

# Institutional Capacity for Sustainable and Integrated Urban Water Management: Interview Results

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## FOREWORD

Water is fundamental to our quality of life, to economic growth and to the environment. With its booming economy and growing population, Australia's South East Queensland (SEQ) region faces increasing pressure on its water resources. These pressures are compounded by the impact of climate variability and accelerating climate change.

The Urban Water Security Research Alliance, through targeted, multidisciplinary research initiatives, has been formed to address the region's emerging urban water issues.

As the largest regionally focused urban water research program in Australia, the Alliance is focused on water security and recycling, but will align research where appropriate with other water research programs such as those of other SEQ water agencies, CSIRO's Water for a Healthy Country National Research Flagship, Water Quality Research Australia, eWater CRC and the Water Services Association of Australia (WSAA).

The Alliance is a partnership between the Queensland Government, CSIRO's Water for a Healthy Country National Research Flagship, The University of Queensland and Griffith University. It brings new research capacity to SEQ, tailored to tackling existing and anticipated future risks, assumptions and uncertainties facing water supply strategy. It is a \$50 million partnership over five years.

Alliance research is examining fundamental issues necessary to deliver the region's water needs, including:

- ensuring the reliability and safety of recycled water systems.
- advising on infrastructure and technology for the recycling of wastewater and stormwater.
- building scientific knowledge into the management of health and safety risks in the water supply system.
- increasing community confidence in the future of water supply.

This report is part of a series summarising the output from the Urban Water Security Research Alliance. All reports and additional information about the Alliance can be found at <http://www.urbanwateralliance.org.au/about.html>.



**Chris Davis**  
Chair, Urban Water Security Research Alliance

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## EXECUTIVE SUMMARY

The recent ‘millennium drought’ in South East Queensland (SEQ) has created an imperative to identify and implement some key water policy, planning and technical innovations to meet future water needs. A number of challenges have contributed to this. First, the uncertainties associated with the science that has traditionally informed water planning are now widely recognised, so that established methods of water planning based on historical average rainfall patterns are being revised. Second, the possibility of increased climate variability and more extreme weather events due to climate change has led to a questioning of traditional approaches to ‘management’ based on prediction and control. Third, the decentralised organisational environment was deemed to be in need of greater coordination in order to optimise the use of scarce water supplies across the region.

Attention has focused internationally on the implications of climate variability for water management, prompting calls for more adaptive water governance arrangements with a capacity for flexibility and innovation in response to environmental change. The need for coordination and communication across the fragmented institutional setting that tends to characterise water management is central to this challenge. Integration has been a primary approach to overcoming institutional fragmentation in SEQ. Institutional integration aims to: manage conflict and enhance social and institutional responsibility; enhance the coordination of effort required for more efficient and responsive management approaches; and enable the sharing of knowledge and the inclusion of diverse perspectives to inform management programs (Lane and Robinson 2009).

This report examines the institutional characteristics associated with water policy reform in SEQ over the last twenty years by drawing on the perspectives of senior managers with extensive experience in the region. The aim is to improve understanding of the institutional capacities for integrated and adaptive water management.

Applying the institutional analysis framework developed by Scott (1995), three interdependent elements contribute to the institutionalisation or stability of water practices: (1) shared understandings, or ‘problem framings’, which influence the kinds of knowledge and expertise considered legitimate for shaping and addressing the problem; (2) shared values and norms, which define roles and responsibilities for action; and (3) the organisational base, or the rules and sanctions that regulate social interaction in pursuit of shared values. Where these conditions are not present – when values, norms or understandings of the problem are not shared – institutional stability is disrupted. For example, new knowledge might challenge path dependency by leading to different conceptions of problems and appropriate solutions that subsequently prompt changes in the way water is managed, or competing interpretations might lead to conflict and catalyse change.

The results of this research suggest that (1) shared understandings, and the associated ‘knowledge capacities’ of water management institutions, are of primary importance in the development of more adaptive and integrated water management institutions. The forms of knowledge and expertise considered to be important for water management have changed over time, so that new disciplinary expertise and evidence bases not previously integral to water management in SEQ have been introduced – from the environmental and biological sciences, to expertise in environmental flows, energy and productivity, demographics, water use in the home, public attitudes, and demand management.

These shifts in knowledge capacity are related to (2) changing roles and responsibilities. As a more integrated approach to promoting healthy waterways developed in the 1990s and early 2000s, a diversity of organisations became involved in SEQ water management. Since around 2004, drought response strategies have involved an intense process of reform in roles and responsibilities to secure water supply. At the same time, there is an increasing recognition of the need to develop adaptive capacity by sharing responsibility and spreading risk across the water system.

In terms of (3), the organisational base, the influence of Council of Australian Governments (COAG) agreements around the mid-1990s promoted new forms of collaboration between government and non-government stakeholders. The need to develop collaborative capacity to structure the interactions between water management organisations was considered to be important to facilitate integrative thinking and organisation. Nonetheless, the role of alliances and collaborations has waxed and waned over time with the changing influence of hierarchical or ‘top-down’ modes of regulation.

The results of this research indicate that there is a range of different organisational responses to uncertainty and the associated challenges facing water management in the shift toward a more adaptive and integrated governance regime. As the influence of different values constrains existing decision systems, new organisational forms, structures and responses are created. Rather than replacing existing management strategies, however, these emerging responses introduce additional strategies for dealing with uncertainty so that a range of institutionalised practices co-exist in a process of ebb and flow. Building the capacity to transfer and integrate knowledge across organisational boundaries has been a key challenge, and will be even more important in the future. The need to bridge the conceptual divide between water quality and quantity issues is a related requirement for effective integration. Institutional capacity for integrating different types of knowledge is necessary to promote technical and organisational learning, contributing to the problem solving and innovation that underpin effective and flexible water systems.

# 1. INTRODUCTION

This report explores the institutional conditions for sustainable and integrated urban water management in South East Queensland (SEQ). Population growth and climate change have focused attention on understanding the requirements of sustainable urban water governance regimes under conditions of social and environmental change. Climate variability and the possibility of more frequent extreme weather events suggest that an essential prerequisite for the sustainability of water governance regimes is their capacity to deal with uncertainty and surprise. Institutions are vital determinants of society's capacity to govern natural resources (Mehta et al. 1999). They represent 'the multitude of means for holding society together, for giving it a sense of purpose, and for enabling it to adapt' (O'Riordan and Jordan 1999, 81). Thus, whilst institutions may be considered 'a relatively stable collection of practices and rules defining appropriate behaviour for specific groups or actors in specific situations' (March and Olsen 1999), institutional innovation to create more adaptive institutions is possible – and necessary – to respond to changing circumstances (Saleth and Dinar 2000).

There are increasing calls for a more adaptive and integrated approach to urban water management in Australia (e.g. Brown and Farrelly 2009), and internationally (e.g. Pahl-Wostl et al. 2007). Institutional capacity building has been widely accepted as the approach for overcoming institutional impediments and for mobilising institutional change (Brown 2007). Yet there is currently very limited understanding of the relationship between the characteristics of institutional capacity for delivering adaptive and integrated urban water management, and how institutions change (Pahl-Wostl 2009).

In Australia, sustainability-related debates about urban water focus on the concept of integrated urban water management, which primarily focused in the past on the physical infrastructure. Urban water infrastructure is understood to be made up of a number of elements (source and receiving water bodies, sewerage networks, wastewater treatment plants, etc.), which need to be controlled and optimised as an integrated system (Cowie and Borrett 2005). Examples of innovations in the urban context are confined to infrastructure developments using total water cycle management concepts (Mitchell 2006). This approach overlooks the fact that the implementation of technical innovations requires institutional and policy changes to foster adoption and diffusion (Ingram and Bradley 2006). Informed by broader concepts of integrated water management, the consideration of water quantity and water quality issues also incorporates the social dimensions of water resources, namely the network of stakeholders and institutions that make up the socio-political context of urban water management. Yet social, institutional and decision-making arenas are not generally seen as principal drivers of change in the Australian context (Syme 2008).

The sustainability challenge has long been recognised as social and institutional:

*The objective of sustainable development and the integrated nature of the global environment/development pose problems for institutions, national and international... Yet most of the institutions facing those challenges tend to be independent, fragmented, working to relatively narrow mandates with closed decision processes...The real world of interlocked economic and ecological systems will not change; the policies and institutions concerned must* (World Commission on Environment and Development 1987: 9).

The issue of institutional fragmentation, raised over two decades ago by Brundtland, remains a major problem in contemporary environmental policy and management (Lane and Robinson 2009; Head 2009). Australia has adopted a range of complementary approaches to address the balance between environmental and economic requirements necessary to achieve the sustainable management and use of surface and groundwater resources. The main elements of Australia's strategy are the adoption and implementation of an integrated water reform framework and a regional approach to deliver on-ground action (Claydon and Milligan 2003). In SEQ, integration has been announced as a primary goal in overcoming institutional fragmentation, which was recognised as a problem only after the onset of drought conditions from 2002–2008. Prevailing arrangements prior to 2007, described in hindsight as

'parochial and fragmented', were deemed to 'suffer from serious systemic weaknesses' (QWC 2008: 41). Governmental response has centred on a comprehensive reform of existing institutional arrangements for the urban water sector. The overarching policy goal is to ensure 'that water in the region is to be managed on a sustainable and integrated basis to provide secure and reliable supplies of water of acceptable quality for all uses' (Queensland Government 2009).

This report aims to improve understanding of the institutional capacities for sustainable and integrated urban water management in SEQ in the context of social and environmental change. Section 1 first reviews the literature on integration and water governance in order to identify key resources and remaining questions associated with the current state of knowledge in this field both nationally, and internationally. Section 2 outlines the research approach, and Section 3 summarises the institutional environment in which water decisions are being made in SEQ. The characteristics of water management institutions associated with two periods of urban water reform between the early-1990s and the mid-2000s are then identified, based on interviews with senior managers with extensive experience in the SEQ water sector. The focus of Section 4 is the integrated approach to water management from the mid-1990s through to the early years of implementing the *Water Act 2000*, while Section 5 centres on the institutional and policy changes that emerged in the early to mid-2000s associated with the severe and extended 'millennium drought'. The report concludes by identifying key themes to emerge from this study regarding institutional characteristics associated with periods of water reform, and the implications for building institutional capacity for adaptive and integrated water management in the context of social and environmental change.

## 2. INSTITUTIONAL CAPACITY FOR INTEGRATED WATER MANAGEMENT

The focus on integration in SEQ has been progressed in response to the fragmented institutional setting that characterised water governance prior to the drought (QWC 2008). Institutional integration aims to: manage conflict and enhance social and institutional responsibility; enhance the coordination of effort required for more efficient and responsive management approaches; and enable the sharing of knowledge and the inclusion of diverse perspectives to inform management programs (Lane and Robinson 2009; Head 2009). Institutional collaboration is often explored as a promising means of achieving integration (Margerum 2008). Communication and knowledge transfer are vital to such collaborative efforts if advances in scientific and other forms of knowledge (technical, bureaucratic, etc) are to be translated and integrated into organisational decision-making (Owens et al. 2006).

However, different models of decision-making understand the communication, use, and transfer of knowledge in different ways. The desire to optimise performance in the integrated urban water management approach is informed by the popular rational choice model of decision-making, which assumes that managers are strongly motivated to incorporate research results into their decision making (Rayner et al. 2005). Failure to incorporate such information is merely characterised as an exogenous barrier. Influential sociological analyses (e.g. Powell and DiMaggio 1991) suggest that information in organisations of all kinds is not a well-behaved commodity that can be transferred from one party to another (Argyris and Schon 1978; Dunn 1983). Empirical studies show that although water managers have a positive attitude toward the use of scientific information in decision making, such information is rarely acted upon directly (Lach et al. 1984). It is now widely recognised that good information does not automatically influence policy and management decisions (Cash et al. 2002; Roux et al. 2006). This challenge has prompted investigations into ‘when and how knowledge matters in the policy process’ (Raedelli 1995, 160). Sociological institutional analyses have found that the use of information is inextricably connected with the shared meaning and identity within an organisation, as well as with the collective pursuit of implicit organisational goals (Rayner et al. 2005).

In Australia, institutional analyses of water governance arrangements have found that the institutional characteristics of traditional water management arrangements pose barriers to change (e.g. Livingston et al. 2004; Brown 2005; Stenekes 2008). The inertia, or path dependence, that characterises urban water management institutions, results from the self-reinforcing characteristics of successive policy choices, so that once a policy commitment is made to follow a particular track, the cost of reversal becomes very high (Pierson 2000). Path dependence is perpetuated through statute law, organisational and professional expectations and norms, and physical infrastructure (Ingram and Bradley 2006).

Urban water management has traditionally been dominated by an industrial engineering paradigm characterised by expert knowledge, practices of optimal design under predictable conditions and technical approaches to risk management where uncertainties can be quantified (Colebatch 2006). The prevailing supply-side approach to infrastructure provision is based on engineering knowledge of large-scale technologies for the supply of potable water and the removal of wastewater. The co-evolution of water institutions and large-scale technological infrastructure generates an interdependence that makes urban water regimes resistant to change. Path dependence can also generate lock-in situations, where established technologies continue to dominate despite inferior performance (Arthur 1994).

An expert culture based on technological solutions to narrowly defined problems has led to a fragmented understanding of the multiple aspects of the urban water system (Pahl-Wostl 2009) – a system that includes both water supply planning, and the allocation and management of water resources for both human and environmental uses. Moreover, environmental and social systems are not seen to be part of the management system, but rather provide external boundary conditions. The result of these institutional conditions has been that traditional systems of water management exhibit limited capacity for change and for integrating different types and sources of knowledge, which may

be needed to fully understand resource governance problems and to identify innovative solutions to address them (Berkes and Folke 2002).

Collaboration between institutions at multiple jurisdictional levels, and with multiple perspectives and knowledge bases, provides the basis for a ‘knowledge partnership’ identified as critical to more integrated natural resource governance regimes (Berkes 2009, 1699). Indeed, it may be that a new, hybrid institution is created that can act as a bridge between different kinds of knowledge and capabilities. Interaction within these ‘boundary organisations’ – also called ‘bridging organisations’ – centres around deliberation between the different stakeholders to generate new knowledge, or to translate knowledge from different sources. Given that the practice of water management involves some degree of interaction between different forms of knowledge, the question for institutional collaboration is: what kind of relationships need to be mobilised between different stakeholders (with their attendant social roles and responsibilities) and different forms of knowledge? (cf. Healey 2008).

### 3. RESEARCH APPROACH

To improve our understanding of institutional stability and change in the urban water sector in SEQ, an exploratory investigation was undertaken into the institutional characteristics associated with changes in water management over the past 20 years or so. Interviews were conducted with 15 key informants with extensive experience in water management in SEQ between December 2008 and February 2009. Participants included staff in senior executive positions across a range of organisations, including the Queensland Water Commission (QWC), Department of Natural Resources and Water (now the Department of Environment and Resource Management (DERM)), SEQ Healthy Waterways Partnership, SEQ Council of Mayors, local government, and State-owned retail entities. The interviews were recorded and transcribed, and analysed using Filemaker Pro computer-assisted qualitative data analysis software. The software was utilised to identify the main themes and ideas raised within each interview transcript. This aided in systematising analytical procedures (Miles and Huberman 1994), and assisted the process of storing, searching, and managing data. Internal reliability was strengthened through cross-checks on coding and analysis by three researchers. External verification was undertaken by inviting a review of the draft report by the study participants to ensure reliability of interview data analysis.

The research design and analysis was guided by a conceptual framework for understanding institutional stability and change in the water sector, which is detailed in Wallington and Robinson (2008). Building on institutional organisational theory developed by Scott (1995), institutions are understood as structured patterns of practice underpinned by three pillars (Table 1):

- (1) Cognitive (what people know): shared understandings or ‘problem framings’, which influence the kinds of knowledge and expertise considered legitimate for shaping and addressing the problem;
- (2) Normative (what people value): shared values and norms, which define roles and responsibilities for action; and
- (3) Regulative (how social life is organised): the organisational base, or the rules and sanctions that regulate social interaction in pursuit of shared values.

**Table 1: Elements of Institutionalisation.**

Elements	Description	Empirical Focus
Knowledge (cognitive)	<ul style="list-style-type: none"> <li>• Shared interpretations, meaning, systems or understandings; giving rise to shared purpose</li> <li>• Knowledge, ideas, categories and typologies (‘frames’) considered legitimate to shape problem definitions and solutions</li> </ul>	<ul style="list-style-type: none"> <li>• Problem definition</li> <li>• Forms of evidence</li> <li>• Skills</li> <li>• Best practice examples (‘what works’)</li> </ul>
<b>▼ Knowledge cultures provide information on how values and norms can be fulfilled.</b>		
Values and norms (normative)	<ul style="list-style-type: none"> <li>• Shared conceptions of the preferred or desirable state of affairs (values supporting practice)</li> <li>• Expectations of appropriate means of pursuing one’s values (norms underpinning practice)</li> </ul>	<ul style="list-style-type: none"> <li>• Roles and responsibilities</li> <li>• Values guiding practice</li> <li>• Best practice standards</li> </ul>
<b>▲ Structure shapes the way a practice is organised to pursue shared values by legitimate means.</b>		
Organising structure (regulative)	<ul style="list-style-type: none"> <li>• How practice is organised; ‘rules of the game’ and their enforcement through laws and sanctions</li> <li>• Formal and informal social sanctions and restraints</li> </ul>	<ul style="list-style-type: none"> <li>• Rules, regulations, procedures, protocols</li> <li>• Sanctions and rewards</li> <li>• Institutionalised practices (e.g. collaboration)</li> </ul>

Source: adapted from Scott (1995).

This framework directs attention to the way water use is ordered through particular organisations, as well as to the interactions between different organisations in the field of water management. Water management is therefore understood as the pattern of institutionalised practices of water management – including water capture, access, distribution, use, and disposal – that are collectively referred to as the ‘water system’ (Colebatch 2006).

Two phases – or management modes – of institutional reform in SEQ water planning and management (described in more detail in Section 3) were explored in the interviews:

- the movement towards an integrated approach to land and water management issues from the mid-1990s through to the early-2000s, when efforts were focused on waterway health (Management Mode 1 – Towards An Integrated Approach To Waterways Health); and
- the institutional and policy changes that emerged post-2004 in response to the severe and extended drought, when efforts were focused on water supply security (Management Mode 2 – Water Supply Security In SEQ).

Interviewees were asked several open-ended questions about the characteristics of SEQ water institutions in these two phases of reform, guided by the institutional analysis framework and associated empirical focus given in Table 1:

- (1) Framing the problem (cognitive): How was the water ‘problem’ defined at different moments of policy change? What was the role of science in illuminating the issues and catalysing change?
- (2) Strategies used to deal with risk and uncertainty (normative): What strategies were adopted to manage risk and offset uncertainty? What were the roles and responsibilities of different institutions?
- (3) Role of dominant organising practices (regulative): What were the factors influencing the role of different practices, e.g. coordination, collaboration? How effective were different practices in responding to changing circumstances?

These three themes structure the presentation of results in Sections 4 and 5. A fourth theme is also introduced, where factors limiting the adoption of a more integrated and adaptive approach are highlighted. These factors may relate to any of the three elements of institutionalisation:

- (4) Limiting factors: Which factors influenced the capacity to deal with ‘the problem’, and limited the adoption of a more integrated and adaptive response?

The next section outlines the institutional context in which water policy and management have developed in SEQ over the last 20 years as a precursor to examining the institutional characteristics associated with water reform over that period.

## 4. INSTITUTIONAL WATER REFORM IN SEQ SINCE THE 1980s

This section summarises the key legislative and policy initiatives that accompanied two recent phases of water reform in SEQ:

- (1) the movement towards an integrated approach to land and water management issues from the mid-1990s through to the early-2000s; and
- (2) the institutional and policy changes that emerged post-2004 in response to the severe and extended drought.

A summary of key initiatives is given in Table 2. As the following discussion will make clear, national-level agreements by the Council of Australian Governments (COAG) in the mid-1990s had a significant influence on State-level reform in later years.

**Table 2: Key Water Policy Initiatives in Australia and Queensland.**

<b>National Policy Initiatives</b>	
1994	<i>COAG Water Policy Agreement</i>
1995	<i>National Competition Policy Agreement</i>
2004	<i>National Water Initiative</i>
<b>Queensland Policy Initiatives</b>	
2000	<i>Water Act 2000</i>
2004	<i>South East Queensland Regional Water Supply Strategy</i>
2005	<i>South East Queensland Regional Plan (SEQRP) 2005–2026</i> <i>Water Plan 2005–2010</i> <i>South East Queensland Regional Water Supply Strategy – Stage 2 Interim Report</i>
2006	<i>Water Amendment Act</i> <i>Draft SEQ Water Strategy</i>

### 4.1. National and State Context of Water Reform

Water resource management has been a State government responsibility since federation. While the name of the Queensland departmental agency responsible for water supply has changed many times (e.g. Water Resources Commission in the 1980s), the functional roles of the responsible department have been fairly consistent over a long period (Pullar and Cook 2001). Some water distribution and revenue collection functions were devolved to local authorities (including Brisbane City Council), who developed these into significant commercial enterprises. In the rural sector, local boards were involved in overseeing irrigation supplies for rural industries. The key roles in planning and funding water resources were retained by the State, and ownership of major water assets for public purposes has remained with the State. The professional knowledge to undertake most of this work – engineering and hydrology – resided largely in state agencies, at least until recent years when consultancy firms became the major providers of technical expertise in infrastructure planning and construction.

At the national level, the context for water and natural resources policy was heavily influenced by three developments in the 1990s, which in turn impacted on the policy climate in Queensland and influenced thinking about both rural and urban water policy. First was the growing concern about the water crisis of the Murray-Darling Basin and its associated issues of water flow variability, river health, and over-extraction by irrigation industries (Pigram 2007, ch. 4). Second was the emergence of integrated policy frameworks for sustainability in natural resources and environment, agreed to either

by Ministerial Councils or as significant initiatives of COAG, including the Water Policy Agreement of 1994. Important requirements for water reform also emerged from the National Competition Policy agreement (1995), placing pressure on state water authorities to: reform the rural irrigation industries; achieve greater efficiencies; adopt full-cost pricing; and introduce water trading. Third was the national productivity and efficiency agenda, reflected in the corporatisation of many government-owned businesses, and micro-economic reforms which required governments to institute full-cost pricing and contestability.

Most of these initiatives had implications for urban water, but the main focus of policy reform before 2005 was upon water use by rural industries and their direct and indirect impacts on aquatic ecosystems. These policy developments flowed through into the National Water Initiative, agreed by COAG in 2004 (NWI 2004). Taken together, these national strategies had a massive impact on the evolution of Queensland policy and legislation over the last 20 years, including the Queensland *Water Act 2000*.

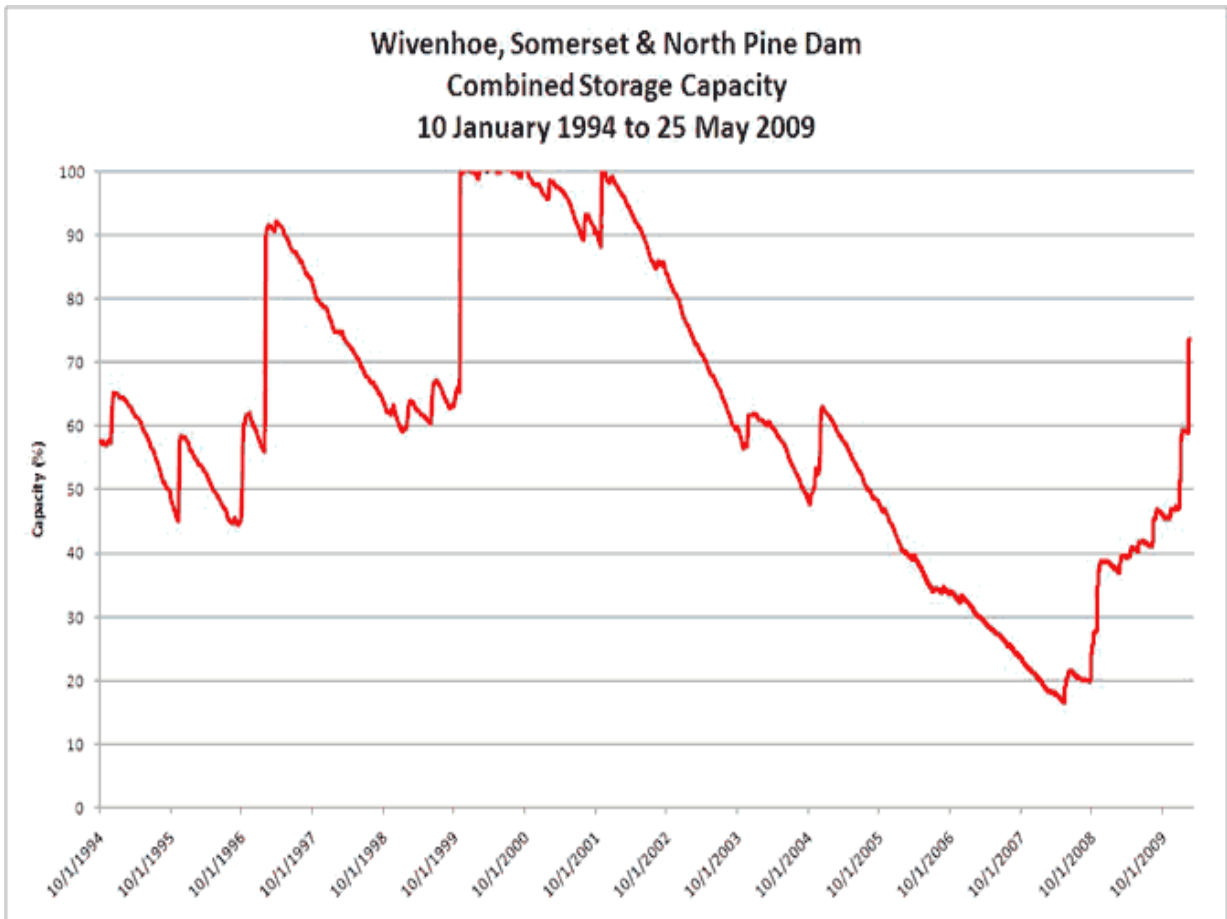
## **4.2. Integrated Approach to Waterway Health in SEQ**

During the 1990s there was growing awareness of the need for more integrated approaches to regional planning in areas of high growth such as SEQ. This commenced on a collaborative basis among local authorities and state agencies, and eventually was formally recognised in the *Integrated Planning Act 1997*. The initial thrust of these discussions centred on competing land uses, infrastructure requirements, areas for future residential growth, and environmental sustainability.

The provision of water supplies for rural industries and also for rapidly growing urban populations have been twin priorities throughout recent decades. Forecasting and modelling stream flows provided the vital background information for the planning of future infrastructure options. Following the major floods in SEQ in 1974, the focus for the next decade was on infrastructure for flood mitigation (hence the Wivenhoe Dam project) rather than boosting water storage for industrial and domestic consumption. Building dams to anticipate growth in demand had been the orthodox approach for many years, but the politics of dam building became an increasingly contested area. In 1990, following a change of government and its decision *not* to build the proposed Woldene dam in the Gold Coast hinterland, there was potential to develop a wider range of planning options. However, most informants in our survey suggested that responsibility for water planning became somewhat diffused rather than clarified over the next decade, and that state/local coordinating bodies (such as the SEQ Water Board) lacked the strategic direction and resources to drive the planning agenda and commission new projects. The State Government retained overall responsibility, including powers in relation to major infrastructure projects under the Coordinator-General legislation.

The *Water Act 2000* requires the development of catchment-based water resource plans (WRPs) and resource operation plans (ROPs) for the allocation and sustainable management of water resources. However its focus is primarily on balancing rural water extraction with other considerations, including the protection of natural ecosystems. Water resource plans were developed and finalised for all major catchments in SEQ – Mary, Moreton, Logan and Gold Coast. The security of urban water supplies was not the main concern and focus of this catchment planning process.

The focus of policy and planning changed rapidly in subsequent years, primarily because major droughts impacted on many cities and towns in most states of Australia. Capital cities like Brisbane, Perth, Adelaide, Melbourne and Sydney shared a substantial concern about lower rainfall, climate variability, and increasing levels of water use from growing city populations. In SEQ, the three water storages supplying most of the region fell from around 100% capacity in 2001 to 50% in 2004, and then plummeted to less than 20% of capacity in 2007 (see Figure 1). The encouraging recovery in 2008–09 generated a partisan political debate about the wisdom of particular measures taken to address the water crisis, and some reconsideration by the State Government about the timetable for introducing potable recycled water (PRW) into the water storages of SEQ.



**Figure 1: Water Storage Trends for Three Major SEQ Dams 1994–2009.**

In the early years of this decade, *regional water supply strategies* were being developed administratively for several regions of Queensland. In particular, the first stage of the regional water supply strategy for SEQ (SEQRWSS) was commissioned by the State and local authorities in May 2003 and was published in 2004. It suggested that at current rates of population growth the water storage capacity in SEQ would not need major augmentation for 20 years, although specific towns and sub-regions had much more urgent requirements (SEQRWSS 2004: p.v).

In 2005, the *SEQ Regional Plan 2005–2026* included the concept of Total Water Cycle Management (TWCM) as an integrated approach to water planning and management. This approach was to be based on the principles of considering all water sources (including wastewater and stormwater), using water sustainably, equitable allocation, and integrating water use and natural water processes including environmental flows and water quality (QDIP 2005: 100). The Regional Plan (p.103) also noted that guidance on water sensitive urban design (WSUD) was to be developed by the SEQ Healthy Waterways Partnership in its review of the regional Water Quality Management Strategy. The discussion of TWCM principles was elaborated in the 2009 revision of the Regional Plan, including greater attention to stormwater, recycled water, and waterway health (QDIP 2009: 127–29).

### 4.3. Securing Water Supply in SEQ

By late 2005, the situation had deteriorated as dam levels continued to fall (Figure 1). At that time, contingency planning to address the deepening drought was incorporated in the Stage 2 Interim Report, including a stated intention by the State Government to review institutional arrangements (SEQRWSS 2005: p.14). The collaborative experience of developing regional strategies for SEQ planning began to bring into focus the underlying difficulties of determining clear strategic directions, assembling relevant knowledge, working with all stakeholders and developing appropriate water governance arrangements.

The institutional arrangements for water planning came under pressure after 2005 as the drought deepened. Two aspects are noted briefly here. The first institutional change was the amalgamation of local authorities in Queensland in 2006 (and the holding of local elections on the new boundaries in March 2007). In the SEQ region, the number of councils was reduced from eighteen to ten:

- Brisbane City Council
- Gold Coast City Council
- Ipswich City Council
- Lockyer Valley Regional Council
- Logan City Council
- Moreton Bay Regional Council
- Redland City Council
- Scenic Rim Regional Council
- Somerset Regional Council
- Sunshine Coast Regional Council

The second major institutional change was the re-centralising of control over water planning by the State. With the continuing drought and the deepening water crisis, the State Government introduced new legislation in May 2006, the *Water Amendment Act*, which overturned the collaborative arrangements and created the Queensland Water Commission (QWC), which was required to develop a regional water *security* plan for SEQ. Importantly, the principle that water should be ‘shared’ across a region, was inscribed in the *Water Act 2000* (s. 346). QWC undertook urgent work on preferred new arrangements for rationalising and restructuring the water supply functions for SEQ (including a single water-grid authority), and this framework was accepted by Government in 2007. In addition, strategic initiatives were developed for tackling water security, drawing on both new *supply-side* options (new or enhanced dams, desalination, potable recycled water, domestic rainwater tanks, etc) and new demand-side options (water restrictions and lower consumption targets). These new approaches were brought together in a *Draft SEQ Water Strategy* (QWC 2008).

## 5. MANAGEMENT MODE 1 – TOWARDS AN INTEGRATED APPROACH TO WATERWAYS HEALTH

This section is focused on the shift toward an integrated approach to waterway and estuary health in SEQ, which occurred from around the mid-1990s. The policy reforms leading up to and following the COAG reforms and the NWI led to a significant shift in the organisational structures and strategies needed to effectively make strategic decisions for water management in Queensland. Harman and Wallington (2009) outline the range of actions detailed to meet the objective of the NWI to achieve a ‘nationally compatible market, regulatory and planning based system for managing surface and ground water resources’ (NWC 2008). This included a need for an integrated approach to water management that would deliver environmental and other public benefit outcomes, along with attention to the design of institutional arrangements to develop and implement management practices to meet these multiple water objectives. In Queensland, the *Water Act 2000* provides for the development of catchment-based water resource plans and resource operation plans as key policy instruments to achieve these goals.

### 5.1. Framing the Problem

The era surrounding water policy reform in the mid-1990s, and the dialogue surrounding the *Water Act 2000*, required considerable attention to how the goal of solving emerging urban water management ‘problems’ might be re-defined to encompass the imperatives of COAG and the NWI for water resource policies to reflect economic, social and environmental objectives.

Water management as a whole has two core aspects. As a senior bureaucrat elaborated:

- water resource management has a focus on the availability of the resource within a catchment or aquifer, both for human and environmental uses; and
- water supply planning and management is concerned with achieving a balance of supply and demand for human uses.

Until recently, the water ‘problem’ in Queensland has tended to be defined as one of having too much water, rather than not enough. This view remains influential in the public psyche to this day, as evidenced by the ranking of stories around the 1974 flood in the top three categories of stories recently collected by the Queensland Museum. Policy makers who remembered the 1974 flood that had inundated Brisbane city and many of its suburbs confirmed that, in the years surrounding the flood, oversupply of water was indeed considered to be the more pressing policy ‘problem’. At that time, infrastructure in the form of the Wivenhoe dam was built for the purpose of flood control, rather than for water storage purposes. The traditional approach to augmenting water supply storage by means of large-scale infrastructure (e.g. dams) remained a core consideration for water management professionals in local and State government through the 1990s. Nonetheless, a consequence of the prevailing view of water issues in terms of oversupply rather than scarcity was what one interviewee described as a ‘water supply planning vacuum’. As such, interviewees noted that having the capacity to identify and plan for security of water supply within water management institutions does not necessarily translate into political or policy commitment.

The water supply ‘planning vacuum’ in SEQ in the mid-1990s may be contrasted with the significant attention to ecological frameworks for water resource planning. By the early 1990s, a range of symptoms of resource degradation – including declining water quality, increasing salinity, toxic algal blooms and loss of biodiversity – meant that water resource management was firmly placed on the national agenda (Claydon and Milligan 2003). Emerging water quality problems, particularly in the Murray-Darling river system, had directed public and political attention to the relationship between water pollution and the input of nutrients originating on farming land. As one interviewee recalled, the connection between land use and water quality, and the need for a more integrated approach to water resource management, had been the focus of scientific attention in SEQ well in advance of the 1994 COAG reforms. Data from monitoring and management efforts in the Brisbane River through the

1970s and 1980s had been highlighting an impending water quality crisis which was endangering the coastal Moreton Bay area. Those interviewees who have long been engaged with SEQ water issues recalled that a significant barrier to the adoption of a more integrated approach to water resource management initially stemmed from the legacy of institutional fragmentation. Separate government institutions and numerous local councils were tackling water issues through engineering solutions on separate parts of the river. The particular focus in SEQ during the 1980s and 1990s was on the health of waterways and estuaries. Informed by ongoing monitoring data, and later buttressed by broader public and political attention, the *Environmental Protection (Water) Policy 1997* – established under the *Environment Protection Act 1994* – and the *Water Act 2000* reflected a significant shift in the way that water, and the management of water, were conceptualised:

*“... the emphasis through the 90s was certainly much more on what you might call integrated catchment management ... water quality, rather than water quantity outcomes.”*

Policy reform widened the understanding of water resource management from an initial focus on water allocation for human uses, to include water allocation for environmental uses, including attention to water quality in terms of ecosystem health. This learning was embodied in the *Water Act 2000* through a shift away from fragmentation to look at water management on a whole-of-catchment basis, based on the recognition that land and water are interconnected elements of the water system.

In the early years of water reform, there was a new emphasis on: clarification of water rights (separated from property, or land); more accurate metering of rural and urban water usage; techniques for more efficient irrigation practices to reduce consumption; documenting the extent of the over-allocation problem; and finding ways to reconcile competing water uses, including price signals. Economics became more relevant in terms of price regimes, establishing the likely costs of irrigation licence buy-outs, and models for implementing water trading as real prices began to move upward. The science of ecosystem health, including water quality, became significant for establishing benchmarks for environmental flows.

The different forms of scientific and technical information that have contributed to managing the water system in SEQ were utilised selectively by different sides of the water resource–water supply divide in the years leading into the drought. With regard to water resource management, one interviewee noted the need to prioritise efforts to determine the amount of water available for the health of aquatic ecosystems, before making decisions about how much water is available for human uses. This required new expertise in environmental and biological sciences and new modelling techniques. Water supply planning, on the other hand, was based on the best available information from hydrological records. As such, hydrology has been considered the key form of scientific knowledge in addressing the supply problem; together with the engineering expertise required to create and build solutions to water supply problems.

The recognition of continued population growth in SEQ, together with the increasing awareness of climate variability, pointed to significant gaps in available science. In response, new expertise was commissioned and brought into government departments. In line with the long time horizon that influences the outlook of water supply-oriented agencies, new forms of expertise and analytic innovation were required, including the future-oriented sciences of climate modelling and prediction and of population and economic forecasting. Where past rainfall records had previously formed the basis of water planning, the messages from climate science about climate variability showed that planning could no longer rely on history. One interviewee explained that, since the historical modelling of available supply was proving inadequate to ensure the availability of water supply, contingency planning was also necessary:

*“..... there were times that supply would fail. The key question is, what were you going to do in that time? What’s your contingency plan? What were the arrangements in place? There were none.”*

## 5.2. Strategies Used to Deal with Risk and Uncertainty

Policy makers noted that the strategies adopted to address water problems were clearly bonded to the water values for which their organisations were accountable. In the urban context, the core value driving water management in Australia has traditionally been the progressive expansion of urban water systems to provide safe and reliable water supplies to a growing population (Productivity Commission 2008). The public right to safe and reliable water means that the organisations responsible for ensuring the public entitlement to water are set apart from ‘politics as usual’. They tend to be highly professionalised and driven by long-term missions that are not subject to the short-term political vagaries of negotiation and compromise.

Historically, the approach to dealing with the management of water systems across water quality and quantity issues has been one of institutional specialisation into functional areas of expertise. Agencies dealing with water tended to focus on only one aspect of the water system. In SEQ, for example, future demand and existing use of urban water are the responsibility of commercialised Water Service Providers, while monitoring of fresh water and storage is the responsibility of the Department of Environment and Resource Management. The South East Queensland Regional Water Supply Strategy (SEQRWSS), a partnership between the Water Service Providers and the Department, aimed to integrate these elements by focusing on future water needs, regional water sharing and major water infrastructure. The conservative disposition of water supply planners – combined with the restricted nature of their mission – means that incremental adaptations such as seeking new sources of supply tended to be favoured. As one interviewee noted:

*“... the water supply will always be a pipes and dams solution in that sense.”*

In contrast, the main policy strategy for rationalising the SEQ water system from the mid-1990s followed the ‘new public management’ logic that came to prevail in all Australian jurisdictions by the early 1990s – the corporatisation and professionalisation of public services, a process reinforced by the inter-governmental Competition Policy framework in 1995. This process influenced the way in which the key values of reliability and quality were to be achieved. Increasingly, the economic value of water came to be a central planning principle to support the achievement of other primary values. In particular, the principle of water accounting has become central to the strategy of optimising economic, social and environmental imperatives in the National Water Initiative of 2004 (see NWC 2008).

## 5.3. Organising Practices

From the mid-1990s, a regional approach to water resource management was further progressed. Local councils have traditionally been responsible for the supply of reticulated urban water and sewerage service delivery within their jurisdictions in Queensland. Efforts to build capacity at local and regional scales meant that new structures and strategies to manage the ‘boundaries’ in water knowledge–action systems emerged through the establishment of regional arrangements that provided frameworks to debate various facets of the ‘water problem’. The shift in problem definition to an integrated approach to water allocation for human and environmental uses was accompanied by a focus on the science–management interface.

Initially, water quality improvement strategies had focused on point sources of pollution – the wastewater treatment plants in the catchment. By the mid-1990s, the link between science and management was institutionalised through the creation of a ‘boundary organisation’ in the form of a scientific advisory panel managed through the Brisbane City Council. A regional steering group of 17 councils, State Government representatives and a scientific expert advisory panel was established to respond to the need for local governments to reduce the effluent loads reaching Moreton Bay. This organisation facilitated the translation of information across the science–management interface, enlarging the capacity for analytical innovations in the modelling that informed water resource management:

*“Then they set up a scientific expert group or advisory panel ... The model was that they would oversee the science and they would oversee the management implications and work out what to do. This then gave rise to all the great work that was done in terms of the hydrodynamic modelling and the nutrient modelling in the Bay and estuarine waters.”*

In 1994, the group expanded its mandate to include diffuse water quality issues under the newly created ‘Healthy Waterways Partnership’, and provided mayors with some collective strength vis-à-vis the State. Later, in the development of the *Water Act 2000*, the strategy of cooperation was central to generating a policy that all stakeholders could agree to. The inherent complexity of water management was exacerbated in this process because of the necessity to include new – and sometimes politically powerful – players in the negotiations, including business sectors. A new approach to ongoing negotiations emerged in a setting of competition and potential conflict – an approach that incorporated traditional interests, but also expanded its constituency to invite potential critics to the negotiation table where necessary. The key players recognised that by working together they could achieve a balanced outcome.

Nonetheless, the shift to a regional scale was not regarded as equally successful for water supply planning. The regional strategy was seen to be particularly problematic for the long-term redundancy approach that has traditionally underpinned contingency planning in the water sector. As one interviewee noted, the sheer number of stakeholders and institutions involved posed problems for achieving agreement on what kind of infrastructure should be constructed, who should fund it, and how those arrangements would be entered into:

*“There were a large number of institutions involved, owned by different people, subject to different political masters and different political whims, and consequently it was very difficult to be able to – even if you agreed what the contingency plan should be – to actually get that implemented at the time.”*

These problems led this commentator to conclude that collaborative arrangements are inappropriate institutional arrangements for water supply planning, and particularly for water security strategies.

This point raises questions about the conditions for, and limits of, collaborative approaches. In general, the perceived benefits of collaborative and institutional partnerships were limited to an information-gathering function. Improvements in the scientific basis for understanding water quality issues and related management issues provided the shared purpose needed for collaboration. But attempts to generate a shared responsibility for addressing the risks and uncertainties associated with water availability and allocation were unsuccessful, owing to a lack of effective accountability and ownership of the water supply issue:

*“...because it was the responsibility of everyone, there was no particular person taking ownership, particularly at a political level. So ... they struggled with successive ministers to get people who would actually own the issue.”*

#### **5.4. Limiting Factors on Capacity**

The above discussion points, in many ways, to the path dependency or inertia of water institutions in SEQ, which have exhibited limited capacity for change. In particular, the conservative disposition deemed necessary to secure water supply sources and associated infrastructure did not favour organisational innovation in terms of collaborative and partnership approaches on the supply-side of water planning. Nor was analytical innovation, in the form of new kinds of expertise, deemed sufficient to replace traditional hydrological and engineering knowledge bases for water supply.

Organisational culture was also noted as a factor limiting the adoption of different organisational strategies for engaging with stakeholders. As a long-serving bureaucrat noted, the choice to adopt a collaborative approach is “... *certainly affected by the organisation and its culture.*” A comparison

between the collaborative Healthy Waterways Partnership and the water utility, Seqwater, was used to illustrate the cultural divide between water quality and water supply focused organisations:

*“Healthy Waterways has always had a collaborative approach in the way they do business ... that’s how they work. At the other extreme I’d put Seqwater. They’ve got a much more risk-averse approach. .... So there, essentially, you’ve got an organisation built on an existing culture, and that’s risk averse.”*

The conceptual and practical separation of water quality and water supply planning elements of water management was another factor limiting the institutional capacity to take a broadly integrated approach to these issues. This was expressed in terms of the need for such an approach to be ‘mainstreamed’ in the water sector, particularly if water quality issues are not to be sidelined in ‘times of emergency’:

*“Water quality issues, to be fully considered and integrated, need a very clever, integrated and nested approach which both articulates higher-level principles that are agreed and are actually used as tests by decision-makers, good catchment/regional land use planning, as well as really practical input to the nitty-gritty....[But] when the going gets tough, water quality can be sacrificed and sorted out later. Also, institutionally, all of that needs to be part and parcel of line agencies dealing with infrastructure development and water supply.”*

The wider social context of planning and regulation was identified by one interviewee as an important locus of uncertainty. Social complexity means that decisions and their effects are not necessarily related in a direct, causal manner. Decision outcomes are uncertain because outcomes depend on how a range of people in society will behave in response to a particular decision. A feedback mechanism would increase decision-makers’ awareness of the consequences of their decisions – which, in turn, provides a resource for policy and institutional learning. The social nature of managing diffuse pollution was also raised as an issue, which was said to involve dealing with ‘diffuse interpersonal relationships’ in the catchments. The lack of staff skilled in connecting with people beyond organisational boundaries was identified as a limitation in the way diffuse pollution had been dealt with in the past.

## 6. MANAGEMENT MODE 2 – WATER SUPPLY SECURITY IN SEQ

This section is focused on the more recent phase of institutional and policy change. From around 2004, a sense of deepening crisis emerged in SEQ owing to an explicit recognition of the severe and extended drought. The introduction of the *Water Amendment Act* in May 2006 represents a significant institutional reform, which created the Queensland Water Commission (QWC) and required the QWC to develop a regional *water security* plan for SEQ. As one of our interviewees said of the QWC:

*“I think it became the centre of gravity in the sense that it would have the mandate to develop the policy and that leadership role became pivotal.”*

### 6.1. Framing the Problem

In a rapidly expanding and heavily urbanised region, with substantial existing pressures on river health and ecological systems, the major drought of 2000–2008 impacted on many different issues connected with water quantity and quality. A number of issues discussed in Section 4 provide background to the re-framing of the water problem that occurred around 2002–2004, the period in which a strategic focus on regional water supply planning took its place on the policy agenda alongside the earlier attention to water quality management. A key issue was the emerging uncertainties associated with the knowledge base previously relied upon. The practical assumption that historic rainfall records could provide a reliable basis for future water planning had been overturned by the experience of the Millennium Drought. Water became scarcer and less predictable. It was no longer a widely available commodity that could be readily managed and distributed cheaply to all water users. There was also a growing awareness of climate change variability and the risk of ‘surprise’ events. Combined with falling dam levels, these issues meant that providing a reliable supply of water to meet future expected population growth in SEQ was an increasingly complex undertaking.

The deepening of the water ‘crisis’ by around 2004 meant that the key problem, as defined by the majority of political leaders and the media, was essentially defined as a *supply-side deficit*. The immediate response to the crisis was therefore to emphasise supply-enhancement solutions. However, water professionals understood very well that the issue of water supply was always linked to a complex series of other issues, which had been widely debated by stakeholders and embedded in broader policy frameworks during the previous decade. Debates about competing water uses, pricing, recycling, demand management, river and estuary water quality, and biodiversity, had become the basis for emergent new frameworks (such as integrated water resource management and total water cycle management). Any solution that seemed to be driven solely or primarily by engineering expertise (the ‘pipes and dams’ approach), or which did not draw on the expertise of the local authorities, was unlikely to pacify all the stakeholders.

By 2004, other new knowledge began to shape the understanding of water management. Bureaucrats in SEQ were starting to network with policy makers in other parts of Australia. As one senior policy maker explained, water managers across Australia were starting to recognise that climate variability was a significant issue for urban water management requiring flexibility in policy development and implementation. A number of capital cities were under stress because of uncharacteristically poor rainfall associated with dry weather patterns. The focus of water management institutions increasingly shifted from an emphasis on the water quality science–management interface toward an iterative, risk-based approach to water demand.

Analytical innovation in integrating climate knowledge into water supply planning had therefore translated into redefining the problem as one of risk management. In particular, the experiences of other capital cities had identified the need for clarity around the assignment of risk arising from future changes in the availability of water for the consumptive pool:

*“... if we miss a wet season ... we tend to miss the fill-up [of dams for] our water supply system.... I'd been exposed to experiences from particularly Western Australia and Melbourne..... [we became aware that] you needed to get into restriction regimes to ... pull demand off earlier rather than later ... to give yourself time to work with people.”*

The analytical learning described here, which pointed to the need to introduce demand management into the supply planning equation, was a key strategy for water management in SEQ. Another trend that added to the complexity of water management issues was the growing population in SEQ. It was becoming clear, as one senior policy interviewee put it, that the institutional capacity in this region had not been built to meet the consequences of population growth with growing demands on water supply.

By around 2004, the water issue was beginning to be dubbed a ‘crisis’ as the indications of an impending drought made it increasingly clear that the institutional capacity for addressing water scarcity in SEQ was insufficiently developed. The nature of the challenge posed by the drought in SEQ was both complex and contested. Water had become a ‘wicked problem’, in terms of the combination of scientific uncertainty, competing values, and disagreement about solutions (Head 2008). Under such conditions, the growth of expert scientific knowledge alone cannot resolve those difficult policy problems simply by filling the gaps in knowledge (Schon and Rein 1994). According to the challenging critique of rational planning by Rittel and Webber (1973), the days of solving major urban and social problems through an ‘engineering’ approach have ended. Modern society is too pluralistic to tolerate solutions designed entirely by experts. Social groups have important differences in attitudes and values that undermine the possibility of clear and agreed solutions. Complex modern problems are generally ‘ill-defined’, and rely more on political judgements than scientific certitudes. In this sense, most major public policy problems are ‘wicked’ (Rittel and Webber 1973: 160), i.e. they are inherently resistant to a clear and agreed solution. As an interviewee commented:

*“And so that's when the policy and the politics and the science kind of merged at that point, and we actually got an understanding that said two things. One is, we haven't been planning on the right basis in South East Queensland – we now need to learn a new way of planning. And two, it follows from that, that our institutional arrangements to manage this aren't going to cope.”*

The identification of water-related needs, uses, problems and solutions identified above were all dependent on the availability of good science. This has been recognised as a key success factor in the past and remains a critical area for ongoing future investments:

*“Science is critical to provide the direction and identify the risk ...[and] technological and engineering expertise are valuable about how to respond in a realistic cost-effective way.”*

However, the types of knowledge that are most valuable may change over time and the mix of professional skills may therefore need to shift in accordance with new challenges. New capabilities in knowledge and professional skills will need to be developed to manage a more complex system with multiple objectives and many stakeholders. The social understanding of consumer behaviour has become vital for demand-management strategies aimed at reducing consumption. Accounting for uncertainty has become a major challenge for short-term contingency planning and for long-term forecasting. New decision-support tools are being developed, including economic and social choice models. New techniques for cost-benefit analysis and full-cost accounting will need to be built to take account of the costs of externalities such as environmental damage:

*“Further work [will be] needed on what a full-cost regime might entail in SEQ especially in relation to full cost of energy used in producing and transporting water, and environmental externalities arising from various water extractions and land-use practices in catchments.....Full-cost would obviously need to include the issue of energy costs and carbon impacts arising from the production and delivery of high-grade water.”*

## 6.2. Strategies Used to Deal with Risk and Uncertainty

The policy response to the growing sense of crisis had complex foundations. On the one hand, there had been an extended period of responding to complexity and inter-connected issues around planning for sustainable development and integrated natural resource management. The inherent natural complexity of water systems had been recognised, and this had important implications for the ways in which public agencies regulated development and undertook services. On the other hand, the institutional landscape had become both collaborative and fragmented. As the following comment makes clear, institutional arrangements for responsible and accountable water governance were not in place. Nor was the more traditional strategy of coordination across organisations deemed to be capable of getting the job done:

*“That’s when we started to realise that we should be moving to contingency arrangements and needed to be moving to them quickly. The challenge in moving to them quickly in South-East Queensland is that there are so many institutions involved. We didn’t have the right institutional arrangements in place in terms of the clear responsibilities and accountabilities. There was the huge transaction costs, with the large number of institutions involved, to be able to get the cooperation and coordination and incentives to do the job that needed to be done.”*

As the pressures increased for decisive action, some of the key players began to identify a problem with fuzzy roles and responsibilities between the State and local bodies. According to one interviewee, there were a lot of ‘islands’ under ‘different regimes of governance’. Some of these bodies were well managed and some less so. Above all, the water responsibilities were not ‘integrated across the region’. These points are summed up by the following comment:

*“We didn’t have the appropriate planning frameworks in place, nor were those planning frameworks institutionalised. They were almost voluntary, or whatever, in terms of ... [the regional] water supply strategy. We’ve changed that by having specific legislation to require what we call regional water security programs. We didn’t have the right institutional arrangements in place in terms of the clear responsibilities and accountabilities. There [were].... huge transaction costs, with the large number of institutions involved, to be able to get the cooperation and coordination and incentives to do the job that needed to be done.”*

The regional water planning exercises from around 2002 adopted an extended time horizon for forecasting supply and demand information:

*“That’s a key part – going right back to 2002, the reason we started the regional water supply strategy is that we wanted to take a 50-year view of what was going to be the demand and supply requirements for South-East Queensland.”*

Contingency planning was placed on a whole-of-region basis rather than just local water schemes, assisted by a large investment in a water grid with greatly increased capacity to move bulk water between major storages. Risk-based planning also favoured diversification of water sources rather than reliance on existing catchment-based storages – hence the strategic investments announced in 2007 included a desalination plant at Tugun and a potable recycled water plant at Bundamba. Neither had been subjected to extensive community consultation under the perceived conditions of crisis.

The shared responsibility model of water planning and supply did not survive the crisis of 2005–07. The urgent goal was to increase certainty around water supply, and to build a governance model that would underpin the water security guarantee pledged by the Government. As one observer commented, it was a governance problem rather than an infrastructure problem:

*“So the challenge was, while there was an interconnected regional supply, there was no interconnected way of achieving efficiency in that regional supply or achieving cooperation and the best outcomes for the region for that supply.”*

### 6.3. Organising Practices

The drive for clarity of responsibilities and a simplification of governance arrangements entailed substantial centralisation. Local authorities owned about 80 percent of the water infrastructure in SEQ prior to this restructuring, but the State Government tended to be blamed for the water crisis. The state decided to acquire most of the water infrastructure assets. The push toward centralisation of control was rapid and successful in terms of embedding a new institutional design. Local government roles were transferred to a range of new State-owned entities. Rather than the informal, voluntary approach that characterised the early days of water supply planning, there was an identified need for a hierarchical regulative environment:

*“When it comes to water supply, particularly when we're in a drought situation, we'd see that just voluntary approaches weren't necessarily going to cut it on their own. So we needed to have more command and control.”*

The efforts by the State to secure water for SEQ by enhancing State decision-making responsibilities and capabilities have created some adverse effects for the institutional collaboration underpinning Healthy Waterways. Local governments have seen their roles in the water ‘business’ diminished and have been hurt financially by increased State involvement.

Nonetheless, whilst the shift to a ‘command and control’ regulatory environment was clearly evident, the broader agenda for sustainable water supply and use remained in the background as an element of the overall water governance regime. State agency interviewees recognised the need for ‘a partnership approach’ to coordinate activities, and the important ongoing roles of Councils in relation to water, land and catchment management responsibilities. As such, sustainability issues championed by Healthy Waterways and the SEQ Regional Plan required a gradual rebuilding of linkages with other groups. Some observers detected an ebb-and-flow process in regard to collaboration and the sharing of knowledge:

*“... when conflict is high and resources are being stretched, there is no role for collaboration – you need the government to be strong and do its job.... [Later you need] a more holistic approach to maintain and deliver the planning decisions that have been made.”*

This comment makes clear the perception of a need to separate the responsibility for strategic decision-making based on government authority, and the role of collaboration in the communication and implementation of those decisions. As such, there needs to be a clear understanding of the role and limits of collaboration, centred on information:

*“[There was a] need for formal collaboration to be very clear on what it could and could not do – Healthy Waterways [was] great on reporting state of rivers and communication / engagement. [But it has] no role in responding to crisis or acting as lobby group to higher levels of government.”*

### 6.4. Limiting Factors on Capacity

The problems associated with collaborative approaches to water supply planning may be contrasted with their achievements in the realm of water resource management. Those involved in the SEQ Council of Mayors forum found it useful for achieving a common understanding and analysis of water policy decisions, and to advance issues that affected all Councils. As the drought deepened and public attention began to focus on responses, however, factions developed between those Councils more affected by the drought, and those less so. Efforts to tackle a whole-of-catchment approach to water quality issues experienced considerable difficulties as outcomes and objectives that had previously focused consensus-building efforts within a bounded constituency became less clear. This lack of a common interest to underpin cooperation meant that the drought itself was not an issue that could readily be brought to the water planning table.

The limitations of decentralised and informal institutional arrangements to tackle management problems that are often uncertain and systemic, and to adopt solutions that may lie beyond the local region, thus emerged as a key issue in this research. Interviewees emphasised the importance of cooperative relationships in the search for knowledge-based solutions that are acceptable to all partners:

*“You absolutely need it to be a science-based or evidence-based ... we still have that. We need management structure that enables those who need to work and act together the ability to do that and we do not have that...”*

This is a clear recognition that cooperative relationships are important; that the science alone does not dictate the nature of the strategic planning process:

*“If you look at a lot of the supporting reports that went onto the web, some of them are very good quality work and they gave us a good basis for the Strategy. They didn't help us make the Strategy itself.”*

Although collaborative approaches were able to bring a range of new knowledge and expertise to the table, the link to policy decisions was not effectively institutionalised:

*“... those alliances and steering committees and so on that we had, they were useful in getting information together, but they weren't useful in making any decision about what we needed to do for water supply. And ... because it was the responsibility of everyone there was no particular person taking ownership, particularly at a political level.”*

## 7. SUMMARY AND CONCLUSIONS

The dynamic nature of urban water reform in Australia in recent years highlights the possibility of institutional innovation and change in a sector long characterised by stability. Institutional change in Australian urban water systems is evident in: recognition of the legitimate contribution of stakeholder knowledge in policy making; the penetration of changing norms and values concerning environmental sustainability; and the organisational separation of management operations and government's policy-making role (see Colebatch 2006).

An institutional perspective on the shifts in the characteristics of the SEQ water system also reveals the connections between knowledge, values and the organisation of water management associated with such change. In the time characterised by an 'integrated approach to waterways health' (Section 4), the attention given to environmental issues in relation to integrated water management reflected the growing value placed on the environment. This influenced the progressive opening up of the organisational framework to different ways of understanding the problem, which challenged the dominant paradigm of supply and disposal, and introduced new knowledge to supplement the dominance of engineering expertise in the identification of solutions.

From 2004 onwards, characterised by a focus on 'water supply security' (Section 5), the organisational dominance of technical experts in the water utilities was contested by political leaders and led to a centralisation of responsibility for water security. These changes in the regulative pillar are matched by cognitive changes. Knowledge about demand management, marketing, outsourcing and consumer behaviour, as well as discourses centred on externalities and environmental impact, contend with engineering-based knowledge about supply and treatment. Finally, the normative dimension has been transformed by the rise of managerial approaches to government, which has resulted in the institutional separation of management organisation (efficiency values) and government (public interest values). Table 3 summarises the key issues raised by interviewees in relation to each phase of water reform in SEQ.

**Table 3: Knowledge Capacities Associated with Institutional Change in SEQ Water Management.**

<b>Phase/ Elements</b>	<b>Management Mode 1: Integrated Approach to Healthy Waterways</b>	<b>Management Mode 2: Water Supply Security in SEQ</b>
<i>Problem Framing</i>	Water quality in estuaries and waterways Integration of land and water issues Integration across science–management interface	Water supply deficit Supply security Water as a 'wicked' problem
<i>Strategies to Deal with Risk</i>	Shared responsibility Agency coordination	Centralised responsibility Share water, spread risk
<i>Organising Practices</i>	Collaborative partnerships Boundary organisation to integrate science into management decisions	Hierarchical regulative environment Separation of operational matters and government's policy-making role
<i>Limiting Factors</i>	Conceptual divide between water quality and quantity issues Cultural divide between supply and resource management organisations	Lack of a cooperative management structure Lack of integration across science–policy interface

The development of 'knowledge capacities' for water management has emerged from this research as one of the most important institutional challenges currently faced by water managers in SEQ. The forms of knowledge and expertise considered to be important to water management have changed over time. New disciplinary expertise and evidence bases not previously integral to water management in SEQ have been introduced – from environmental and biological sciences, to expertise in environmental flows, energy and productivity, demographics, water use in the home, public attitudes, and demand management. On the whole, these knowledge-related changes reflect transitions in the style of water management that have been observed internationally (see Table 4).

The interdependence of the three elements of institutions means that cognitive attention to knowledge and shared problem framings must be understood in relation to the normative and regulative aspects of institutional arrangements. In SEQ, shifts in knowledge capacity were clearly related to changing roles and responsibilities. As the integrated approach to healthy waterways developed in the 1990s and early 2000s, a diversity of organisations became involved in water management. From around 2004, drought response strategies have involved a dynamic reform of roles and responsibilities to secure water supply. At the same time, there is an increasing recognition of the need to develop adaptive capacity by sharing responsibility for water and thereby spreading risk across the water system.

In terms of the organisational base, the influence of inter-governmental agreements since the mid-1990s had promoted new forms of collaboration between government and non-government stakeholders. The need to develop collaborative capacity to structure the interactions between water management organisations was considered to be important to facilitate integrative thinking and organisation. Nonetheless, the role of alliances and collaborations has waxed and waned over time with the changing influence of hierarchical, or ‘top-down’, modes of regulation. This suggests the need for attention to the role and limitations of collaborative arrangements for different purposes.

The results of this research therefore indicate that there is a range of different organisational responses to uncertainty and the associated challenges facing water management. As the influence of different values constrains existing decision systems, new organisational forms, structures and responses are created. Rather than replacing existing management strategies, however, these emerging responses introduce a wider range of strategies for dealing with uncertainty so that a range of institutionalised practices co-exist in a dynamic process of ebb and flow.

**Table 4: Water Management Styles – Traditional and Future.**

1970s	2001 and Beyond
<ul style="list-style-type: none"> <li>• Singular problem</li> </ul>	<ul style="list-style-type: none"> <li>• Inter-related problems</li> </ul>
<ul style="list-style-type: none"> <li>• Locality-based technical planning</li> </ul>	<ul style="list-style-type: none"> <li>• System-based spatial planning</li> </ul>
<ul style="list-style-type: none"> <li>• Solve today's problem</li> </ul>	<ul style="list-style-type: none"> <li>• Anticipate tomorrow's problems</li> </ul>
<ul style="list-style-type: none"> <li>• Disciplinary professional skills</li> </ul>	<ul style="list-style-type: none"> <li>• Interdisciplinary professional skills</li> </ul>
<ul style="list-style-type: none"> <li>• Engineers</li> </ul>	<ul style="list-style-type: none"> <li>• Engineers, biologists, public managers, spatial planners, etc</li> </ul>
<ul style="list-style-type: none"> <li>• Hierarchical, top-down</li> </ul>	<ul style="list-style-type: none"> <li>• Networks, participation</li> </ul>

Source: adapted from Van der Brugge and Rotmans (2007).

Developing an integrated approach to water management, in SEQ and elsewhere, requires continuing effort to overcome impediments. Although the dynamic nature of institutional change in SEQ has revealed the capacity for institutional change, the prospect of changing social and environmental conditions requires the continuous transfer and integration of knowledge for long-term problem-solving capacity. The issue of knowledge integration has emerged as a key challenge in this regard. Key issues raised include: the need to integrate diverse forms of knowledge; to address the conceptual divide between water quantity and quality and the related fragmentation of organisational responsibilities; and to bridge the gap between science and strategy development. Related water management research has demonstrated the value of brokers to translate knowledge across the interface between science, management and policy (Cash et al. 2002). This issue, in turn, points to a requirement for collaborative capacity, or the formal and informal arrangements to facilitate structured interaction between water management organisations.

The results of this research resonate with related work, which has identified the capacity of government, industry and community organisations to transfer, translate and integrate different types of knowledge to inform water policy and management responses as a key challenge (Lane and Robinson 2009). Information-sharing between organisations and the need for collaborative inter-

organisational relationships were also identified as important issues for sustainable urban water governance in Sydney (van de Meene et al. 2009). The results of comparative analyses identified integrated cooperation structures (including non-governmental stakeholders, governments from different sectors and different hierarchical levels), and advanced information management (including joint/participative information production, consideration of uncertainties, and broad communication) as the key factors leading towards higher levels of learning (Pahl-Wostl 2009). Building capacities to transfer and integrate knowledge promotes technical and organisational learning, contributing to the problem solving and innovation that underpin effective and flexible water systems (Pahl-Wostl 2008). Adaptive governance and social learning are considered to be vital ingredients in dealing with abrupt change (Folke et al. 2005).

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