927	20,963	20,964	100%	
Environmental Water	**E.1.3 Murray Flood Ecology A & B**	**Total**	671,692	683,887	171,749	-	-	1,527,329	754,958	772,371	102%	10,300
Climate Change	**C.1.1 Climate Change**	**Total**	526,020	2,117,139	2,220,279	2,148,816	-	7,012,255	3,411,876	3,600,378	106%	-
Urban Water	**U.1.1 WSUD Targets**	**Total**	95,837	212,971	-	-	-	308,809	142,073	166,735	117%	
Industry Development	**I.2.1 FLOWS - Stage 1**	**Total**	513,176	1,899,212	674,484	-	-	3,086,872	1,535,710	1,551,162	101%	88,542
Environmental Water	**E.2.2 South East – Phase 1**	**Total**	189,419	332,224	21,459	-	-	543,103	245,272	297,831	121%	
Environmental Water	**E.1.4 Expert Panel MDB Plan Review**	**Total**		153,541	7,218	-	-	160,759	80,576	80,183	100%	187,990
Environmental Water	**E.2.4 SE Catchment & Drains**	**Total**	-	36,748	186,633	139,018	-	362,399	179,267	183,132	102%	-
Industry Development	**I.1.2 River Torrens (quality) Improvement Trial for Su**	**Total**		161,233	245,151	-	-	406,383	174,472	231,911	133%	-
Industry Development	**I.1.1 Scoping MLR Water Allocation Planning**	**Total**	-	155,296	108,942	-	-	264,238	117,989	146,249	124%	92,815
Environmental Water	**E.1.5 Scoping River Murray Catchment**	**Total**	-	148,881	50,527	-	-	199,408	99,690	99,718	100%	-
Environmental Water	**E.2.3 Regional Groundwater Balance**	**Total**	-	-	676,441	141,406	-	817,848	408,923	408,925	100%	99,600
Urban Water	**U.1.2 WSUD Impediments**	**Total**	-	-	939,269	582,252	-	1,521,521	760,760	760,761	100%	
Environmental Water	**E.1.6 Peer Review**	**Total**		-	58,679	-	-	58,679	30,970	27,709	89%	
Urban Water	**U.2.2 Optimal Water Resource Mix for Metropolitan**	**Total**	-	-	1,638,650	1,424,381	-	3,063,031	1,493,669	1,569,362	105%	156,048
Environmental Water	**E.2.5 Wetlands in SE**	**Total**	-	-	365,540	497,585	242,717	1,105,842	548,314	557,528	102%	319,354
Industry Development	**I.1.5 Torrens Lake Dilution Trial 2012/13**	**Total**	-	-	248,226	-	-	248,226	120,863	127,363	105%	657,216
Industry Development	**I.1.3 Recycled Water & Salinity**	**Total**	-	-	89,061	178,122	62,039	329,222	164,611	164,611	100%	1,070,746
Industry Development	**I.1.4 Water Allocation Planning**	**Total**	-	-	925,003	1,794,518	1,075,431	3,794,951	1,898,619	1,896,332	100%	1,240,951
Environmental Water	**E.1.8 Riverbank Collapse in Lower River Murray**	**Total**	-	-	270,856	470,000	248,668	989,523	494,761	494,762	100%	258,501
Environmental Water	**E.1.9 River Murray Channel EWR**	**Total**	-	-	203,789	189,995	-	393,784	196,892	196,892	100%	-
Urban Water	**U.2.3 Governance**	**Total**	-	-	22,803	480,111	-	502,914	251,457	251,457	100%	17,680
Industry Development	**I.1.6 Adelaide Groundwater**	**Total**	-	-	141,356	1,987,301	871,310	2,999,968	1,499,984	1,499,984	100%	-
Research Projects Total			2,615,347	6,232,438	10,510,570	10,702,641	2,500,166	32,561,162	15,973,419	16,587,743	104%	9,084,069

Not Approved Program			Goyder Budget 2010/11	2011/12	2012/13	2013/14	2014/15	Total	Goyder Cash Total	In-Kind Budget Total	In-Kind to Goyder
Research Projects	**Not Approved**	**Total**	-	-	1,000,000	2,000,000	6,867,574	9,867,574	4,933,787	4,933,787	**100%**
Goyder Institute Total		**Total**	3,145,825	7,830,236	13,126,056	14,934,519	11,577,688	50,614,324	25,000,000	25,614,324	**102%**

Project Actual Expenditures

Goyder Institute Annual Research and Development Plan

Annual Actuals as at 30 June 2013

		Participant	Expenditure 2010/11	2011/12	2012/13	2013/14	2014/15	LTD	Goyder Cash LTD	In-Kind LTD	In-Kind to Goyder
Research Projects		CSIRO	1,183,698	3,586,697	5,092,827	-	-	9,863,222	4,958,061	4,905,161	99%
Research Projects		Flinders	179,295	380,727	335,387	-	-	895,410	392,898	502,512	128%
Research Projects		Uni of Adelaide	216,441	1,273,586	1,719,866	-	-	3,209,893	1,475,060	1,734,833	118%
Research Projects		Uni of SA	264,205	743,092	963,076	-	-	1,970,373	1,097,632	872,741	80%
Research Partners			1,843,640	5,984,102	8,111,156	-	-	15,938,898	7,923,651	8,015,247	101%
Research Projects		SARDI	318,893	725,713	528,295	-	-	1,572,901	732,363	840,538	115%
Research Projects		AWQC	6,513	20,297	230,366	-	-	257,176	150,787	106,389	71%
Research Projects Total		**Total**	**2,169,046**	**6,730,112**	**8,869,817**	**-**	**-**	**17,768,975**	**8,806,801**	**8,962,174**	**102%**
Research Adoption	PhD Stipend TopUps	Total	-	240,000	255,000	-	-	495,000	495,000	-	
Research Adoption	ANZSOG	Flinders						-	-	-	
Research Adoption	Knowledge Management	Total		28,556	95,276			123,832	123,832	-	
Research Adoption	PhD contributions	Total	86,210	324,452	466,709	-	-	877,371	-	877,371	
Research Adoption		**Total**	**86,210**	**593,008**	**816,985**	**-**	**-**	**1,496,203**	**618,832**	**877,371**	**-**
Admin	**Goyder Office**	**Total**	**444,268**	**861,902**	**869,052**			**2,175,222**	**1,216,881**	**958,341**	**79%**
Goyder Institute Total		**Total**	**2,699,524**	**8,185,022**	**10,555,855**	**-**	**-**	**21,440,400**	**10,642,514**	**10,797,887**	**101%**

Program	Project	Participant	Expenditure 2010/11	2011/12	2012/13	2013/14	2014/15	LTD	Goyder Cash LTD	In-Kind LTD	In-Kind to Goyder
Urban Water	**U.2.1 MARSUO**	**Total**	14,127	320,049	1,219,302	-	-	1,553,478	880,400	673,078	76%
Environmental Water	**E.1.1 MDB Review**	**Total**	238,689	239,093	-	-	-	477,783	237,148	240,635	101%
Environmental Water	**E.2.1 SE Urgent**	**Total**	84,175	-	-	-	-	84,175	38,601	45,574	118%
Environmental Water	**E.1.2 MFE Urgent**	**Total**	30,298	11,629	-	-	-	41,927	20,963	20,964	100%
Environmental Water	**E.1.3 Murray Flood Ecology**	**Total**	534,083	906,448	159,362	-	-	1,599,893	709,083	890,810	126%
Climate Change	**C.1.1 Climate Change**	**Total**	515,442	2,271,282	2,158,843	-	-	4,945,568	2,518,487	2,427,081	96%
Urban Water	**U.1.1 WSUD Targets**	**Total**	95,837	212,971	-	-	-	308,809	142,073	166,736	117%
Industry development	**I.2.1 FLOWS - Stage 1**	**Total**	466,974	1,839,503	917,805	-	-	3,224,282	1,465,097	1,759,185	120%
Industry development	**E.2.2 South East – Phase 1**	**Total**	189,419	332,224	21,459	-	-	543,103	245,272	297,831	121%
Environmental Water	**E.1.4 Expert Panel MDB Plan Review**	**Total**		153,541	7,218	-	-	160,759	80,576	80,183	100%
Environmental Water	**E.2.4 SE Catchment & Drains**	**Total**		21,234	163,184	-	-	184,417	85,000	99,417	117%
Industry Development	**I.1.2 River Torrens (quality) Improvement Trial for Su**	**Total**		161,233	245,151	-	-	406,383	174,472	231,911	133%
Industry Development	**I.1.1 Scoping MLR Water Allocation Planning**	**Total**		155,296	108,942	-	-	264,238	117,989	146,249	124%
Environmental Water	**E.1.5 Scoping River Murray Catchment**	**Total**		105,608	100,833	-	-	206,441	-	206,441	-
Environmental Water	**E.2.3 Regional Groundwater Balance**	**Total**		-	662,264	-	-	662,264	269,518	392,746	146%
Urban Water	**U.1.2 WSUD Impediments**	**Total**		-	839,537	-	-	839,537	565,696	273,841	48%
Environmental Water	**E.1.6 Peer Review**	**Total**		-	58,679	-	-	58,679	30,970	27,709	89%
Urban Water	**U.2.2 Optimal Water Resource Mix for Metropolitan**	**Total**		-	1,464,848	-	-	1,464,848	729,519	735,329	101%
Environmental Water	**E.2.5 Wetlands in SE**	**Total**		-	116,357	-	-	116,357	273,759	- 157,402	-57%
Industry Development	**I.1.5 Torrens Lake Dilution Trial 2012/13**	**Total**		-	138,080	-	-	138,080	77,615	60,465	78%
Industry Development	**I.1.3 Recycled Water & Salinity**	**Total**		-	-	-	-	-	45,268	- 45,268	-100%
Industry Development	**I.1.4 Water Allocation Planning**	**Total**		-	307,269	-	-	307,269	-	307,269	-
Environmental Water	**E.1.8 Riverbank Collapse**	**Total**		-	164,659	-	-	164,659	17,628	147,031	834%
Environmental Water	**E.1.9 River Murray Channel EWR**	**Total**		-	16,026	-	-	16,026	81,667	- 65,641	-80%
Urban Water	**U.2.3 Governance**	**Total**		-	-	-	-	-	-	-	-
Industry Development	**I.1.6 Adelaide Groundwater**	**Total**		-	-	-	-	-	-	-	-
Total			**2,169,046**	**6,730,112**	**8,869,817**	**-**	**-**	**17,768,975**	**8,806,801**	**8,962,174**	**102%**

A.2 Investment profile

Project Register & Investment profile v10.xlsx		Budget Approvals ToDate			Budget Approvals 2013_14			Budget Approvals 2014_15			Total LifeTime		
		Budget	Cash	In-Kind	Budget	Cash	In-Kind	Budget	Cash	In-Kind	Budget	Cash	In-Kind
RESEARCH BUDGET													
Research projects													
C.1	Regional Downscaling	7,012,255	3,411,876	3,600,379	-	-	-	-	-	-	7,012,255	3,411,876	3,600,379
E.1	River Murray	3,949,611	1,966,168	1,983,443	3,000,000	1,500,000	1,500,000	-	-	-	6,949,611	3,466,168	3,483,443
E.2	Surface water, groundwater, wetland relationship	2,913,366	1,420,378	1,492,988	2,000,000	1,000,000	1,000,000		-	-	4,913,366	2,420,378	2,492,988
I.1	Water allocation planning & water quality improvement	8,042,988	3,987,509	4,055,479	-	-	-	-	-	-	8,042,988	3,987,509	4,055,479
I.2	Mining & outback water	3,086,872	1,535,710	1,551,162	2,750,000	1,375,000	1,375,000		-	-	5,836,872	2,910,710	2,926,162
U.1	Water sensitive urban design	1,830,329	902,834	927,496	500,000	250,000	250,000	495,210	247,605	247,605	2,825,539	1,400,439	1,425,101
U.2	Water resources mix for Adelaide	5,826,161	2,810,126	3,016,035	500,000	250,000	250,000	500,000	250,000	250,000	6,826,161	3,310,126	3,516,035
	projects subtotal	*32,661,583*	*16,034,601*	*16,626,982*	*8,750,000*	*4,375,000*	*4,375,000*	*995,210*	*497,605*	*497,605*	*42,406,793*	*20,907,206*	*21,499,587*
Research adoption and dissemination													
Knowledge management & dissemination		200,000	200,000	-	100,000	100,000	-	100,000	100,000	-	400,000	400,000	-
PhD Supplements		750,000	750,000	-	30,000	30,000	-		-	-	780,000	780,000	-
Additional in-kind PhD		1,206,053		1,206,053	281,743		281,743	245,350		245,350	1,733,146	-	1,733,146
ANZSOG		-	-	-	500,000	250,000	250,000	500,000	250,000	250,000	1,000,000	500,000	500,000
	adoption & dissemination subtotal	*2,156,053*	*950,000*	*1,206,053*	*911,743*	*380,000*	*531,743*	*845,350*	*350,000*	*495,350*	*3,913,146*	*1,680,000*	*2,233,146*
Research budget TOTAL		**34,817,636**	**16,984,601**	**17,833,035**	**9,661,743**	**4,755,000**	**4,906,743**	**1,840,560**	**847,605**	**992,955**	**46,319,939**	**22,587,206**	**23,732,733**
ADMIN BUDGET													
Goyder Institute Office		2,177,709	1,216,881	960,828	1,020,135	585,939	434,196	1,074,598	609,974	464,624	4,272,442	2,412,794	1,859,648
Admin budget TOTAL		**2,177,709**	**1,216,881**	**960,828**	**1,020,135**	**585,939**	**434,196**	**1,074,598**	**609,974**	**464,624**	**4,272,442**	**2,412,794**	**1,859,648**
Goyder Institute TOTAL		**36,995,345**	**18,201,482**	**18,793,863**	**10,681,878**	**5,340,939**	**5,340,939**	**2,915,158**	**1,457,579**	**1,457,579**	**50,592,381**	**25,000,000**	**25,592,381**