Water Accounting Report 1: South East Queensland Water Accounts and Data for Integrated Urban Water Management Models – Introduction and Methodology

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The Urban Water Security Research Alliance (UWSRA) is a $50 million partnership over five years between the Queensland Government, CSIRO's Water for a Healthy Country Flagship, Griffith University and The University of Queensland. The Alliance has been formed to address South East Queensland's emerging urban water issues with a focus on water security and recycling. The program will bring new research capacity to South East Queensland tailored to tackling existing and anticipated future issues to inform the implementation of the Water Strategy.

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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, e-Water 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 5 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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GLOSSARY

ABS	Australian Bureau of Statistics
BOM	Bureau of Meteorology
DERM	Department of Environment and Resource Management
IUWM	Integrated Urban Water Management
LCA-IM	Life Cycle Analysis and Integrated Modelling
NWI	National Water Initiative
QWC	Queensland Water Commission
SEEAW	United Nations System of Environmental-Economic Accounting for Water
SEQ	South East Queensland
SEQRP	South East Queensland Regional Plan
SEQWG	South East Queensland Water Grid, a network of two-way pipelines connecting major bulk water sources in the region. This system will be able to redistribute water directly from areas of surplus and to those experiencing a shortfall.
SEQWS	South East Queensland Water Strategy
SWIM	Statewide Water Information Management
UWSRA	Urban Water Security Research Alliance
VPM	Volumetric Point Measurement
WGM	Water Grid Manager
WRON	Water Resources Observation Network
WSP	Water Service Providers

1. INTRODUCTION

This report provides a description of the the Queensland Water Commission's (QWC) South East Queensland (SEQ) *WaterHub* water information system and its potential to contribute to the data needs of the *HydroPlanner SEQ prototype* and other integrated urban water management models (IUWM) under consideration for achieving the water balance and security objectives of the South East Queensland Water Strategy (SEQWS) (2009). A major aim is to outline the *WaterHub* water information system, as a potential source of data for the developers of integrated urban water management models, and to establish a methodology to identify existing data exchange potential and likely gaps in the content and spatial and temporal resolution of the data planned for the *WaterHub*. This volume of the report describes the methodological basis for the actual data matching and assessment analysis that is completed and summarised in Daniels and McBean (2010) (Volume 2 of this report).

At the time that this report was first compiled (June 2008), the *WaterHub* was planned to have very extensive water accounting functions and the *HydroPlanner SEQ prototype* was in developmental phases as a primary option for urban hydrological modelling in the region. Unfortunately, substantial modifications occurred to the scope, coverage and role of both the *WaterHub* and the *HydroPlanner SEQ prototype,* delaying the finalisation of some key aspects of the data needs for integrated urban water management modelling. Hence, there are some inconsistencies in the WaterHub and *HydroPlanner* model descriptions and in the specific nature of the proposed method in this report, and the approaches addressed in Volume 2. However, the comparative framework has retained its essential features and the basic objectives are still valid and addressed in the same manner. Volume 2 actually involves an extension of the assessment process to cover available water accounting data in the relevant frameworks of the Bureau of Meteorology's *Australian Water Information System (AWRIS)* and *National Water Accounts*, as well Queensland's *Statewide Water Information Management (SWIM) project.*

Over the past decade, Queensland has experienced one of the worst droughts in the State's recorded history. SEQ's major water storages last filled during the summer of 2000-01 and, after that, storage levels steadily declined. Even after exceptional rains early in 2008, the combined water level for all SEQ dams was only 39.47% of maximum capacity at the end of June 2008. Urban, rural and agricultural communities have all experienced the impacts of such critical water shortages, ranging from declining crop productivity to stricter enforcement of water use regulations. Compounding the pressure on water supplies, the population growth rate in SEQ steadily increased throughout this period. With supplies at an all time low, and demand on the rise, water managers and planners were forced to consider alternative approaches to water management to ensure a sustainable water supply in the long-term. It is no longer possible to rely on dams and weirs as the region's main water sources. Instead, alternative sources such as recycled water, rainwater tanks, stormwater harvesting and desalinated water, and strong demand management, are being pursued as viable options for sustainable and comfortable lifestyles.

Changes in perception and approaches to water management have resulted in the growing need for reliable empirical water information to assess and analyse aspects of water resource management, such as water cycle behaviour. Water accounts are being recognised as an integral component of water resource management. Water accounting involves the systematic collection and compilation of empirical information measuring physical volumes of water flows and stocks within, or at, predefined spatial and temporal boundaries and nodes. It typically involves the measurement of both "natural" flows and stocks within the ecosphere as well as significant flows that are extracted, diverted, modified, collected, used, embodied or discharged by human activities.

A key aspect of water accounting is to assess the extent of human intervention and appropriation of water in terms of specific sources and types of human activities and land use. Hence, water accounts include a variety of hydrological "supply" measures focused upon natural flows (and perhaps human land use change influences) as well as supply and demand measures of water captured, produced and demanded from the various components of the human economy. The ability to relate physical and monetary data relating to water provides a strong basis for helping decision-making that supports the socially-efficient (that is, producing the best net community economic welfare) outcomes related to the sustainable management of water. This approach has been adopted in a wide range of natural resource accounting frameworks that have been developed internationally (United Nations, 2003).

Water accounting is relatively new in terms of methodology and practice. However, in response to growing pressures and awareness of serious supply-demand imbalances across many regions of the world, its development has been rapid over the past decade. This is highlighted in the Australian context where water sustainability issues have risen to the top of the political and public agenda. There are now several, partially-related sets of water accounting frameworks in various stages of design and implementation. The QWC's *WaterHub* data framework for SEQ is perhaps the most detailed and elaborate of these schemas. The *WaterHub* is a growing database that aims to provide a comprehensive set of water data and information for SEQ to assist regional water management.

The Life Cycle Analysis and Integrated Modelling (LCA-IM) Project, a collaborative project of the Urban Water Security Research Alliance (UWSRA), is an initiative that has been established to support water-supply decision making over the medium to long term. The availability of reliable and accurate water data and information is essential to support development and implementation of the project's modelling tools. The following report aims to provide an overview of the potential synergy between the *WaterHub* and the LCA-IM project – primarily the *HydroPlanner SEQ prototype* being developed at the time to simulate all aspects of the integrated urban water system within a single modelling framework.

To assist in the effective utilisation of empirical water data for integrated urban water management modelling in the region, this first report (Report 1) provides an introduction and overview of the QWC's *WaterHub* - its purpose, scope and evolution. A second major aim is to outline the methodology for a comparative analysis of data characteristics of the SEQ *WaterHub* and the *HydroPlanner IUWM prototype.* Report 2 will provide the results of the application of this methodology to provide insight into data availability and potential exchange and ways in which the evolving water accounting frameworks might better support IUWM modelling essential for sustainable water management in the region.

2. WHAT IS THE SEQ *WATERHUB*?

The SEQ *WaterHub* is a regional database and information management hub that compiles and standardises water-related data and information for the SEQ region. The data and information provided by the *WaterHub* will assist in facilitating strategic water planning and the achievement of the total water balance in SEQ in both the short and long term (QWC, 2008e; 2008g; 2008h). Achievement of the total water balance relies upon the sustainable management of water so that gaps between water supply and demand can be reliably avoided. The QWC is currently responsible for the development and implementation of the *WaterHub* and aims to create a centralised source of regional water-related information. The data that form the basis of the *WaterHub* (see Appendix A) are sourced from 18 Water Service Providers (WSPs), primarily local government authorities, within the SEQ region.

Box 1 What is the SEQ *WaterHub*?

The *WaterHub* is a regional database and information management hub that compiles and standardises water related data and information for the South East Queensland (SEQ) region.

The data and information provided by the *WaterHub* will assist in facilitating strategic water planning and the achievement of the total water balance in SEQ in both the short and long term.

Initially, the *WaterHub* was conceived as a tool for providing water demand data to assist in monitoring potable water demand targets as outlined in the South East Queensland Regional Plan 2005-2026 (SEQRP). Through 2005 and 2006, the concept evolved with the development of the South East Queensland Water Strategy (SEQWS), which is directed towards securing water balance within the SEQ region for the next 50 years. It represents a response to the perceived necessity for appropriate, detailed and systematic water accounts to underpin the implementation of the SEQWS and monitor its underlying demand assumptions. It was also recognised that data from the *WaterHub* could be used to support various regional water initiatives, such as the Bureau of Meteorology's (BOM) planned *National Water Accounts*. To support these initiatives, it became apparent that the *WaterHub* would need to provide more than just demand management data. Therefore, the concept of the *WaterHub* expanded to include further data and information related to water production, supply, storage and data to support achievement of the total water balance (Kurki and Vogelsang, 2007).

The *WaterHub* is developing as a flexible system to ensure that necessary extension in data needs can be accommodated when future information requirements are identified. In 2008, the QWC reviewed the information requirements of all relevant institutional entities, including an assessment of the data requirements for the BOM's *National Water Accounts* and the Statewide Water Information Management (SWIM) project. This review aimed to ensure the development of a systematic framework that provides relevant data for all interested stakeholders. Implementation of the *WaterHub* will occur in a phased and modular approach, with the critical information needs of the QWC and the Water Grid Manager (WGM) being addressed by the completion of Phase 1 of the *WaterHub* development (Oliver, 2008).

3. THE PURPOSE OF THE WATERHUB

The *WaterHub* must provide sufficient data to support a variety of functions for a range of stakeholders. For example, in order to monitor the water balance, demand management data is not sufficient. It is necessary to have access to high-level data on sources and volumes of water and access to geographic data that will allow the relationship between consumption and spatial area to be assessed. The intended purposes of the *WaterHub* are:

- To provide historical and forecasting data that will support the QWC's reporting requirements, such as production of a detailed Water Report that "provides a data and information 'snapshot' of water performance management and usage within South East Queensland" (Queensland Water Commission 2008).
- Provide historical and forecasting data that will support the information needs of the WSPs, such as demand forecasts for their geographic region.
- Provide historical and forecasting data that will support the information needs of the Water Grid Manager (WGM), who is responsible for coordinating the region's bulk water supply operations in agreement with the SEQ Water Strategy (SEQWS).
- Provide historical and forecasting data that will support potential reporting requirements of various State and National entities, such as those of the Bureau of Meteorology's (BOM) *National Water Accounts.*
- Support the implementation of water initiatives as outlined in the SEQWS e.g. desalination plants.
- Monitor the demand assumptions underpinning the SEQWS.
- Improve the quality, consistency and accuracy of regional water data by preventing duplication of data provision from the Water Service Providers (WSPs) and all grid participants, thereby reducing costs.
- Provide accurate data that can be used to respond to media enquires, such as daily consumption i.e. litres/person/day.
- Provide accurate data to facilitate strategic water planning.
- Provide data and analysis for input into parliamentary briefs, respond to inter-agency requests and support restrictions compliance monitoring.
- Provide data to support the development of Queensland's *State of the Region* report, a five-yearly report aimed at providing a link between the desired outcomes of the SEQ Regional Plan and environmental, economic and social sustainability indicators.
- Produce forecast demand profiles that can support achievement of the SEQ water balance.
- Provide actual grid bulk water measurements.

Source: Qld Department of Infrastructure and Planning (2007) and QWC (2008b, 2008g, 2008).

3.1 Key Stakeholders and Users

Stakeholders involved in the development, implementation and use of the *WaterHub* include the QWC, the Department of Environment and Resource Management (DERM), the Department of Local Government, Planning, Sport and Recreation, 18 Water Service Providers, Seqwater, the Queensland Water Directorate, the Bureau of Meteorology (BOM) and the SEQ Water Grid Manager. These stakeholders contribute through the provision of data to the *WaterHub,* or as potential users of the data and information provided by the *WaterHub*, or both. The WSPs are required under the Water Act 2000 to provide the QWC with requested water data and information at regular intervals. Other stakeholders, such as the BOM, are liaising with the *WaterHub* project team in order to coordinate their data collection requirements with the activities of the *WaterHub*.

3.2 SEQ WaterHub Development and Governance

The *WaterHub* is developing as a centralised water accounting system that provides accurate and consistent data that are essential to support all 'water related planning, monitoring, reporting, compliance management and program development' in the SEQ region (Oliver, 2008). The *WaterHub* has been driven by various factors throughout its development, including: the critical information needs of the QWC and the WGM; the information needs of other State and National entities (e.g. BOM and SWIM); the QWC's Strategic Plan for 2008-2012; and the development of the SEQ Water Strategy (QWC, 2008a).

Box 2 Current *WaterHub* Drivers

- **The information needs of the QWC**
- **The information needs of the WGM**
- **The information needs of other state and national entities (BOM and SWIM)**
- **The development of QWC's Strategic Plan for 2008-2012**
- **The implementation of the SEQ Water Strategy**

All legal arrangements governing *WaterHub* development and implementation are outlined in the Queensland Water Act 2000. Under the Act, the QWC holds various powers in regards to the collection, storage and distribution of water data and information. A review of these powers has revealed that, in order for the QWC to 'establish itself as the regional water information hub for all SEQ water accounting and reporting purposes', various amendments to the Act must be made (QWC, 2008a). These amendments relate to the strengthening of the QWC's statutory powers in regard to data collection from all grid participants and to the supply of data and information to other State and National entities, such as the BOM. To ensure that the QWC becomes the sole custodian of all regional water information, and that all necessary powers are in place to support the collection and distribution of data, the QWC proposed:

- The ongoing development of sufficient water information capability for the QWC to fulfil a central regional planning, coordination and compliance management role;
- The continuing development of the *WaterHub* as the 'single point of truth' for regional water accounting information, initially directed for its regional planning, coordination and compliance roles and the operational requirements of the Water Grid Manager;
- In parallel to the technical development of the *WaterHub*, that the QWC investigate the governance arrangements, including any enhanced statutory powers, required to ensure adequate and consistent information is reliably supplied as required, by all grid participants; and
- The continuing liaison with BOM and DERM to identify the specific benefits of and impediments to establishing QWC as the single reporting entity for all data and information collected through the *WaterHub*.

Source: Queensland Water Comm. (2008a).

Had the QWC not being granted sole custodianship of the *WaterHub,* there could have been a risk of inconsistencies and substantial data gaps in reporting information. Such inconsistencies have the potential to undermine the key initiatives that the QWC aims to support through the development of the *WaterHub*, such as the ongoing achievement of the total water balance.

The Regional Water Information Management Unit (RWIMU), a division of QWC, has the mandate to develop and implement the *WaterHub* database. The RWIMU is responsible for the collection and storage of water data for the QWC. It is also responsible for the technical development and maintenance of databases to house the data, and models that will be capable of analysing historical and forecast water demand trends in SEQ. The RWIMU is also responsible for estimating water usage per person per day in the SEQ region (QWC, 2008).

The RWIMU conducted an assessment of the information needs of the QWC and the WGM (Oliver, 2008). This process guaranteed that the appropriate data and information necessary to support the immediate needs of the QWC and the water grid system were identified prior to the implementation of *WaterHub*. The RWIMU will, on an ongoing basis, update the *WaterHub* in order to meet the evolving needs of the needs of the QWC and the WGM.

4. THE LCA-IM ALLIANCE PROJECT DESCRIPTION – KEY AIMS AND METHODOLOGY

The Life Cycle Analysis and Integrated Modelling (LCA-IM) project of the Urban Water Security Research Alliance (UWSRA) aims to support water supply and demand decision-making over the medium to long term by providing methodological approaches and tools to assess the impacts of alternative urban water management options. The project adopts an integrated approach to water management and is guided by the need to assess alternative resource management options that optimise human lifestyle, but do not jeopardise ecosystem health.

The major aims of the LCA-IM project are:

- To develop a decision support system and integrated water cycle modelling tool for the region, quantifying water, nutrient, sediment, energy, greenhouse gas emissions and materials flow implications of alternative urban water management options in a total water cycle context. This is to aid regular reviews of the SEQ Water Strategy (SEQWS) (http://www.qwc.qld.gov.au/), and to inform policy development, planning and operational phases in SEQ, related to urban water, including key performance indicators for the efficiency of urban water service provision.
- To assist understanding of a "systems view" of the urban water system by considering how water supply, wastewater and stormwater systems interact with each other and with the natural and built environment in terms of water, nutrient, sediment, energy, greenhouse gas emissions and materials flows.
- Contribute to the development of new urban water management options or approaches not yet embedded into regional water strategy in SEQ by recognising and evaluating influences outside the water cycle.

The LCA-IM project will be responsible for supporting the SEQ Water Strategy through the assessment of proposed alternative configurations of the SEQ water cycle to optimise the overall system (LCA-IM Project Team, 2007). All major proposals outlined in the Strategy will be reviewed and their impacts on the total water cycle will be determined, including an assessment of the energy use, greenhouse gas emissions and nutrient discharges. Assessment of these scenarios will provide information for the SEQWS, to help inform program development. The LCA-IM project tools will use improved resolution modelling to determine whether the SEQWS will be able to meet its objectives.

Tools such as the *HydroPlanner SEQ prototype* aim to provide the capacity to assess alternative water supply options to optimise social benefits and support sustainable water management at the regional level (Maheepala, 2008). Water cycle impacts of various urban water management options, such as stormwater harvesting, wastewater and grey water use, will be modelled in order to provide a numerical analysis of regional water quality and quantity under different scenarios. Results from the modelling will assist decision makers by informing policy development and will assist planners with the best possible approach to total water cycle management and planning.

5. THE SEQ WATERHUB AND THE HYDROPLANNER SEQ PROTOTYPE – A COMPARISON OF OBJECTIVES

Similarities between the *WaterHub* and the *HydroPlanner SEQ prototype* are found in their common objective to provide data that can be used to support the many facets of sustainable urban water management in SEQ. The main objective of the QWC's *WaterHub* is to provide data that will be able to meet the information needs of the QWC, the WGM and other relevant State and national agencies. This data will support strategic water planning and the ongoing achievement of the water balance within the SEQ region. The QWC aims to enhance the reliability, quality, consistency and accuracy of the data by becoming the sole custodian of all regional water information. This will ensure that duplication of data provision from the WSPs is minimised, which will also reduce costs and the risk of error that is associated with the duplication of reporting information.

The emergence of Integrated Urban Water Management (IUWM), as an alternative to traditional management practices that focus on system components as individual units (i.e. water supply, wastewater and stormwater systems) without considering the integrated and interactive nature of the entire system, has necessitated the development of IUWM modelling tools (Maheepala, 2008). The *HydroPlanner SEQ prototype* tool aims to simulate the entire urban water cycle, from supply catchments to receiving waters, within a single modelling framework and quantify water quantity and quality aspects of various urban water management scenarios within a system that is not linear in nature. The data generated from these simulations will support decision makers in assessing supply and demand options that optimise net social benefits in regards to the most significant material and energy flows.

Both the *WaterHub* and the IUWM tool also function to support development and implementation of the SEQWS (see Table 1). The SEQWS is a long-term plan to address water supply and water security in SEQ for the next fifty years. Through a series of measures, including investment in new infrastructure, decreased reliance on dams and weirs as a reliable water source, implementation of demand management programs and the development of drought response plans, the Queensland government is committed to meeting the water needs of urban, industrial and rural growth and of the environment (QWC, March 2008).

The *WaterHub* will provide relevant data that will be used to support the implementation of strategies outlined in the SEQWS and to enable ongoing monitoring of the urban demand assumptions guiding the Strategy. The urban water demand assumptions underpinning the Strategy are based on historical and future water consumption patterns, population growth projections, assessment of the historical effectiveness of water savings programs and water availability. Through the provision of consistent and accurate data for the entire SEQ region, the *WaterHub* provides the capacity to monitor these demand assumptions, which have a direct impact on planning, decision-making, program development and performance (QWC, March 2008). Not only will the *WaterHub* provide data to monitor demand assumptions, it will also provide data to support other initiatives that are developed and implemented under the SEQWS (Kurki and Vogelsang, 2007).

An IUWM tool will enable critical questions to be addressed, such as, how the SEQWS components individually and collectively affect water system behaviour (LCA-IM Project Team, 2007). Assessment of the impacts on quantity and quality aspects of the total water cycle, from alternative configurations, will provide necessary information for planners and managers to review the Strategy and recommend appropriate modifications. Alternative configurations of the water cycle will be guided by the aim of optimising the overall system. The *HydroPlanner SEQ prototype* aimed to enable review of the supply and demand balances of the Strategy to determine whether the SEQWS will be capable of meeting its objectives.

Table 1: A general comparison of the objectives of the SEQ *WaterHub* and the *HydroPlanner SEQ prototype*.

Objectives of the SEQ *WaterHub*
• Support the information requirements of the QWC, WGM and other state and national agencies • Facilitate strategic water planning and the ongoing achievement of the water balance • Enhance reliability, quality, consistency and accuracy of regional water data • Minimise duplication of data provision from the WSPs • Support the implementation of the SEQWS and other regional initiatives. • Monitor the urban demand assumptions underpinning the SEQWS (South East Qld Water Strategy) and ensure that they remain constant • Provide data to support initiatives developed and implemented under the SEQWS
Objectives of *HydroPlanner SEQ prototype*
• Simulate the entire urban water cycle within a single modelling framework • Generate data to support decision making in regards to supply and demand options. Quantify water quantity and quality aspects of various urban water management scenarios in an integrated manner • Assess alternative configurations for the total water cycle • Evaluate major proposals outlined in the SEQWS • Provide recommendations to the SEQWS in regards to potential modifications to program development • Optimise overall system configurations • Determine whether the SEQWS will be able to meet its objectives

6. WATER ACCOUNTS AND INTEGRATED URBAN WATER MODELLING – DATA AND METHODOLOGICAL LINKAGES

The recent emergence of water accounting frameworks at both the State and National level opens a plethora of potential linkages between the data provided through the accounts and a wide variety of water initiatives, including the development of environmental water models. Understanding of the potential linkages between water accounts and environmental water models is still in its infancy.

The following section of this report offers an overview of the potential linkages between water accounts and integrated urban water modelling. Firstly, it outlines the nature of water accounting and the general applications and benefits of water accounts. This is followed by a description of how empirical data from water accounts can provide valuable information for the development and implementation of environmental water models, in particular, support for synergies between the *HydroPlanner SEQ prototype* and the *WaterHub*.

This report only covers the methodological approach that will be used in the ongoing research by this part of the LCA-IM team. Further detailed compatibilities between the *WaterHub* and the IUWM model will be presented in a second report (Report 2) that aims to facilitate a mutually beneficial process of exchange between the empirical and modelling systems to optimise their development and application as critical joint systems for sustainable water management in the region.

6.1. Water Accounts – the Rapid Expansion in Development and Applications

Water accounting involves the systematic collection and compilation of empirical information measuring physical volumes of water flows and stocks within, or at, predefined spatial and temporal boundaries and nodes. It typically involves the measurement of both "natural" flows and stocks within the ecosphere as well as significant flows that are extracted, diverted, modified, collected, used, embodied or discharged by human activities.

A key aspect of water accounting is to assess the extent of human intervention and appropriation of water in terms of specific sources and types of human activities and land use. Hence, water accounts include a variety of hydrological "supply" measures focused upon natural flows (and perhaps human land use change influences) as well as supply and demand measures of water captured, produced and demanded from the various components of the human economy. The ability to relate physical and monetary data relating to water provides a strong basis for helping decision-making that supports the socially-efficient (that is, producing the best net community economic welfare) outcomes related to the sustainable management of water. This approach as been adopted in wide range of natural resource accounting frameworks that have been developed within the international context (United Nations, 2003).

Water accounting is relatively new in terms of methodology and practice. However, in response to growing pressures and awareness of serious supply-demand imbalances across many regions of the world, its development has been rapid over the past decade. This is highlighted in the Australian context where water sustainability issues have risen to the top of the political and public agenda. There are now several, partially-related sets of water accounting frameworks in various stages of design and implementation. The *WaterHub* data framework for SEQ is perhaps the most detailed and elaborate of these schemas.

Box 3 What is Water Accounting?

Water accounting involves the systematic collection and compilation of empirical information measuring physical volumes of water flows and stocks within, or at, predefined spatial and temporal boundaries and nodes.

6.2. General Application for Water Account Data

The concentrated efforts under way to develop and implement water accounts are predicated upon the recognition of water sustainability problems and the essential need for data to effectively address these problems. The traditional response of unrestricted expansion of supply faces severe biophysical and related economic constraints. Effective and efficient strategies must now be clearly based on an understanding of the supply and use relationships within the natural and human realms.

In this section, we outline some of the general applications which have underscored the profound push towards implementing appropriate water accounting systems.

The overarching use of water accounts is to provide the primary supply and use data required for the efficient management and planning for water resources within some defined geographical area. The data collected enable the construction of a wide range of water sustainability indicators that measure and relate historical, current and future supply and use trends. The state of the water balance is a key target for water accounts with recognition of water use options as part of increasing effective water supply. While there tends to be a special interest in human-influenced supply and consumption, water accounts are also increasingly integrating climatological and hydrological data measuring water in the environment, such as in catchments, surface and groundwater flows, and evapotranspiration (Australian Bureau of Statistics, 2006; National Water Commission, 2007). The principal goal is to assess and monitor medium- and long-term trends in the gap between supply and demand for water, and environmental, economic and social pressures associated with the supply-demand balance based on existing and potential quantities available and patterns of use.

Water quality is also growing in significance in water accounts which can be extended to delineate system-integrated flows for water of different quality. The matching of appropriate and acceptable water quality for specific consumptive purpose is realised as a major option for achieving the efficient use of water.

> **Box 4 The Purpose of Water Accounts**
>
> **The overarching use of water accounts is to provide the primary supply and use data required for the efficient management and planning for water resources within some defined geographical area.**
>
> **The data collected enable the construction of a wide range of *water sustainability indicators* that measure and relate historical, current and future supply and use trends.**

The integration of water accounts within spatial database systems has also become an essential aspect of resource accounting, given the dramatic increase in information capabilities that geo-coding of stock and flows can proffer.

Other typical general benefits and applications of water accounts include:

- the identification of specific, detailed and comparable sources of water use, demand or consumption. This is undertaken with a view to linking to other regional or national water accounts, resource accounts, and monetary national income accounts. It also provides the detailed household and economic actor "end-use" and final demand data for social and behavioural analysis and incentives related to water management.
- the estimation of "water productivity" - the relative economic benefits associated with specific uses. This can include full "embodied" or "virtual" water use via the application of input-output analyses and facilitates the design of cost-effective ("low hanging fruit") policy. Detailed

sectoral indicators help prioritise and design efficient strategic responses to pressure on water resources. Mapping of biophysical flows to economic sectors is ideal for assessing the least-cost potential for strategies and policy instruments designed to enhance the efficient use of water.

- the provision of comprehensive geographic water flow and stock data in order to identify and measure links and flows between major natural and human economy system components covering water sources, economic uses, losses, and releases; thus facilitating an integrated water planning framework.
- providing the water accounting framework so that water use and supply options (and their water balance outcomes) can be linked and assessed in terms of other material, energy and environmental resource (pollution; forestry, land, energy) impacts and requirements.
- the provision of empirical time-series data for detailed monitoring and estimation of the impacts of strategies, policy and other economic, social and environmental condition changes on flows associated with specific water sources, uses and releases. This aspect represents one of the major applications for use of water accounts in integrated urban water models (IUWM) by potentially providing the data basis for predicting and measuring physical and economic system-wide water flow consequences of alternative supply options and technologies.
- the generation of physical water data on flow quantities and quality as the basis for economic valuation techniques (private and possibly full social costs and benefit estimation) for water markets and pricing and cost recovery from economic sources.
- the production data to support mass or material balance accounting frameworks for water that enable robust and systematic tracking and cross-checking of flows. This integrated, balanced accounting method enables both: (a) the estimation of many highly problematic flows (for example, evaporation and sewerage system losses); and (b) the validation of all important flow estimates.
- the evaluation of access to water and sanitation services (e.g. in accordance with Millennium Development targets).

6.3. General Uses of Empirical Water Data for Integrated Urban Water Management Models

Environmental models concerned with water tend to focus on the mathematical representation of processes and biophysical conditions to simulate and estimate movement of water quantity and associated pollutant flows. They are used to analyse data, to generate predictions based on existing trends or posited scenarios, and to provide information for use by other models. Most of the models in use are computer-based, and incorporate a mixture of physical process description models, statistical relationships or empirical models, and other information, often of a tacit nature (see Box 5). The tacit information often represents "common" assumptions or *a priori* scientific or technical knowledge about processes, parameters and data.

The point and non-point modelling associated with water are often predicated upon high levels of temporal and spatial resolution given the continuous but highly differentiated spatial nature of water sources and flows. This fine level of resolution is often taken to mean that the more broad-scaled, discrete empirical water data collected by water accounts are largely irrelevant to hydrological and related modelling. However, there are several reasons why water accounts can have a very useful interchange with water-related environmental modelling.

Box 5 Types of Empirical Models

Models can take many forms ranging from conceptual, through empirical, to physical, based on difference equations, ordinary differential and partial differential equations. Conceptual models will not be dealt with here, as attention will be limited to the more empirical and physical models.

Empirical Models

This class of model relies heavily on the statistical relationships, which can be, or have been, established between the variables. An example is the relationship between rainfall and runoff for a particular catchment, as established by examination and analysis of the observed rainfall and the observed runoff from the catchment. The statistical relationship thus established may then be used to predict future runoff from observed rainfall, or can be used to consider "what if" scenarios. For linked catchments, the connectivity network and its extent can be important. Relevant criteria, or questions, that can be raised include:

- What are the dependent and independent variables used in the model?
- How well established are the statistical relationships on which the model relies?
- How extensive is the connectivity network that can be handled?
- What are the input data requirements of the model? This will include questions as to the spatial and temporal scales required in the data, and the resolution and accuracy required of the data.
- What are the temporal and spatial scales of the outputs?
- Are the outputs in a suitable form for storage in a data base, or for use with other packages?

Physical Process Models

The physical models can take several forms, e.g. difference and differential, but they are all based on physical, chemical, and biological processes of various forms. An example is the transport of sediment by a stream, where the hydrodynamics of the water flow are coupled with the detachment and transport of particles by the water. Usually such processes can be represented by differential equations, coupled with algebraic relationships between variables. Where time is discrete, difference equations may be appropriate. The criteria, or questions, include:

- What physical processes are incorporated in the model, and are the parameter values available at sufficient accuracy?
- Is the model based on difference equations, ordinary differential equations, or partial differential equations?
- What are the dependent, and independent variables used in the model?
- Is the model "steady state", or can it handle both transient and steady state?
- Is the physical region well defined?
- What is the nature of the initial data, and the boundary condition data, for the model, and at what space and temporal scales?
- What are the temporal and spatial scales of the outputs?
- Are the outputs available in a suitable form for storage in a data base, or for use with other packages?

Firstly, there is the growing detail and systematic nature of water accounts, with enhanced geographic and temporal detail and potential to link directly to model functions. Secondly, the increasingly comprehensive and integrated nature of water accounts provides the appropriate contextual schema and quantitative information for complete and detailed analyses of mass balance flows between key human and natural regional system components. This is directly aligned with the holistic approach embodied in "total water cycle management" which is a precept for all contemporary hydrological-related water models – especially for complex integrated models (Buchanan, 1994).

Thirdly, the current development of water accounting in a consistent, precise and systematic manner enables the aggregation and disaggregation of data for water cycle models at all temporal and spatial scales to inter-relate with empirical water account frameworks. The research introduced in this report is intended to enhance and facilitate this concordance between water cycle models and regional water accounts in order to realise the very substantial potential for mutually beneficial co-development and data exchange.

Two other related aspects of water accounts can help in the planning and effective implementation of total water cycle management systems and their component models. Firstly, empirical water balance information, and the identification of major regional flows between key system components of the total water cycle system, provides critical inputs and checks in conceptualising and positioning integrated water management models and their function and role in contributing to effective strategic water management. Secondly, the existing demand-side emphasis of water accounting developments will provide detailed and very useful bases for end use models which have become intrinsic components of integrated urban/regional water management models. These demand analysis models necessarily have a strong empirical component that is well-served by the water accounting process.

Empirical water accounts can help in at least five main areas of water cycle-related model design, implementation and improvement. "Field" water data from appropriate accounts has both *ex ante* (conceptualisation, structural identification and initial calibration) and *ex post* (validation and reconceptualisation) information role.

1. Data Inputs for Decision Variables and Scenario Formulation or Specification

Decision variable values and user functions for water cycle models are often based on "what-if" scenarios directed by prescriptive policy or exogenous urban or land use development options. However, historical data series can be vital in identifying the nature of likely scenarios to be assessed by models and in the input of realistic data input values required for model output and estimation.

2. System Conceptualisation

Ideally, any modelling should incorporate what is known scientifically about the relations and major components of the system being modelled (Jakeman, Letcher *et al.*, 2006). The ability for water accounting frameworks to contribute to the system conceptualisation aspect of modelling depends upon their underlying depth of knowledge and understanding of water-related processes within the study area. Once again, for water accounts, this is likely to be most advanced for human supply and use factors. This information basis is also expanding rapidly with the growing impetus for developing and implementing detailed water accounts. Empirical water account information, and its organising framework, can help identify major flows and system components and hence guide the selection and measurement detail of incorporated variables and the associated nature of assumptions underlying the model construction. In particular, if water cycle models are to be useful and relevant for planning and management, they should be highly cognisant of the specific constitution of their counterpart regional water accounting frameworks given that the accounts are a response to perceived issues and key dimensions in the problem area.

3. Model Structural Identification

This part of modelling development involves identifying the general nature of links between system components (or internal variables), processes, and output variables, including the likely functional form and relevant additivity or interactive effects and feedback. Again, water accounting frameworks and data can inform this step in initial design phases or as part of the iterative improvement procedures resulting from the next two steps. Important aspects to establish at this stage are the overall data structure, measurement units and ways of specifying links, and the optimal spatial and temporal scales of processes and their interactions. There are many potential symbiotic data conditions between water accounts and models if consistency is considered explicitly in their planning processes.

4. Parameter Estimation or Calibration

Empirical water flow data can also be useful to calibrate or estimate relevant model variable parameter values and non-parametric variables and their uncertainties (for example, those that structure rainfall-runoff relationships). While water account data may often be too aggregated for this purpose, finer resolution estimates may be derived for context-specific situations, by temporal interpolation, or by aggregating relevant model results to levels that are comparable with water account data.

5. Model Evaluation or Validation

Testing of the robustness and accuracy of model performance is undertaken in the validation stage. A comparison of actual (empirical) versus model estimate outputs provides useful feedback on the integrity of the objective functions, goodness of fit and predictive power of the model. The error characteristics of the observed data contain important information about the uncertainty characteristics of the model. Although resolution or (dis-)aggregation of data may be required, water accounts will often provide suitable data for verification and comparison against model outputs. In turn, this model evaluation and statistical testing phase will allow reconceptualisation of the system and reassessment of the model structure and functional form, and parameter values. In order to optimise model performance, an iterative, heuristic process can use the existing model to retrospectively simulate and compare against historical data or use forecast verification comparing model predictions and observed outcomes as they occur. Evaluation in the light of empirical data can help judge if the assumptions or simplifications, interactions and outcomes of the model are feasible, defensible and credible (Jakeman, Letcher *et al.*, 2006).

In summary, the interplay of water account data and water cycle models garners confidence and transparency in the application of models as a decision-making support tool. The use of substantive empirical inputs helps complete and reaffirm their inductive, scientific basis.

6.4. Potential Linkages between the SEQ WaterHub and Integrated Urban Water Management Models (HydroPlanner SEQ Prototype)

In this section, we provide an overview of the major potential types of linkage between SEQ's *WaterHub* water accounts framework and the proposed prototype integrated urban water model (IUWM) for the region developed by the LCA-Integrated Modelling project team (see section 4 for a description of the *HydroPlanner SEQ prototype*). The discussion provides an outline of the broad areas of mutual benefit and data exchange, followed by a description of the research approach undertaken to investigate specific complementarities and data exchange. The aim of the study (with detailed findings presented in Volume 2) is to maximise the methodological and data synergies between these two important water management tools for the region, thus enhancing the value-added to each other's development and operation.

6.4.1. Scope of the WaterHub

The *WaterHub* is a modular based system with each module containing data to support a specific group of functions, such as demand and supply management (QWC, 2008). This approach to implementation will ensure that additional modules can be accommodated within the *WaterHub* as required. Implementation of additional modules will be based on the need for the information required and the availability of data to suit the objectives of the module. Modules are being implemented in a phased approach. Appendix A provides a detailed description of the proposed scope of the *WaterHub*. Below is a brief description of the modules that have been proposed for Phase 1 and Phase 2 development.

Modules implemented within Phase 1 include:

1. Volumetric Point Measurement Module: The Volumetric Point Measurement (VPM) tool has been designed to report on the actual volumes of water moved through the water grid. This allows the WGM to manage the sale and movement of water. The VPM monitors the volumes

of water measured by the bulk supply meters located within the grid system. Once volumes are recorded, they will be used to facilitate billing of the various entities.

2. Demand and Supply Management Module: A module to support the immediate and critical information needs of the QWC, including data and information that will assist with water supply and demand management. Data provided within this module includes: consumption, production, wastewater flows, population, climate, supply, storage and spatial data.
3. WEMP module: A module to support monitoring of Water Efficiency Management Plans (WEMPs). WEMPs are required for non-residential water users who consume more than 10 million litres of water annually. The WEMP describes how the water is used, options to improve water use efficiency and a time frame within which the options will be implemented (QWC, 2008). This module will provide data that will enable WEMP performance monitoring.

Modules proposed to be implemented within Phase 2 include:

1. Bureau of Meteorology (BOM) Module: will provide the necessary data to support the BOM's information requirements.
2. Statewide Water Information Management (SWIM) Module: will provide the necessary data to support the SWIM project.
3. Compliance, Reporting and Water Quality Monitoring Module: will provide the necessary data to support the water grid, market compliance and water quality compliance monitoring.
4. Billing and Financial Module: will provide the necessary data to support billing, financial and commercial reporting needs.
5. Policy Development Module: will provide data and information to support policy development, policy or program performance monitoring, internal reporting needs, monitor Business Water Efficiency Programs (BWEP) and assess the efficacy of subsidy initiatives and behavioural change over time.

6.4.2. Future Direction of the WaterHub

Endorsement of the QWC's role as sole custodian of all regional water information and endorsement of the necessary powers to support this role have effectively secured the future of the *WaterHub*.

Implementation of Phase 1 of the *WaterHub* was completed by July 2008. With Phase 1 of the *WaterHub* operational, implementation of the other modules commenced as required. The system is being developed to ensure that it has the capacity to be expanded to 'collect, store, analyse and report on all information needs of the QWC, WGM, other State agencies and BOM' (QWC, 28th March 2008).The flexibility of the system allows for potential future increase in the scope of the *WaterHub* to include additional geographic regions, additional reporting entities with additional information needs and the provision of data to other State or national database systems (QWC, 2008). The *WaterHub* project team liaises with local, state and national reporting entities to define the various reporting requirements that may be supported through the *WaterHub*. Definition of these reporting requirements is essential if the *WaterHub* is to be expanded to cater for various entities.

6.4.3. Some Major Areas of Potential Data Transfer between the WaterHub Water Accounts and Proposed SEQ Integrated Urban Water Model

The *WaterHub* has the potential to provide data that will be able to support calibration and validation of the *HydroPlanner SEQ prototype*. All models require validation against known results, or results that have been obtained by others. This is essential in order to verify the accuracy of the results generated by the models. This validation process provides a method to 'gain confidence in the numerical predictions and outputs of the model' (Braddock, 2008).

Appropriate data may be obtained from the *WaterHub* to feed into specific component models of the *HydroPlanner SEQ prototype* tool, but until it is known what data is required and at what temporal and spatial resolutions, it is difficult to determine the detailed use of data available from the *WaterHub* for this project. Temporal and spatial resolutions of the data provided by the *WaterHub* will play a significant role in determining the potential of using the data for integrated urban water model input. Data provided by the *WaterHub* will most likely be of a coarser resolution than the data required by the IUWM modelling tool, but aggregation of the data may be possible to help overcome this problem. The data provided through the *WaterHub* has the potential to be expanded to incorporate the requirements of additional reporting entities. The flexibility of this system allows potential scope for the specific data requirements of the IUWM tool to be met through the *WaterHub*. This would result in the provision of accurate, reliable and consistent data to meet the data requirements of the LCA-IM project. Major general areas of synergy between the *WaterHub* and integrated water cycle models for SEQ are discussed below:

- One of the major mutual benefits of the coordinated development of water accounts and integrated urban water models in SEQ is rather subtle. It involves the potential for sharing of knowledge about: (1) the biophysical and anthropogenic nature of the regional water cycle system; and (2) the practical policy needs that justify these tools and provide direction for their scientific and accounting foci. Although the integrated models would tend to consider the more detailed biophysical relationships used to explain water quantity and quality, both tools require their own specialised understanding of all parts of the water cycle system. In combination, they result in a better knowledge base and appropriate goals, coverage, output and data to effectively achieve their shared goals of sustainable and efficient regional water management. The IUWM can yield knowledge and data on important contextualised factors and key components in the water cycle to the *WaterHub* and the *WaterHub* can provide strategic policy direction and an overarching empirical framework for scenario and modelling development.

- An initial review of the framework plans suggests that the *WaterHub* will be a useful informational basis for many aspects of the *HydroPlanner SEQ prototype*. Detailed empirical measurement of the flows of water from nature; extractions, distribution and use through the primary economy system components (including recycling and reuse); and discharges and losses back into the environment, will support the integrated modelling development and operation in many areas. As discussed in Section 6.3, direct empirical applications include the provision of reliable data for scenario formulation and input, system conceptualisation and structure, calibration, and output validation for the *HydroPlanner SEQ prototype* and its component models. Hence, an ideal strategic initiative for effective water management in the region would be to ensure that both the *WaterHub* and IUWM take into consideration each other's needs and preferences regarding measurement scales and spatial and temporal resolution, in order to maximise compatibility and potential data interchange synergies and benefits. The ongoing work in this project (to be presented in Volume 2) will help identify the potential commonalities between the two tools. The main objective is to highlight existing beneficial linkages and suggest possible variations, so that time-step and spatial nodes and boundaries can be readily adjusted to facilitate plausible re-aggregation and interpolation.

- Many of the IUWM variables utilise daily (or sub-daily) time-steps and this level of detail is appropriate for some optimisation and operational needs regarding the short-term allocation of water between storages and across the Water Grid. While some *WaterHub* data will be recorded at comparable intervals, the UWSRA goals are directed towards the SEQ Water Strategy and its longer-term focus on selecting the infrastructure and strategies for a socially efficient and sustainable mix of alternative water sources and demand management options through to 2050 (QWC, 2008). Given their shared goals of supporting the SEQ Water Strategy, the ability to relate and transfer data, between these two major water management tools, will be vital.

- As noted in the previous point, the *WaterHub* will play an instrumental role in providing the essential empirical data for guiding the assessment and evaluation of the supply-demand water options considered in the 2008-2050 SEQ Water Strategy. As the *HydroPlanner SEQ prototype* is being developed as a decision-support tool to ensure the efficient and sustainable balancing of water demands and supplies in the region, it is desirable that the IUWM and water accounts utilise consistent data and methodological approaches wherever possible so that they "add maximum value" to each other's function. The *WaterHub* is capable of producing valuable information for assessing, monitoring and testing the regional water (supply-demand) balance and effectiveness of the specific scenarios being adopted in the Water Strategy. This is strongly aligned with the total water cycle management guiding principle of the *HydroPlanner SEQ prototype* and has many conceptual and operational overlaps with the P2 water allocation and P5 whole of catchment component models. The *WaterHub* will be vital in providing the empirical measures of integrated regional flow implications (in any part of the SEQ nature-economy water system) of scenario simulation and projection outcomes – results that are intrinsic to the operation of the IUWM.

- The *WaterHub* encompasses detailed collection of water consumption data and will be of substantial value to the end use analysis and demand forecasting aspects of the IUWM (located within the P3 model component).
- The detailed study of the linkages between the *WaterHub* accounts and the IUWM process will facilitate the clear identification and prioritisation of data gaps and needs for the required empirical and modelling systems for sustainable water management in the region.
- The *WaterHub* measurement of economy–environment flow interactions will assist in the formulation of hydrological modelling functions that consider the influence of human activity (including land use and urban development patterns and information, economic and household sectors, and socio-demographic data).
- Regional water accounts (especially if framed within a mass balance/material flow approach) provide the empirical basis for extensions of IUWM model inputs, internal variables, processes and outputs to potentially assess impacts of water balance scenarios on other regional material, energy and nutrient flows and cost. (This is closely linked to the life cycle analysis aims of this UWSRA project.)
- Given that the *WaterHub* is developed in a manner consistent with other major national and international water/resource accounts, its development interaction with the *HydroPlanner SEQ prototype* will enhance the potential application of both instruments to a wide range of policy and strategic assessment functions (thus expanding their relevance, usefulness, commercial viability and marketability).

Box 7 Synergies between the *WaterHub* and Integrated Urban Water Management Models

- **The sharing of knowledge about: (1) the biophysical and anthropogenic nature of the regional water cycle system; and (2) the practical policy needs that justify these tools and provide direction for their scientific and accounting foci**
- **The provision of reliable data from the *WaterHub* for scenario formulation and input, system conceptualisation and structure, calibration, and output validation for SEQ IUWM models requires that the *WaterHub* and IUWM models take into consideration each other's needs and preferences regarding measurement scales, and spatial and temporal resolution, in order to maximise compatibility and potential data interchange synergies and benefits**

It is desirable that IUWM models and water accounts utilise consistent data and methodological approaches wherever possible so that they add maximum value to each other's function in regard to their support for the SEQ Water Strategy.

Water consumption data provided through the *WaterHub* will be of substantial value to the water end use analysis and demand forecasting aspects of IUWM models.

The *WaterHub* measurement of economic–environment flow interactions will assist in the formulation of hydrological modelling functions that consider the influence of human activity.

Regional water accounts provide the empirical basis for extensions of IUWM model inputs, internal variables, processes and outputs to potentially assess impacts of water balance scenarios on other regional material, energy and nutrient flows and cost.

Given that the *WaterHub* is developed in a manner consistent with other major national and international water/resource accounts, its development interaction with the *HydroPlanner SEQ prototype* will enhance the potential application of both instruments to a wide range of policy and strategic assessment functions.

6.4.4. Identifying Specific Links between the WaterHub Data and HydroPlanner SEQ Prototype – Planned Methodological Approach

A major aim of this component of LCA-Integrated Modelling project was to identify how the developing empirical water accounts can contribute to the scientific and strategic assessment of water supply-demand options for SEQ (especially that associated with integrated, total water cycle modelling). While this contribution has been explored in a general way in this section, the ongoing research will involve the close examination of the specific current, planned, and possible future, water and water-related variables measured in the *WaterHub*. These "measurands" (or phenomena being measured, such the flow through a pipe, or concentration or flow at a particular node) will be evaluated in terms of how they could be utilised and related to the scenarios, internal variables and outputs of the integrated water cycle models.

In addition to their content relevance, the other major measurand attributes that must be considered for support capability for the range of planned models includes their spatial and temporal resolution, scale measurement, quality differentiation, reporting frequency and lags. The aim is to facilitate a mutually beneficial process of exchange between the empirical and modelling systems so that their developmental stages take heed of each other's requirements and perspectives, and create systems that yield cost-effective supporting data and information to each other. Hence, Report 2 will propose recommendations to the *WaterHub* in view of integrated modelling requirements and will give a detailed background on *WaterHub* accounts so that the IUWM process is fully informed about the empirical data and system knowledge provided by the *WaterHub*.

The planned research process for the detailed investigation of *WaterHub* measurand links to the integrated model components is described in this section. It is best demonstrated with reference to the matrix presented in Table 2, which lists most of the major variables covered, or planned for coverage, by the *WaterHub* over the next decade. The first six columns of the table list the various data measurands that are planned to be available from the SEQ *WaterHub* (the columns shaded in blue). The final columns (in green) will indicate whether the data in the *WaterHub* plan are of potential use in the IUWM (and the relevant component where applicable).

The measurands listed in the first column of the table have been classed and presented in rough order of their "position" in the water cycle, starting from climate data, through to storage inflows, major extraction sources, initial water treatment or production, distribution, consumption, recycling and discharge (and system losses throughout these paths). The completion of the table's columns represents the essence of the research approach and findings. The first group of columns focuses on the specific identification of time phase for implementation, spatial and temporal resolution, scale measurement, quality differentiation, reporting frequency and lags. The final columns will link the *WaterHub* measurands to specific aspects of the models that will form the main components of the *HydroPlanner SEQ prototype*. This will include identifying their content role as well as temporal and spatial compatibility and potential for aggregation to facilitate useful information.

Phase 1 *WaterHub* measurands are primarily comprised of: (1) more detailed data recording and extensions of current measures such as storage inflows, water treatment plant production, supply and sewerage connections, power station and residential and commercial use, and wastewater inflows; and (2) climate data, specific source volumes, environmental flows, water exports, Water Grid measures, wastewater treatment outflows, and recycled water use by major type and penetration levels. Phase 2 is likely to focus on Water Grid performance and compliance reporting, water quality management, data for supporting the water efficiency management (WEMP) and business water efficiency programs (BWEP), sophisticated extensions for more sophisticated demand analysis and forecasting, and the auxiliary data needs of SWIM and BOM and other significant water planning tools (including the integrated urban water models).

An example of the measurand analysis and comparison is provided for storage inflows (see under Water Supply Data on the first page of Table 2). This measurand has closest linkages to the P5 IUWM component, which includes modelling of catchment environmental flows, but the IUWM data would need to be aggregated to daily flows at suitable catchment levels.

The next stage of the research from this project section will proceed along these lines to provide a detailed analysis, comparison and recommendations for the interactive development of *WaterHub* measurands and IUWM modelling needs.

Table 2: **Proposed Methodology for Linking Water Account Data Available Via the SEQ *WaterHub* to the *HydroPlanner SEQ Prototype*.**
(Method and Structure Only - Volume 2 will present the results)

	WaterHub Data Available						*HydroPlanner SEQ Prototype* Data Needs	
			GENERAL	**TEMPORAL**	**SPATIAL**	**REPORTING**		
	Measurand – Data Available Through the *SEQ WaterHub* (and BOM)	**Phase Status**	**1. Unit 2. Water Quality Differentiation? 3. Water State -** Raw, Treated (WTP), Recycled, Manuf, Discharge	**1. Measuremt frequency 2. Period covered**	**1. Measuremt node – geog location/ sites 2. Measuremt geographic coverage (if applicable)**	**1. Reporting entity 2. Reporting frequency 3. Lag from Measuremt to Reporting**	**Main HydroPlanner (Sub) Model Link**	**Likely IUWM data resolution adjustments for WH data matching**
CLIMATE DATA								
	Total rainfall	PHASE 1 ?	1. mm		2. per water service provider area			
	Average Maximum temperature	PHASE 1 ?						
	Average Minimum temperature	PHASE 1 ?						
	Average annual rainfall	PHASE 1 ?	1. mm					
WATER SUPPLY DATA								
	ULTIMATE SOURCE							
	STORAGE							
	* Storage inflows - ≡ catchment inflow?	CURRENT	1. ML 2. Quantity only 3. Raw	1. Daily? 2. 24 hours	1. Individual major storages in SEQ (20?) 2. Catchments for major measured storages	1. SEQ Water? other? 2. Daily 3. end of day?	P5 - Catchment to envir flows (Qty)	Aggregation - subdaily IUWM data to daily water accounts data? - IUWM catchment areas up to WH dam catchments?
	* Storage levels	CURRENT	1. ML 2. Quantity only 3. Raw				P5 - Catchment to envir flows (Qty)	Aggregation - subdaily data to daily? - catchment areas up to WH dam catchments
	* Storage closure?	CURRENT						
	VOLUME SOURCED OR RECEIVED							
	Volume sourced from **dams**	PHASE 1 ?	1. ML 2. Quantity only 3. Raw				P2 - Dams to urban	Adjust for non-urban use?
	Volume sourced from **rivers**	PHASE 1	1. ML				P2 - Rivers to urban	

INCOMPLETE – PARTIAL EXAMPLE ONLY

	***WaterHub* Data Available**						***HydroPlanner SEQ Prototype* Data Needs**	
			GENERAL	**TEMPORAL**	**SPATIAL**	**REPORTING**		
	Measurand – Data Available Through the *SEQ WaterHub* (and BOM)	**Phase Status**	**1. Unit 2. Water Quality Differentiation? 3. Water State -** Raw, Treated (WTP), Recycled, Manuf, Discharge	**1. Measuremt frequency 2. Period covered**	**1. Measuremt node – geog location/ sites 2. Measuremt geographic coverage (if applicable)**	**1. Reporting entity 2. Reporting frequency 3. Lag from Measuremt to Reporting**	**Main HydroPlanner (Sub) Model Link**	**Likely IUWM data resolution adjustments for WH data matching**
	Volume sourced from **groundwater**	PHASE 1	1. ML				P2 - Groundwater to urban	
	Volume sourced from **desalination**	PHASE 1	1. ML					
	Volume sourced from **recycling**	PHASE 1	1. ML					
	Volume received from **bulk supplier**	PHASE 1	1. ML					
	WATER PRODUCTION DATA							
	Water Treatment Plant (WTP) bulk readings							
	WTP production	CURRENT - Phase 1	1. ML 2. Quality and Quantity 3. Raw - Potable	1. daily 2. 24 hours	1. All WTP outflows?	1. WSPs/Councils - currently 12 ;will be 16 2. weekly - last bus day each wk 3. end of week	P2? or P5?	
	Volume of water per product type		1. ML					
WATER DISTRIBUTION DATA								
	Water Grid / market compliance / water quality compliance							
	Bulk flow measures – VPM?	PHASE 1			VPM Label and Descr system 1. Bulk supply meters located within the grid			
	Compliance reporting and water quality monitoring	PHASE 2						
	Annual registration and fee payment	PHASE 2						
	Water Grid performance	PHASE 2						

	***WaterHub* Data Available**						***HydroPlanner SEQ Prototype* Data Needs**	
			GENERAL	**TEMPORAL**	**SPATIAL**	**REPORTING**		
	Measurand – Data Available Through the *SEQ WaterHub* (and BOM)	**Phase Status**	**1. Unit 2. Water Quality Differentiation? 3. Water State -** Raw, Treated (WTP), Recycled, Manuf, Discharge	**1. Measuremt frequency 2. Period covered**	**1. Measuremt node – geog location/ sites 2. Measuremt geographic coverage (if applicable)**	**1. Reporting entity 2. Reporting frequency 3. Lag from Measuremt to Reporting**	**Main HydroPlanner (Sub) Model Link**	**Likely IUWM data resolution adjustments for WH data matching**
USE OF WATER - DEMAND / CONSUMPTION								
	Power station consumption	CURRENT						
	Urban Water Consumption							
	Residential water consumption - detailed?	CURRENT - not detailed PHASE 1 - detailed	1. ML & L/person/day 2. Yes, see 3 3. Metered and non-metered, potable and non-potable	1. Daily (estimate?)	2. Household			
	Commercial and industrial water consumption	CURRENT - not detailed PHASE 1 - detailed	1. ML 2. Yes, see 3 3. Metered and non-metered, potable and non-potable				P2 - Env flows to agric/irrigation if covered (but likely DERM)	
	Water Efficiency Mgt Program **(WEMP)** data - regulation; req for > 10 ML with Level 4+ restr	PHASE 2						
	Business Water Efficiency Program **(BWEP)** - subsidy	PHASE 2						
	Higher user program							
	Other water supplied	PHASE 1 ?	1. ML					
	EXAMPLE OUTPUT - Consumption by land use by geog unit, consumption per serviced person by suburb							
	DEMAND UNITS							
	Connected Properties and Population							
	Population receiving water supply services	CURRENT ?	thousands		2. Council region			
	Connected residential properties - water supply	CURRENT	thousands					

	***WaterHub* Data Available**						***HydroPlanner SEQ Prototype* Data Needs**	
			GENERAL	**TEMPORAL**	**SPATIAL**	**REPORTING**		
	Measurand – Data Available Through the *SEQ WaterHub* (and BOM)	**Phase Status**	**1. Unit** **2. Water Quality Differentiation?** **3. Water State -** Raw, Treated (WTP), Recycled, Manuf, Discharge	**1. Measuremt frequency** **2. Period covered**	**1. Measuremt node – geog location/ sites** **2. Measuremt geographic coverage (if applicable)**	**1. Reporting entity** **2. Reporting frequency** **3. Lag from Measuremt to Reporting**	**Main HydroPlanner (Sub) Model Link**	**Likely IUWM data resolution adjustments for WH data matching**
	Connected non-residential properties - water supply	CURRENT	thousands					
	Population receiving sewerage services	CURRENT	thousands					
	Connected residential properties - sewerage	CURRENT	thousands					
	Connected non-residential properties - sewerage	CURRENT	thousands					
	SYSTEM LOSS							
	Pressure and leakage program	PHASE 1						
	Evaporation data	PHASE 1			2. per water service provider area		P2 - Dam - evaporation	
	Total Leakage	PHASE 1	1. m3/km	1. Daily ?				
	Losses	PHASE 1	1. L/km	1. Daily				
	WATER DISCHARGES, OUTFLOWS - from SEQ System Boundary							
	Environmental flows supplied	PHASE 1?	1. ML					
	Volume of bulk water exports	PHASE 1 ?						
	Effluent data							
	* wastewater inflows at WWTP	CURRENT						
	* WWTP outflows?	Planned						
	RECYCLED WATER USE							
	Recycled Water Use							
	Residential recycled water supplied	PHASE 1?	1. ML					
	Industrial/commercial recycled water supplied	PHASE 1?	1. ML					
	Municipal irrigation water supplied	PHASE 1?	1. ML					

WaterHub Data Available							*HydroPlanner SEQ Prototype* Data Needs	
			GENERAL	TEMPORAL	SPATIAL	REPORTING		
	Measurand – Data Available Through the *SEQ WaterHub* (and BOM)	**Phase Status**	**1. Unit 2. Water Quality Differentiation? 3. Water State -** Raw, Treated (WTP), Recycled, Manuf, Discharge	**1. Measuremt frequency 2. Period covered**	**1. Measuremt node – geog location/ sites 2. Measuremt geographic coverage (if applicable)**	**1. Reporting entity 2. Reporting frequency 3. Lag from Measuremt to Reporting**	**Main HydroPlanner (Sub) Model Link**	**Likely IUWM data resolution adjustments for WH data matching**
	Agricultural recycled water supplied	PHASE 1?	1. ML					
	On-site recycled water supplied	PHASE 1?	1. ML					
	Environmental recycled water supplied		1. ML					
	Recycled water - town water substitution	PHASE 1?	1. ML					
	Water Recycling							
	Recycled water	PHASE 1?	ML					
	Recycled water (% of effluent)	PHASE 1?	%					
	Percent of recycled water substituting raw water abstractions	PHASE 1?	%					
	Percent of recycled water substituting potable water use	PHASE 1?	%					
WATER BALANCE - DEMAND, SUPPLY NEEDS								
	DEMAND FORECASTING TOOLS	PHASE 2?						
	Above historical data with trends and geo-coding?							
	Storage Information	PHASE 2?						
	Water Production	PHASE 2?						
	Water and wastewater flows /availability	PHASE 2?						
	Metering data across the water grid to monitor water usage and pressure and leakage	PHASE 2?						
MISC								
	Customer Service							
	Special drought response restrictions							
	Description of restrictions							
	Total number of days water restrictions applied during the year							

WaterHub Data Available							*HydroPlanner SEQ Prototype* Data Needs	
			GENERAL	**TEMPORAL**	**SPATIAL**	**REPORTING**		
	Measurand – Data Available Through the *SEQ WaterHub* (and BOM)	**Phase Status**	**1. Unit** **2. Water Quality Differentiation?** **3. Water State -** Raw, Treated (WTP), Recycled, Manuf, Discharge	**1. Measuremt frequency** **2. Period covered**	**1. Measuremt node – geog location/ sites** **2. Measuremt geographic coverage (if applicable)**	**1. Reporting entity** **2. Reporting frequency** **3. Lag from Measuremt to Reporting**	**Main HydroPlanner (Sub) Model Link**	**Likely IUWM data resolution adjustments for WH data matching**
	PROGRAM ASSESSMENT							
	- see WEMP and BEMP above							
	QUALITY MEASUREMENTS							
	Water quality performance	PHASE 2						
	OTHER COMPLIANCE REPORTING							
	SWIM - Statewide Water Information Management Project information reporting requirements	PHASE 2						
	BOM - Bureau of Meteorology information reporting requirements	PHASE 2						
	Additional info reporting needs	PHASE 2						

6.5 Links between the WaterHub Data and Life Cycle Analysis of Water Supply-Demand Options

The SEQ *WaterHub* water accounts will be amongst the most detailed and elaborate systems of this type in the world. As such they will hold considerable potential to directly help operate, test, calibrate and refine integrated urban water models developed for the region in this LCA-Integrated Modelling (IM) project for the UWSRA. However, the *WaterHub* will also provide a substantive, comprehensive set of water accounts that can be utilised for measuring economy-wide resource flow relations needed for accurate life cycle assessment (LCA) of water supply-demand options being adopted in the SEQ Water Strategy. If the *WaterHub* follows national and international resource accounting frameworks being developed by the Australian Bureau of Statistics, United Nations and other agencies, the water resource accounts will be suitable for linking to other major resource flow accounts (including energy), thus facilitating the assessment of system-wide joint impacts of water supply and demand options under an integrated approach. Integration with monetary income accounts allows the possibility of applying support for economic valuation and other efforts at comparing and aggregating lifecycle impacts. Hence, the alignment of regional water accounts with life cycle assessment design can facilitate reliable cost-effectiveness analysis of supply-demand options and ongoing policy for sustainable water management.

LCA is based on product, technological or process sources and their cradle-to-grave material and energy demands. It is a functional approach only – for example, examining the environmental impacts of supplying one cubic metre of water utilising different options. By itself, LCA does not incorporate the integrated nature of water flows across a region. The region-wide accounting of water can help overcome the limits of LCA associated with its functional basis, and embed LCA within a spatial system boundary where useful integrated management links can be identified for regional flow-on effects and interdependencies for water, energy and other significant environmental materials. Furthermore, the empirical measurement of water balance trends and implications of alternative options considered for the SEQ Water Strategy provide an ideal analytical basis for the LCA component of the study. More specific potential interactions between the *WaterHub* accounts data and LCA component of this UWSRA project will be examined alongside the detailed analysis of measurand potential for the IUWM.

7. THE RELATIONSHIP BETWEEN THE SEQ WATERHUB AND BUREAU OF METEOROLOGY'S (BOM) WATER ACCOUNTS

The Australian Government has recognised the importance of providing consistent and reliable national water data and information to aid policy development, planning and decision-making by governments, business and the community (Bureau of Meteorology, 2008). Its investment of $12.9 billion in the *Water for the Future* project is testament to a long-term commitment to securing Australia's water supply. As a subsidiary program to the *Water for the Future* project, the *Improving Water Information* program aims to expand and transform the nation's water resources information. This $450 million program will be administered by the Bureau of Meteorology and is backed by the Commonwealth Water Act 2007.

As part of the *Water for the Future* program the Bureau will be responsible for developing and implementing a National Water Account (Bureau of Meteorology, 2008). These accounts will be made public through the development of a national water information system. Under the Water Act 2007, the bureau will be responsible for:

- Issuing national water information standards
- Collecting and publishing water information
- Conducting regular national water resources assessments
- Publishing an annual national water account
- Providing regular water availability forecasts
- Giving advice on matters relating to water information
- Enhancing understanding of Australia's water resources.

Data will be collected by the Bureau from over 270 entities nation-wide and will be used to support these responsibilities. To reduce demand on the agencies providing data, the Bureau has been liaising with the QWC's Regional Water Information Management Unit (RWIMU) in order to establish compatibilities between the information needs of BOM and the information that can be provided by the *WaterHub*. The BOM has provided an extract within Section 126 of the Water Act 2007 (Bureau of Meteorology, 2008), which specifies the kinds of water information that it is required to collect.

The BOM has expressed interest in terms of the potential for the QWC's *WaterHub* to meet BOM's information requirements. QWC has resolved a number of initial concerns identified with BOM, including: establishing legislative powers for collecting data from the WSPs; data ownership issues; data quality; and potential data gaps between information required by the BOM and information provided by the WaterHub (QWC, 28th March 2008).

To meet the information requirements of the BOM, several key differences were identified between the data the *WaterHub* will provide and the data required by the BOM. The temporal frequency (often daily) at which the BOM requires much of its information to be provided may place significant pressure on the WSPs to match this frequency of reporting. Another key difference is that the data required by the Bureau are focused more on rural water information as opposed to the urban focus of the data provided by the *WaterHub*. It is not envisioned that measurands relating to volumes of irrigation water will fall within the scope of data provided by the QWC. Specific types of water information that cannot currently be met by the *WaterHub* include: surface water resource information including watercourse height and detailed storage information; groundwater resource information including depth to groundwater and groundwater pressure; wind speed and direction, solar and net radiation fluxes; humidity; stormwater discharges; detailed rural irrigation extraction and returns to watercourses and storages; and water quality information including electrical conductivity, total nitrogen, total phosphorus, turbidity or total suspended solids, pH and dissolved oxygen.

Many of these measures (not currently planned for the *WaterHub*) are likely to have direct relevance for the provision of inputs, parameters, calibration and evaluation of the integrated urban water models being developed by the project team. Unfortunately, there are many uncertainties regarding the spatial and temporal resolution and suitability of measurement nodes and periods as well as whether, how and when the requested BOM data are collected. It is possible that many of these BOM data requirements may be covered in the future and it is important that the potential benefits of this data collection for integrated water modelling are considered in the ongoing process of *WaterHub*-BOM developments.

Despite the current differences between the BOM requirements and *WaterHub* plans, there is still a substantial amount of water information provided through the *WaterHub* that will be relevant to the Bureau and the QWC is committed to meeting as many of its needs as is possible within its capacity. Compatibilities between information provided by the *WaterHub* and BOM's requirements include volumes of water stored and sourced, volumes of water supplied to various users, environmental flows, treated wastewater discharges, precipitation, temperature, evaporation, water entitlements and trades, and information on water use restrictions. They tend to be enhanced for water accounts related to urban flows and reticulated water. Accessing this information through the *WaterHub* will alleviate pressure on the WSPs by reducing duplication of reporting information and will benefit the Bureau by providing convenient and reliable access to the information.

The BOM has recently drafted amendments to the Water Act 2007 to specify which agencies must provide data and information for their reporting needs. Initially, the BOM failed to recognise the QWC as one of its direct reporting entities (Oliver, 2008). Instead it identified various State government departments, local councils and water grid entities to be direct reporting agents to the BOM. Under these conditions, the efforts of the QWC to create a centralised water information hub may have been undermined.

Box 8 BOM Water Accounts and the IUWM Models

Many of the BOM data requirements (including those not currently planned for the *WaterHub*) are likely to have direct relevance for the provision of inputs, parameters, calibration and evaluation of the integrated urban water models. It is possible that many of these BOM data requirements may be covered in the future and it is important that the potential benefits of this data collection for integrated water modelling are considered in the ongoing process of *WaterHub*-BOM developments.

The QWC continues to liaise with the Bureau in order to determine whether the *WaterHub* will be able to provide the water information required by the BOM. QWC representatives feel that, in order for the BOM to acquire all of its desired water information, it would be best for the Bureau to liaise directly with the *WaterHub* rather than with individual WSPs and grid participants. The integrity and consistency of regional data and information may be jeopardised if the QWC is not recognised as a direct reporting entity to the BOM.

The Department of Environment and Resource Management and the Department of Local Government and Planning have expressed their support for the QWC to become a direct reporting entity to the BOM and to assume the role as the sole custodian of all regional water information in the long-term (Oliver, 2008). These departments recognised the potential for the *WaterHub* to be expanded to provide for all State and National reporting requirements. However, the initial uncertainty associated with the QWC's ownership of regional data and the differences between the data provided by the *WaterHub* and the data requirements of the BOM could have potentially impeded the realisation of this situation and underline the importance of the QWC being recognised as a direct reporting entity to the BOM under the Water Act 2007.

8. CONCLUDING COMMENTS

The QWC's SEQ *WaterHub* is a world-class initiative that, through the provision of consistent, reliable, accurate and high quality data, promotes a comprehensive approach to urban water management. The parallel development of the *HydroPlanner SEQ prototype* and the *WaterHub* offers a unique opportunity to investigate the potential synergies between water accounts and environmental water models and to maximise the benefits that can be gained from identifying their commonalties and linkages. The provision of data to the modelling tool from the *WaterHub* can assist development of system conceptualisation and structure and the calibration and validation of model outputs. The *WaterHub* can thus enhance confidence in the models' predictions and provide more robust support for urban/regional water resource management and decision-making. However, this relationship is also mutually beneficial through the interchange of knowledge about the nature of the regional water cycle and by adding value to each other's functions, for example for assessment of integrated urban water management options in the development of sub-regional and local government total water cycle management plans.

This first report from the Griffith University team of the LCA-IM project has provided an introduction to the concept of water accounting specifically focusing upon the development of the QWC's *WaterHub*. It has also outlined the general nature of potential relations between water accounts and water models and has highlighted the advantages of recognising the relationship that can exist between the two. It is recommended that the Urban Water Security Research Alliance continues research into: (1) the data requirements of the *HydroPlanner SEQ prototype*, including key consideration of optimal planning for spatial and temporal resolutions and boundaries: and (2) monitoring and liaison with the progressive development of the SEQ *WaterHub* and its phased measurands (and their potential expansion due to the BOM water data requirements – many with direct potential application for water modelling in the region). This is a formative period for setting the empirical and deductive scientific basis for sustainable water management and there are very substantial economies to be derived from co-ordination of key work in the area.

APPENDIX A - PROPOSED SCOPE OF THE WATERHUB

Phase 1 and Phase 2 proposed scope of the QWC's *WaterHub* outlining the details of each module, including the aim of the module, data required, products and services covered, geographic coverage and the target completion date.

Proposed Scope of Phase 1 of the WaterHub

Aim of Phase 1: To meet the immediate and critical information needs of the QWC and the WGM

Module 1 Volumetric Point Measurement (VPM)	**Aim**	The Volumetric Point Measurement (VPM) tool has been designed to report on the actual volumes of water moved through the water grid. This allows the WGM to manage the sale and movement of water through the grid. The VPM monitors the volumes of water measured by the bulk supply meters located within the Grid System. Once volumes are recorded, they will be used to facilitate billing of the various entities.
	Data Required	• Bulk water measurements • Water usage • Water leakage • Water pressure
	Products/ Services Covered	• All water sources, including Purified Recycled Water (PRW)
	Geographic Coverage	17 SEQ WSPs + Toowoomba
	Target Completion	Completed
Module 2 Supply and Demand Data Module	**Aim**	Develop a regional database and reporting tool to provide data and information that will assist with water supply and demand management
	Data Required	• Water consumption data (daily usage per household) • Water production data (daily water production from treatment plants) • Water and wastewater flows/availability • Population data (growth in number of serviced residents per WSP) • Service connected population – residential and non-residential • Climate data (rainfall and evaporation per WSP area) • Water supply data (available volume of water per product type) • Storage information • Spatial data/Geographic Information System (GIS) data – consumption per serviced person by suburb, and • Demand forecasting analysis tools
	Products/ Services Covered	• Raw water • Potable water (including desalination) • Recycled water • Wastewater

Proposed Scope of Phase 2 of the WaterHub **Aim of Phase 2:** to support any additional information needs as identified through a needs assessment process		
Module 1 Bureau of Meteorology (BOM) Module	**Aim**	Provide data and information to the Bureau of Meterology (BOM) for the development of the National Water Accounts
	Data Required	• All data from phase one of SEQWAF and SWIM • Water entitlements and permits – entitlements transfers and allocation announcements • Dead storage levels and volumes • Metadata – site detail information, data transfer method, water sensor detail, temporal measurements
	Products/ Services Covered	
	Geographic Coverage	17 SEQ WSPs + Toowoomba
	Target Completion	unspecified
Module 2 SWIM Module	**Aim**	Provide data and information relevant to the State Wide Information Management (SWIM) project
	Data Required	• National performance report indicators • Environmental flows • Storage releases and transfers • Non-revenue water • Uses of recycled water • Water asset information • High level metadata (no. of pumps, length of water mains)
	Products/ Services Covered	
	Geographic Coverage	17 SEQ WSPs + Toowoomba
	Target Completion	unspecified

Module 3 Compliance Module	**Aim**	Provide data and information to support water grid, market compliance and water quality compliance reporting needs
	Data Required	
	Products /Services Covered	Compliance reporting and water quality monitoring Annual registration and fee payments
	Geographic Coverage	17 SEQ WSPs + Toowoomba
	Target Completion	
Module 4 Billing and Financial Module required for module reporting needs	**Aim**	Provide data and information to support billing, financial and commercial reporting needs
	Data Required	• Actual performance against forecast • Billing information • Future water demand and pricing information • Possible benchmarking of volumetric water usage trends relative to regional targets and regional performance • Metering data
	Products/Services Covered	
	Geographic Coverage	17 SEQ WSPs + Toowoomba
	Target Completion	unspecified
Module 5 Policy Development Module	**Aim**	• Provide data and information to support policy development, policy or program performance monitoring and internal reporting needs • Support monitoring of Business Water Efficiency Programs (BWEP) - • Assess effectiveness of subsidy initiatives and behavioural change over time
	Data Required	
	Products/Services Covered	
	Geographic Coverage	17 SEQ WSPs + Toowoomba
	Target Completion	unspecified

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