

Report on Integrated Surface Water – Groundwater Management Investigation in Australia



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EXECUTIVE SUMMARY

This summary addresses the working investigation of Dr. Ken Knox to Tasmania in November 2009 and to northern Queensland in February 2010. As author of this report, I was granted the privilege to share ideas and professional experiences with leading Australian scientists, government officials, and managers of water resources in different geopolitical, climatic, and topographic areas – with a focused intent to advance water resources management in both Australia and the United States.

The travel program was comprehensive, and included visits to large irrigation districts in Tasmania and to the Lower Burdekin in Queensland. Presentations were provided at two conferences (NWC Groundwater Forum in Canberra and Lower Burdekin Water Forum in Ayr, Queensland) and many informal technical workshops were conducted in collaboration with various government, research institutes, universities, and water user organisations.

This summary reflects the general purpose, findings, and recommendations of the author in regard to the integration of groundwater within the regulatory environment in Tasmania and general impressions of water resources management in the Burdekin River Valley.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the professional and organisational efforts of Dr. Keith Bristow, Mr. Jeff Camkin, and Ms. Di Popham (CSIRO/NAIF), Mr. Ludovic Schmidt (DPIPWE), and Dr. Imogen Fullagar (Weathering Change) who provided not only logistics and timely coordination of the working trip, but were invaluable in sharing their professional expertise and guiding the author throughout Australia.

The author also thanks the CSIRO, the CRC for Irrigation Futures, the Burdekin Water Futures, and the Tasmania Department of Primary Industries, Parks, Water and Environment (DPIPWE) who kindly sponsored the trip. The author is particularly thankful to CRC IF and DPIPWE for providing the majority of the funding for the trip.

Additionally, the author thanks a number of other people who were invaluable in providing technical and logistical support for the working trip, sharing their professional expertise, and sincere acts of kindness. These numerous and unnamed individuals also retain the author's deepest respect and gratitude.

BACKGROUND ABOUT THE INVESTIGATION

The foundation for this investigation and international sharing of professional water management expertise is the collaborative working relationship developed between the author and CSIRO and State of Tasmania officials that developed through international water management studies conducted by Mr. Jeff Camkin and Dr. Imogen Fullager, who visited the United States on a Churchill Fellowship study tour and in conducting research for a doctoral dissertation, respectively. The author was then employed by the State of Colorado as the Chief Deputy State Engineer, responsible for interstate river compacts, surface and groundwater management, and litigation activities during the period of Mr. Camkin's and Dr. Fullager's study in the United States.

Subsequent to those visits, the author continued to frequently communicate with these individuals and the opportunity was presented to conduct a collaborative investigation as part of a working trip to Australia with CSIRO and Tasmania water officials. This investigation was segmented into three primary components, of which this report addresses the first two.

Phase 1 – Interview Tasmania water officials and perform a comprehensive review of existing water management practices, applicable technical analyses, and Tasmania water law necessary to develop a baseline understanding of the potential challenges to integrating groundwater within a surface water dominant system. Two comprehensive draft reports were provided to Tasmania water officials on 31 January 2010 that provide an initial assessment of key findings and recommendations. The reports are titled:

- *Independent Assessment of the Tasmania Water Management Act of 1999: Risks That May Impede Groundwater Regulation and Effective Management of Connected Groundwater and Surface Water*

- *Assessment of Litigation Risks for Groundwater Management in Tasmania*

A Keynote presentation was provided at the National Water Commission annual Groundwater Forum in Canberra in addition to other technical workshops and presentations as part of this initial phase.

Phase 2 – Review the integration of surface and groundwater management in the Lower Burdekin River Valley. Presentations were also conducted at the Burdekin Water Forum and to other scientific and government agencies in Queensland.

Phase 3 – Upon review and consideration of the aforementioned draft reports, it is anticipated the author will return to Tasmania and work with DPIPWE officials to refine the recommended water management, technical, and budgetary items to implement a robust and defensible integrated surface water/groundwater management system. This third phase is tentatively scheduled for 2010.

TRAVEL ITINERARY

The working trip was segmented into two phases. The primary states and cities are described in Table 1 below.

Table 1. Australian States/Territory and Cities visited in the Working Trip.

Phase	State/Territory	Cities
Nov 2009	Tasmania	Hobart
	ACT	Canberra
Feb 2010	Queensland	Brisbane, Townsville, Ayr

Considering the wide spectrum of ecosystems, climate and levels of water development visited by the author during the working trip, as well as the professional expertise and technical support of the hosting team, it was possible to develop a fairly representative understanding of the water resources aspects and issues in these three regions.

INSTITUTIONS VISITED AND PRESENTATIONS

Several scientific, community, and government institutions were visited by the author during the working trip. Technical presentations were provided at each location, followed by discussion with the audience. Tables 2 and 3 below lists the institutions visited and their locations, as well as the title of the presentation.

Table 2. Institutions visited during the first phase of the investigation and presentations in November 2009.

Date	Institution / Location	Presentation Title
Mon, 16 November	DPIPWE, Hobart, Tasmania	"Integration of Surface Water – Groundwater Resources in the United States"
Mon, 16 November through Sun, 22 November	DPIPWE, Hobart, Tasmania	Technical investigation and interview of Tasmania water officials regarding the legal, political, and technical integration of groundwater resources within existing water management practices
Mon, 23 November	National Groundwater Centre, Canberra, ACT	Informal discussion with Centre Board of Directors on the technical and practical integration of groundwater resources in modern society
Tue, 24 November	NWC Groundwater Forum, Canberra, ACT	"Colorado's experience of 'one resource' water management" (Keynote address)
Thu, 26 November	CSIRO Black Mountain Laboratory, Canberra, ACT	"Challenges and Opportunities in Water Resources Management in the United States"
Fri, 27 November	Murray Darling Basin Authority, Canberra, ACT	"Colorado's Experience of 'One Resource' Water Management"

Table 3. Institutions visited during the second phase of the investigation and presentations in February 2010.

Date	Institution / Location	Presentation Title
Mon, 15 February	Burdekin Water Forum, Ayr, QLD	“Groundwater – An International Perspective”
Tues, 16 February	Burdekin Water Forum, Ayr, QLD	“Groundwater Management”
Wed, 17 February	Burdekin Water Futures/ Burdekin Shire Council, Ayr, QLD	Review and assessment of Burdekin Water Forum
Thur, 18 February	CSIRO/Davies Laboratory, Townsville, QLD	“Integrated Water Management in the United States”
Mon, 22 February	Queensland Department of the Environment & Resource Management, Brisbane, QLD	“Colorado Water Planning & Decision Support Tools”
Mon, 22 February	University of Queensland Brisbane, QLD	Integrated surface and groundwater management and role of academia discussion with Professor David Lockington

STATE OF TASMANIA

The State of Tasmania is at the threshold of developing significant groundwater supplies and integration of these resources within a single and comprehensive water management system. Tasmania water officials recognise the region typically receives adequate water supplies to meet traditional irrigation, domestic, municipal and hydropower generation needs. However, increasing demand and concern over adverse long-term climate changes prompted these officials to proactively define and implement a robust water management system to address current and future water management issues in an equitable, practical, cost effective, and environmentally responsible manner that is based upon sound science and water management practices. Candidly, these officials presciently recognise the opportunity presented to them to develop an integrated water resource management system before harmful effects from overdraft of limited groundwater resources occurs, as evident in the western United States and other Australian States.

The assessment, risks, and recommendations for integrating groundwater resources in a single comprehensive management system are provided in the aforementioned two draft reports. The major findings and preliminary recommendations are provided below.



(View of Tyenna River from Mt. Tim Shea, Tasmania, photograph by author)

Summary Assessment of Tasmania Water Management Act

The Tasmania Water Management Act of 1999 is a comprehensive and proactive legal instrument designed to create a viable water management system that promotes the sustainable use of water resources in an equitable manner for the current and future generations in Tasmania. It provides a general framework that strives toward achieving a balance between economic development of water resources with ecological values and community involvement.

In addition to the comments and suggested narrative offered in this assessment, it is highly recommended that additional policy documents and rules and regulations be developed to refine the general framework of the Act.

Composition of these detailed instruments will provide the opportunity to infuse proven water management practices and scientific expertise from Tasmania water officials into a “working” document that complements the legal text. The adoption rules and policy instruments will provide additional clarity of the legal and administrative context of groundwater management for the community. They will also provide value by providing the details and logic used by water management officials in the review and analysis of pending water licenses, water management plans, and regulatory functions in a consistent and transparent manner.

Risks that may impede the practical implementation of groundwater regulation and options to minimise these risks in proactive and cost-effective manner that reflects DPIPW capacity

1. Lack of competent staff¹. The management and regulation of groundwater resources is complex and requires a highly-developed level of expertise in rigorous scientific disciplines such as geology, hydrogeology, mathematical modeling, and/or water resources engineering. The number of individuals that retain this groundwater expertise and experience is often quite limited. For government agencies that are charged with the implementation of groundwater regulation, recruiting and retaining these individuals is often difficult in a competitive employment market when private industry may offer more lucrative compensation and other financial benefits.

To recruit and retain qualified individuals, it is highly recommended that elected and budget officials dedicate sufficient revenue that is necessary to provide an adequate and equitable salary that is comparative to similar jobs and responsibilities in the private-employment market. Further, it is important to provide a long-term² career path within a natural resources management agency that provides opportunity for advancement in terms of increased supervisory duties, subject matter expertise, or combination

¹ At this juncture it is important to unequivocally state it is the author’s objective position that the DPIPW personnel that were interviewed and assisted in this investigation reflect the highest professional standard and competency in the water resources discipline, the challenge is to retain and recruit additional personnel of the same caliber in the future.

² A long-term career path is defined as 10 to 30 years in duration to provide incentive for continuous professional development and positive contribution to the employer.

thereof in a stable environment. Retention of skilled employees will provide significant and long-term savings to a government agency by (1) reducing time and resources expended during the recruitment and hiring process; and (2) recognition that competent and dedicated employees provide a much higher rate of return in terms of \$\$ per hour toward achieving the work objectives of an agency.

2. Insufficient funding for operations and expenses. Implementation of a groundwater regulation system requires the expenditure of funds for data collection, community educational efforts, development of groundwater modeling and other expenses. Candidly, the claim that a government agency is underfunded is simply not an innovative or unique assertion. However, failure to provide adequate funding will indeed limit or delay successful implementation of a groundwater regulation system.

In a global perspective, the traditional source of funding for water resources programs in democratic societies has been from general tax revenues received and dispersed by representative governments as a “public good”. However, the emergence of the “enterprise economic principle” is gaining increased application and/or replacement in the western United States to supplement diminished general fund allocations by a state government.³ Succinctly, this economic principle may be considered as “those who receive the benefit, pay for the benefit”. An example would be for an individual seeking to obtain a groundwater well permit to be assessed an initial processing fee that is commensurate with the amount of time/salary of government personnel necessary to receive, analyse, and process said permit. Further, it may be appropriate for a nominal annual fee be imposed to offset the cost of associated with management of the groundwater license and is consistent with the language in Section 79 of the Act.

³ A fee schedule that describes the type of service and monetary assessment used in Colorado and other states in Australia may be compiled for consideration and comparative purposes.

Another accepted and proven method to offset the cost to DPIPWE is cost-sharing. In particular, for local groundwater management or water user organisations that receive tangible benefits from groundwater monitoring and measurement activities, it is appropriate for them to provide funding or in-kind services to assist in program operations. In a similar manner, it is recommended that state and local governments continue to actively solicit funding assistance in the form of grants or other assistance from the federal government.

3. Change. New or additional government regulations, that reflect a change in operations or compliance with additional authoritative requirements, are typically met with resistance by a community that is subject to said groundwater regulation.

The measure of success, or failure, of groundwater regulatory actions is often directly proportional to the amount of effort that is expended by government officials to gain community support prior to their implementation. For example, the solicitation for assistance by local community leaders, councils, water user organisations, water well drillers, and environmental coalitions is critical. The most time and cost-effective mechanism to achieve this community support is through providing informational presentations at the councils and local communities at night when individuals are less conflicted by their employment schedules and able to attend. Follow-up meetings to address any comments previously raised by the local constituents and to provide additional information are especially productive and positive because they reflect a sincere willingness to listen and learn from local knowledge.

4. Inertia. Inertia is a powerful force in the physical environment and may also interfere with initial creation and implementation of government regulatory actions. Unfortunately, one of the leading impediments to the successful implementation of a groundwater regulatory system is the failure to simply start the process due to overwhelming and competing

demands that are imposed upon government officials who are charged with many responsibilities, opposing views and demands from different constituent groups, and multiple groundwater areas that warrant action.

Although it may appear overly simplistic, the most effective mechanism to combat a strong inclination toward deferral is to begin the process with conviction. It is highly recommended that a new groundwater regulatory program be implemented in an area with two primary characteristics: (1) there is a demonstrated hydrologic need that will substantiate the value of implementing a groundwater regulatory regime; and (2) it be conducted in an area that is less complex than others in terms of ancillary hydrogeology and societal factors. The insight and knowledge gained from the first groundwater regulatory scheme will serve as the foundation for expanding the regulatory system as needed to subsequent and more challenging areas.

5. Lack of resources and experience. A deficit in the level of experience, technical support, and resources within a government agency relevant to the discrete task of establishing a new groundwater regulatory program may lead to deferral or missteps in development of the program. In contrast to surface water regulation, the concept and implementation of comprehensive groundwater regulatory actions is relatively new and a subject agency may not have the benefit of prior experience. Further, it is a common reality that government agencies are fully encumbered with existing responsibilities and may simply not have the time or resources available for dedication to the task of establishing the framework for a new groundwater program. This concept cannot be understated because groundwater regulation often invites controversy and a well-constructed framework may defray extraneous costs, delays, and political intervention.

The key to successful implementation of a new groundwater regulatory program is reliance upon individuals with direct experience and expertise in the creation, implementation, and operation of these programs.

Capturing the water management, technical, financial, and legal expertise of these individuals will prove invaluable in terms of program implementation, effectiveness, and cost savings. It is also recommended that state government water resource agencies look to expertise available from individuals or other similar agencies with direct experience in the same discipline and on a comparable level.

Prioritise the relative importance of technical investments and regulatory processes with reference to Colorado’s experience with public expectations

Provided below are the top 5 technical investments and regulatory processes that are recommended for consideration. They are provided in priority and in context that the DPIPWE wishes to continue providing optimal water management practices and service to the people of Tasmania, but it is also constrained by limited personnel and financial resources.

1. Creation and implementation of a central database.
2. Require permits be required for all groundwater wells in Tasmania
3. Design and implement an extended groundwater monitoring network
4. Develop an expanded streamflow measurement system in Tasmania.
5. Design and Implement Decision Support Systems

Assessment of litigation risks for groundwater management

The development and use of groundwater supplies continues to increase in many areas in Tasmania, similar to other regions throughout the world in which the demand for reliable and high-quality water is necessary to supplement limited surface water supplies. It is important to recognise the source of groundwater from alluvial aquifers is typically water recharged by percolation through the earthen crust from precipitation and this source may be effectively managed with streamflows as part of a conjunctive water use system. However, for deeper bedrock aquifers that retain ancient water supplies that were developed over many millenia, the advancement of groundwater pumping typically prompts a “mining” effect which is not sustainable under typical agriculture or domestic water use cycles. In these areas of development, careful thought and analysis is warranted and should include the impacts of

groundwater withdrawals upon the environment and the opportunities/consequences to the social, economic, and political community.

Commensurate with groundwater development is the requisite management of groundwater resources, and perhaps the ensuing litigation actions. Water management activities, including groundwater resources, inevitably invite dispute. However, the proactive actions by DPIPWE officials to recognise, understand and address the adverse impacts of litigation are to be applauded and demonstrate vision. The primary reasons litigation is prompted in groundwater management activities include:

- Perceived inaction of government water management officials
- Perceived adverse impact to aquatic ecology or the riparian environment
- Additional costs (time and money) to comply with new rules or groundwater administrative regimes
- In protest to administrative orders requiring the installation of measurement devices



(Groundwater playa near Turnbridge, Tasmania; photograph by author)

Implement a Risk Management Plan

The primary goal of the risk management process is to reduce exposure to the consequences of risk events to levels that are considered acceptable to the enacting government agency or business. A risk management plan was suggested as a systematic application of management policies, processes, and documentation procedures to identify, analyse, assess, treat, and monitor risks that may be inherent to water management functions performed by the DPIPWE. Provided below is the general outline of the risk management process and key participants.

<u>Risk Management Process</u>	<u>Key Participants</u>
1. Establish Context <ul style="list-style-type: none">• Assessment criteria	Project Manager Risk Analyst
2. Risk Identification <ul style="list-style-type: none">• Identify risk events• Estimate likelihood• Identify consequences	Risk Analyst Expert Panel Stakeholders Project Manager
3. Risk Analysis <ul style="list-style-type: none">• Analyse risks• Evaluate risk profiles• Rank & short-list risk events	Risk Analyst Project Manager
4. Develop Treatment Strategy <ul style="list-style-type: none">• Compare risk levels w/ acceptability criteria• Evaluate options• Reduce risk/Transfer risk/ Accept risk	Risk Analyst Stakeholders Project Manager
5. Implement Strategy <ul style="list-style-type: none">• Risk Action plans	Project Manager
6. Review <ul style="list-style-type: none">• Critical review and update	Project Manager

LOWER BURDEKIN

The author was granted the privilege of attending the Burdekin Water Forum and to participate in field investigations to learn about water management and irrigation issues directly from lead scientists, elected officials and Burdekin Shire technical staff, water management officials, and many members of the Burdekin community that are dependant upon water resources and agriculture in this area. Although an exhaustive technical or conjunctive use management analysis was not conducted, the following narrative describes the general impressions of this author based upon personal interviews, research, and observation.

Water Management

The distribution and allocation of irrigation water supplies in the Lower Burdekin appear to be addressed by two primary entities:

1. Lower Burdekin Water – which effectively represents the interests of the North Burdekin Water Board and South Burdekin Water Board through a centralised management system? The Executive Officer Andrew Kelly and his staff oversee pipelines, channels, and recharge pits to supplement subterranean water supplies and thereby increase the quantity and quality of the underground water resources.
2. SunWater – which provides direct water supply service to a large number of customers, including irrigators and to local communities. They also construct, maintain and operate water weirs, pumping stations, pipelines, dams and other diversion and storage infrastructure from the Burdekin River.

It is the author's opinion these two entities work in a collaborative manner to assist agriculture producers in obtaining a reliable water supply in their respective regions.



(Dr. Keith Bristow and Professor Shabaz Khan at Clare Weir, Burdekin River; photograph taken by author)

Technical Support

Northern Queensland and Burdekin River Valley benefit from extensive scientific and extensive professional expertise available from CSIRO Davies Laboratory and supplemental research from professors at the University of Queensland. This author is impressed with both the quality and scope of scientific and technical expertise in water supply, irrigation efficiency, water quality, riparian ecology, and other disciplines available to serve the Burdekin community. Candidly, it is unique to retain this high of a level of expertise in a region and I recommend utilising these entities

to the fullest extent possible to achieve and maintain a sustainable water supply – particularly in context of addressing potential adverse impacts to the Great Barrier Reef.

Government Administration

The National Water Commission (NWC), at a federal level, is responsible for implementing the National Water Initiative. Primary authority for water management and control is vested to the State governments. This author is appreciative of the professional dedication and expertise of NWC leadership in Canberra who demonstrate a tangible understanding of the need and complexity to develop a sustainable water supply for Australia. The NWC achieves this goal primarily through dedication of funds to assist State and local governments, research organisations, and others in developing effective water resource management tools and control systems. The NWC also provides invaluable technical assistance through involvement of its professional staff and hosting conferences, forums, and workshops in which the state of science and water management are advanced through open discussion and debate.

State of Queensland

State water officials are tasked with overall management responsibilities for water quantity and quality control, including the Burdekin Catchment. However, they do not appear to provide on-the-ground or daily water administration services. This is of personal interest to the author, as the former official for the State of Colorado, where technical leadership and daily management of water resources is conducted by State officials to the expectation of the water using community. Nevertheless, Queensland officials indicate they are initiating development of a groundwater model and are in discussion with the Federal Government for funding support. In conference with Queensland leadership, this author respectfully recommended extension of the project to include the following factors:

1. Initiate a steering committee comprised of local water managers and scientists in the Burdekin River Valley with Queensland officials to assist in defining the water management goals/objectives, priority of work products, and establish technical parameters.
2. Initiate a peer review process at the initiation of model development and continue with periodic workshops to capture the extensive scientific expertise and water management experience necessary to create a reliable model.
3. Create a centralised relational database. Numerous sources of government and water management agencies indicated they independently retain critical water quality and hydrologic data. However, it is apparent that no single entity retains a single or comprehensive database of pertinent water resources information. HydroBase is an example of said comprehensive relational database developed by the State of Colorado that provides the most powerful and effective asset in water resources management. It is highly recommended the development of this database be initiated and maintained by the State of Queensland as the first priority.
4. Extend the concept of developing a groundwater model to a comprehensive decision support system (DSS) that provides a suite of models, data management/reporting, and user interface tools. A DSS is necessary in modern and effective water management systems with complex hydrology such as the Burdekin. Development of a groundwater model in isolation will provide little, if any, tangible value to water managers and farmers in performance of their daily work. It is highly recommended that Queensland officials complement their professional competency by

capturing the expertise available by consultancies and Burdekin River Valley constituents. Based upon this author's personal experience in DSS design and development of river basin models, the State of Queensland will be better able to meet their stated objectives by securing additional funds, expertise, and time to develop a robust and implementable DSS for the Burdekin River.



(Homestead and irrigated sugarcane fields in Lower Burdekin Valley, photograph by author)

RECOMMENDATIONS

The working trip reinforces the value of sharing pragmatic water management experience and technical expertise in the pursuit of developing a sustainable water supply system among international colleagues – in Australia and the United States. Although the work in Tasmania is not complete and time spent in the Burdekin was limited, the following recommendations are respectfully submitted for consideration and complement those previously

described in this paper and those provided in detail in the two draft reports provided to Tasmania water officials.

- In recent activities, the approach to water management in Australia appears to have reversed to a more centralised regulatory approach by the federal government. It is recommended that a balance be carefully considered and implemented that includes a decentralised approach for daily and on-the-ground water management practices toward the States and water users. This concept appears to facilitate the integration of a national strategy, being implemented by the National Water Commission;
- Consultation processes at the scientific and community levels are assisting toward achieving technically and economically sound decisions, particularly under water-scarce conditions. These additional technical resources should continue to be used as much as possible in continuing water supply and management plans and projects;
- In the Lower Burdekin, significant investigation and investment in drainage systems and nitrate loading are necessary. These two integrated factors contribute to declining crop production, land use, and downstream ecologies – including potential adverse impacts to the Great Barrier Reef;
- Continue to fund value-based initiatives in water resources management, particularly those related to integrated water resources management and development of sustainable water supplies;
- Continue to study the impacts of climate change scenarios to Australian water resources, particularly in context of trend analyses, using suitable tools to assess the sector's vulnerability and adaptive capacity;
- Continue to develop practical and useful tools for the equitable and efficient allocation of water, balancing environmental needs and economic values of water;
- Continue to develop opportunities to exchange international expertise and experience in the scientific, technical, management and governance of water resources.

LIST OF CONTACTS

The following list of contacts represents those individuals in which significant professional discussion and business cards were exchanged:

Prof. Ian Acworth, University of New South Wales

Mr. Jason Bayly-Stark, DPIPWE, Tasmania

Dr. Nerida Bleakley, DPIPWE, Tasmania

Dr. Keith Bristow, CSIRO Townsville

Ms. Elke Bobenhausen, DPIPWE, Tasmania

Mr. James Cameron, NWC, Canberra

Mr. Jeff Camkin, CSIRO, Perth

Mr. Bruce Campbell, MDBA, Canberra

Mr. Greg Claydon, DERM, Queensland

Prof. Peter Cook, National Centre for Groundwater Research, Canberra

Dr. Jane Coram, Geoscience Australia, Canberra

Mr. Randall Cox, DERM, Queensland

Mr. Chris Davis, NWC, Canberra

Mr. David Dreverman, MDBA, Canberra

Dr. Richard Evans, SKM, Victoria

Dr. Imogen Fullagar, Weathering Change, Tasmania

Mr. Bruce Gill, Dept. Primary Industries, Victoria

Mr. Graham Hawke, Southern Rural Water, Victoria

Ms. Virginia Hilliard, Australia Drilling Industry, New South Wales

Dr. Rafik Hirji, World Bank, New York

Mr. Ian Household, DPIPWE, Tasmania

Prof. Tony Jakeman, Australian National University

Dr. Fazul Karim, CSIRO, Townsville

Mr. Andrew Kelly, Lower Burdekin Water, Ayr

Mr. Matt Kendall, NWC, Canberra

Mr. Scott Keyworth, CSIRO, Canberra

Dr. Shahbaz Khan, UNESCO Chief of Water and Sustainable Development

Dr. Graham Kingston, BSES Southern, Queensland

Dr. Miladin Latinovic, DPIPWE, Tasmania

Mr. Leon Leach, DERM, Queensland

Dr. Matt Lenahan, CSIRO, Townsville

Prof. David Lockington, University of Queensland

Mr. Henry Maxwell, DPIPWE, Tasmania

Mr. Nick McIntyre, Dept. Water, Land, & Biodiversity, South Australia

Cr. Lyn McLaughlin, Mayor Burdekin Shire Council, Ayr

Dr. Tony McLeod, MDBA, Canberra

Dr. Jehangir Punthakey, EcoSeal Groundwater & Environment

Mr. Don Rockliff, DPIPWE, Tasmania

Mr. Ludovic Schmidt, DPIPWE, Tasmania

Prof. Craig Simmons, National Groundwater Centre, Canberra

Ms. Jody Swirepik, MDBA, Canberra

Dr. Jim Wallace, CSIRO Townsville

Mr. Trevor Williams, Burdekin Shire Council, Ayr